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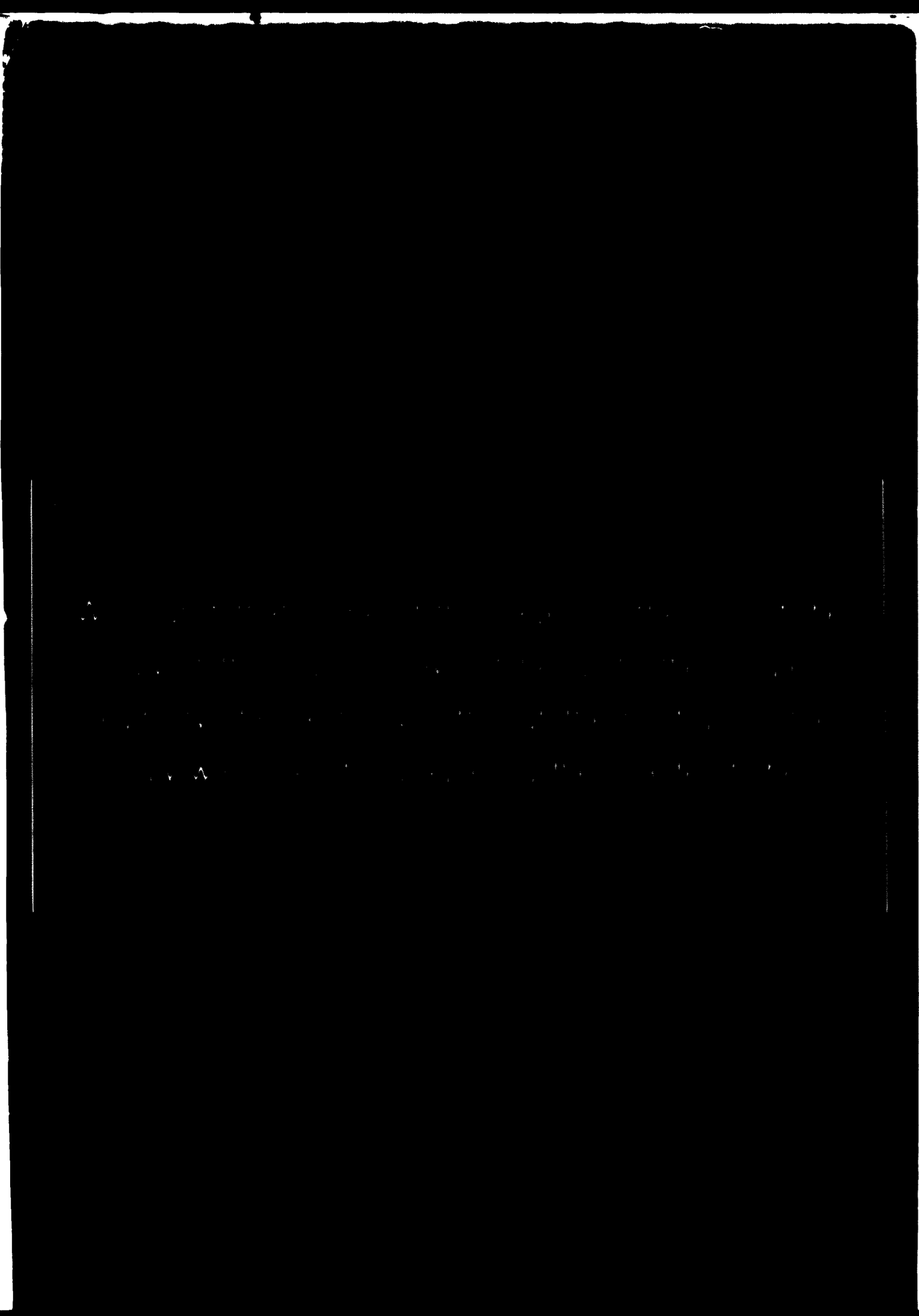

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BUREAU D'ETUDES
INDUSTRIELLES ET
DE COOPÉRATION DE
L'INSTITUT FRANÇAIS
DU PÉTROLE

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PETROVIETNAM
PRE-INVESTMENT STUDY

VOLUME 3 0885

REFINING

APPENDIXES (4)

S/F PETROLEUM

C/F VIETNAM

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APPENDIX 1

Détermination of petroleum product prices

APPENDIX 2

Products main characteristics

APPENDIX 3

Finished product composition

APPENDIX 4

Product specifications

APPENDIX 5

Process description.

APPENDIX 1

DETERMINATION OF PETROLEUM PRODUCT PRICES

DETERMINATION OF PETROLEUM PRODUCT PRICES

1. PRINCIPLE

The principle which has been applied for this determination is to calculate with a refinery model the total netback required by a refiner in order to cover its expenses and its profit.

From a practical point of view this results in the determination of an ex-refinery price structure for petroleum products, related both to the crude oil cost and to the operating cost. We are speaking of price of products and not cost because the selling prices in a joint product industry do not equal the cost of manufacture, except by coincidence. As a matter of fact the best proof of this is the selling price of fuel oil which is sold at a lesser cost than the crude oil itself though incurring an operating expense. This means that the cost of manufacture is not directly related to the market price for a particular product but of course the total value of the products is equal to the total manufacturing cost plus profit.

The problem will therefore be to find a way to allocate the operating cost to the different products. Several solutions can be investigated :

- Either proportional to the gravity of the product
- Or proportional to the heating value of the product
- Or proportional to the market price of the product
- Or according to the actual operating incurred by the product.

The third method is the only one which permits to determine the prices of products which are near the actual selling prices, and is the one which we have adopted.

2. REFINERY MODEL

The refinery model is based on a 34° API crude oil (ARABIAN LIGHT) yielding the following finished products, with a hydroskimming scheme.

	% wt
L P G	3.3
Naphtha	1.5
Regular gasoline	2.6
Premium gasoline	10.5
Kerosene	10.5
Gas oil	23.5
Fuel oil	42.4
Sub-Total	94.3
Refinery fuel oil, losses	5.7
T O T A L	100.0

This crude has been chosen as it yields a products structure which is near the industrialized countries consumption structure (such as JAPAN or EUROPE).

The main properties of the products are the following :

L P G	NG PSA specification
Naphtha	Petrochemical feedstock grade
Regular gasoline	92 NOR (0.15 g/litre of lead)
Premium gasoline	98 NOR (0.15 g/litre of lead)
Kerosene	IATA specification
Gas oil	50 cetane number minimum
Fuel oil	350 cst at 122°F maximum.

Tables 3 and 4 present the overall material balance as well as the investment and operating cost, on a 1978 basis (mid of year).

3. BREAKDOWN OF MANUFACTURING COST AMONG THE DIFFERENT PRODUCTS

As explained previously we have split the overall operating cost by taking into account the actual selling prices (ex refinery prices) so that the sales realisation will be equal to the total manufacturing cost.

The following assumptions have been made :

- Liquefied petroleum gas price has been set at 1.35 times the crude cost
- Fuel oil price (3 % sulphur) has been fixed at 15 % less than the crude cost.

Starting from these bases we have split the operating cost according to the average market (ex-refinery) price of the products. The results are presented in the table 1.

For a crude landed cost (SINGAPORE) of 97.0$/ton (see table 2) the following prices of product are determined and compared with the spot ROTTERDAM and SINGAPORE prices and average ex-refinery price in EUROPE.

	Computed prices $/ton	Spot price SINGAPORE August 78	Spot price ROTTERDAM Summer 78	Average Ex-Refinery Price in EUROPE Early 78
LPG	131			
Naphtha	150	130	150	
Regular	180	154	160	189
Premium	195	165	170	203
Kerosene	138	137	145	145
Gas Oil	130	127	122	135
Fuel Oil(3.5%S)	82	72	73	85

With these prices the total balance between cost and sales realization is the following :

Sales	559 500 000 $
Manufacturing cost	559 300 000 $

TABLE 1

BREAKDOWN OF MANUFACTURING COST

AMONG THE DIFFERENT PRODUCTS

1) Manufacturing Cost

		$/year
Crude Purchase		5,000,000 C
Operating Cost	74,300,000	
Total cost to be recovered	74,300,000 + 5,000,000 C	

2) Sales Realization

	Yield % wt/crude	Price Breakdown (Per ton of product)		Sales Realization
LPG	3.3	1.35 C		222,750 C
Naphtha	1.5	14 + 1.40 C	1,050,000 +	104,900 C
Regular	2.6	28 + 1.57 C	3,640,000 +	202,000 C
Premium	10.5	38 + 1.82 C	19,900,000 +	850,000 C
Kerosene	10.5	26 + 1.16 C	13,675,000 +	609,000 C
Gas-oil	23.5	25 + 1.09 C	29,400,000 +	1,280,000 C
Fuel-oil	42.4	0,85 C		1,802,000 C
Total	94.3		67.685,000 +	5,072,650 C

Basis :

(1) Fixed price : LPG equal to 1.35 times the crude cost
Fuel oil equal to 0.85 times the crude cost

(2) The distribution of the balanced cost has been made according to the following :

- Taking into consideration the supply/demand balance
- Taking into consideration the part of manufacturing cost required to produce the respective finished products.

TABLE 2

CRUDE LANDED COST IN SINGAPORE

F.O.B. RAS TANURA	12.70 /bl or 93.47$/ton
TRANSPORT COST *	2.95$/ton
UNLOADING AND HANDLING	0.60$/ton
LANDED COST IN SINGAPORE	97.00$/ton (rounded)

*Based on 150 000 DWT - AFRA INDEX 50 Worldscale

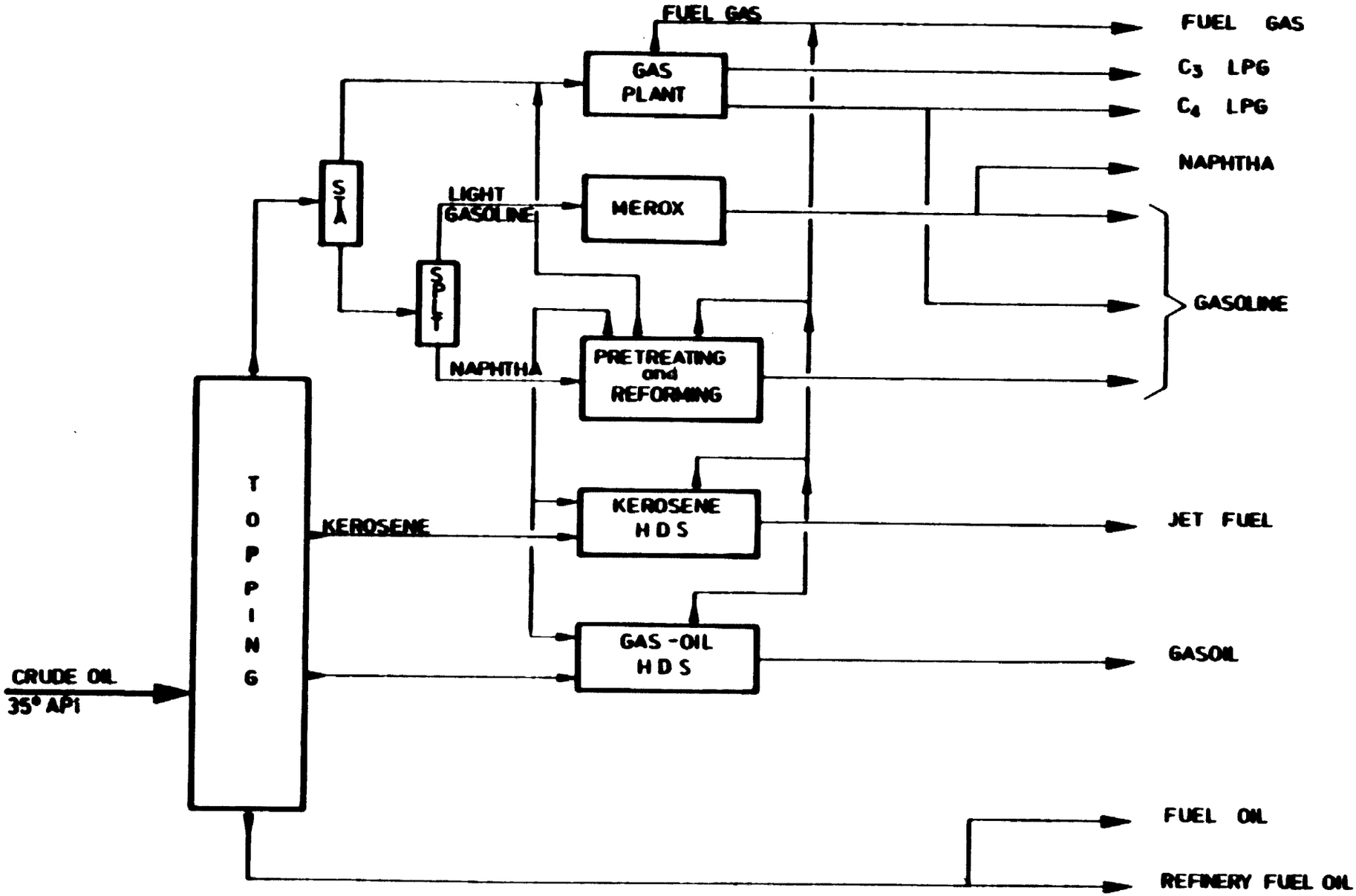

FUEL GAS
GAS PLANT
FUEL GAS
C3 LPG
C4 LPG
NAPHTHA
S I A
LIGHT GASOLINE
MEROX
S P L I T
GASOLINE
NAPHTHA
PRETREATING and REFORMING
T O P P I N G
KEROSENE
KEROSENE H D S
JET FUEL
GAS - OIL H D S
GASOIL
CRUDE OIL 35° API
FUEL OIL
REFINERY FUEL OIL

TABLE 3

OVERALL MATERIAL BALANCE

ton/year

	Fuel Gas	C_3 LPG	C_4 LPG	Naphtha	Regular	Premium	Kerosene	Gasoil	Fuel oil	Total
From										
Topping	500			76.000	40.000	82.000			2.285.000	
Gas Plant	5.850	10.800	59.850		5.100	20.390				
Reforming	75.980	46.330	47.190		86.500	424.010				
HDS Kerosene	2.500						525.000			
HDS Gasoil	31.000							1.176.000		
TOTAL	115.830	57.130	107.040	76.000	131.600 (No. 92)	526.400 (No. 98)	525.000	1.176.000	2.285.000	5.000.000

TABLE 4

MANUFACTURING COST

ERECTED COST IN EUROPE/JAPAN MID OF 1978 : 280 000 000 US$

BASIS : GRASS-ROOT REFINERY - CASH PAYMENT

	Quantity	Unit Cost $	Total U.S. $
VARIABLE CHARGES			
1. RAW MATERIAL	5.000.000 Tons	C	5.000.000 C
2. UTILITIES (included in investment and as fuel consumption)			
3. CHEMICALS AND CATALYSTS			2.000.000
FIXED CHARGES			
4. LABOUR AND SUPERVISION	400	22.000/Year	8.800.000
5. MAINTENANCE (MATERIALS AND LABOUR)	3% of investment		8.400.000
6. OVERHEADS	1% of investment		2.800.000
7. INSURANCES, TAXES	1.5% of investment		4.200.000
8. INTEREST ON WORKING CAPITAL	10% of working capital		8.100.000
9. DEPRECIATION AND RETURN ON INVESTMENT	14.3%of investment		40.000.000
TOTAL			74.300.000
			+5.000.000 C

BASIS

- LABOUR AND SUPERVISION 18.000 $ per man year
- WORKING CAPITAL estimated at 2 months crude cost

APPENDIX 2

PRODUCTS MAIN CHARACTERISTICS

PRODUCTS MAIN CHARACTERISTICS

The refinery products have been splitted into intermediate and finished products.

The following two series of tables show a preliminary estimate of the main characteristics of intermediate and finished products issued from both crudes processed MINAS and ARABIAN.

1. INTERMEDIATE PRODUCTS

See the following tables :

1.1. MINAS CRUDE/light products : light gasoline - total gasolines

1.2. MINAS CRUDE/Heavy gasolines - reformate

1.3. MINAS CRUDE/Kerosene

1.4. MINAS CRUDE/Light gas oil

1.5. MINAS CRUDE/Heavy gas oil

1.6. MINAS CRUDE/Heavy gas oil - Residuum - Coke

1.7. ARABIAN CRUDE/Light products : gasoline

1.8. ARABIAN CRUDE/Light products : gasoline - reformate

1.9. ARABIAN CRUDE/Kerosene - light gas oil

1.10. ARABIAN CRUDE/Heavy gas oil

1.11. ARABIAN CRUDE/Residuum

TABLE : 1-1

INTERMEDIATE PRODUCTS MAIN CHARACTERISTICS

MINAS CRUDE/LIGHT PRODUCTS : LIGHT GASOLINE - TOTAL GASOLINE

(PRELIMINARY ESTIMATE)

INTERMEDIATE PRODUCTS	C5/65 SR	C5/80 SR	C5/80 HCK	C5/150 SR	C5/170 FCC	C5/170 COKER	C5/170 VB/TC
. SPECIFIC GRAVITY	0,654	0,666	0,660	0,720	0,710	0,720	0,720
. SULPHUR CONTENT (% Wt)	< 0,01	< 0,01	-	< 0,01	< 0,01	-	-
MERCAPTANS " (PPM Wt)	< 5	< 5	-	< 5	-	-	-
H_2S " (PPM Wt)	< 5	< 5	-	< 5	-	-	-
NITROGEN " (PPM Wt)	< 1	< 1	-	< 1	-	-	-
. OCTANE NUMBER							
RESEARCH CLEAR	70	64	75	49	93	65	65
. REID VAPOR PRESSURE (BAR)	0,8	0,7	0,7	0,35	-	-	-
. COMPOSITION (% VOL.)							
PARAFFINS	-	-	-	59	-	-	-
NAPHTENES	-	-	-	40	-	-	-
AROMATICS	-	-	-	1	-	-	-
. ASTM DISTILLATION (°C)							
IP	-	-	-	49	-	-	-
10 % (VOL.)	-	-	-	69	-	-	-
50 % (VOL.)	-	-	-	101	-	-	-
90 % (VOL.)	-	-	-	139	-	-	-
EP	-	-	-	147	-	-	-

TABLE : 1-2
INTERMEDIATE PRODUCTS MAIN CHARACTERISTICS
MINAS CRUDE/LIGHT PRODUCTS : HEAVY GASOLINE - REFORMATE
(PRELIMINARY ESTIMATE)

INTERMEDIATE PRODUCTS	65/150 SR	80/150 HDK	80/170 SR	80/170 COKER	80/170 VB/TC	REFORMATE
. SPECIFIC GRAVITY	0,725	0,740	0,739	0,740	0,740	0,790
. SULPHUR CONTENT (% Wt)	< 0,01	-	< 0,01	-	-	< 0,01
MERCAPTANS " (PPM Wt)	< 5	-	< 5	-	-	-
H_2S " (PPM Wt)	< 5	-	< 5	-	-	-
NITROGEN " (PPM Wt)	< 1	-	< 1	-	-	-
. OCTANE NUMBER RESEARCH CLEAR	42	45/50	37	40	40	95
. REID VAPOR PRESSURE (BAR)	-	-	-	-	-	0,34
. COMPOSITION (% VOL.)						
PARAFFINS	58	-	60	-	-	-
NAPHTENES	40	-	37	-	-	-
AROMATICS	2	-	3	-	-	-
. ASTM DISTILLATION (°c)						
IP	70	-	-	-	-	54
10 % (VOL.)	80	-	-	-	-	73
50 % (VOL.)	110	-	-	-	-	115
90 % (VOL.)	137	-	-	-	-	142
EP	143	-	-	-	-	170

TABLE : 1-3
INTERMEDIATE PRODUCTS MAIN CHARACTERISTICS
MINAS CRUDE/KEROSENE
(PRELIMINARY ESTIMATE)

INTERMEDIATE PRODUCTS	150/185 HDK	150/220 SR	170/220 SR	170/260 SR	185/250 HDK
. SPECIFIC GRAVITY	0,760	0,770	0,778	0,797	0,795
. SULPHUR CONTENT (% Wt)	< 0,01	< 0,01	< 0,01	0,01	0,01
. FREEZING POINT (°C)	- 65	- 61	- 56	- 43	< - 50
FLASH " (°C)	-	43	56	60	60
SMOKE " (mm)	33	38	35	30	30
. AROMATICS CONTENT (% VOL.)	< 5	8	9	11	-
. ASTM DISTILLATION (°C)					
IP	-	152	171	174	-
10 % (VOL)	-	162	177	188	-
50 % (VOL)	-	182	189	210	-
90 % (VOL)	-	200	204	235	-
EP	-	211	211	247	-

TABLE : 1-4
INTERMEDIATE PRODUCTS MAIN CHARACTERISTICS
MINAS CRUDE/LIGHT GAS OIL
(PRELIMINARY ESTIMATE)

INTERMEDIATE PRODUCTS	220/300 SR	260/350 SR	LCO FCC	170/350 COKER	170/350 VB - TC
. SPECIFIC GRAVITY	0,818	0,830	0,865	0,860	0,860
. SULPHUR CONTENT (% Wt)	0,02	< 0,05	< 0,05	< 0,05	< 0,05
. POUR POINT (°C)	- 18	+3	- 7	- 5	- 5/+ 0
FLASH " (°C)	93	120	-	-	-
. VISCOSITY (CST)					
AT 20°C	3,5	-	-	-	-
38°C	2,4	4,0	-	7,0	10/7
54°C	1,8	2,8	2,2	-	-
99°C	-	1,5	-	2,0	2,5/2,0
. CETANE NUMBER	66	71	30/40	40	40

TABLE : 1-5
INTERMEDIATE PRODUCTS MAIN CHARACTERISTICS
MINAS CRUDE/HEAVY GAS OIL
(PRELIMINARY ESTIMATE)

INTERMEDIATE PRODUCTS	250/350 HCK	300/370 SR	350/370 SR	HCD FCC	350+ COKER	350+ VB - TC
• SPECIFIC GRAVITY	0,850	0,839	0,846	0,900	0,920	0,910
. SULPHUR CONTENT (% Wt)	0,01	0,05	0,06	0,10	< 0,3	< 0,5
. POUR POINT (°C)	+ 0	+ 17	+ 27	+ 46	+ 15	+ 20
FLASH " (°C)	-	145	180	-	-	-
ANILINE " (°C)	-	88	91	-	-	-
. VISCOSITY (CST)						
AT 38°C	5,8	6,0	8,5	-	-	-
50°C	-	4,3	-	12,6	15	380
99°C	1,9	-	2,3	-	-	-
140°C	-	-	-	-	-	-
. CETANE NUMBER	75	74	77	-	-	-

TABLE : 1-6
INTERMEDIATE PRODUCTS MAIN CHARACTERISTICS
MINAS CRUDE/HEAVY GAS OIL - RESIDUUM - COKE
(PRELIMINARY ESTIMATE)

INTERMEDIATE PRODUCTS	370/550 SR	370+ SR	550+ SR	DCD FCC	GREEN COKE
. SPECIFIC GRAVITY	0.865	0.896	0.934	1.020	2.06/2.08
. SULPHUR CONTENT (% Wt)	0.09	0.12	0.18	< 0.2	< 1.0
. POUR POINT (°C)	+ 52	+ 49	+ 46	+ 50	-
FLASH " (°C)	-	220	-	-	-
ANILINE " (°C)	107	-	-	-	-
. VISCOSITY (CST)					
AT 50°C	17.5	120	2200	-	-
99°C	5.5	16	105	-	-
149°C	-	-	22	< 50	-
. METAL CONTENT (PPM Wt)					
VANADIUM	< 0.02	0.6	< 1.5	-	< 15
NICKEL	0.03	20	< 50	-	< 250
NITROGEN CONTENT(PPM Wt)	500	2000	3400	-	-
. CONRADSON CARBON	-	4.8	10.9	5.7	-
. WATER + VCM CONTENT (% Wt)	-	-	-	-	< 20

TABLE : 1-7
INTERMEDIATE PRODUCTS MAIN CHARACTERISTICS
ARABIAN LIGHT CRUDE/LIGHT PRODUCTS : GASOLINE
(PRELIMINARY ESTIMATE)

INTERMEDIATE PRODUCTS	C5/65 SR	C5/75 SR	C5/80 HCK	C5/155 SR	C5/170 FCC
. SPECIFIC GRAVITY	0,647	0,653	0,670	0,708	0,720
. SULPHUR CONTENT (% WT)	< 0,03	< 0,03	< 0,01	0,03	
MERCAPTANS " (PPM Wt)	273	279	-	238	-
H_2S " (PPM Wt)	8	8	-	22	-
NITROGEN " (PPM Wt)	-	-	-	-	-
. OCTANE NUMBER RESEARCH CLEAR	65,5	64,5	74	43	93
. REID VAPOR PRESSURE (BAR)	0,87	0,79	0,7	0,36	-
. COMPOSITION (% VOL)					
PARAFFINS	95,5	93,4	-	80,8	-
NAPHTENES	3,7	5,5	-	12,1	-
AROMATICS	0,8	1,1	-	7,0	-

TABLE : 1-8
INTERMEDIATE PRODUCTS MAIN CHARACTERISTICS
ARABIAN LIGHT CRUDE/LIGHT PRODUCTS : GASOLINE - REFORMATE
(PRELIMINARY ESTIMATE)

INTERMEDIATE PRODUCTS	65/155 SR	65/165 SR	75/185 SR	80/150 HDK	REFORMATE
. SPECIFIC GRAVITY	0,729	0,734	0,747	0,750	0,790
. SULPHUR CONTENT (% Wt)	0,03	< 0,04	< 0,05	< 0,01	< 0,01
MERCAPTANS " (PPM Wt)	226	227	218	-	-
H_2S " (PPM Wt)	26	28	35	-	-
NITROGEN " (PPM Wt)	< 2	< 2	< 2	-	-
. OCTANE NUMBER RESEARCH CLEAR	-	-	-	50	95
. REID VAPOR PRESSURE (BAR)	-	-	-	-	0,25
. COMPOSITION (% VOL)					
PARAFFINS	76,4	75,2	72,6	-	-
NAPHTENES	14,8	14,9	15,1	-	-
AROMATICS	8,8	9,9	12,3	-	-

TABLE : 1-9
INTERMEDITAE PRODUCTS MAIN CHARACTERISTICS
ARABIAN LIGHT CRUDE/KEROSENE - LIGHT GAS OIL
(PRELIMINARY ESTIMATE)

INTERMEDIATE PRODUCTS	150/185 HCK	155/240 SR	165/240 SR	185/240 SR	185/250 HCK	240/340 SR
. SPECIFIC GRAVITY	0,750	0,790	0,792	0,798	0,800	0,886
. SULPHUR CONTENT (% Wt)	< 0,01	0,10	0,11	0,12	< 0,1	1,10
. FREEZING POINT (°C)	- 65	- 53	- 51	- 44	< - 50	-
FLASH " (°C)	-	-	-	-	60	127
POUR " (°C)	-	-	-	-	-	- 13
SMOKE " (mm)	33	23	23	23	30	-
ANILINE " (°C)	-	-	-	-	-	70,5
. AROMATICS CONTENT (% VOL)	< 5	19,7	18,2	17,9	-	-
. VISCOSITY (CST)						
AT 38°C	-	-	-	-	-	3,6
50°C	-	-	-	-	-	2,8
. CETANE NUMBER	-	-	-	-	-	50

TABLE : 1-10
INTERMEDIATE PRODUCTS MAIN CHARACTERISTICS
ARABIAN LIGHT CRUDE/HEAVY GAS OIL
(PRELIMINARY ESTIMATE)

INTERMEDIATE PRODUCTS	LCO FCC	260/350 HCK	340/370 SR	HCO FCC	370/550 SR
. SPECIFIC GRAVITY	0,905	0,860	0,886	0,925	0,920
. SULPHUR CONTENT (% Wt)	2,60	0,05	2,17	3,0	2,5
. POUR POINT (°C)	- 15	- 5	+ 10	+ 20	+ 39
FLASH * (°C)	-	-	180	-	-
ANILINE * (°C)	-	-	74	-	82
. VISCOSITY (CST)					
AT 38°C	-	-	9,5	-	-
50°C	3,5	4,0	-	10,7	39,6
99°C	-	-	2,6	-	8,0
. CETANE NUMBER	30/40	70	43	-	-

TABLE : 1-11
INTERMEDIATE PRODUCTS MAIN CHARACTERISTICS
ARABIAN LIGHT CRUDE/RESIDUUM
(PRELIMINARY ESTIMATE)

INTERMEDIATE PRODUCTS	370+ SR	550+ SR	DCO FCC
. SPECIFIC GRAVITY	0,957	1,025	1,050
. SULPHUR CONTENT (% Wt)	3,05	3,96	4,0
. POUR POINT (°C)	+ 18	+ 33	+ 40
. VISCOSITY (CST)			
AT 38°C	718	-	-
50°C	300	-	-
99°C	31	1170	-
. METAL CONTENT (PPM)			
VANADIUM	32	84	-
NICKEL	7	20	-
NITROGEN CONTENT (PPM)	450	930	
. CONRADSON CARBON	8,9	23,4	10/15

TABLE : 2-1
FINISHED PRODUCTS MAIN CHARACTERISTICS
LPG/GASOLINE
(PRELIMINARY ESTIMATE)

FINISHED PRODUCTS	LPG	GASOLINE			
		TYPE I	TYPE II	TYPE III	AVIATION TYPE
. OCTANE NUMBER					
- RESEARCH (F1)	-	-	-	93 MIN	-
- MOTOR (F2)	-	72	76	-	70
. SPECIFIC GRAVITY	0,55	0,72-0,75	0,73-0,76	0,75-0,77	0,72-0,75
. SULPHUR CONTENT (% Wt)	NIL	⩽ 0,05	⩽ 0,05	⩽ 0,05	⩽ 0,05
. REID VAPOR PRESSURE (BAR)	4,8	0,60-0,67	0,53-0,67	0,53-0,67	⩽ 0,48
. ASTM DISTILLATION (°C)					
IP	-	⩽ 50	⩽ 50	⩽ 50	⩽ 50
10 % VOL.	-	80	80	80	88
50 % VOL.	-	140	120	120	105
90 % VOL	-	< 180	< 180	< 180	145
EP	-	< 200	< 200	< 200	180

REMARK : 1 - THE SPECIFICATION CONCERNING ASTM DISTILLATION INITIAL POINT AND REID VAPOR PRESSURE ARE NOT CONSISTANT IN ORDER TO RESPECT RVP SPECIFICATION, ASTM IP SPECIFICATION HAS BEEN ESTIMATED TO 50°C.

2 - THE SPECIFICATION CONCERNING TYPES I AND II GASOLINE GUM SEDIMENTATION WILL NOT BE RESPECTED IF THEIR FABRICATION INVOLVES A LARGE QUANTITY OF FCC GASOLINE.

TABLE : 2-2
FINISHED PRODUCTS MAIN CHARACTERISTICS
JET FUEL/KEROSENE/DIESEL OIL
(PRELIMINARY ESTIMATE)

FINISHED PRODUCTS	JET FUEL		KEROSENE	DIESEL OIL		
	JP4	TC1		TYPE I	TYPE II	TYPE III
. SPECIFIC GRAVITY	0,75-0,80	0,78-0,80	0,79-0,81	0,82-0,85	0,82-0,85	0,85-0,90
. SULPHUR CONTENT (% Wt)	< 0,10	< 0,10	0,05	0,5 - 0,8	0,5-0,8	< 1,0
. AROMATICS CONTENT (% VOL)	< 18	< 18	-	-	-	-
. FREEZING POINT (°C)	- 60	- 60	-	-	-	-
FLASH " (°C)	-	-	-	70 MIN	90 MIN	70 MIN
POUR " (°C)	-	-	< - 5	+ 10/+ 0	+ 0	+ 15
SMOKE " (mm)	20/30	20/30	23/30	-	-	-
. VISCOSITY (CST)						
AT 20°C	-	-	-	3/8	3/8	-
50°C	-	-	-	-	-	< 10
. CETANE NUMBER	-	-	-	45	50	-
. ASTM DISTILLATION (°C)						
IP	< 150	< 150	150-185	220-240	220-240	240 -300
EP	220-250	220-250	240-300	340-370	340-370	-

REMARKS : 1 - DIESEL OIL SULPHUR CONTENT SPECIFICATION WILL NOT BE RESPECTED WHEN IMPORTED ARABIAN LIGHT CRUDE IS PROCESSED.
2 - TC_1 JET FUEL FLASH POINT SPECIFICATION SHOULD BE CHECKED LATER.
3 - DUE TO A MAXIMUM USE OF HEAVY GAS OIL CUTS IN DIESEL OIL COMPOSITION, TYPE 1 AND II DIESEL OIL ASTM DISTILLATION EP SHOULD BE CHECKED LATER.
4 - TYPE I AND II DIESEL OIL POUR POINT SPECIFICATIONS SHOULD BE DETERMINED MORE ACCURATELY BY MEANS OF BLENDING ASSAYS.

TABLE : 2-3

FINISHED PRODUCTS MAIN CHARACTERISTICS

FUEL OIL/CALCINED COKE

(PRELIMINARY ESTIMATE)

FINISHED PRODUCTS	FUEL OIL			CALCINED COKE
	TYPE 1	TYPE II	TYPE III	
. SPECIFIC GRAVITY	0,92-0,96	0,96	0,93-0,96	2,08
. SULPHUR CONTENT (% Wt)	2,8 - 3,1	3,1	2,9 - 3,1	< 1,0
. POUR POINT (°C)	+ 21	+ 20	+ 25	-
FLASH " (°C)	160	-	-	-
. VISCOSITY (CST) AT 50°C	< 120	< 300	300-500	-

REMARKS: 1 - FUEL OIL SULPHUR CONTENT SPECIFICATION WILL NOT BE RESPECTED WHEN IMPORTED ARABIAN LIGHT CRUDE IS PROCESSED.

2 - IN ORDER TO RESPECT POUR POINT SPECIFICATION LIGHT CUTS ARE USED IN FUEL OIL COMPOSITION AND CONSEQUENTLY TYPE I AND II VISCOSITY ESTIMATE IS MUCH LOWER THAN THE SPECIFICATION REQUIRED.

3 - DATA CONCERNING BLENDING OPERATIONS WITH ARABIAN LIGHT AND MINAS HEAVY CUTS IS NOT AVAILABLE ; BLENDING ASSAYS SHOULD BE REQUIRED IN ORDER TO FIX MORE ACCURATELY THE FUEL OIL COMPOSITION.

APPENDIX 3

FINISHED PRODUCTS COMPOSITION

1. MINAS/ARABIAN 50/50 DESIGN BASIS

5.0 MMT/YEAR OF 50/50 MINAS/ARABIAN CRUDES

See following tables

1.a Refining scheme n°1

1.b Refining scheme n°2

1.c Refining scheme n°3

1.d Refining scheme n°4

1.e Refining scheme n°5

1.f Refining scheme n°6

TABLE 1.a

REFINING SCHEME N° 1 MINAS/ARABIAN 50/50 %

GASOLINE POOL COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	TYPE 1 MON = 72	TYPE 2 MON = 76	TYPE 3 RON = 93	AVIATION MON = 70
. LIGHT GASOLINE SR		73	79	2	3
C_5/80 MINAS	40.5				
C_5/75 ARABIAN	116.5				
. HEAVY GASOLINE SR		41	48.5	-	3
80/170 MINAS	36.5				
75/185 ARABIAN	56				
. REFORMATE		153	224	31	8
MINAS	131				
ARABIAN	285				
. LPG (BUTANE)	21.5	8	12.5	1	-
. TOTAL PRODUCTION	687	275	364	34	14
. % OF TOTAL PRODUCTION	100	40	53	5	2

TABLE 1.d (continued)

REFINING SCHEME N° 1 CASE : MINAS/ARABIAN 50/50 %

JET FUEL COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	TYPE 1 JP 4	TYPE 2 TC 1
. HEAVY GASOLINE SR		18,5	14
80/170 MINAS	15,5		
75/185 ARABIAN	17		
. KEROSENE SR		38,5	123
170/220 MINAS	81,5		
185/240 ARABIAN	80		
. LPG (BUTANE)	1	1	-
. TOTAL PRODUCTION	195	58	137
. % OF TOTAL PRODUCTION	100	30	70

TABLE 1.a(continued)

REFINING SCHEME N° : I CASE : MINAS/ARABIAN 50/50 %

KEROSENE COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR
. KEROSENE SR	
170/220 MINAS	86
185/240 ARABIAN	150
. LIGHT GAS OIL SR	
220/300 MINAS	9
. TOTAL PRODUCTION	245

TABLE 1.a (continued)

REFINING SCHEME N° 1 CASE : MINAS/ARABIAN 50/50 %

DIESEL OIL COMPOSITION (*)

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	TYPE 1 CI = 50	TYPE 2 CI = 50	TYPE 3 LOW SPEED
. LIGHT GAS OIL SR		482	125	45
220/300 MINAS	313.5			
240/340 ARABIAN	338.5			
. HEAVY GAS OIL SR		173	60	230
300/370 MINAS	322.5			
340/370 ARABIAN	140.5			
. TOTAL PRODUCTION	1115	655	185	275
. % OF TOTAL PRODUCTION	100	59	16.5	24.5

(*) DIESEL OIL SPECIFICATION CONCERNING SULPHUR CONTENT WILL NOT BE WELL RESPECTED.

TABLE 1.a (continued)

REFINING SCHEME N° : 1 CASE : MINAS/ARABIAN 50/50 %

FUEL OIL COMPOSITION (*)

PETROLEUM CUTS	TOTAL 10^3T/YEAR	TYPE 1	TYPE 2	TYPE 3
. LIGHT GAS OIL SR 240/340 ARABIAN	101	101	-	-
. ATMOSPHERIC RESIDUUM 370+ MINAS	185.5	879	210	210
370+ ARABIAN	1 113.5			
. TOTAL PRODUCTION	1 400	980	210	210
. % OF TOTAL PRODUCTION	100	70	15	15

(*) FUEL OIL SPECIFICATION CONCERNING SULPHUR CONTENT WILL NOT BE RESPECTED.

TABLE 1.a (end)

REFINING SCHEME N° 1 CASE : MINAS/ARABIAN 50/50 %

EXCESS PRODUCTS

PETROLEUM CUTS	TOTAL 10^3 T/YEAR
. ATMOSPHERIC RESIDUUM 370+ MINAS	1 23/ (*)

(*) MAY BE USED TO AMMONIA SYNTHESIS GAS PRODUCTION BY PARTIAL OXYDATION PROCESS.

TABLE 1.b

REFINING SCHEME N° 2 CASE : MINAS/ARABIAN 50/50 %

GASOLINE POOL COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	TYPE 1 MON=72	TYPE 2 MON=76	TYPE 3 RON=93	AVIATION MON=70
. LIGHT GASOLINE SR C5/80 MINAS C5/65 ARABIAN	 40.5 97	73	59	2	3.5
. HEAVY GASOLINE SR 80/170 MINAS 65/165 ARABIAN	 75 43.5	58.5	57.5	-	2.5
. REFORMATE MINAS ARABIAN	 100 232.5	74	227	27	4.5
. FCC GASOLINE C5/170 MINAS	157.5	93.5	50.5	9	4.5
. LPG (BUTANE)	24	9	14	1	-
. TOTAL PRODUCTION	770	308	408	39	15
. % OF TOTAL PRODUCTION	100	40	53	5	2

TABLE 1.b(continued)

REFINING SCHEME N°2 CASE : MINAS/ARABIAN 50/50 %

JET FUEL COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	TYPE 1 JP4	TYPE 2 TC1
.HEAVY GASOLINE SR		18.5	14
80/170 MINAS	15.5		
65/165 ARABIAN	17		
. KEROSENE SR		38.5	123
170/220 MINAS	81.5		
165/240 ARABIAN	80		
. LPG BUTANE	1	1	-
. TOTAL PRODUCTION	195	58	137
. % OF TOTAL PRODUCTION	100	30	70

TABLE 1.b (continued)

REFINING SCHEME N° 2 CASE : MINAS/ARABIAN 50/50 %

KEROSENE COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR
. KEROSENE SR 170/220 MINAS 165/240 ARABIAN	 86 250
. TOTAL PRODUCTION	336

TABLE 1.b (continued)

REFINING SCHEME N° 2 CASE : MINAS/ARABIAN 50/50 %

DIESEL OIL COMPOSITION (*)

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	TYPE 1 CI=45	TYPE 2 CI=50	TYPE 3 LOW SPEED
. LIGHT GAS OIL SR 220/300 MINAS 240/340 ARABIAN	322.5 439.5	592	125	45
. HEAVY GAS OIL SR 300/370 MINAS 340/370 ARABIAN	322.5 140.5	173	60	230
. LIGHT CYCLE OIL FCC MINAS	72.5	72.5	-	-
. TOTAL PRODUCTION	1 297.5	837.5	185	275
. % OF TOTAL PRODUCTION	100	65	14	21

(*) DIESEL OIL SPECIFICATION CONCERNING SULPHUR CONTENT WILL NOT BE WELL RESPECTED.

TABLE 1.b (continued)

REFINING SCHEME N° 2 CASE : MINAS/ARABIAN 50/50 %

FUEL OIL COMPOSITION (*)

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	TYPE 1	TYPE 2	TYPE 3
. ATMOSPHERIC RESIDUUM 370+ MINAS	-	713	210	190.5
370+ ARABIAN	1 113.5			
. VACUUM RESIDUUM 550+ MINAS	109.5	90	-	19.5
. HEAVY CYCLE OIL FCC MINAS	137.5	137.5	-	-
. DECANT OIL FCC MINAS	39.5	39.5	-	-
. TOTAL PRODUCTION	1 400	980	210	210
. % OF TOTAL PRODUCTION	100	70	15	15

(*) FUEL OIL SPECIFICATION CONCERNING SULPHUR CONTENT WILL NOT BE RESPECTED.

TABLE 1.b (continued)

REFINING SCHEME N° 2 CASE : MINAS/ARABIAN 50/50 %

EXCESS PRODUCTS

PETROLEUM CUTS	TOTAL 10^3 T/YEAR
. ATMOSPHERIC RESIDUUM 370+ MINAS	477.5
. VACUUM RESIDUUM 550+ MINAS	310.5
. TOTAL PRODUCTION	(=) 788

(=) MAY BE USED TO AMMONIA SYNTHESIS GAS PRODUCTION BY PARTIAL OXYDATION PROCESS.

TABLE 1.c

REFINING SCHEME N° 3 CASE : MINAS/ARABIAN 50/50 %

GASOLINE POOL COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	TYPE 1 MON=72	TYPE 2 MON=76	TYPE 3 RON=93	AVIATION MON=70
. LIGHT GASOLINE SR		48.5	43	2	3.5
C5/65 MINAS	-				
C5/65 ARABIAN	97				
. HEAVY GASOLINE SR		32		-	2.5
65/150 MINAS	-				
65/165 ARABIAN	34.5				
. REFORMATE		74	127	27	4.5
MINAS	-				
ARABIAN	232.5				
. FCC GASOLINE		144.5	130	9	4.5
C5/170 MINAS	288				
. COKER GASOLINE					
C5/170 MINAS	94	-	94	-	-
. LPG (BUTANE)	24	9	14	1	-
. TOTAL PRODUCTION	770	308	408	39	15
. % OF TOTAL PRODUCTION	100	40	53	5	2

TABLE 1.c (continued)

REFINING SCHEME N° 3 CASE : MINAS/ARABIAN 50/50 %

JET FUEL COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	TYPE 1 JP4	TYPE 2 TC1
. HEAVY GASOLINE SR		18	8
65/150 MINAS	-		
65/165 ARABIAN	26		
. KEROSENE SR		39	129
150/220 MINAS	88		
165/240 ARABIAN	80		
. LPG (BUTANE)	1	1	-
. TOTAL PRODUCTION	195	58	137
. % OF TOTAL PRODUCTION	100	30	70

TABLE 1.c (continued)

REFINING SCHEME N° 3 CASE : MINAS/ARABIAN 50/50 %

KEROSENE COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR
. KEROSENE SR	
150/220 MINAS	135
165/240 ARABIAN	250
. LIGHT GAS OIL SR	
220/300 MINAS	105
. TOTAL PRODUCTION	490

TABLE 1.c (continued)

REFINING SCHEME N° 3 CASE : MINAS/ARABIAN 50/50 %

DIESEL OIL COMPOSITION (*)

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	TYPE 1 CI=45	TYPE 2 CI=50	TYPE 3 LOW SPEED
. LIGHT GAS OIL SR 220/300 MINAS 240/340 ARABIAN	 217.5 439.5	487	125	45
. HEAVY GAS OIL SR 300/370 MINAS 340/370 ARABIAN	 322.5 140.5	173	60	230
. LIGHT CYCLE OIL FCC MINAS	87	87	-	-
. LIGHT COKER GAS OIL MINAS	226	226	-	-
. TOTAL PRODUCTION	1 433	973	185	275
. % OF TOTAL PRODUCTION	100	68	13	19

(*) DIESEL OIL SPECIFICATION CONCERNING SULPHUR CONTENT WILL NOT BE WELL RESPECTED.

TABLE 1.c (continued)

REFINING SCHEME N° 3 CASE : MINAS/ARABIAN 50/50 %

FUEL OIL COMPOSITION (*)

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	TYPE 1	TYPE 2	TYPE 3
. ATMOSPHERIC RESIDUUM 370+ MINAS	-	690	210	160
370+ ARABIAN	1 060			
. HEAVY CYCLE OIL FCC MINAS	167	137	-	30
. DECANT OIL FCC MINAS	60	40	-	20
. HEAVY COKER GAS OIL MINAS	113	113	-	-
. TOTAL PRODUCTION	1 400	980	210	210
. % OF TOTAL PRODUCTION	100	70	15	15

(*) FUEL OIL SPECIFICATION CONCERNING SULPHUR CONTENT WILL NOT BE RESPECTED.

TABLE 1.c (end)

REFINING SCHEME N° 3 CASE : MINAS/ARABIAN 50/50 %

EXCESS PRODUCTS

PETROLEUM CUTS	TOTAL 10^3 T/YEAR
. TOTAL GASOLINE SR C5/150 MINAS C5/165 ARABIAN	197 - (*)
. ATMOSPHERIC RESIDUUM 370+ ARABIAN	53.5
. CALCINED COKE	103
. TOTAL PRODUCTION	353.5

(*) MAY BE USED TO AMMONIA SYNTHESIS GAS PRODUCTION BY NAPHTA STEAM REFORMING.

TABLE 1.d

REFINING SCHEME N° 4 CASE : MINAS/ARABIAN 50/50 %

GASOLINE POOL COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	TYPE 1 MON=72	TYPE 2 MON=76	TYPE 3 RON=93	AVIATION MON = 70
. LIGHT GASOLINE		97	96	2	2.5
C5/80 SR MINAS	40.5				
C5/80 HCK MINAS	70				
C5/65 SR ARABIAN	97				
. HEAVY GASOLINE		77	73	-	3.5
80/170 SR MINAS	-				
80/150 HCK MINAS	100				
65/165 SR ARABIAN	43.5				
. REFORMATE		125	225	36	9
MINAS	162.5				
ARABIAN	232.5				
. LPG (BUTANE)	24	9	14	1	-
. TOTAL PRODUCTION	770	308	408	39	15
. % OF TOTAL PRODUCTION	100	40	53	5	2

TABLE 1.d (continued)

REFINING SCHEME N° 4 CASE : MINAS/ARABIAN 50/50 %

JET FUEL COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	TYPE 1 JP4	TYPE 2 TC1
. HEAVY GASOLINE SR		19	10
80/170 MINAS	12		
65/165 ARABIAN	17		
. KEROSENE HCK			
150/185 MINAS	45	-	45
. LIGHT GAS OIL HCK			
185/250 MINAS	40	10	30
. KEROSENE SR			
165/240 ARABIAN	80	28	52
. LPG (BUTANE)	1	1	-
. TOTAL PRODUCTION	195	58	137
. % OF TOTAL PRODUCTION	100	30	70

TABLE 1.4 (continued)

REFINING SCHEME N° : 4 CASE : MINAS/ARABIAN 50/50 %

KEROSENE COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR
. KEROSENE SR 170/260 MINAS 165/240 ARABIAN	 240 250
. TOTAL PRODUCTION	490

TABLE 1.d (continued)

REFINING SCHEME N° 4 CASE : MINAS/ARABIAN 50/50 %

DIESEL OIL COMPOSITION (*)

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	TYPE 1 CI = 45	TYPE 2 CI = 50	TYPE 3 LOW SPEED
. KEROSENE SR 170/260 MINAS	82.5	82.5	-	-
. LIGHT GAS OIL SR 260/350 MINAS 240/340 ARABIAN	392.5 332	589.5	85	50
. HEAVY GAS OIL SR 350/370 MINAS 340/370 ARABIAN	97.5 140.5	88	-	150
. LIGHT GAS OIL HCK 185/250 MINAS	165	145	20	-
. HEAVY GAS OIL HCK 250/350 MINAS	350	195	80	75
. TOTAL PRODUCTION	1 560	1 100	185	275
. % OF TOTAL PRODUCTION	100	71	11.5	17.5

(*) DIESEL OIL SPECIFICATION CONCERNING SULPHUR CONTENT WILL NOT BE WELL RESPECTED.

TABLE 1.d (continued)

REFINING SCHEME N° 4 CASE : MINAS/ARABIAN 50/50 %

FUEL OIL COMPOSITION (=)

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	TYPE 1	TYPE 2	TYPE 3
. LIGHT GAS OIL SR 240/340 ARABIAN	107.5	107.5	-	-
. ATMOSPHERIC RESIDUUM 370+ ARABIAN	1 113.5	693.5	210	210
. VACUUM RESIDUUM 550+ MINAS	179	179	-	-
. TOTAL PRODUCTION	1 400	980	210	210
. % OF TOTAL PRODUCTION	100	70	15	15

(=) FUEL OIL SPECIFICATION CONCERNING SULPHUR CONTENT WILL NOT BE RESPECTED.

TABLE 1.d (end)

REFINING SCHEME N° 4 CASE : MINAS/ARABIAN 50/50 %

EXCESS PRODUCTS

PETROLEUM CUTS	TOTAL 10^3 T/YEAR
. VACUUM RESIDUUM 550+ MINAS	448.5 (*)

(*) MAY BE USED TO AMMONIA SYNTHESIS GAS PRODUCTION BY PARTIAL OXYDATION PROCESS

TABLE 1.e

REFINING SCHEME N° 5 CASE : MINAS/ARABIAN 50/50 %

GASOLINE POOL COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	TYPE 1 MON=72	TYPE 2 MON=76	TYPE 3 RON=93	AVIATION MON=70
. LIGHT GASOLINE		45.5	119	2	2.5
C5/65 SR MINAS	22				
C5/80 HCK MINAS	50				
C5/65 ARABIAN	97				
. HEAVY GASOLINE		84.5	-	-	3.5
65/150 SR MINAS	-				
80/150 HCK MINAS	44.5				
65/165 SR ARABIAN	43.5				
. REFORMATE		125	225	36	9
MINAS	162.5				
ARABIAN	232.5				
. COKER GASOLINE					
C5/170 MINAS	94	44	50	-	-
. LPG (BUTANE)	24	9	14	1	-
. TOTAL PRODUCTION	770	308	408	39	15
. % OF TOTAL PRODUCTION	100	40	53	5	2

TABLE 1.e (continued)

REFINING SCHEME N° 5 CASE : MINAS/ARABIAN 50/50 %

JET FUEL COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	TYPE 1 JP4	TYPE 2 TC1
. HEAVY GASOLINE SR		19	10
65/150 MINAS	12		
65/165 ARABIAN	17		
. KEROSENE HCK			
150/185 MINAS	58.5	-	58.5
. KEROSENE SR	106.5	38	68.5
150/220 MINAS			
. LPG (BUTANE)	1	1	
. TOTAL PRODUCTION	195	58	137
. % OF TOTAL PRODUCTION	100	30	70

TABLE 1.e (continued)

REFINING SCHEME N° 5 CASE : MINAS/ARABIAN 50/50 %

KEROSENE COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR
. KEROSENE SR 150/220 MINAS 165/240 ARABIAN	 116.5 330
. LIGHT GAS OIL SR 220/300 MINAS	43.5
. TOTAL PRODUCTION	490

TABLE 1.e (continued)

REFINING SCHEME N° 5 CASE : MINAS/ARABIAN 50/50 %

DIESEL OIL COMPOSITION (*)

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	TYPE 1 CI=45	TYPE 2 CI=50	TYPE 3 LOW SPEED
. LIGHT GAS OIL SR		431	85	50
220/300 MINAS	279			
240/340 ARABIAN	287			
. HEAVY GAS OIL SR		313	-	150
300/370 MINAS	322,5			
340/370 ARABIAN	140.5			
. LIGHT GAS OIL HCK				
185/250 MINAS	230	210	20	-
. HEAVY GAS OIL HCK				
250/350 MINAS	350	195	80	75
. LIGHT COKER GAS OIL				
170/350 MINAS	226	226	-	-
. TOTAL PRODUCTION	1 835	1 375	185	275
. % OF TOTAL PRODUCTION	100	75	10	15

(*) *DIESEL OIL SPECIFICATION CONCERNING SULPHUR CONTENT WILL NOT BE WELL RESPECTED.*

TABLE : 1.e (continued)

REFINING SCHEME N° 5 CASE : MINAS/ARABIAN 50/50 %

FUEL OIL COMPOSITION (a)

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	TYPE 1	TYPE 2	TYPE 3
. LIGHT GAS OIL SR 240/340 ARABIAN	152,5	152,5	-	-
. ATMOSPHERIC RESIDUUM 370° ARABIAN	1113,5	693,5	210	210
. HEAVY COKER GAS OIL 350° MINAS	113	113	-	-
. TOTAL PRODUCTION	1379	959	210	210
. % OF TOTAL PRODUCTION	100	69,4	15,3	15,3

(a) FUEL OIL SPECIFICATION CONCERNING SULPHUR CONTENT WILL NOT BE RESPECTED

TABLE 1.e (end)

REFINING SCHEME N° 5 CASE : MINAS/ARABIAN 50/50 %

EXCESS PRODUCTS

PETROLEUM CUTS	TOTAL 10^3 T/YEAR
. CALCINED COKE	103

TABLE 1.f

REFINING SCHEME N° 6 CASE : MINAS/ARABIAN 50/50 %

GASOLINE POOL COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	TYPE 1 MON=72	TYPE 2 MON=76	TYPE 3 RON=93	AVIATION MON=70
. LIGHT GASOLINE SR		69	63	2	3.5
C5/65 MINAS	22				
C5/65 ARABIAN	97				
. HEAVY GASOLINE SR		41	-	-	2.5
65/150 MINAS	-				
65/165 ARABIAN	43.5				
. REFORMATE		144	280	36	9
MINAS	236.5				
ARABIAN	232.5				
. COKER GASOLINE					
C5/170 MINAS	114.5	45	51	-	-
. LPG (BUTANE)	24	9	14	1	-
. TOTAL PRODUCTION	770	308	408	39	15
. % OF TOTAL PRODUCTION	100	40	53	5	2

TABLE : 1.f (continued)

REFINING SCHEME N° 6 CASE : MINAS/ARABIAN 50/50 %

DIESEL OIL COMPOSITION (x)

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	TYPE 1 CI = 45	TYPE 2 CI = 50	TYPE 3 LOW SPEED
. LIGHT GAS OIL SR		423	125	45
220/300 MINAS	220.5			
240/340 ARABIAN	372.5			
. HEAVY GAS OIL SR		173	60	230
300/370 MINAS	322.5			
340/370 ARABIAN	140.5			
. LIGHT COKER GAS OIL				
170/350 MINAS	374	374	-	-
. TOTAL PORDUCTION	1430	970	185	275
. % OF TOTAL PRODUCTION	100	68	13	19

(x) DIESEL OIL SPECIFICATION CONCERNING SULPHUR CONTENT WILL NOT BE WELL RESPECTED

TABLE : 1.f (continued)

REFINING SCHEME N° 6 CASE : MINAS/ARABIAN 50/50 %

FUEL OIL COMPOSITION (a)

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	TYPE 1	TYPE 2	TYPE 3
. LIGHT GAS OIL SR 240/340 ARABIAN	67	67	-	-
. ATMOSPHERIC RESIDUUM 370° ARABIAN	1113.5	693.5	210	210
. ATMOSPHERIC RESIDUUM 370+ MINAS	127	127	-	-
. HEAVY COKER GAS OIL 350+ MINAS	92.5	92.5	-	-
. TOTAL PRODUCTION	1400	980	210	210
. % OF TOTAL PRODUCTION	100	70	15	15

(a) FUEL OIL SPECIFICATION CONCERNING SULPHUR CONTENT WILL NOT BE RESPECTED.

TABLE 1.f (continued)

REFINING SCHEME N° 6 CASE : MINAS/ARABIAN 50/50 %

JET FUEL COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	TYPE 1 JP 4	TYPE 2 TC 1
. HEAVY GASOLINE SR 65/150 MINAS 65/165 ARABIAN	 12 17	19	10
. KEROSENE SR 150/220 MINAS 165/240 ARABIAN	 85 80	38	127
. LPG (BUTANE)	1	1	-
. TOTAL PRODUCTION	195	58	137
. % OF TOTAL PRODUCTION	100	30	70

TABLE 1.f (continued)

REFINING SCHEME N° 6 CASE : MINAS/ARABIAN 50/50 %

KEROSENE COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR
. KEROSENE SR 150 /220 MINAS 165/240 ARABIAN	138 250
. LIGHT GAS OIL SR 220/300 MINAS	102
. TOTAL PRODUCTION	490

TABLE : 1.f (end)

REFINING SCHEME N° 6 CASE : MINAS/ARABIAN 50/50 %

EXCESS PRODUCTS

PETROLEUM CUTS	TOTAL 10^3 T/YEAR
. ATMOSPHERIC RESIDUUM 370° MINAS	370,5 (*)
. CALCINED COKE	109
. TOTAL PRODUCTION	479,5

(*) MAY BE USED TO AMMONIA SYNTHESIS GAS PRODUCTION BY PARTIAL OXYDATION PROCESS

2. MINAS/ARABIAN 50/50 DESIGN BASIS

5MM T/YEAR of MINAS CRUDE

See following tables

2.a Refining scheme n°1

2.b Refining scheme n°2

2.c Refining scheme n°3

2.d Refining scheme n°4

2.e Refining scheme n°5

2.f Refining scheme n°6

TABLE : 2.a

REFINING SCHEME N° 1 CASE : MINAS/ARABIAN 50/50 DESIGN BASIS
100 % MINAS FEED MATERIAL BALANCE

GASOLINE POOL COMPOSITION

PETROLEUM CUTS	TOTAL 10^3T/YEAR	TYPE I MON = 72	TYPE 2 MON = 76	TYPE 3 RON = 93	AVIATION MON = 70
. LIGHT GASOLINE SR C5/80	81	32	46	1.5	1.5
. HEAVY GASOLINE SR 80/170	73	37	34	-	2
. REFORMATE	262	98	139	20	5
. LPG (BUTANE)	13	5	7.7	0.3	-
. TOTAL PRODUCTION	429	172	226.7	21.8	8.5
. % OF TOTAL PRODUCTION	100	40	53	5	2

TABLE : 2.a (continued)

REFINING SCHEME N° 1

CASE : MINAS/ARABIAN 50/50 DESIGN BASIS
100 % MINAS FEED MATERIAL BALANCE

KEROSENE COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR
. KEROSENE SR 170/220	172
. LIGHT GAS OIL SR 220/300	73
. TOTAL PRODUCTION	245

TABLE : 2.a (continued)

REFINING SCHEME N° 1

CASE : MINAS/ARABIAN 50/50 DESIGN BASIS
100% MINAS FEED MATERIAL BALANCE

JET FUEL COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	TYPE 1 JP 4	TYPE 2 TC 1
. HEAVY GASOLINE SR 80/170	31	23	8
. KEROSENE SR 170/220	163	34	129
. LPG (BUTANE)	1	1	
. TOTAL PRODUCTION	195	58	137
. % OF TOTAL PRODUCTION	100	30	70

TABLE : 2.a (continued)

REFINING SCHEME N° 1 CASE : MINAS/ARABIAN 50/50 DESIGN BASIS
100 % MINAS FEED MATERIAL BALANCE

DIESEL OIL COMPOSITION (*)

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	TYPE 1 CI = 45	TYPE 2 CI = 50	TYPE 3 LOW SPEED
. LIGHT GAS OIL SR 220/300	572	402	125	45
. HEAVY GAS OIL SR 300/370	645/483	355/193	60	230
. TOTAL PRODUCTION	1217/1055	757/595	185	275
. % OF TOTAL PRODUCTION	100	62/56	15/18	23/26

(*) SUMMER PRODUCTION/WINTER PRODUCTION

TABLE : 2.a (end)

REFINING SCHEME N° 1

CASE : MINAS/ARABIAN 50/50 DESIGN BASIS
100 % MINAS FEED MATERIAL BALANCE

EXCESS PRODUCTS

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	
	SUMMER PRODUCTION	WINTER PRODUCTION
. HEAVY GAS OIL SR 300/370	-	162 (*)
. ATMOSPHERIC RESIDUUM 370+	2845	2845 (**)
. TOTAL PRODUCTION	2845	3007

(*) MAY BE USED AS FUEL OIL TYPE I

(**) MAY BE USED TO AMMONIA SYNTHESIS GAS PRODUCTION BY PARTIAL OXYDATION PROCESS

TABLE : 2.b

REFINING SCHEME N° 2

CASE : MINAS/ARABIAN 50/50 DESIGN BASIS
100 % MINAS FEED MATERIAL BALANCE

GASOLINE POOL COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	TYPE 1 MON = 72	TYPE 2 MON = 76	TYPE 3 MON = 93	AVIATION MON = 70
. LIGHT GASOLINE SR C5/80 MINAS	81	48	28	2	3
. HEAVY GASOLINE SR 80/170 MINAS	124	58	64	-	2
. REFORMATE MINAS	220	50	150	20	-
. FCC GASOLINE C5/170 MINAS	190	90	83	9	8
. LPG (BUTANE)	20	7	12	1	-
. TOTAL PRODUCTION	635	253	337	32	13
. % OF TOTAL PRODUCTION	100	40	53	5	2

TABLE : 2.b (continued)

REFINING SCHEME N° 2 CASE : MINAS/ARABIAN 50/50 DESIGN BASIS
100 % MINAS FEED MATERIAL BALANCE

JET FUEL COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	TYPE 1 JP4	TYPE 2 TC1
. HEAVY GASOLINE SR 80/170 MINAS	31	23	8
. KEROSENE SR 170/220 MINAS	163	34	129
. LPG (BUTANE)	1	1	-
. TOTAL PRODUCTION	195	58	137
. % OF TOTAL PRODUCTION	100	30	70

TABLE : 2.b (continued)

REFINING SCHEME N° 2 CASE : MINAS/ARABIAN 50/50 DESIGN BASIS
100 % MINAS FEED MATERIAL BALANCE

KEROSENE COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T / YEAR
. KEROSENE SR 170/220 MINAS	172
. LIGHT GAS OIL SR 220/300	73
. TOTAL PRODUCTION	245

TABLE : 2.b (continued)

REFINING SCHEME N° 2 CASE : MINAS/ARABIAN 50/50 DESIGN BASIS
100 % MINAS FEED MATERIAL BALANCE

DIESEL OIL COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	TYPE 1 CI = 45	TYPE 2 CI = 50	TYPE 3 LOW SPEED
. LIGHT GAS OIL SR 220/300 MINAS	572	402	125	45
. HEAVY GAS OIL SR 300/370 MINAS	645/483	355/193	60	230
. TOTAL PRODUCTION	1217/1055	757/595	185	275
. % OF TOTAL PRODUCTION	100	62/56	15/18	23/26

REMARKS : 1 - SUMMER PRODUCTION / WINTER PRODUCTION

2 - THE SPECIFICATION CONCERNING THE POUR POINT SHOULD BE DETERMINED MORE ACCURATELY BY MEANS OF BLENDING ASSAYS.

TABLE : 2.b (continued)

REFINING SCHEME N° 2 CASE : MINAS/ARABIAN 50/50 DESIGN BASIS
100 % MINAS FEED MATERIAL BALANCE

FUEL OIL COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	TYPE 1	TYPE 2	TYPE 3
. CYCLE OIL FCC	167	107/17	-/90	60
. DECANT OIL FCC	40	-	-	40
. HEAVY GAS OIL SR 300/370 MINAS	0/162	0/162	-	-
. VACUUM RESIDUUM 550 + MINAS	258/420	148/190	-/120	110
. TOTAL PRODUCTION	465/789	255/369	-/210	210
. % OF TOTAL PRODUCTION	100	55/46	-/27	45/27

REMARKS : 1 - SUMMER PRODUCTION / WINTER PRODUCTION

2 - THE SPECIFICATION CONCERNING THE POUR POINT SHOULD BE DETERMINED MORE ACCURATELY BY MEANS OF BLENDING ASSAYS.

TABLE : 2.b (end)

REFINING SCHEME N° 2 CASE : MINAS/ARABIAN 50/50 DESIGN BASIS
100 % MINAS FEED MATERIAL BALANCE

EXCESS PRODUCTS

PETROLEUM CUTS	TOTAL 10^3 T / YEAR
. ATMOSPHERIC RESIDUUM 370° MINAS	1900
. VACUUM RESIDUUM 550° MINAS	162/0
. TOTAL PRODUCTION	2062/1900

REMARKS : 1 - SUMMER PRODUCTION / WINTER PRODUCTION

2 - ATMOSPHERIC / VACUUM RESIDUUM EXCESS PRODUCTS MAY BE USED IN AMMONIA SYNTHESIS GAS PRODUCTION BY PARTIAL OXYDATION PROCESS.

TABLE : 2.c

REFINING SCHEME N° 3 CASE : MINAS/ARABIAN 50/50 DESIGN BASIS
100 % MINAS FEED MATERIAL BALANCE

GASOLINE POOL COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	TYPE 1 MON = 72	TYPE 2 MON = 76	TYPE 3 RON = 93	AVIATION MON = 70
. LIGHT GASOLINE SR C5/80 MINAS	81	32,5	43	2	3,5
. HEAVY GASOLINE SR 80/170 MINAS	101	50	48,5	-	2,5
. REFORMATE MINAS	238	79,5	127	27	4,5
. FCC GASOLINE C5/170 MINAS	232	88,5	130	9	4,5
. COKER GASOLINE C5/170 MINAS	94	48,5	45,5	-	-
. LPG (BUTANE)	24	9	14	1	-
. TOTAL PRODUCTION	770	308	408	39	15
. % OF TOTAL PRODUCTION	100	40	53	5	2

TABLE : 2.c (continued)

REFINING SCHEME N° 3 CASE : MINAS/ARABIAN 50/50 DESIGN BASIS
100 % MINAS FEED MATERIAL BALANCE

JET FUEL COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	TYPE 1 JP4	TYPE 2 TC1
. HEAVY GASOLINE SR 80/170 MINAS	31	23	8
. KEROSENE SR 170/220 MINAS	163	34	129
. LPG (BUTANE)	1	1	-
. TOTAL PRODUCTION	195	58	137
. % OF TOTAL PRODUCTION	100	30	70

TABLE : 2.c (continued)

REFINING SCHEME N° 3 CASE : MINAS/ARABIAN 50/50 DESIGN BASIS
100 % MINAS FEED MATERIAL BALANCE

KEROSENE COMPOSITON

PETROLEUM CUTS	TOTAL 10^3 T/YEAR
. KEROSENE SR 170/220 MINAS	172
. LIGHT GAS OIL SR 220/300	73
. TOTAL PRODUCTION	245

TABLE : 2.c (continued)

REFINING SCHEME N° 3 CASE : MINAS/ARABIAN 50/50 DESIGN BASIS
100 % MINAS FEED MATERIAL BALANCE

DIESEL OIL COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	TYPE 1 CI = 45	TYPE 2 CI = 50	TYPE 3 LOW SPEED
. LIGHT GAS OIL SR 220/300 MINAS	572	482	45	45
. HEAVY GAS OIL SR 300/370 MINAS	645	335	80	230
. LIGHT CYCLE OIL FCC	57	57	-	-
. LIGHT COKER GAS OIL 170/350 MINAS	226	166	60	- -
. TOTAL PRODUCTION	1500	1040	185	275
. % OF TOTAL PRODUCTION	100	70	12	18

TABLE : 2.c (continued)

REFINING SCHEME N° 3 CASE : MINAS/ARABIAN 50/50 DESIGN BASIS
100 % MINAS FEED MATERIAL BALANCE

FUEL OIL COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	TYPE 1	TYPE 2	TYPE 3
. LIGHT CYCLE OIL FCC	55	55	-	-
. HEAVY CYCLE OIL FCC	212	212	-	-
. DECANT OIL FCC	60	-	30	30
. HEAVY COKER GAS OIL 350+ MINAS	113	53	40	20
. ATMOSPHERIC RESIDUUM 370+ MINAS	200	170	35	55
. TOTAL PRODUCTION	700	490	105	105
. % OF TOTAL PRODUCTION	100	70	15	15

REMARK : THE SPECIFICATION CONCERNING THE POUR POINT SHOULD BE DETERMINED MORE ACCURATELY BY MEANS OF BLENDING ASSAYS.

TABLE : 2.c (end)

REFINING SCHEME N° 3 CASE : MINAS/ARABIAN 50/50 DESIGN BASIS
100 % MINAS FEED MATERIAL BALANCE

EXCESS PRODUCTS

PETROLEUM CUTS	TOTAL 10^3 T/YEAR
. ATMOSPHERIC RESIDUUM 370° MINAS	1162,5
. CALCINED COKE	103
. TOTAL PRODUCTION	1265,5

REMARK : ATMOSPHERIC RESIDUUM EXCESS PRODUCT MAY BE USED IN AMMONIA SYNTHESIS GAS PRODUCTION BY PARTIAL OXYDATION PROCESS.

TABLE : 2.d

SCHEME N° 4

CASE : MINAS/ARABIAN 50/50 DESIGN BASIS
100 % MINAS FEED MATERIAL BALANCE

GASOLINE POOL COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	TYPE 1 MON = 2	TYPE 2 MON = 76	TYPE 3 RON = 93	AVIATION MON = 70
. LIGHT GASOLINE		54	92	2	3
C5/80 SR MINAS	81				
C5/80 HCK MINAS	70				
. HEAVY GASOLINE					
80/170 SR MINAS		69	29	-	2
80/150 HCK MINAS	100				
. REFORMATE	320	106	180	27	7
MINAS					
. LPG (BUTANE)	18	6	11	1	-
. TOTAL PRODUCTION	589	235	312	30	12
. % OF TOTAL PRODUCTION	100	40	53	5	2

TABLE : 2.d (continued)

SCHEME N° 4

CASE : MINAS/ARABIAN 50/50 DESIGN BASIS
100 % MINAS FEED MATERIAL BALANCE

JET FUEL COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	TYPE 1 JP4	TYPE 2 TC1
. HEAVY GASOLINE SR 80/170 MINAS	31	23	8
. KEROSENE HDK 150/185 MINAS	45	-	45
. LIGHT GAS OIL HDK 185/250 MINAS	118	34	84
. LPG (BUTANE)	1	1	-
. TOTAL PRODUCTION	195	58	137
. % OF TOTAL PRODUCTION	100	30	70

TABLE : 2.d (continued)

REFINING SCHEME N° 4 CASE : MINAS/ARABIAN 50/50 DESIGN BASIS
100 % MINAS FEED MATERIAL BALANCE

KEROSENE COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR
. KEROSENE SR 170/260 MINAS	245

TABLE : 2.d (continued)

REFINING SCHEME N° 4 CASE : MINAS/ARABIAN 50/50 DESIGN BASIS
100 % MINAS FEED MATERIAL BALANCE

DIESEL OIL COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	TYPE 1 CI = 45	TYPE 2 CI = 50	TYPE 3 LOW SPEED
. KEROSENE SR 170/260 MINAS	400	400	-	-
.LIGHT GAS OIL HCK 185/250 MINAS	87	87	-	-
. LIGHT GAS OIL SR 200/350 MINAS	468	263	55	150
. HEAVY GAS OIL HCK 250/350 MINAS	350	290	60	-
. HEAVY GAS OIL SR 350/370 MINAS	195		70	125
. TOTAL PRODUCTION	1500	1040	185	275
. % OF TOTAL PRODUCTION	100	70	12	18

TABLE : 2.d (continued)

REFINING SCHEME N° 4 CASE : MINAS/ARABIAN 50/50 DESIGN BASIS
100 % MINAS FEED MATERIAL BALANCE

FUEL OIL COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	TYPE 1	TYPE 2	TYPE 3
. LIGHT GAS OIL SR 260/350 MINAS	317	218	55	44
. ATMOSPHERIC RESIDUUM 370+	55,5	-	-	55,5
. VACUUM RESIDUUM 550+	627,5	482	95	50,5
. TOTAL PRODUCTION	1000	700	150	150
. % OF TOTAL PRODUCTION	100	70	15	15

REMARK : THE SPECIFICATION CONCERNING THE POUR POINT SHOULD BE DETERMINED MORE ACCURATELY BY MEANS OF BLENDING ASSAYS.

TABLE : 2.d (end)

REFINING SCHEME N° 4

CASE : MINAS/ARABIAN 50/50 DESIGN BASIS
100 % MINAS FEED MATERIAL BALANCE

EXCESS PRODUCTS

PETROLEUM CUTS	TOTAL 10^3 T/YEAR
. ATMOSPHERIC RESIDUUM 370° MINAS	1367 (*)

(*) MAY BE USED IN AMMONIA SYNTHESIS GAS PRODUCTION BY PARTIAL OXYDATION PROCESS.

TABLE : 2.e

REFINING SCHEME N° 5 CASE : MINAS/ARABIAN 50/50 DESIGN BASIS
100 % MINAS FEED MATERIAL BALANCE

GASOLINE POOL COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	TYPE 1 MON = 72	TYPE 2 MON = 76	TYPE 3 MON = 93	AVIATION MON = 70
. LIGHT GASOLINE		58.5	67.5	2	3
C5/80 SR MINAS	81				
C5/80 HCK MINAS	50				
. HEAVY GASOLINE		42.5	-	-	2
80/170 SR MINAS	-				
80/150 HCK MINAS	44.5				
. REFORMATE MINAS	350	103	210	29	8
. COKER GASOLINE C5/170 MINAS	94	44	50	-	-
. LPG (BUTANE)	20.5	7	12.5	1	-
. TOTAL PRODUCTION	640	255	340	32	13
. % OF TOTAL PRODUCTION	100	40	53	5	2

TABLE :2.e (continued)

REFINING SCHEME N° 5 CASE : MINAS/ARABIAN 50/50 DESIGN BASIS
100 % MINAS FEED MATERIAL BALANCE

JET FUEL COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	TYPE 1 JP4	TYPE 2 TC1
. HEAVY GASOLINE SR 80/170 MINAS	31	23	8
. KEROSENE MCK 150/185 MINAS	58,5	-	58,5
. LIGHT GAS OIL MCK 185/250	104,5	34	70,5
. LPG (BUTANE)	1	1	-
. TOTAL PRODUCTION	195	58	137
. % OF TOTAL PRODUCTION	100	30	70

TABLE : 2.e (continued)

REFINING SCHEME N° 5 CASE : MINAS/ARABIAN 50/50 DESIGN BASIS
100 % MINAS FEED MATERIAL BALANCE

KEROSENE COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR
. KEROSENE SR 1/0/260 MINAS	245

TABLE : 2.e (continued)

REFINING SCHME N° 5 CASE : MINAS/ARABIAN 50/50 DESIGN BASIS
100 % MINAS FEED MATERIAL BALANCE

DIESEL OIL COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	TYPE 1 CI = 45	TYPE 2 CI =50	TYPE 3 LOW SPEED
. KEROSENE SR 170/260 MINAS	400	400	-	-
. LIGHT GAS OIL MINAS		490	115	150
185/250 HCK	125,5			
170/350 COKER	226			
260/350 SR	403,5			
. HEAVY GAS OIL MINAS		350	70	125
250/350 HCK	350			
350/370 SR	195			
. TOTAL PRODUCTION	1700	1240	185	275
. % OF TOTAL PRODUCTION	100	73	11	16

B-152

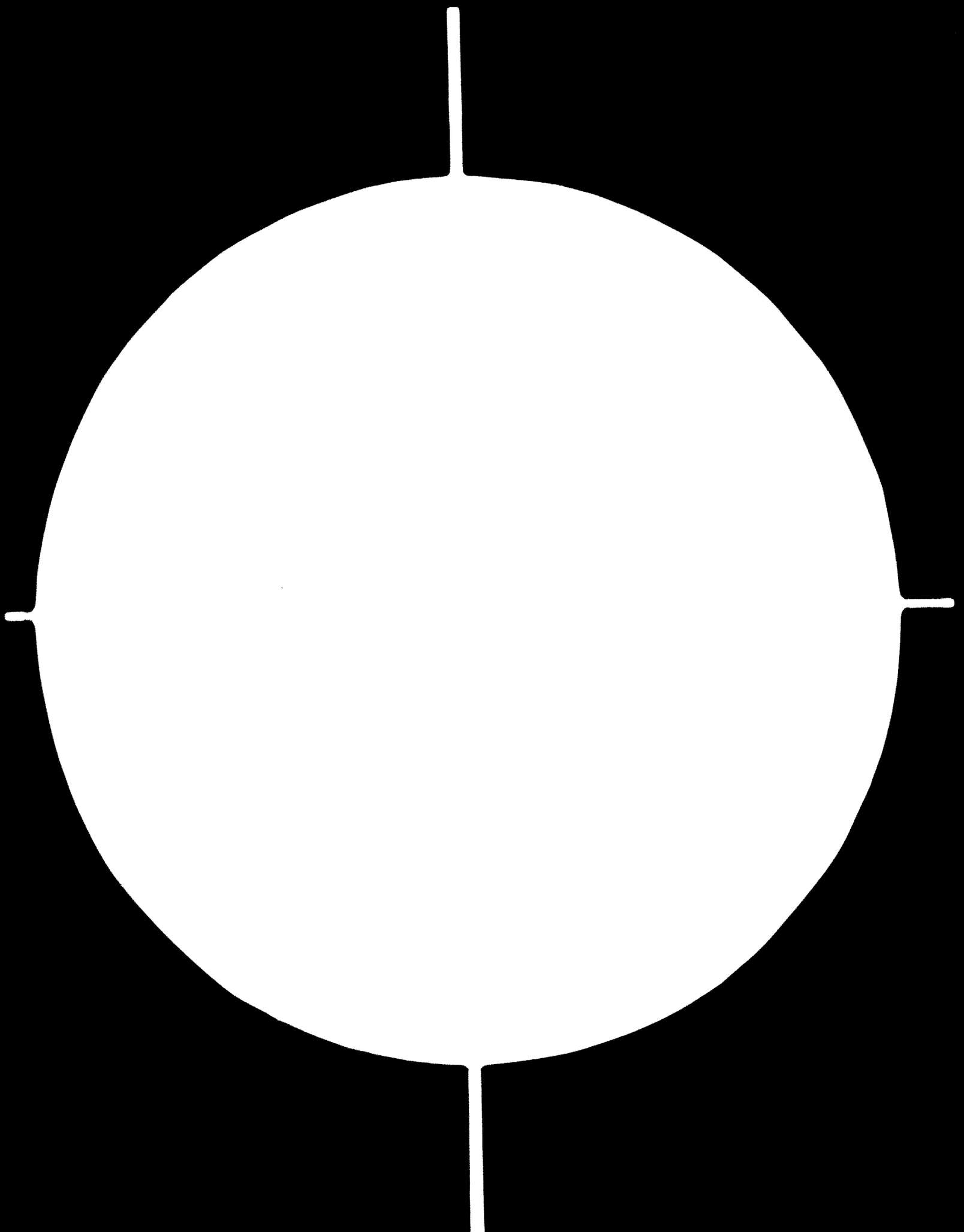
TABLE : 2.e (continued)

REFINING SCHEME N° 5 CASE : MINAS/ARABIAN 50/50 DESIGN BASIS
100 % MINAS FEED MATERIAL BALANCE

FUEL OIL COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	TYPE 1	TYPE 2	TYPE 3
. LIGHT GAS OIL SR 260/350 MINAS	381.5	261.5	60	60
. ATMOSPHERIC REMOUUM 370⁺ MINAS	705.5	505.5	80	120
. HEAVY COKER GAS OIL 350⁺ MINAS	113	73	40	-
. TOTAL PRODUCTION	1200	840	180	180
. % OF TOTAL PRODUCTION	100	70	15	15

REMARK : THE SPECIFICATION CONCERNING THE POUR POINT SHOULD BE DETERMINED MORE ACCURATELY BY MEANS OF BLENDING ASSAYS



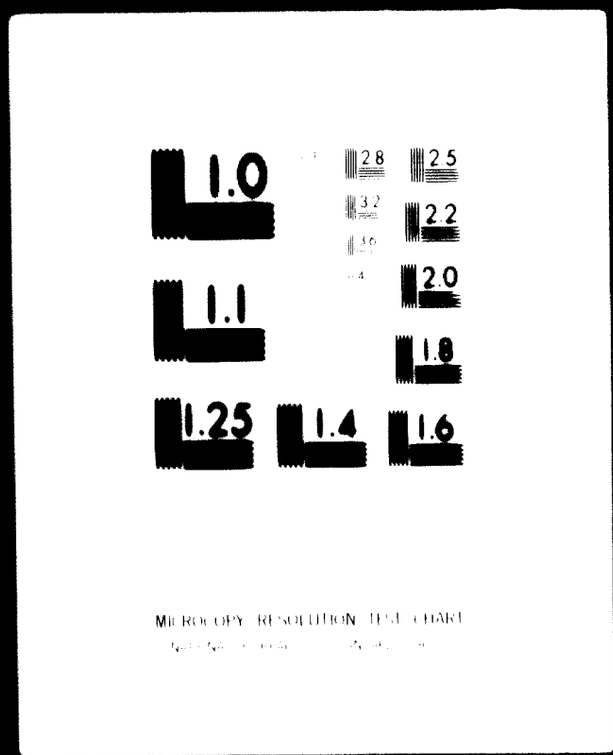


TABLE : 2.e (end)

REFINING SCHEME N° 5 CASE : MINAS/ARABIAN 50/50 DESIGN BASIS
100 % MINAS FEED MATERIAL BALANCE

EXCESS PRODUCTS

PETROLEUM CUTS	TOTAL 10^3 T/YEAR
. ATMOSPHERIC RESIDUUM 370° MINAS	717 (*)
. CALCINED COKE	103
. TOTAL PRODUCTION	820

(*) MAY BE USED IN AMMONIA SYNTHESIS GAS PRODUCTION BY PARTIAL OXYDATION PROCESS.

TABLE : 2.1

REFINING SCHEME N° 6 CASE : MINAS/ARABIAN 50/50 DESIGN BASIS
100 % MINAS FEED MATERIAL BALANCE

GASOLINE POOL COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	TYPE 1 RON = 72	TYPE 2 RON : 76	TYPE 3 RON : 93	AVIATION RON = 70
. LIGHT GASOLINE SR C5/80 MINAS	81	46	30	2	3
. REFORMATE MINAS	400	151	212	29	8
. COKER GASOLINE C5/170 MINAS	143,5	54	87,5	-	2
. LPG (BUTANE)	20,5	7	12,5	1	-
. TOTAL PRODUCTION	645	258	342	32	13
. % OF TOTAL PRODUCTION	100	40	53	5	2

TABLE : 2.f (continued)

REFINING SCHEME N° 6 CASE : MINAS ARABIAN 50/50 DESIGN BASIS
100 % MINAS FEED MATERIAL BALANCE

JET FUEL COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	TYPE 1 JP4	TYPE 2 TC1
. HEAVY GASOLINE SR 80/170 MINAS	31	23	8
. KEROSENE SR 170/220 MINAS	163	34	129
. LPG (BUTANE)	1	1	-
. TOTAL PRODUCTION	195	58	137
. % OF TOTAL PRODUCTION	100	30	70

TABLE : 2.f (continued)

REFINING SCHEME N° 6 CASE : MINAS/ARABIAN 50/50 DESIGN BASIS
100 % MINAS FEED MATERIAL BALANCE

KEROSENE COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR
. KEROSENE SR 170/220 MINAS	172
. LIGHT GAS OIL SR 220/300 MINAS	73
. TOTAL PRODUCTION	245

TABLE : 2.f (continued)

REFINING SCHEME N° 6 CASE : MINAS/ARABIAN 50/50 DESIGN BASIS
100 % MINAS FEED MATERIAL BALANCE

DIESEL OIL COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	TYPE 1 CI = 45	TYPE 2 CI = 50	TYPE 3 LOW SPEED
. LIGHT GAS OIL SR 220/300 MINAS	481	311	125	45
. HEAVY GAS OIL SR 300/370 MINAS	545	255	60	230
. LIGHT COKER GAS OIL 170/350 MINAS	374	374	-	-
. TOTAL PRODUCTION	1400	940	185	275
. % OF TOTAL PRODUCTION	100	67	13	20

TABLE : 2.f (continued)

REFINING SCHEME N° 6 CASE : MINAS/ARABIAN 50/50 DESIGN BASIS
100 % MINAS FEED MATERIAL BALANCE

FUEL OIL COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	TYPE 1	TYPE 2	TYPE 3
. GAS OIL SR		116	45	30
220/300 MINAS	91			
300/370 MINAS	100			
. HEAVY COKER GAS OIL 350° MINAS	92.5	92.5	-	-
. ATMOSPHERIC RESIDUUM 370° MINAS	616.5	421.5	90	105
. TOTAL PRODUCTION	900	630	135	135
. % OF TOTAL PRODUCTION	100	70	15	15

REMARK : THE SPECIFICATION CONCERNING THE POUR POINT SHOULD BE DETERMINED MORE ACCURATELY BY MEANS OF BLENDING ASSAYS.

TABLE : 2.f (end)

REFINING SCHEME N° 6 CASE : MINAS/ARABIAN 50/50 DESIGN BASIS
100 % MINAS FEED MATERIAL BALANCE

EXCESS PRODUCTS

PETROLEUM CUTS	TOTAL 10^3 T/YEAR
. ATMOSPHERIC RESIDUUM 370° MINAS	1303,5 (x)
. CALCINED COKE	109
. TOTAL PRODUCTION	1412,5

(x) MAY BE USED IN AMMONIA SYNTHESIS GAS PRODUCTION BY PARTIAL OXYDATION PROCESS

3. MINAS/ARABIAN 50/50 DESIGN BASIS

6 MM T/YEAR OF ARABIAN CRUDE

See following tables

3.a Refining scheme n°1

3.b Refining scheme n°2

3.c Refining scheme n°4

TABLE : 3.a

REFINING SCHEME N° 1 CASE : MINAS/ARABIAN 50/50 DESIGN BASIS
100 % ARABIAN FEED MATERIAL BALANCE

GASOLINE POOL COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	TYPE 1 RON = 72	TYPE 2 RON = 76	TYPE 3 RON = 93	AVIATION RON = 70
. LIGHT GASOLINE SR C5/65	194	93	104	2	3
. HEAVY GASOLINE SR 65/165	87	36	40	-	3
. REFORMATE	465	170	250	36	9
. LPG (BUTANE)	24	9	14	1	-
. TOTAL PRODUCTION	770	308	408	39	15
. % OF TOTAL PRODUCTION	100	40	53	5	2

TABLE : 3.a (continued)

REFINING SCHEME N° 1 CASE : MINAS/ARABIAN 50/50 DESIGN BASIS
100 % ARABIAN FEED MATERIAL BALANCE

JET FUEL COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	TYPE 1 JP4	TYPE 2 TC1
. HEAVY GASOLINE SR 65/165	34	14	20
. KEROSENE SR 165/240	160	43	117
. LPG (BUTANE)	1	1	-
. TOTAL PRODUCTION	195	58	137
. % OF TOTAL PRODUCTION	100	30	70

TABLE : 3.a (continued)

REFINING SCHEME N° 1 CASE : MINAS/ARABIAN 50/50 DESIGN BASIS
100 % ARABIAN FEED MATERIAL BALANCE

KEROSENE COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR
. KEROSENE SR 165/240	245

TABLE : 3.a (continued)

REFINING SCHEME N° 1 CASE : MINAS/ARABIAN 50/50 DESIGN BASIS
100 % ARABIAN FEED MATERIAL BALANCE

DIESEL OIL COMPOSITION (*)

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	TYPE 1 CI = 45	TYPE 2 CI = 50	TYPE 3 LOW SPEED
. KEROSENE SR 165/240	255	255	-	-
. LIGHT GAS OIL SR 240/340	789	564	125	100
. HEAVY GAS OIL SR 340/370	281	46	60	175
. TOTAL PRODUCTION	1325	865	185	275
. % OF TOTAL PRODUCTION	100	65	14	21

(*) DIESEL OIL SULPHUR CONTENT SPECIFICATION WILL NOT BE RESPECTED

TABLE : 3.a (continued)

REFINING SCHEME N° 1 CASE : MINAS/ARABIAN 50/50 DESIGN BASIS
100 % ARABIAN FEED MATERIAL BALANCE

FUEL OIL COMPOSITION (*)

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	TYPE 1	TYPE 2	TYPE 3
. LIGHT GAS OIL SR 240/340	90	90	-	-
. ATMOSPHERIC RESIDUUM 370+	1310	890	210	210
. TOTAL PRODUCTION	1400	980	210	210
. % OF TOTAL PRODUCTION	100	70	15	15

(*) FUEL OIL SULPHUR CONTENT SPECIFICATION WILL NOT BE RESPECTED

TABLE : 3.a (end)

REFINING SCHEME N° 1 CASE : MIXAS/ARABIAN 50/50 DESIGN BASIS
100 % ARABIAN FEED MATERIAL BALANCE

EXCESS PRODUCTS

PETROLEUM CUTS	TOTAL 10^3 T/YEAR
. ATMOSPHERIC RESIDUUM 370°	917 (x)

(x) MAY BE USED TO AMMONIA SYNTHESIS GAS PRODUCTION BY PARTIAL OXYDATION PROCESS

TABLE : 3.b

REFINING SCHEME N°2 CASE : MINAS/ARABIAN 50/50 DESIGN BASIS
100 % ARABIAN FEED MATERIAL BALANCE

GASOLINE POOL COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	TYPE 1 RON = 72	TYPE 2 RON = 76	TYPE 3 RON = 93	AVIATION RON =70
. LIGHT GASOLINE SR C5/65	176	93,5	77	2	3,5
. HEAVY GASOLINE SR 65/155	83	30	42,5	-	2,5
. REFORMATE	329,5	74	224	27	4,5
. FCC GASOLINE C5/170	157,5	93,5	50,5	9	4,5
. LPG (BUTANE)	24	9	14	1	-
. TOTAL PRODUCTION	770	308	408	39	15
. % OF TOTAL PRODUCTION	100	40	53	5	2

TABLE : 3.b (continued)

REFINING SCHEME N° 2 CASE : MINAS/ARABIAN 50/50 DESIGN BASIS
100 % ARABIAN FEED MATERIAL BALANCE

JET FUEL COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	TYPE 1 JP4	TYPE 2 TC1
. HEAVY GASOLINE SR 65/155	34	14	20
. KEROSENE SR 155/240	160	43	117
. LPG (BUTANE)	1	1	-
. TOTAL PRODUCTION	195	58	137
. % OF TOTAL PRODUCTION	100	30	70

TABLE : 3.b (condinute)

REFINING SCHEME N° 2 CASE : MINAS/ARABIAN 50/50 DESIGN BASIS
100 % ARABIAN FEED MATERIAL BALANCE

KEROSENE COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR
. KEROSENE SR 155/240	245

TABLE : 3.b (continued)

REFINING SCHEME N° 2 CASE : MINAS/ARABIAN 50/50 DESIGN BASIS
100 % ARABIAN FEED MATERIAL BALANCE

DIESEL OIL COMPOSITION (x)

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	TYPE 1 CI = 45	TYPE 2 CI = 50	TYPE 3 LOW SPEED
. KEROSENE SR 155/240	340	340	-	-
. LIGHT GAS OIL SR 240/340	879	654	125	100
. HEAVY GAS OIL SR 340/370	281	46	60	175
. LIGHT CYCLE OIL	50	50	-	-
. TOTAL PRODUCTION	1550	1090	185	275
. % OF TOTAL PRODUCTION	100	70	12	18

(x) DIESEL OIL SULPHUR CONTENT SPECIFICATION WILL NOT BE RESPECTED

TABLE : 3.b (continued)

REFINING SCHEME N° 2 CASE : MINAS/ARABIAN 50/50 DESIGN BASIS
100 % ARABIAN FEED MATERIAL BALANCE

FUEL OIL COMPOSITION (a)

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	TYPE 1	TYPE 2	TYPE 3
. CYCLE OIL FCC		152	20	10
- LIGHT	103			
- HEAVY	79			
. DECANT OIL FCC	39	-	-	39
. ATMOSPHERIC RESIDUUM 370+	839	669	90	80
. VACUUM RESIDUUM 550+	340	159	100	81
. TOTAL PRODUCTION	1400	980	210	210
. % OF TOTAL PRODUCTION	100	70	15	15

(a) FUEL OIL SULPHUR CONTENT SPECIFICATION WILL NOT BE RESPECTED.

TABLE : 3.b (continued)

REFINING SCHEME N° 2 CASE : MINAS/ARABIAN 50/50 DESIGN BASIS
100 % ARABIAN FEED MATERIAL BALANCE

EXCESS PRODUCTS

PETROLEUM CUTS	TOTAL 10^3 T/YEAR
. HEAVY GASOLINE SR 65/155	107.5
. ATMOSPHERIC RESIDUUM 370+	523
. TOTAL PRODUCTION	630.5

TABLE : 3.c

REFINING SCHEME N° 4 CASE : MINAS/ARABIAN 50/50 DESIGN BASIS
100 % ARABIAN FEED MATERIAL BALANCE

GASOLINE POOL COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	TYPE 1 RON = 72	TYPE 2 RON = 76	TYPE 3 RON = 93	AVIATION RON = 70
. LIGHT GASOLINE		140,5	96	2	2,5
C5/65 SR	176				
C5/80 HCK	65				
. HEAVY GASOLINE		36,5	73	-	3,5
65/155 SR					
80/150 HCK	113				
. REFORMATE	392	122	225	36	9
. LPG (BUTANE)	24	9	14	1	-
. TOTAL PRODUCTION	770	308	408	39	15
. % OF TOTAL PRODUCTION	100	40	53	5	2

TABLE : 3.c (continued)

REFINING SCHEME N° 4 CASE : MINAS/ARABIAN 50/50 DESIGN BASIS
100 % ARABIAN FEED MATERIAL BALANCE

JET FUEL COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	TYPE 1 JP4	TYPE 2 TC1
. HEAVY GASOLINE SR 65/155	34	14	20
. KEROSENE 155/240 SR	110	43	11/
150/185 MIX	50		
. LPG (BUTANE)	1	1	-
. TOTAL PRODUCTION	195	58	13/
. % OF TOTAL PRODUCTION	100	30	70

TABLE : 3.c (continued)

REFINING SCHEME N° 4 CASE : MINAS/ARABIAN 50/50 DESIGN BASIS
100 % ARABIAN FEED MATERIAL BALANCE

KEROSENE COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR
. KEROSENE SR 155/240	271

TABLE : 3.c (continued)

REFINING SCHEME N° 4 CASE : MINAS/ARABIAN 50/50 DESIGN BASIS
100 % ARABIAN FEED MATERIAL BALANCE

DIESEL OIL COMPOSITION (a)

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	TYPE 1 CI = 45	TYPE 2 CI = 50	TYPE 3 LOW SPEED
. KEROSENE SR 155/240	364	364	-	-
. LIGHT GAS OIL		633	125	100
240/340 SR	674			
185/250 HCK	184			
. HEAVY GAS OIL		378	60	175
340/370 SR	281			
250/350 HCK	332			
. TOTAL PRODUCTION	1835	1375	185	275
. % OF TOTAL PRODUCTION	100	75	10	15

(a) DIESEL OIL SULPHUR CONTENT SPECIFICATION WILL NOT BE RESPECTED.

TABLE : 3.c (continued)

REFINING SCHEME N° 4 CASE : MINAS/ARABIAN 50/50 DESIGN BASIS
100 % ARABIAN FEED MATERIAL BALANCE

FUEL OIL COMPOSITION (a)

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	TYPE 1	TYPE 2	TYPE 3
. LIGHT GAS OIL SR 240/340	205	165	20	20
. ATMOSPHERIC RESIDUUM 370°	680	500	90	90
. VACUUM RESIDUUM 550°	515	315	100	100
. TOTAL PRODUCTION	1400	980	210	210
. % OF TOTAL PRODUCTION	100	70	15	15

(a) FUEL OIL SULPHUR CONTENT SPECIFICATION WILL NOT BE RESPECTED.

TABLE : 3.c (end)

REFINING SCHEME N° 4 CASE : MINAS/ARABIAN 50/50 DESIGN BASIS
100 % ARABIAN FEED MATERIAL BALANCE

EXCESS PRODUCTS

PETROLEUM CUTS	TOTAL 10^3 T/YEAR
. HEAVY GASOLINE SR 65/155	132
. ATMOSPHERIC RESIDUUM 370°	237
. TOTAL PRODUCTION	369

4. 100 % MINAS DESIGN BASIS

5 MMT/YEAR OF MINAS CRUDE

See following tables

4.a Refining scheme n°1

4.b Refining scheme n°2

4.c Refining scheme n°3

4.d Refining scheme n°4

4.e Refining scheme n°5

4.f Refining scheme n°6

4.g Refining scheme n°7

TABLE : 4.a

REFINING SCHEME N° 1 CASE : 100 % ARAVIS CRUDE DESIGN BASIS

GASOLINE POOL COMPOSITION

PETROLEUM CUTS	TOTAL 10^3T/YEAR	TYPE I RON = 72	TYPE 2 RON = 76	TYPE 3 RON = 93	AVIATION RON = 70
. LIGHT GASOLINE SR C5/80	81	32	46	1.5	1.5
. HEAVY GASOLINE SR 80/170	73	37	34	-	2
. REFORMATE	262	98	139	20	5
. LPG (BUTANE)	13	5	7.7	0.3	-
. TOTAL PRODUCTION	429	172	226.7	21.8	8.5
. % OF TOTAL PRODUCTION	100	40	53	5	2

TABLE : 4.a (continued)

REFINING SCHEME N° 1 CASE : 100 % ARAB CRUDE DESIGN BASIS

EXCESS PRODUCTS

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	
	SUMMER PRODUCTION	WINTER PRODUCTION
. HEAVY GAS OIL SR 300/370	-	182 (x)
. ATMOSPHERIC RESIDUUM 370+	2045	2045 (xx)
. TOTAL PRODUCTION	2045	2227

(x) MAY BE USED AS FUEL OIL TYPE I

(xx) MAY BE USED TO AMMONIA SYNTHESIS GAS PRODUCTION BY PARTIAL OXIDATION PROCESS

[redacted]

[redacted]

[redacted]

PETROLEUM CUTS	TOTAL 10³ T/YEAR	TYPE 1 CI - 45	TYPE 2 CI - 50	TYPE 3 LOW SPEED
. LIGHT GAS OIL SR 220/300	572	402	125	45
. HEAVY GAS OIL SR 300/370	645/483	355/193	80	230
. TOTAL PRODUCTION	1217/1055	757/595	105	275
. % OF TOTAL PRODUCTION	100	62/56	15/10	23/26

- (a) SUMMER PRODUCTION/WINTER PRODUCTION

TABLE 1 4.a (continued)

[redacted]

[redacted]

PETROLEUM CUTS	TOTAL 10^3 T/YEAR
. KEROSENE SR 170/220	172
. LIGHT GAS OIL SR 220/380	73
. TOTAL PRODUCTION	245

TABLE : 4.a (end)

REFINING SCHEME N° 1 . CASE : 100 % ARAB CRUDE DESIGN BASIS

JET FUEL COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	TYPE 1 JP 4	TYPE 2 TC 1
. HEAVY GASOLINE SR 80/170	31	23	8
. KEROSENE SR 170/220	163	34	129
. LPG (BUTANE)	1	1	-
. TOTAL PRODUCTION	195	58	137
. % OF TOTAL PRODUCTION	100	30	70

TABLE : 4.b

REFINING SCHEME N° 2 CASE : 100 % MINAS CRUDE DESIGN BASIS

GASOLINE POOL COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	TYPE 1 RON = 72	TYPE 2 RON = 76	TYPE 3 RON =93	AVIATION RON = 70
. LIGHT GASOLINE SR C5/80	81	41.5	34	2	3.5
. HEAVY GASOLINE SR 80/170	150	70.5	77	-	2.5
. REFORMATE	200	-	182	18	-
. FCC GASOLINE C5/170	315	187	101	18	9
. LPG (BUTANE)	24	9	14	1	-
. TOTAL PRODUCTION	770	308	408	39	15
. % OF TOTAL PRODUCTION	100	40	53	5	2

TABLE : 4.b (continued)

REFINING SCHEME N° 2 CASE : 100 % MINAS CRUDE DESIGN BASIS

JET FUEL COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	TYPE 1 JP 4	TYPE 2 TC1
. HEAVY GASOLINE SR 80/170	31	23	8
. KEROSENE SR 170/220	163	34	129
. LPG (BUTANE)	1	1	-
. TOTAL PRODUCTION	195	58	137
. % OF TOTAL PRODUCTION	100	30	70

TABLE : 4.b (continued)

REFINING SCHEME N° 2 CASE : 100 % MINAS CRUDE DESIGN BASIS

KEROSENE COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR
. KEROSENE SR 170/220	172
. LIGHT GAS OIL SR 220/300	73
. TOTAL PRODUCTION	245

TABLE : 4.b (continued)

REFINING SCHEME N° 2 CASE : 100 % MINAS CRUDE DESIGN BASIS

DIESEL OIL COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	TYPE 1 CI = 45	TYPE 2 CI = 50	TYPE 3 LOW SPEED
. LIGHT GAS OIL SR 220/300	512	340	125	45
. HEAVY GAS OIL SR 300/370	495	255	60	180
. LIGHT CYCLE OIL FCC	145	95	-	50
. TOTAL PRODUCTION	1150	690	185	275
. % OF TOTAL PRODUCTION	100	60	16	24

TABLE :4.b (continued)

REFINING SCHEME N° 2 CASE : 100 % MINAS CRUDE DESIGN BASIS

FUEL OIL COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	TYPE 1	TYPE 2	TYPE 3
. LIGHT GAS OIL SR 220/300	62	62	-	-
. HEAVY GAS OIL SR 300/370	150	60	45	45
. HEAVY CYCLE OIL FCC	275	215	60	-
. DECANT OIL FCC	79	49	-	30
. VACUUM RESIDUUM 550^+	134	104	-	30
. TOTAL PRODUCTION	700	490	105	105
. % OF TOTAL PRODUCTION	100	70	15	15

REMARK : THE SPECIFICATION CONCERNING THE POUR POINT SHOULD BE DETERMINED MORE ACCURATELY BY MEANS OF BLENDING ASSAYS

TABLE : 4.b (end)

REFINING SCHEME N° 2 CASE : 100 % MINAS CRUDE DESIGN BASIS

EXCESS PRODUCTS

PETROLEUM CUTS	TOTAL 10^3 T/YEAR
. ATMOSPHERIC RESIDUUM 370+	955
. VACUUM RESIDUUM 550+	706
. TOTAL PRODUCTION	1661 (*)

(*) MAY BE USED TO AMMONIA SYNTHESIS GAS PRODUCTION BY PARTIAL OXYDATION PROCESS

TABLE : 4.c'

REFINING SCHEME N° 3 CASE : 100 % MINAS CRUDE DESIGN BASIS

GASOLINE POOL COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	TYPE 1 MON = 72	TYPE 2 MON = 76	TYPE 3 MON = 93	AVIATION MON = 70
. LIGHT GASOLINE SR C5/65	34	16	15	2	1
. HEAVY GASOLINE SR 65/150	-	-	-	-	-
. REFORMATE	200	62	120	18	-
. FCC GASOLINE C5/170	315	139	150	18	8
. COKER GASOLINE C5/170	197	82	109	-	6
. LPG (BUTANE)	24	9	14	1	-
. TOTAL PRODUCTION	770	308	408	39	15
. % OF TOTAL PRODUCTION	100	40	53	5	2

TABLE : 4.c (continued)

REFINING SCHEME N° 3 CASE : 100 % MINAS CRUDE DESIGN BASIS

JET FUEL COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	TYPE 1 JP4	TYPE 2 TC1
. HEAVY GASOLINE SR 65/150	31	23	8
. KEROSENE SR 150/220	163	34	129
. LPG (BUTANE)	1	1	-
. TOTAL PRODUCTION	195	58	137
. % OF TOTAL PRODUCTION	100	30	70

TABLE : 4.c (continued)

REFINING SCHEME N° 3 CASE : 100 % MINAS CRUDE DESIGN BASIS

KEROSENE COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR
. KEROSENE SR 150/220	283
. LIGHT GAS OIL SR 220/300	207
. TOTAL PRODUCTION	490

TABLE : 4.c (continued)

REFINING SCHEME N° 3 CASE : 100 % MINAS CRUDE DESIGN BASIS

DIESEL OIL COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	TYPE 1 CI = 45	TYPE 2 CI = 50	TYPE 3 LOW SPEED
. LIGHT GAS OIL SR 220/300	430	260	125	45
. HEAVY GAS OIL SR 300/370	400	160	60	180
. LIGHT CYCLE OIL FCC	80	80	-	-
. LIGHT COKER GAS OIL 170/350	556	506	-	50
. TOTAL PRODUCTION	1474	1014	185	275
. % OF TOTAL PRODUCTION	100	69	12,5	18,5

TABLE : 4.d (continued)

REFINING SCHEME N° 4 CASE : 100 % MINAS CRUDE DESIGN BASIS

KEROSENE COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR
. KEROSENE SR 170/260	490

TABLE : 4.c (continued)

REFINING SCHEME N° 3 CASE : 100 % MINAS CRUDE DESIGN BASIS

FUEL OIL COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	TYPE 1	TYPE 2	TYPE 3
. HEAVY GAS OIL SR 300/370	245	245	-	-
. ATMOSPHERIC RESIDUUM 370+	250	110	60	80
. CYCLE OIL FCC		419		
- LIGHT	65			
- HEAVY	275			
- DECANT.OIL FCC	79			
. HEAVY COKER GAS OIL	286	66	120	100
. TOTAL PRODUCTION	1200	840	180	180
. % OF TOTAL PRODUCTION	100	70	15	15

TABLE : 4.c (end)

REFINING SCHEME N° 3 CASE : 100 % MIMAS CRUDE DESIGN BASIS

EXCESS PRODUCTS

PETROLEUM CUTS	TOTAL 10^3 T/YEAR
. GASOLINE	180 (x)
- TOTAL SR C5/150	75
- COKER C5/170	105
. CALCINED COKE	208
. TOTAL PRODUCTION	388

(x) MAY BE USED TO AMMONIA SYNTHESIS GAS PRODUCTION BY NAPHTA STEAM REFORMING

TABLE : 4.d

REFINING SCHEME N° 4 CASE : 100 % MINAS CRUDE DESIGN BASIS

GASOLINE POOL COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	TYPE 1 MON = 72	TYPE 2 MON = 76	TYPE 3 RON = 93	AVIATION MON = 70
. LIGHT GASOLINE		88,5	128	2	2,5
C5/80 SR	81				
C5/80 HCK	140				
. HEAVY GASOLINE		64	45,5	-	3,5
80/170 SR	-				
80/150 HCK	113				
. REFORMATE	395	141	210	35	9
. LPG (BUTANE)	23	8,5	13,5	1	-
. TOTAL PRODUCTION	752	302	397	38	15
. % OF TOTAL PRODUCTION	100	40	53	5	2

TABLE : 4.d (continued)

REFINING SCHEME N° 4 CASE : 100 % MINAS CRUDE DESIGN BASIS

JET FUEL COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	TYPE 1 JP4	TYPE 2 TC1
. HEAVY GASOLINE SR 80/170	31	23	8
. KEROSENE HCK 150/185	90	19	71
. LIGHT GAS OIL HCK 185/250	73	15	58
. LPG (BUTANE)	1	1	-
. TOTAL PRODUCTION	195	30	137
. % OF TOTAL PRODUCTION	100	30	70

TABLE : 4.d (continued)

REFINING SCHEME N° 4 CASE : 100 % MINAS CRUDE DESIGN BASIS

DIESEL OIL COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	TYPE 1 CI = 45	TYPE 2 CI = 50	TYPE 3 LOW SPEED
. KEROSENE SR 170/260	155	155	-	-
. LIGHT GAS OIL SR 260/250	500	365	85	50
. HEAVY GAS OIL SR 350/370	143	43	-	100
. LIGHT GAS OIL HCK 185/250	337	317	20	-
. HEAVY GAS OIL HCK 250/250	700	495	80	125
. TOTAL PRODUCTION	1835	1375	185	275
. % OF TOTAL PRODUCTION	100	75	10	15

TABLE : 4.d (continued)

REFINING SCHEME N° 4 CASE : 100 % MINAS CRUDE DESIGN BASIS

FUEL OIL COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	TYPE 1	TYPE 2	TYPE 3
. LIGHT GAS OIL SR 260/350	285	227	23	35
. HEAVY GAS OIL SR 350/370	52	-	32	20
. VACUUM RESIDUUM 550+	513	369	72	72
. TOTAL PRODUCTION	850	595	127	127
. % OF TOTAL PRODUCTION	100	70	15	15

TABLE : 4.d (continued)

REFINING SCHEME N° 4 CASE : 100 % MINAS CRUDE DESIGN BASIS

EXCESS PRODUCTS

PETROLEUM CUTS	TOTAL 10^3 T/YEAR
. VACUUM RESIDUUM 550+	742 (x)

(x) MAY BE USED TO AMMONIA SYNTHESIS GAS PRODUCTION BY PARTIAL OXYDATION PROCESS.

TABLE : 4, e

REFINING SCHEME N° 5 CASE : 100 % MINAS CRUDE DESIGN BASIS

GASOLINE POOL COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	TYPE 1 MON = 72	TYPE 2 MON = 76	TYPE 3 MON = 93	AVIATION MON = 70
. LIGHT GASOLINE		92	50,5	2	2,5
C5/65 SR	42				
C5/80 HCK	105				
. HEAVY GASOLINE		31	15,5	-	3,5
65/150 SR	-				
80/150 HCK	50				
. REFORMATE	395	125	22,5	36	9
. COKER GASOLINE C5/170	154	51	103	-	-
. LPG (BUTANE)	24	9	14	1	-
. TOTAL PRODUCTION	770	308	408	39	15
. % OF TOTAL PRODUCTION	100	40	53	5	2

TABLE 4.e (continued)

REFINING SCHEME N° 5 CASE : 100 % MINAS CRUDE DESIGN BASIS

JET FUEL COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	TYPE 1 JP4	TYPE 2 TC 1
. HEAVY GASOLINE SR 65/150	31	23	8
. KEROSENE SR 150/220	81	34	47
. KEROSENE HCK 150/185	82	-	82
. LPG (BUTANE)	1	1	-
. TOTAL PRODUCTION	195	58	137
. % OF TOTAL PRODUCTION	100	30	70

TABLE : 4.e (continued)

REFINING SCHEME N° 5 CASE : 100 % MINAS CRUDE DESIGN BASIS

KEROSENE COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR
. KEROSENE SR 150/220	365
. LIGHT GAS OIL SR 220/300	125
. TOTAL PRODUCTION	490

TABLE : 4.e (continued)

REFINING SCHEME N° 5 CASE : 100 % MINAS CRUDE DESIGN BASIS

DIESEL OIL COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	TYPE 1 CI = 45	TYPE 2 CI = 50	TYPE 3 LOW SPEED
. LIGHT GAS OIL		665	105	50
220/300 SR	520			
185/250 MIX	300			
. HEAVY GAS OIL		461	80	225
300/370 SR	261			
250/350 MIX	505			
. LIGHT COKER GAS OIL 170/350	249	249	-	-
. TOTAL PRODUCTION	1835	1375	185	275
. % OF TOTAL PRODUCTION	100	75	10	15

TABLE : 4.e (continued)

REFINING SCHEME N° 5 CASE : 100 % MINAS CRUDE DESIGN BASIS

FUEL OIL COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	TYPE 1	TYPE 2	TYPE 3
. HEAVY GAS OIL SR 300/370	384	384	-	
. ATMOSPHERIC RESIDUUM 370+	520	330	80	110
. COKER GAS OIL		155	130	100
- LIGHT 170/350	120			
- HEAVY 350+	185			
. TOTAL PRODUCTION	1209	789	210	210
. % OF TOTAL PRODUCTION	100	65	17.5	17.5

TABLE : 4.e (end)

REFINING SCHEME N° 5 CASE : 100 % MINAS CRUDE DESIGN BASIS

EXCESS PRODUCTS

PETROLEUM CUTS	TOTAL 10^3 T/YEAR
. CALCINED COKE	160

TABLE : 4.f

REFINING SCHEME N° 6 CASE : 100 % MINAS CRUDE DESIGN BASIS

GASOLINE POOL COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	TYPE 1 RON = 72	TYPE 2 RON = 76	TYPE 3 RON = 93	AVIATION RON = 70
. LIGHT GASOLINE SR C5/65	44	20	20	2	2
. REFORMATE	400	125	230	36	9
. COKER GASOLINE C5/170	302	154	144	-	4
. LPG (BUTANE)	24	9	14	1	-
. TOTAL PRODUCTION	770	308	408	39	15
. % OF TOTAL PRODUCTION	100	40	53	5	2

TABLE :4.f (continued)

REFINING SCHEME N° 6 CASE : 100 % MINAS CRUDE DESIGN BASIS

JET FUEL COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	TYPE 1 JP 4	TYPE 2 TC1
. HEAVY GASOLINE SR 65/150	31	23	8
. KEROSENE SR 150/220	163	34	129
. LPG (BUTANE)	1	1	-
. TOTAL PRODUCTION	195	58	137
. % OF TOTAL PRODUCTION	100	30	70

TABLE : 4.f (continued)

REFINING SCHEME N° 6 CASE : 100 % MINAS CRUDE DESIGN BASIS

KEROSENE COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR
. KEROSENE SR 150/220	283
. LIGHT GAS OIL SR 220/300	207
. TOTAL PRODUCTION	490

TABLE : 4.f (continued)

REFINING SCHEME N° 6 CASE : 100 % MINAS CRUDE DESIGN BASIS

DIESEL OIL COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	TYPE 1 CI = 45	TYPE 2 CI = 50	TYPE 3 LOW SPEED
. LIGHT GAS OIL SR 220/300	438	283	105	50
. HEAVY GAS OIL SR 300/370	450	145	80	225
. LIGHT COKER GAS OIL 170/350	612	612	-	-
. TOTAL PRODUCTION	1500	1040	185	275
. % OF TOTAL PRODUCTION	100	69	12,5	18,5

TABLE : 4.f (continued)

REFINING SCHEME N° 6 CASE : 100 % MINAS CURDE DESIGN BASIS

FUEL OIL COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	TYPE 1	TYPE 2	TYPE 3
. HEAVY GAS OIL SR 300/370	195	195	-	-
. ATMOSPHERIC RESIDUUM 370+	611	451	75	85
. COKER GAS OIL		124	90	80
- LIGHT 170/350	114			
- HEAVY 350+	180			
. TOTAL PRODUCTION	1100	770	165	165
. % OF TOTAL PRODUCTION	100	70	15	15

TABLE : 4.f (end)

REFINING SCHEME N° 6 CASE : 100 % MINAS CRUDE DESIGN BASIS

EXCESS PRODUCTS

PETROLEUM CUTS	TOTAL 10^3 T/YEAR
. ATMOSPHERIC RESIDUUM 3/0⁺	434
. CALCINED COKE	212
. TOTAL PRODUCTION	646

TABLE : 4.g

REFINING SCHEME N° / CASE : 100 % MINAS CRUDE DESIGN BASIS

GASOLINE POOL COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	TYPE 1 MON = 72	TYPE 2 MON = 76	TYPE 3 RON = 93	AVIATION MON = 78
. LIGHT GASOLINE SR C5/80	81	32	46	1	2
. REFORMATE	320	120	170	24	6
. VB/TC GASOLINE C5/170	105	46	57	-	2
. LPG (BUTANE)	16	6	9	1	-
. TOTAL PRODUCTION	522	209	277	26	10
. % OF TOTAL PRODUCTION	100	40	53	5	2

TABLE 4.g (continued)

REFINING SCHEME N° 7 CASE : 100 % MINAS CRUDE DESIGN BASIS

JET FUEL COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	TYPE 1 JP4	TYPE 2 TC1
. HEAVY GASOLINE SR 80/170	31	23	8
. KEROSENE SR 170/220	163	34	129
. LPG (BUTANE)	1	1	-
. TOTAL PRODUCTION	195	58	137
. % OF TOTAL PRODUCTION	100	30	70

TABLE : 4.g (continued)

REFINING SCHEME N° 7 CASE : 100 % MINAS CRUDE DESIGN BASIS

KEROSENE COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR
. KEROSENE SR 170/220	172
. LIGHT GAS OIL SR 220/300	73
. TOTAL PRODUCTION	245

TABLE : 4.g (continued)

REFINING SCHEME N° 7 CASE : 100 % MINAS CRUDE DESIGN BASIS

DIESEL OIL COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	TYPE 1 CI = 45	TYPE 2 CI = 50	TYPE 3 LOW SPEED
. LIGHT GAS OIL SR 220/300	472	347	80	45
. HEAVY GAS OIL SR 300/370	645	355	60	230
. VB/TC GAS OIL 170/350	245	200	45	-
. TOTAL PRODUCTION	1362	902	185	275
. % OF TOTAL PRODUCTION	100	66	14	20

TABLE : 4.g (continued)

REFINING SCHEME N° 7 CASE : 100 % MINAS CRUDE DESIGN BASIS

FUEL OIL COMPOSITION

PETROLEUM CUTS	TOTAL 10^3 T/YEAR	TYPE 1	TYPE 2	TYPE 3
. LIGHT GAS OIL		160	20	-
220/300 SR	100			
VB/TC GAS OIL	80			
. ATMOSPHERIC RESIDUUM 370+	120	120	-	-
. VB/TC RESIDUUM	1100	700	190	210
. TOTAL PRODUCTION	1400	980	210	210
. % OF TOTAL PRODUCTION	100	70	15	15

REMARK : THE STABILITY OF FUEL OIL (ASPHALTENES SEDIMENTATION) SHOULD BE CHECKED MORE ACCURATELY BY MEANS OF BLENDING ASSAYS.

TABLE : 4.g (end)

REFINING SCHEME N° 7 CASE : 100 % MINAS CRUDE DESIGN BASIS

EXCESS PRODUCTS

PETROLEUM CUTS	TOTAL 10^3 T/YEAR
. ATMOSPHERIC RESIDUUM 370°	1250 (*)

(*) MAY BE USED TO AMMONIA SYNTHESIS GAS PRODUCTION BY PARTIAL OXYDATION PROCESS

APPENDIX 4

PRODUCT SPECIFICATIONS

(MAIN PRODUCTS)

For complementary information see : volume BASIC DATA.

L.P.G.

	TESTS	LIMITS
1	Vapour pressure at 37.8 °C kg/cm^2	Max. 4.8
2	95 % boiling point (760 mm Hg) °C	Max. 2
3	Water	Nil
4	Copper strip corrosion	No - 1 strip
5	Specific gravity at 15.6°C (in liquid form)	0.55

MOTOR GASOLINE

		GOST 2084-67	GOST 5266-68	GOST 55810-71
		Type I	Type II	Type III
1	Knock rating F1 O.N	-	-	Min 93
	" " F2 O.N	72	76	-
2	TEL content gr/kg	-	-	0.41
3	Sulphur % wt max	0.05	0.05	0.05
4	Oxidation stability (ind. period) min.	480-600	480-600	480-600
5	Reid vapour pressure month at 100°F	450-500	400-500	400-500
6	Distillation I.B.P. °C min	40	40	40
	- 10 % evaporated at °C	80	80	80
	50 % evaporated at °C	140-145	120	115-120
	90 % evaporated at °C	180-195	180-195	180
	end point °C	200-205	200-205	200-205
7	Gum potential mg/100 ml	max. 5	max. 5	max. 5
8	Acid number mg KOH/gr	3	3	3
9	Sediment	Nil	Nil	Nil
10	Acid and base soluble in water	Nil	Nil	Nil
11	Copper strip corrosion	remains	remains	remains

JET FUEL

GOST 3134-52

	TESTS	TC-1
1	Specific grevity 20°C gr/cm3 min	0.775
2	Distillation I.B.P. °C max	150
	" 10 % evaporated at °C	165
	" 50 % "	185
	" 90 % "	230
	" 98 % "	250
3	Viscosity cst at 20°C min	125
	at -4°C max	8
4	Inferior calorific value kcal/kg	10,250
5	Sulphur content %	0.1
6	Smoke point mm	20-45
7	Acid number g KOH/100 ml max	0.7
8	Reid vapour pressure max	-
9	Pour point °C max	- 60
10	Flash point °C min	28
11	Iod number gr I_2/100 gr	3.5
12	Aromatics content	22
13	Gum mg/100 ml	5
14	Sulphur mercapten %	0.005
15	Thermal (150°C, 4 hr) mg/100 ml	10
16	Ash % wt	0.003
17	Water and sediment	Nil
	Copper strip corrosion (100°C, 3hr)	Remains

KEROSENE

GOST 4153-68

	TESTS		LIMITS
1	Specific gravity at 20°C gr/cm³ max		0.830
2	Smoke point	mm. min	20
3	Distillation I.B.P.	°C	150
	Distillation 20 % evaporated at	°C	200
	end point	°C	275-300
4	Colour	max	3.0
5	Pour point	°C	- 5
6	Flash point Abel	°C min	45
7	Acid number mg KOH/100 ml max		1.3
8	Ash	% max	0.005
9	Sulphur content	% max	0.05
10	Water		Nil
11	Copper strip corrosion		remains

GAS OIL

	TEST	GOST 305-12 TYPE 1	GOST 305-82 TYPE 2
1	Catene number	45	50
2	Viscosity kihematic at 20°C, CST	3 - 8	3 - 8
3	Distillation 50 % evaporated at °C max	300	280
	98 % at °C max	350	340
4	Flash point P.M. cc °C	min 70	min 80
5	Freezing point in summer °C	+ 10°	0 all the time
	in winter °C	0°	(season)
6	Sulphur content, % max	0.2	0.2
7	Acide number mg KOH/100 ml max	5	5
8	Ash, % max	0.01	0.01
9	Sulphur mercapten % max	0.01	0.01
10	Gum mg/100 ml max	60	60
11	Water	NIL	NIL
12	Sediment	NIL	NIL
13	Iod number gr I_2/100 gr max	6	6
14	Copper strip corrosion	remains	remains

GAS OIL - TYPE DT

For low speed diesel GOST 1667-68

	TESTS	LIMITS
1	Specific gravity at 20°C, gr/cm^3 max	0.930
2	Distillation evaporated at 250°C % max	15
3	Viscosity at 50°C, kinematic, max	30.0
4	Coke, % max	3.0
5	Ash, % max	0.04
6	Sulphur content, % max	0.5
7	Water % max	0.5
8	Flash point °C min	68
9	Freezing point °C	15

FUEL OIL TYPE 1

	TESTS		LIMITS
1	Distillation.Recovery at 270°C	% v.	max 48
2	Flash point P.M. cc	°C	62.2-160
3	Pour point	°C	max 21
4	Sediment	% w	max 0.15
5	Specific gravity at 15.6°C		max 0.975
6	Sulphur content	% w	1
7	Viscosity kinematic 50°C		max 120
8	Gross calorific value Kcal/kg		min 10,220
9	Water	% v	0.75

FUEL OIL

GOST 10585-63 GOST 17565-63

	TESTS	Type 2	Type 3
1	Specific gravity at 20°C, gr/cm³ max		1.015
2	Viscosity at 50°C, °E	-	-
	at 80°C, °E	8 - 11	15.5
3	Ash, % max	0.04	0.05
4	Sediment, % max	0.15	0.15
5	Water, % max	0.5	Nil
6	Sulphur content, %	1.5	2
7	Inferior calorific value Kcal/kg min	8 500	8 500
8	Flash point, °C	100 - 110	120
9	Freezing point °C	20	25

APPENDIX 5

PROCESS DESCRIPTION

1. Catalytic reforming unit
2. Catalytic cracking unit
3. Hydrocracking unit
4. Delayed coker unit
5. Visbreaking / thermal cracking
6. Thermal cracking / delayed coking unit.

CATALYTIC REFORMING UNIT

PROCESS DESCRIPTION

The process flow diagram 78060 A.201 - hereafter shows the main features of the catalytic reforming process.

The catalytic reforming process permits the production of high octane-number compounds to be incorporated to the gasoline pool. The most suitable constituents of catalytic reformer feeds are paraffin and naphthene ; the main occuring reactions are the following :

a) dehydrogenation of naphthene to give aromatics plus hydrogen

b) isomerization : paraffin isomerization is an effective reaction for increasing anti-knock quality for the lower molecular weight C_5 and C_6 only.

The largest gain in octane number is obtained in the conversion of naphthenes and paraffins into aromatics by dehydrogenation and dehydrocyclization reactions.

Catalytic reformer feeds are saturated (not olefinic) materials boiling up a maximum of about 190°C. In the majority of cases the feed will be a straight-run naphta, but other by-product low-octane naphtas (coker naphta, visbreaking/thermal cracking naphta) may be processed after pretreatment to remove olefins and other contaminants. Hydrocracker naphta that contains substantial quantities of naphthenes is also a suitable feed.

The unit includes the following sections :

a) pretreatment of the feed

b) catalytic reforming with reformate and light ends recovery.

1. PRETREATMENT OF THE FEED

This section permits to eliminate sulphur, nitrogen, metals and other contaminants contained in the fresh feed.

Pretreatment is carried out in two steps :

. catalytic reaction in a fixed bed reactor

. hydrotreated effluent stripping.

The hydrotreated naphta after stripping is sent to the reforming section.

The flashed vapours from the LP separator and stripper are sent to the sour gas washing section of the gas plant unit before being used as refinery fuel gas.

The hydrogen make-up is provided by means of the reforming section H_2 rich off-gas.

2. CATALYTIC REFORMING

This section permits to upgrade the low octane number hydrotreated naphta into high octane number reformate.

This operation is carried out in two steps :

. catalytic reaction

. reformate stabilization.

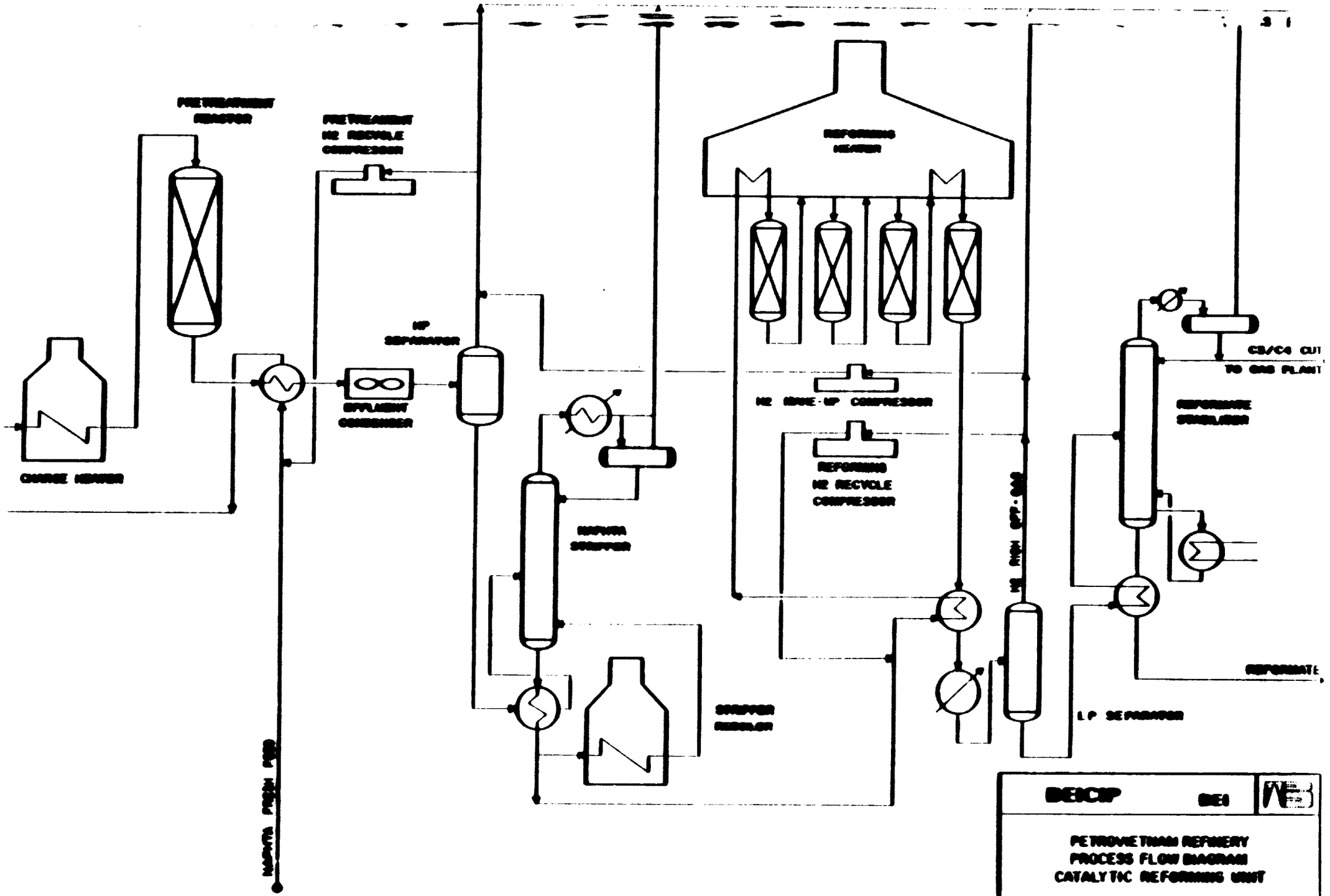
Four catalytic reactors are provided in order to produce a reformate with 95 research octane number clear.

The stabilized reformate is directly incorporated to the gasoline pool.

The part of the H_2 rich off-gas is recycled to the pretreatment section (H_2 make-up). The other part is sent to the gas plant unit before being used as refinery fuel gas.

This H_2 rich off-gas may be used also as make-up in kerosene HDS or cracked distillate hydrotreating.

The C_3/C_4 cut recovered in the reformate stabilization is sent to the gas plant unit before being Merox sweetened and stored.



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PETROVIETNAM REFINERY
PROCESS FLOW DIAGRAM
CATALYTIC REFORMING UNIT

09 / 78	78 060	A 201

FLUID CATALYTIC CRACKING UNIT

PROCESS DESCRIPTION

The process flow diagram 78060A.202 hereafter shows the main features of the fluid catalytic cracking process.

The catalytic cracking process permits to upgrade a heavy gas oil cut (VGO) into lighter products as LPG, gasoline and middle distillate.

The main process characteristics are the following :

- fluidized bed process with continuous regeneration of the catalyst (combustion of the coke deposited on the spent catalyst).
- low pressure process with no hydrogen needs
- the aromatic molecules are slightly affected by the catalytic cracking reactions ; the product composition shows high aromatics and olefins contents.

The unit includes the following sections :

a) reaction/regeneration including :

- the transformation of heavy compounds into lighter products
- the catalyst regeneration (coke combustion)

b) fractionation including :

- gasoline/middle distillates recovery
- overhead gas compression and C_3/C_4 cut recovery

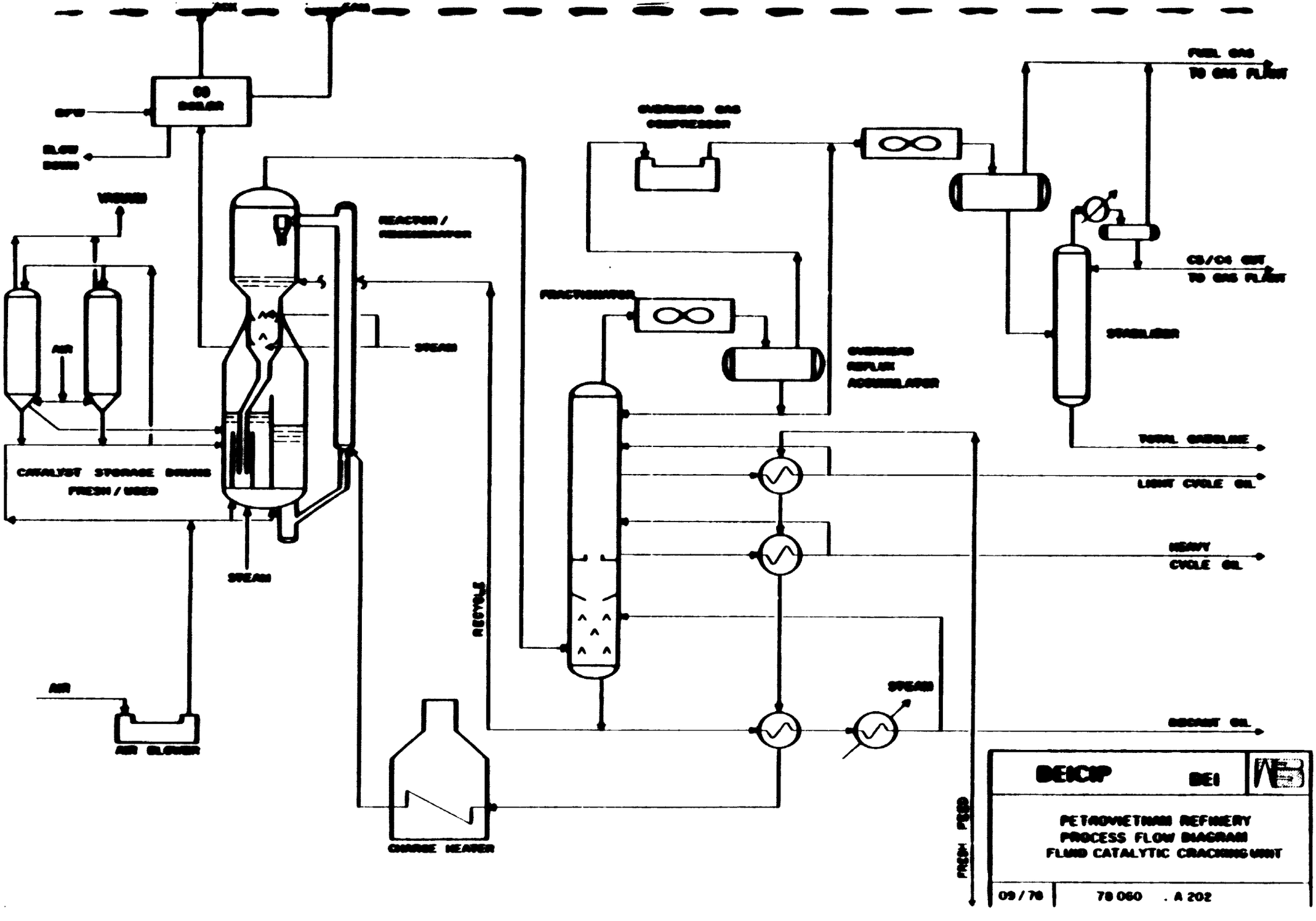
c) flue gas thermal recovery/steam generation

3. THERMAL RECOVERY/STEAM GENERATION

The heat recovery around the fractionator and the regenerator is carried out as follows :

. preheating of the fresh feed and boiler feed water by means of the fractionator side streams.

. High pressure steam generation in the CO boiler.



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HYDROCRACKING UNIT

PROCESS DESCRIPTION

The process flow diagram 78060 A.203 hereafter shows the main features of the hydrocracking process.

Generally speaking the hydrocracking processing scheme depends on :

. the feedstocks to be treated

. the choice of the finished products : gasoline/jet fuel/ middle distillates.

Presently two main types of hydrocracking process are available :

. one-stage, once through or with recycle

. two-stage, "series flow" or with pretreatment. (*)

The two-stage process allowing a greater conversion is generally used for the production of gasoline or jet fuel from heavy distillate as VGO or deasphalted oil ; it may be used in the case of high impurities content feedstocks (**).
The one-stage process is the most suitable for the production of middle distillates from vacuum distillates or thermally cracked heavy gas oil.

A one-stage with recycle hydrocracking unit has been introduced in the PETROVIETNAM refinery schema in order to upgrade the reduced crude into diesel oil. The recycle feature permits the entire conversion of the VGO feedstock.

The unit includes the following sections :

a) High pressure section with :

. charge + hydrogen heater

. reactor

. effluent condenser and separator

. hydrogen recycle compressor.

b) Low pressure section with distillate fractionation and light ends recovery.

(*) *The "series flow" process has been recently developped ; the hydrocracking reactions take place in both reactors with no effluent separation between the first and second stage. In the two-stage process with pretreatment the first reactor works as a feed pretreater and the hydrocracking reactions take place mainly in the second one : an effluent separation is necessary between the first and second stage.*

(**) *Impurities as nitrogen or metals which are catalyst poisons.*

1. HIGHT PRESSURE SECTION

Before entering the reactor the fresh feed, VGO, mixed with the H_2 recycle is heated first in a feed bottom exchanger and then in the charge + H_2 heater.
A number of H_2 recycle quench injections are provided in the reactor design in order to regulate the temperature profile and to avoid catalyst to be damaged.
The reactor is a fixed bed with several catalyst layers.

The chemical reaction which occur in the hydrocracking reactor can be divided in two groups :

1. REACTION/REGENERATION SECTION

Before entering the reactor the fresh feed, VGO, is preheated in two steps ; first by means of the fractionator side streams and then in the charge heater.
The preheated fresh feed, mixed with the fluidized catalyst enters the reaction zone where catalytic cracking reactions take place.
After separation in cyclones the cracked vapors are directly sent to the fractionator, the spent catalyst drops down to the regenerator where the combustion of the disposited coke occurs. The air required to the combustion is provided by means of an air blower. In order to get a good stripping of the catalyst and cracked products a number of steam injections are provided in the bottoms of the reactor, and regenerator.
Two drums have been provided for the storage of catalyst. The spent catalyst drum is capable of containing the entire convector inventory.

2. FRACTIONATION SECTION

Cracked hydrocarbon vapors, steam and inert gas flow from the reactor to the base of the main fractionator. The reactor vapors flow upward through a series of baffles over which cooled fractionator bottoms liquid, or slurry reflux is circulated. Above the baffle section there are two trays which serve to prevent any entrained fractionator bottoms reflux or catalyst from being carried up the tower to the heavy cycle oil draw off.
Heat removed from the tower by the circulating bottom is used first for preheating the fresh feed and then for steam generation.
The heavy and light cycle oil are withdrawn and circulated though heat exchangers to remove heat from the fractionator.

The fractionator overhead vapours are cooled and partially condensed in order to provide an upper reflux. The vapours coming from the overhead reflux accumulator are compressed and they recontacted with the liquid phase. After condensation the liquid/vapour phase is recovered in a separator drum.
The vapour phase is sent to the gas plant sour gas washing section ; the liquid phase directly feeds the stabilizer.
The stabilized total gasoline is recovered and transferred to storage.
The C_3/C_4 cut recovered from the overhead reflux drum is sent to the gas plant unit.

a) hydrogenolisis aromatics hydrogenation ; these reactions are favoured by the hydrogenating function of the catalyst (metal)

b) hydrodealylation, hydrocyclisation, hydrocracking and hydroisomeration ; these reactions are promoted by the acid function of the catalyst (support). This function may be affected by feedstock nitrogen content.

The operating conditions of the hydrocracking process are mainly :

. hydrogen partial pressure

. hydrogen recycle ratio

. reaction temperature

. space velocity through the reactor.

The rector effluent is cooled and washed before entering the HP separator.

The hydrogen rich vapor phase from the HP separator is sent to the H_2 recycle compressor before being recycled to the reactor.
Hydrogen make-up is provided at the H_2 recycle compressor suction.

The liquid phase issued from the HP separator is then flashed to the LP separator where the flashed vapors are recovered as fuel gas and sent to the refinery gas plant.

2. LOW PRESSURE SECTION

The liquid phase from the LP separator is first preheated with the effluent reactor and then debutanized in the stabilizer.
The C_3/C_4 recovered are sent to the refinery gas plant before being valorised as LPG.
The stabilized bottom feeds the fractionating section which includes :

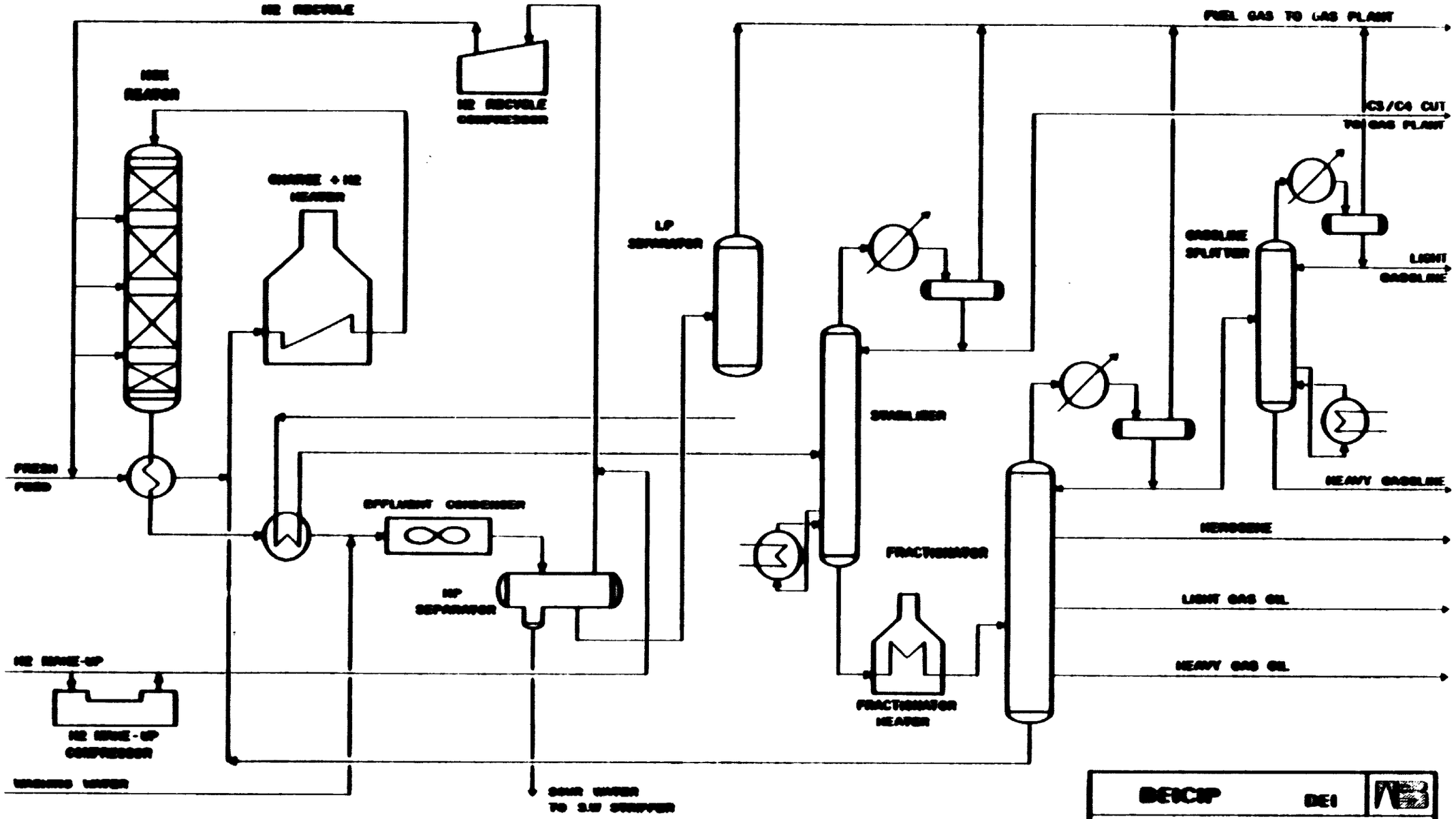
. the fractionator heater

. the fractionator

. the gasoline splitter.

Kerosene, light gas oil and heavy gas oil are directly with drawn from the fractionator and sent to storage. The overhead total gasoline is splitted into light and heavy gasoline. Both gasoline cuts are directly incorporated to the gasoline pool ; part of the heavy gasoline may be used as catalytic reforming feedstock to produce ligh R.O.N. reformate.

The fractionate bottoms are recycled and mixed to the fresh feed in order to get a higher middle distillate conversion.



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PETROVIETNAM REFINERY PROCESS FLOW DIAGRAM HYDROCRACKING UNIT	
09/78	78 060 . A 203

DELAYED COKING UNIT

PROCESS DESCRIPTION

The process flow diagram 78060 A. 204 - hereafter shows the main features of the delayed coking process -

The unit includes the following sections :

- coking of residue
- fractionation : distillates and light ends recovery
- green coke recovery
- blowdown and sour water stripping
- heat recovery/steam generation

1 - COKING OF RESIDUE

The fresh atmospheric or vacuum residue is fed to the bottom of the fractionator in order to quench the rising vapours coming from the coke drum.

The bottom product (fresh feed + coke drum recycle) is transferred to the delayed coking heater where a partial vaporization and a wild cracking occur. Then the heater effluents are directed through a switch valve to one of the two coke drums, where a stronger cracking takes place with a polymerization of the liquid phase before the final separation of gas and coke.

Small condensate injections are provided in each pass of the coking heater in order to regulate the flow velocity in the tubes and consequently to reduce the risk of coking.

The overhead vapours from the coke drum are transferred to the fractionator bottom where the recycle flow is condensed and the lighter fractions cooled before fractionation.

2 - FRACTIONATION : DISTILLATES AND LIGHT ENDS RECOVERY

The separation of the lighter fractions takes place in the upper section of the fractionator.

First the heavy gas oil is condensed and drawn-off ; this 350+ cut is cooled and sent to storage before being integrated to the fuel oil pool.

Then, a light gas oil 170/350 is drawn-off and stripped with MP steam. This cut is directly transferred to the coker hydrotreating unit.

The fractionator overhead vapours are cooled and partially condensed in order to provide an upper reflux.

The vapours coming from the overhead reflux accumulator are compressed and then recontacted with the liquid phase.

After condensation the liquid/vapour phase is recovered in a separator drum.

The vapour phase is sent to the gas plant sour gas washing section ; the liquid phase directly feeds the gasoline stabilizer.

The stabilized gasoline C5/170 is recovered and transferred to the coker hydrotreating unit.

The C3/C4 cut recovered from the overhead reflux drum is sent to the gas plant depropanizer.

3 - GREEN COKE RECOVERY

Two coke drums have been provided ; when one is in the delayed coking sequence the other one is in the decoking sequence.

The cycle corresponds to a 48 hours period :

- delayed coking sequence : 24 hours
- decoking sequence : 24 hours

The Decoking sequence is operated as follows :

- stripping towards fractionator : the coke filled drum is stripped with MP steam towards the fractionator in order to recover the light ends contained in the coke.
- stripping towards blowdown : the flow of stripping steam is increased and the products of stripping is routed to the blowdown section to be condensed.

This operation permits to recover heavier cuts and to reduce the VCM (volatil content matter) of the green coke produced.

. water cooling of coke drums

. draining and unheading : the water from the coke drum is drained and then the head and bottom flanges are removed.

. decoking : an hydraulic decoking special tool cuts out, in horizontal layers, the coke contained within the drum ; then the coke is dropped into a paved area immediately adjacent to the coke drums.

. steam out and leak test

. preheating : the coke drum is preheated by the vapour effluents coming from the other drum which is at the end of the coking sequence.

The water/coke separation takes place on the paved area adjacent to the coke drums ; this paved area is sloped so as to permit decoking water to be drained ; the coke fines are removed from the decoking water using the coke bed as a filter medium ; final clean up of the decoking water takes place in the coke settling maze.

4 - BLOWDOWN AND SOUR WATER STRIPPING

The blowdown system includes :

. a blowdown drum
. a blowdown settling drum
. a condenser
. an oil circulation with cooling facilities.

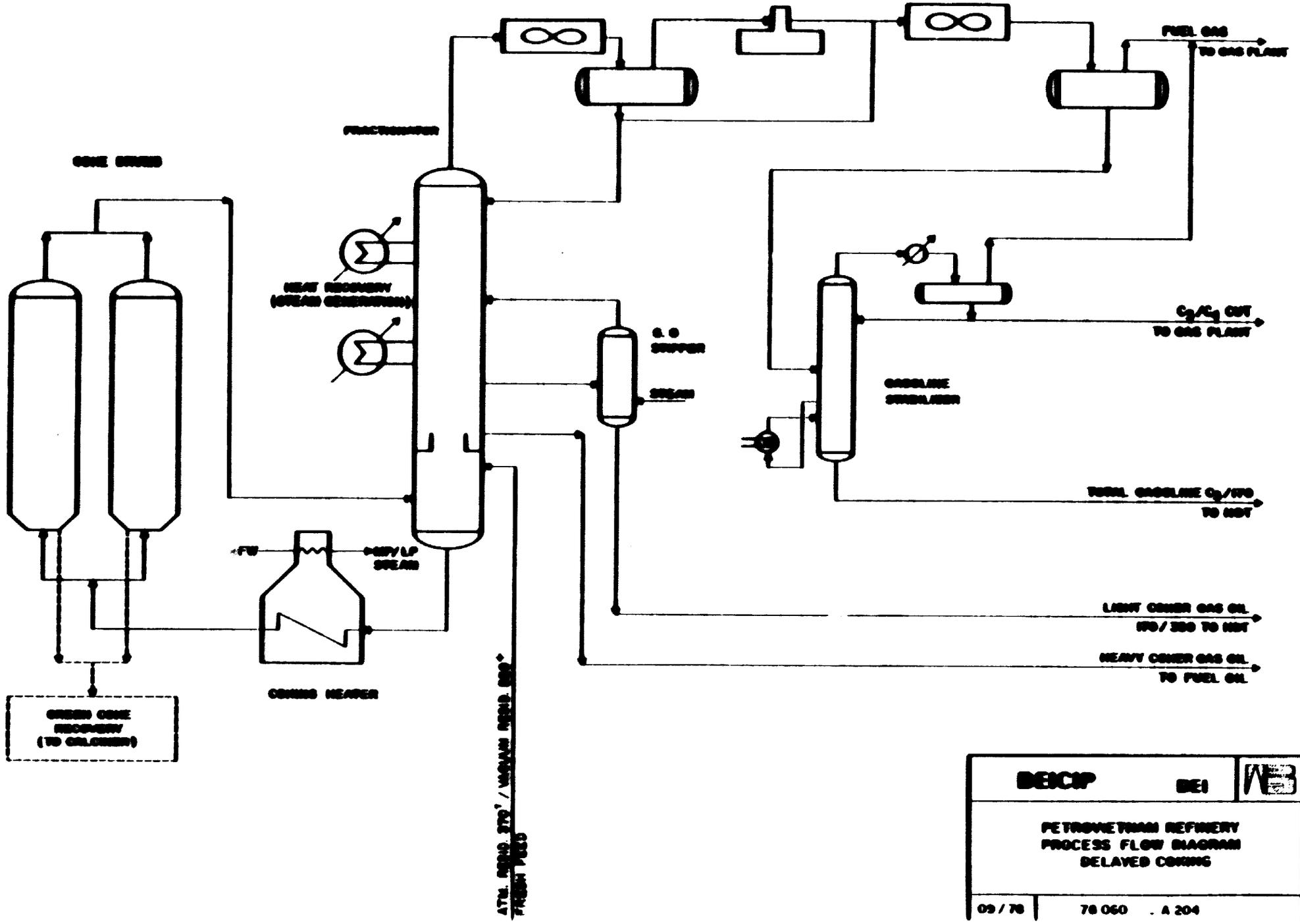
Its permits stripping steam to be condensed and to recover the heavier products before recycle to the fractionator.

All the sour condensates coming from the various condensing systems are collected and treated in a stripper before reuse.

5 - HEAT RECOVERY/STEAM GENERATION

The heat recovery around the fractionator and coking heater is carried out as follows :

- preheating of fresh feed and boiler feed water
- MP/LP steam generation around the fractionator and coking heater



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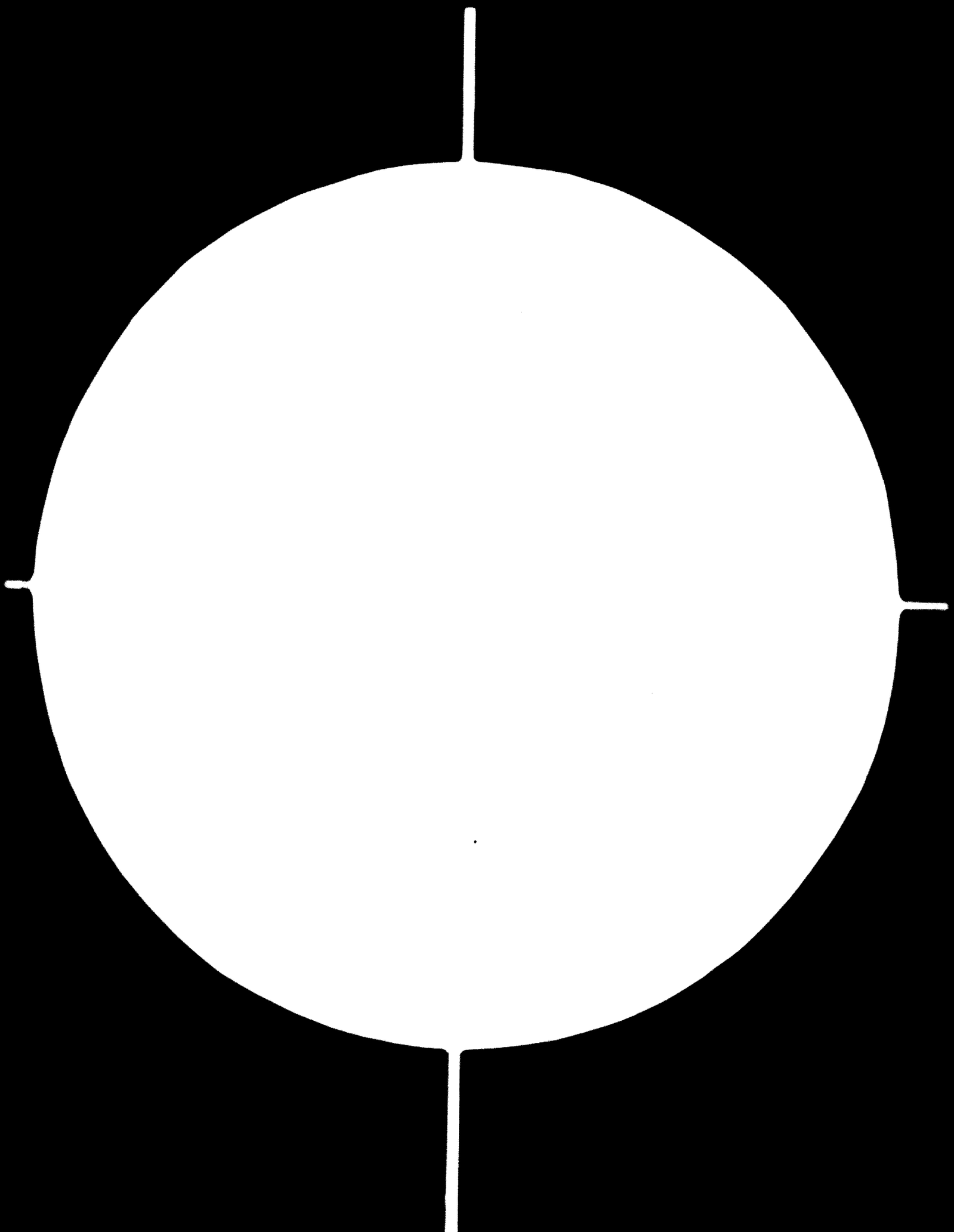
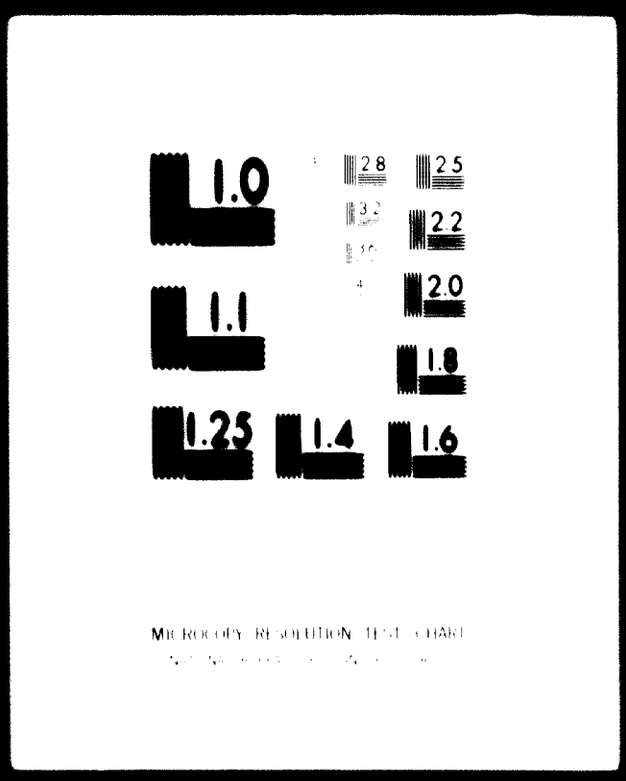




VISBREAKING / THERMAL CRACKING UNIT

PROCESS DESCRIPTION

The process flow diagram 78060A. 205 - hereafter shows the main features of the visbreaking/thermal cracking.

Process : The unit includes the following sections :

- visbreaking of atmospheric residue
- thermal cracking of heavy gas oil
- fractionation : distillates and light ends recovery
- heat recovery/steam generation

1 - VISBREAKING OF ATMOSPHERIC RESIDUE

The atmospheric residue fresh feed is first preheated and then transferred to the visbreaking heater where cracking takes place under carefully controlled pressure and temperature conditions.

The heater effluent is quenched, in order to prevent risk of coking in the transfer line, before being flashed towards the fractionator bottom zone.

The flashed vapours entering the fractionator are cooled and partially condensed by means of a bottom pumparound stream.

2 - THERMAL CRACKING OF HEAVY GAS OIL

After leaving the fractionator bottom heat exchange zone the heaviest part of vapours, heavy gas oil plus recycle, is condensed, with drawn and sent to the thermal cracking heater. The cracking is operated at high pressure in order to reduce vaporization. The heater effluent is quenched and flashed before entering the fractionator bottom zone where the thermal residue is condensed ; recycle and lighter fractions are cooled and then condensed in the upper section of the tower.

Both heater effluent quenches are provided by means of heavy gas oil after cooling.

MP steam stripping of the visbroken residue is provided in the fractionator bottom zone.

3 - FRACTIONATOR : DISTILLATES AND LIGHT ENDS RECOVERY

The separation of the lighter fractions takes place in the upper section of the fractionator.

First the heavy gas oil is condensed and with drawn before being transferred to the thermal cracking heater or used to quench both heater effluents.

Then a light gas oil 170/350 is with drawn and stripped with MP steam. This cut is directly transferred to the VB/TC hydrotreating unit.

The fractionator overhead vapours are cooled and partially condensed in order to provide an upper reflux. The vapours coming from the overhead reflux accumulator are compressed and then recontacted with the liquid phase. After condensation the liquid/vapour phase is recovered in a separator drum.

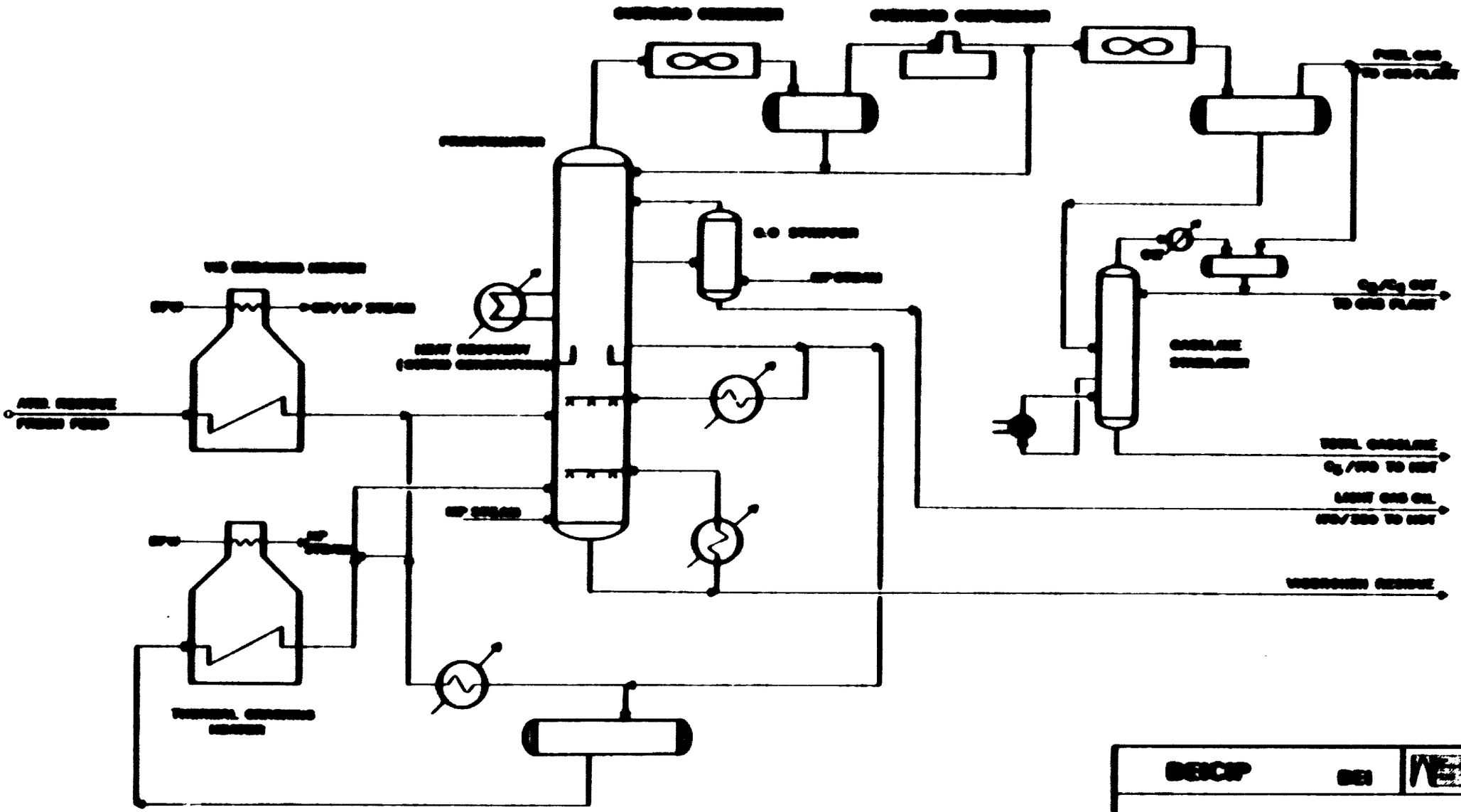
The vapour phase is sent to the gas plant sour gas washing section ; the liquid phase directly feeds the gasoline stabilizer.

The stabilized gasoline C5/170 is recovered and transferred to the VB/TC hydrotreating unit. The C3/C4 cut recovered from the overhead reflux drum is sent to the gas plant depropanizer.

4 - HEAT RECOVERY/STEAM GENERATION

The heat recovery around the fractionator and both thermal cracking/visbreaking heaters is carried out as follows :

- preheating of fresh feed and boiler feed water
- MP/LP steam generation around the fractionator and visbreaking heater
- HP steam generation in the thermal cracking heater.



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PETRAMETHANI REFINERY
PROCESS FLOW DIAGRAM
HYDROCRACKING / THERMAL CRACKING

09/78 | 78 000 . A 206

THERMAL CRACKING / DELAYED COKING UNIT

PROCESS DESCRIPTION

The process flow diagram 78060 A. 206 hereafter shows the main features of the thermal cracking/delayed coking process.

This unit includes all the sections of the delayed coking unit plus :

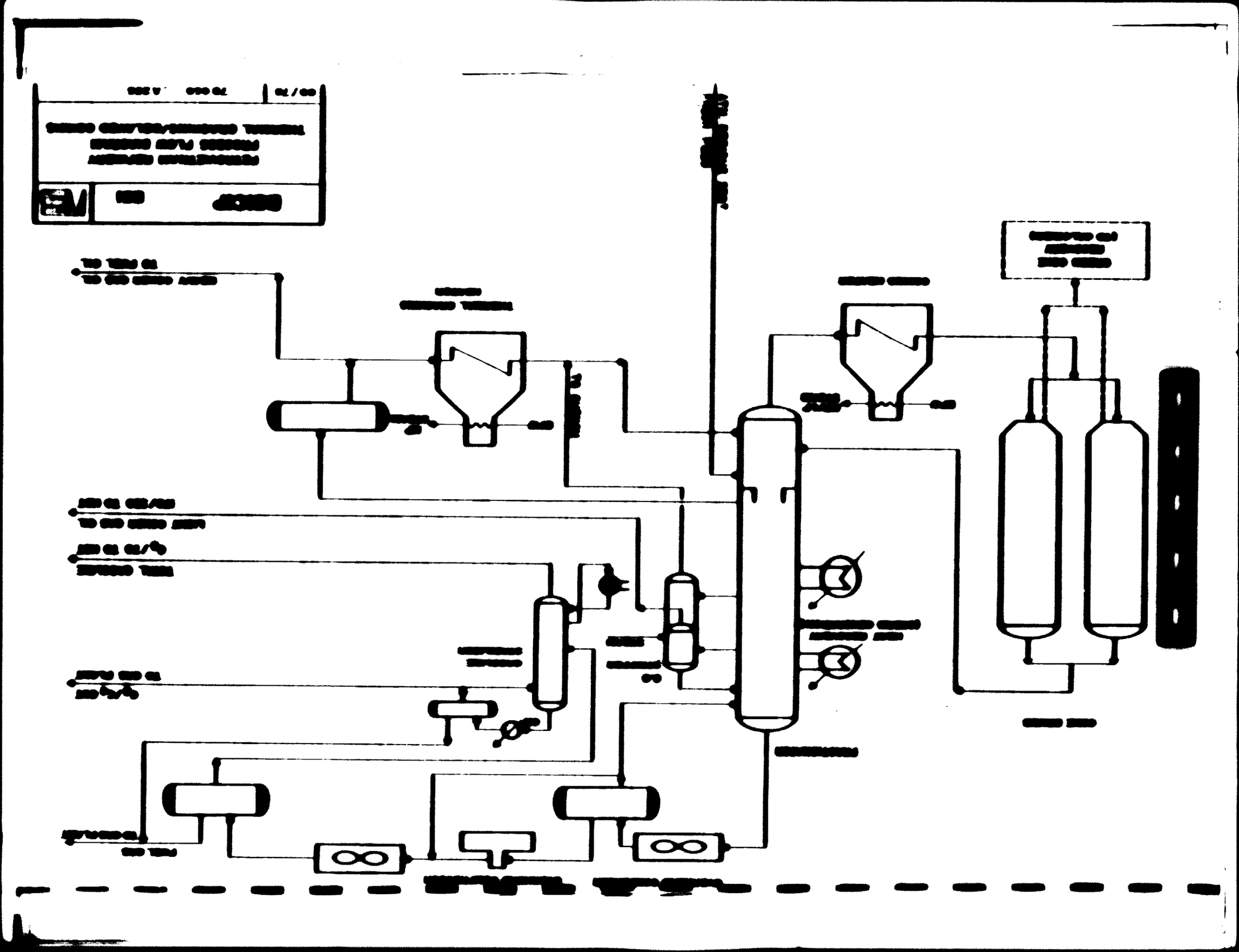
- thermal cracking of heavy gas oil

The description of this added section is as follows :

The major part of the 350 + cut with drawn plus recycle feeds the thermal cracking heater operated at high pressure in order to reduce vaporization. The heater effluent is quenched and flashed before entering the fractionator where thermal tar is condensed ; recycle and lighter fractions are cooled and then condensed in the upper section of the tower.

A little part of the 350 + cut is directly sent to storage before being integrated to the fuel oil pool.

A HP steam generation is provided in the thermal cracking heater.



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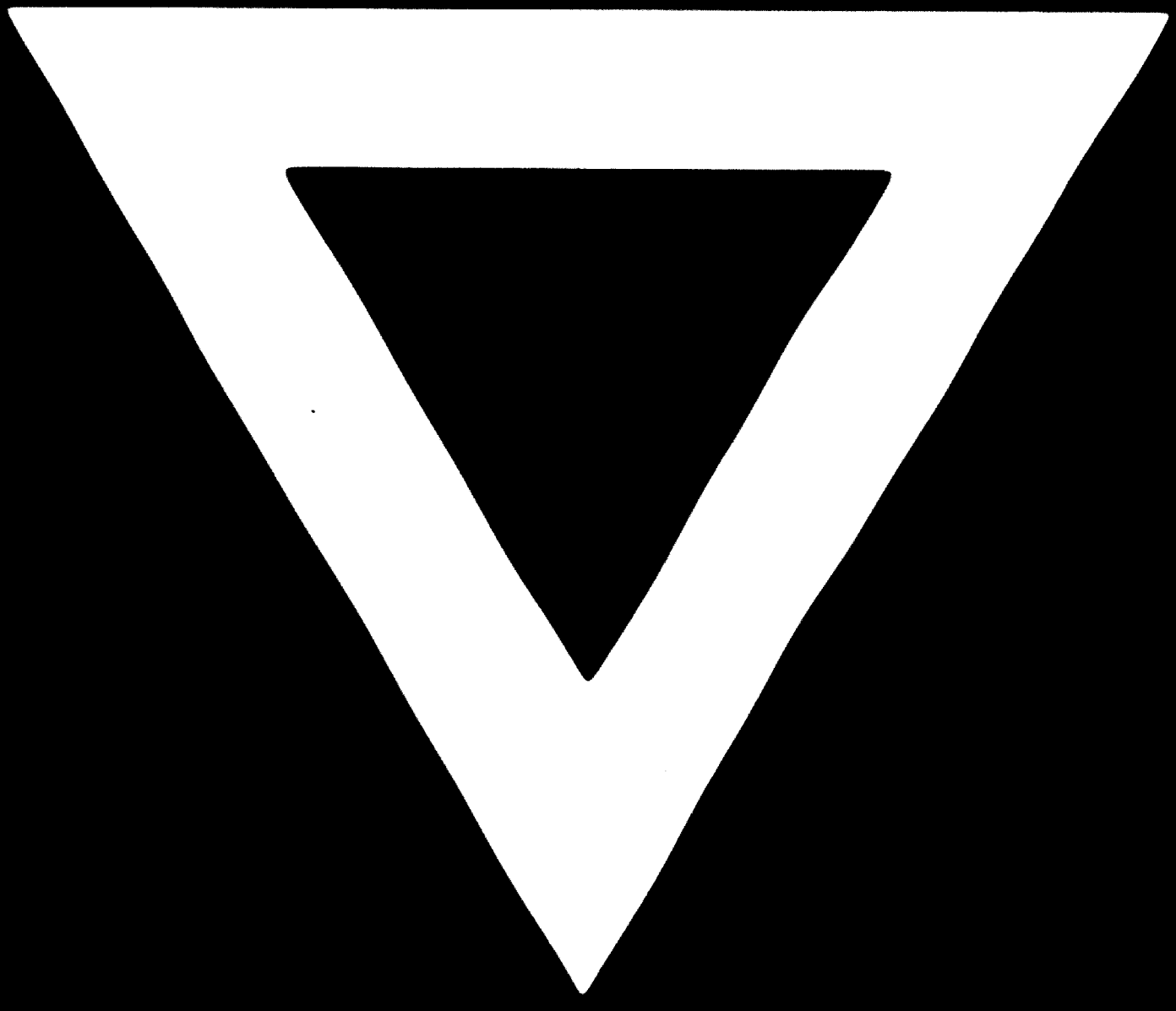

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