Due consideration are paid for appropriate segregations in view of safety, operability, maintenability, etc.

Economical arrangements are considered to an optimum extent without sacrifice of mandatory requirements relating safety/operation/maintenance.

Reasonable extent of future area is also included.

A plot plan for Bangchak-A case is presented in Figure III-20-1. The plant are located outside the fence of the existing refinery, next to the LPG distribution depot being under construction and adjacent to north boundary of the existing refinery.

In Bangchak-B case, the existing property is to be utilized to a maximum extent as described in 5-2-3 of this part. A plot plan for this case is shown in Figure III-20-2.

Required areas for six cases are estimated in Table III-25. In Bangchak-AX case, 50,000m2 of additional area for wax production is required as compared with Bangchak-A case. Areas for Bangchak-AY case and Sri Racha-A case are estimated to be the same as that of Bangchak-A case. For Sri Racha-B case, it is estimated to be 50,000m2 less than that of Sri Racha-A case due to maximum utilization of the existing facilities.

5-8 Construction Execution Plan

In this section, as a part of project implementation the construction execution plan is described in order to provide a basis for cost estimates in Part IV. The items covered are as follows:

- Project Construction Schedule
- Shipping Schedule
- Manpower Mobilization Plan
- Construction Organization

(1) Project Construction Schedule

The project master implementation schedule is mentioned in Part IV. Among the schedules the project construction schedule is detailed and presented in Figure III-21. The schedule is based on the following assumptions:

- It is assumed that the E.P.C contract is to be awarded to a prime contractor on January 1, 1988.

- By the date of the contract award, basic design for the Plant can be available to the contractor and process licensors are already selected.

- Four months period is considered for quotation of major equipment.

- Expected equipment delivery time is based on the current condition of worldwide suppliers.

- One month of equipment transportation period is considered from fabricators to the erection site.

- Infrastructural requirements such as site preparation and access way are assumed to be developed prior to E.P.C contract award.

- It is estimated that six (6) months including precommissioning and start-up will be necessary from the date of Plant's mechanical completion to the commercial operation.

Based on the above assumptions, it is concluded that required are 36 months period including 30 months for construction and 6 months for commissioning to build the lube base oil plant after the contract award to E.P.C contractor.

(2) Transport Plan

Bangchak Case

The size of navigable ships in the Chao-Phaya river near Bangchak site is limited to 15,000 DWT. The road between the port of PAT and the site is narrow and not suited for transport of heavy equipment. Therefore heavy equipment are to be unloaded at along the existing wharf of MOR in the following manner:

- Heavy equipment are lifted from large ships to barges.
- Heavy equipment are unloaded from the barges to the wharf of MOR by floating crane.

Equipment and materials purchased in Thailand are transported to the site by means of barges or trucks.

Sri Racha Case

Equipment and materials purchased outside Thailand are transported by ocean ships and are to be unloaded at the Sattahip commercial port by shipdericks. Further they are transported from the port to the site a distance of 50 Km by trucks. On the other hand, equipment and materials purchased in Thailand are transported to the site by means of barges or trucks.

Ocean Freight

Figure III-22 illustrates the bimonthly shipping schedule of the freight for the lube base oil plant.

(3) Manpower Mobilization Plan

Construction manpower is estimated quarterly to cover the entire construction period. The construction manpower is divided into the following three categories:

- Supervisory Staff:

Construction management and his staff who will be engaged in various field work of supervision and coordination.

- Direct Laborers:

Foreman and skilled, semi-skilled, and un-skilled labors such as brick masons, cement masons, carpenters, iron workers, mill-wrighters, welders, pipe fitters, electricians, instrument men, insulators, sheet metal workers, painters and other laborers necessary for the construction of the plant.

- Indirect Laborers:

Supporting personnel who will engage in indirect work such as construction and maintenance of the temporary facilities, and administrative work in the field office.

The required manpower is built up based on consultant's experiences in similar plants.

Manpower mobilization plans for supervisory staff and construction laborers are presented in Figure III-23 and Figure III-24 respectively. The required manpower of each quater and accumulation of the manpower is presented in Table III-26.

(4) Home Office/Field Office

The outlines of Home office/Field office organizations are preliminarily prepared and shown in Figure III-25 and Figure III-26 respectively.

Table III-1 PRODUCT SPECIFICATION OF BASE OILS

Properties \ Grades		60N	150N	300N	500N	150BS
Viscosity @40°C, cst		8.5-11.5	-	-	-	-
@100°C,cst		-	4.5-5.5	7.0-8.0	10.0-12.0	29.5-34.5
Pour Point, °C	Max.	-10	-10	-10	-10	-10
Viscosity Index	Min.	95	100	95	95	95
Sulfur Content, wt%	Max.	0.3	0.3	0.3	0.3	0.5
Colour (ASTM)	Max.	0.5	0.5	2.0	2.5	4.5
Total Acid Value, mg KOH/g	Max.	0.1	0.1	0.1	0.1	0.1
Flash Point, °C	Min.	130	190	210	230	240
Carbon Residue, wt%	Max.	-	-	-	0.3	0.8

Table III-2 PRODUCT SPECIFICATION OF BY-PRODUCTS

Properties		Specification	
2000" Fuel Oil			
Specific Gravity (15/4°C)		Max. 0.995	
Sulfur Content,	wt%	Max. 3.5	
Viscosity @50°C,	cst	Max. 230	
Flash Point,	°C	Min. 60	
Pour Point,	°C	Max. 30	
Blown Asphalt			
Specific Gravity (15/4°C)		1.01 - 0.06	
Softening Point (R&B),	°C	50 - 58	
Penetration @25°C, 0.1	mm	40 - 60	
Ductility @25°C,	cm	Min. 100	
Loss on Heating,	wt%	Max. 0.2	
Drop in Penetration,	%	Max. 110	
Solubility in CCl_4,	wt%	Min. 99.0	
Flash Point (COC),	°C	Min. 250	
Hard Waxes		(140P)	(150P)
Melting Point,	°C	59 - 62	64 - 67
Oil Content,	wt%	Max. 0.5	Max. 1.0
Colour		White	White
FDA Test		Pass	Pass

Table III-3 EXAMPLE OF ECONOMIC COMPARISON BY REFINING SCHEME

	Conventional Scheme	Hydrotreating Scheme
Feedstock		
Crude Source	Kuwait	Kuwait
Charge Rate	Base	20 - 25% lower
Production Rate		
Base Oils, 10^3kl/Y	200	200
By-products, "	1,000	780
Plant Construction Cost	Base	20 - 30% higher
Utilities Cost	Base	Same or less
Hydrogen Cost	Base	10 times
Refining Cost of Base Oil	Base	15 - 25% higher

Table XII-4 CRUDE RUN AND PETROLEUM DERIVATIVES PRODUCED BY REFINERIES

(Unit: 10^6 liters)

Years	Input		Loss and Unfinished Products & Refining Fuel	Petroleum Products Derived	Output						
	Crude Oil	Condensate and Natural Gasoline			Diesel Oil	Gasoline	Fuel Oil	Kerosene	Jet Fuel	L.P.G.	Bitumen
					TORC						
1978	3,750.775	-	281.401	3,469.374	1,230.007	1,001.528	627.532	113.106	390.976	82.533	23.692
1979	3,788.905	-	179.951	3,608.954	1,306.921	1,045.780	590.275	120.921	424.208	97.041	23.808
1980	3,663.194	-	207.601	3,455.593	1,243.035	918.018	579.863	163.886	440.585	88.938	21.268
1981	3,585.717	49.510	155.644	3,479.583	1,129.257	895.929	654.189	194.262	499.643	84.129	22.174
1882	3,352.858	223.656	213.862	3,362.652	1,069.407	940.263	518.918	193.959	542.179	73.599	24.327
					BANGCHAK						
1978	3,433.624	-	284.699	3,148.925	567.343	536.781	1,800.922	85.955	110.069	47.192	0.663
1979	3,740.224	-	210.944	3,529.280	626.868	531.551	2,113.585	134.320	71.969	50.987	-
1980	2,772.045	-	178.589	2,593.456	747.892	445.146	1,220.734	75.604	58.437	45.643	-
1981	2,939.579	-	211.854	2,727.725	768.527	477.613	1,195.755	107.020	123.178	55.632	-
1982	2,851.755	-	125.334	2,726.421	808.336	542.134	1,155.272	86.693	94.579	39.407	-
					ESSO						
1978	2,565.149	-	54.125	2,511.024	775.199	518.838	684.485	62.156	254.200	88.812	127.334
1979	2,775.504	-	72.726	2,702.778	835.261	539.143	777.148	63.525	286.137	102.865	98.699
1980	2,547.348	-	57.244	2,490.104	799.341	463.803	705.211	53.222	277.781	97.359	93.387
1981	2,701.004	-	67.290	2,633.714	849.152	447.564	765.461	51.946	302.272	103.813	113.506
1982	2,767.997	-	64.253	2,703.744	958.451	497.262	676.396	79.862	311.877	80.538	99.358
					FANG						
1978	16.990	-	0.073	16.917	3.066	1.137	11.549	1.165	-	-	-
1979	10.835	-	0.101	10.734	2.822	0.684	7.074	0.154	-	-	-
1980	13.285	-	0.153	13.132	3.772	0.847	8.513	-	-	-	-
1981	17.117	-	0.485	16.632	4.358	1.289	10.985	-	-	-	-
1982	29.481	-	0.240	29.241	8.744	2.387	18.110	-	-	-	-
					TOTAL						
1978	9,766.538	-	620.298	9,146.240	2,575.615	2,058.284	3,124.488	262.382	755.245	218.537	151.689
1979	10,315.468	-	463.722	9,851.746	2,771.872	2,117.158	3,488.082	318.920	782.314	250.893	122.507
1980	8,995.872	-	443.587	8,552.285	2,794.040	1,827.814	2,514.321	292.712	776.803	231.940	114.655
1981	9,243.417	49.510	435.273	8,857.654	2,751.294	1,822.395	2,626.390	353.228	925.093	243.574	135.680
1982	9,002.091	223.656	403.689	8,822.058	2,844.938	1,982.046	2,368.696	360.514	948.635	193.544	123.685

Source: Excise Department

Table III-5 MOR BANGCHAK REFINERY UNIT CAPACITY (EXISTING) (BPSD)

Unit	No.1	No.2	No.3
Crude Distillation	10,000*4	15,000*2	45,000*2
Vacuum Distillation	5,800*1	(20,000)*3	(50,000)*3
LT Ends Recovery		7,000	8,000
LT End Desulfurizer		18,000	-
Naphtha Desulfurizer			5,500
Catalytic Reformer		5,000	5,500
Merox Treater			6,000
Bitumen Unit	3,200*1		
Thermal Cracking		4,000	
/Vis. Breaking		6,000	
MEA			14 Ton/day as H_2S 18 Ton/day as CO_2

Notes: *1 Idling now.
*2 Registered capacity
*3 ( ) Design capacity
*4 Slop treating from No.2 & No.3 units

Table III-6 HYDROGEN BALANCE OF BANGCHAK REFINERY

Unit	Capacity (BPSD)	Production Rate (SCF/Bbl)	Production Amount (MMSCFD)
Hydrogen Produced			
1) No.2 unit Reformer *1	5,000	450	2.25
2) No.3 unit Reformer *1 (Mangnaformer)	5,500	450	2.48
3) Hydrogen Plant	4.7 MMSCFD (2.3 MMSCFD)		4.7 (2.3)*3
			9.43 (7.1)
Hydrogen consumed			
1) No.2 unit All range desulfurizer	18,000	70*2	1.26
2) No.3 unit Naphtha Hydrotreater	5,500	20*2	0.1
			1.36
Surplus Hydrogen			8.07 (5.7)

Notes: *1 Operating Press. 450 psi and Bitumental catalyst
*2 Estimation
*3 Half Load operation now (2.35 MMSCFD)

Table III-7 MOR BANGCHAK REFINERY UNIT CAPACITY (AFTER DEBOTTLENECKING)

Unit	No.1	No.2	No.3
Crude Distillation	No.1	20,000	60,000
Vacuum Distillation	No.1		
LT End Recovery	No.1	7,000	9,600
LT End Desulfurizer	Scrapped	18,000	-
Naphtha Desulfurizer	Scrapped	-	6,600
Catalytic Reformer	Scrapped	5,000	6,600
Merox Treater	Scrapped		7,200
Bitumen Unit	Scrapped		
Thermal cracking	Scrapped	4,000	
/Vis. Breaking	Scrapped	6,000	

Table III-8 TORC SRI RACHA UNIT CAPACITY (EXPANSION)

Unit	Phase I			Phase II		
	TORC I	TORC II	Common	TORC I	TORC II	TORC III
Crude Distillation	38,500	45,000		38,500	45,000	65,000
Vacuum Distillation	17,000		32,300	17,000		32,300
LE Desulfurization						
Catalytic Reforming	3,200	8,600		3,200	8,600	
Thermal Cracking			18,800			18,800
Catalytic Cracking	10,400			10,400		
Gas Oil Desulfurization						
Bitumen	1,250 (200t/d)			1,250 (200t/d)		
Hydrocracker			17,050			17,050
Hydrogen Plant			78MT/SD			78MT/SD
MEROX Unit						
ADIP/MEA			130MT/SD			
Sulfur Unit			2 x 57.5			
Splitter						
Stabilizer						
LT. Ends Recovery						

Table III-9 TORC SRI RACHA UNIT CAPACITY (EXISTING)

Unit	TORC I	TORC II
Crude Distillation	35,000	30,000
Vacuum Distillation	17,000	
LE Desulfurization	20,000	18,000
Catalytic Reforming	3,200	5,150
Thermal Cracking		9,700
Catalytic Cracking	7,000	
Gas Oil Desulfurization		9,600
Bitumen	450	

Table III-10 ESSO REFINERY UNIT CAPACITY (EXISTING)

Unit	(BPSD)
Crude Distillation	52,000
LSR Gasoline	
MEROX Treater	7,500
Light Ends Recovery	
Naphtha Desulfurizer	13,000
Catalytic Reformer	
Distillate Desulfurizer	8,000
Vacuum Distillation	20,000
Bitumen	1,750

Table III-11 ESSO REFINERY UNIT CAPACITY (AFTER DEBOTTLENECKING)

Unit	(BPSD)
Crude Distillation	70,000
LSR Gasoline	
MEROX Treater	15,200
Light Ends Recovery	
Naphtha Desulfurizer	29,000
Catalytic Reformer	
Distillate Desulfurizer	20,000
Vacuum Distillation	40,000
Bitumen	1,750

Table III-12 CASE DEFINITION

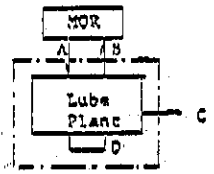
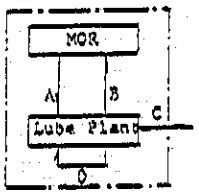
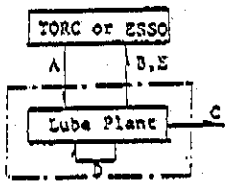
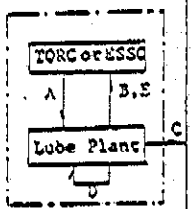
Plant Site	Bangchak			Expansion	Siracha	
Type of operation	Independent				Independent	Expansion
Additional Process		Wax Production	No Asphalt Production			
CASE NO.	Bangchak A	Bangchak AX	Bangchak AY	Bangchak B	Siracha A	Siracha B
a) Operation body	New company	—→	—→	M O R	New company	TORC or ESSO
b) Plant Site	Proximity of Bangchak refinery	—→	—→	Inside fence of Bangchak refinery	Proximity of TORC or ESSO refinery	—→
c) By-products flow	 New Company			 Existing	 New Company	 Existing
	A: Long Residue, Hydrogen	A: —→	A: —→	A: —→	A: Long Residue, Hydrogen	—→
	B: LVGO, HF Gas oil VB Naphtha	B: —→	B: —→	B: —→	B: LVGO, HF Gas oil	—→
	C: Base oil, Fuel oil, Asphalt, Sulfur	C: Base oil, Fuel oil, Asphalt, Sulfur, Wax	C: Base oil, Fuel oil, Sulfur	C: Same as Bangchak A	C: Base oil, Fuel oil, Asphalt, Sulfur	—→
	D: Ref. Fuel, Gas	D: —→	D: —→	D: —→	D: Refinery Fuel oil & Gas	—→
					E: FCC Feedstock, Thermal Cracker Feedstock to TORC	—→
d) Feed oil (Long Residue)	From MOR	—→	—→	—→	From TORC or ESSO	—→
e) Utility 1) Hydrogen	From MOR	—→	—→	—→	From H_2 plant of TORC or ESSO Cat Reformer	—→
11) Cooling water	River water	—→	—→	—→	Bangpra reservoir	—→

Table III-13 SUMMARY OF FEEDSTOCK AND PRODUCTS

CASE		BANGCHAK CASE				SRIRACHA CASE	
		BANGCHAK-A	BANGCHAK-AX	BANGCHAK-AY	BANGCHAK-B	SRIRACHA-A	SRIRACHA-B
1. Feedstock							
Arabian Light Long Residue,	10³Kl/Annum	1,192.0	1,192.0	1,192.0	1,192.0	1,192.0	1,192.0
2. Salable Products							
Lube Base Oils							
60 Neutral Oil,	10³Kl/Annum	23.9					
150 Neutral Oil,	10³Kl/Annum	13.3	Same as BANGCHAK-A	Same as BANGCHAK-A	Same as BANGCHAK-A	Same as BANGCHAK-A	Same as BANGCHAK-A
300 Neutral Oil,	10³Kl/Annum	14.9					
500 Neutral Oil,	10³Kl/Annum	138.6					
Bright Stock Oil,	10³Kl/Annum	59.3					
Lube Base Oils Total,	10³Kl/Annum	250.0	250.0	250.0	250.0	250.0	250.0
Fuel Oil,	10³Kl/Annum	760.4	737.0	810.7	761.0	167.0	167.8
Asphalt,	10³Kl/Annum	33.5	33.5	-	33.5	33.5	33.5
Wax,	10³Kl/Annum	-	13.3	-	-	-	-
Light Vacuum Gas Oil,	10³Kl/Annum	19.6	19.6	19.6	19.6	19.6	19.6
Hydrofinishing Gas Oil,	10³Kl/Annum	3.2	3.2	3.2	3.2	3.2	3.2
Visbreaker Naphtha,	10³Kl/Annum	4.8	5.3	8.5	4.8	-	-
FCC Feedstocks,	10³Kl/Annum	-	-	-	-	280.3	280.3
Thermal Cracker Feedstocks,	10³Kl/Annum	-	-	-	-	317.5	317.5
By-products Total,	10³Kl/Annum	841.5	831.9	842.0	842.1	841.1	841.9
Sulfur,	10³Ton/Annum	2.6	2.6	2.6	2.6	2.6	2.6
3. Refinery Use							
Fuel Gas (RFO),	10³Kl/Annum	3.6	4.3	5.3	3.6	1.7	1.7
Fuel Oil,	10³Kl/Annum	98.8	108.1	97.8	98.3	100.5	99.7
Refinery Use Total,	10³Kl/Annum	102.4	112.4	103.1	101.9	102.2	101.4

Table III-14 BASE OILS QUALITIES SUMMARY

PROPERTIES		SPECIFICATION	ESTIMATED QUALITY
60N			
Viscosity @40°C,	cst	8.5 - 11.5	10.0
Viscosity Index,	-	Min. 95	95
Pour Point,	°C	Max. -10	-10
Sulfur Content,	wt%	Max. 0.3	0.12
Colour (ASTM)		Max. 0.5	0.5
Flash Point,	°C	Min. 130	154
Total Acid Value,	mg-KOH/g	Max. 0.1	0.01
150N			
Viscosity @100°C,	cst	4.5 - 5.5	4.9
Viscosity Index,	-	Min. 100	100
Pour Point,	°C	Max. -10	-10
Sulfur Content,	wt%	Max. 0.3	0.14
Colour (ASTM)		Max. 0.5	0.5
Flash Point,	°C	Min. 190	216
Total Acid Value,	mg-KOH/g	Max. 0.1	0.01
300N			
Viscosity @100°C,	cst	7.0 - 8.0	7.0
Viscosity Index,	-	Min. 95	95
Pour Point,	°C	Max. -10	-10
Sulfur Content,	wt%	Max. 0.3	0.14
Colour (ASTM)		Max. 2.0	0.5
Flash Point,	°C	Min. 210	232
Total Acid Value,	mg-KOH/g	Max. 0.1	0.01
500N			
Viscosity @100°C,	cst	10.0 - 12.0	11.0
Viscosity Index,	-	Min. 95	95
Pour Point,	°C	Max. -10	-10
Sulfur Content,	wt%	Max. 0.3	0.22
Colour (ASTM)		Max. 2.5	1.0
Flash Point,	°C	Min. 230	262
Total Acid Value,	mg-KOH/g	Max. 0.1	0.01
Carbon Residue,	wt%	Max. 0.3	0.05
BS			
Viscosity @100°C,	cst	29.5 -34.5	32.0
Viscosity Index,	-	Min. 95	95
Pour Point,	°C	Max. -10	-10
Sulfur Content,	wt%	Max. 0.5	0.38
Colour (STM)		Max. 4.5	2.5
Flash Point,	°C	Min. 240	310
Total Acid Value,	mg-KOH/g	Max. 0.1	0.01
Carbon Residue,	wt%	Max. 0.8	0.4

Table III-15 BY-PRODUCTS QUALITIES SUMMARY

(1) FUEL OIL

PROPERTIES	SPECIFICATION(1)	BANGCHAK CASE				SRIRACHA CASE	
		BANGCHAK-A	BANGCHAK-AX	BANGCHAK-AY	BANGCHAK-B	SRIRACHA-A	SRIRACHA-B
Specific Gravity (15/4°C)	Max. 0.995	0.969	0.971	0.972		0.994	
Sulfur, wt%	Max. 3.5	3.5	3.5	3.5		4.2	
Viscosity @50°C, cst	Max. 230	230	230	230	Same as BANGCHAK-A	230	Same as BANGCHAK-A
Flash Point, °C	Min. 60	60	60	60		-	
Pour Point, °C	Max. 30	30	30	30		-	

Notes (1) This specification is for 2000" grade of fuel oil.

(2) In Sriracha cases, fuel oil produced is evaluated as bunker fuel oil.

Table III-15 BY-PRODUCTS QUALITIES SUMMARY (Cont'd)

(2) BLOWN ASPHALT

PROPERTIES		SPECIFICATION	ESTIMATED QUALITY
Specific Gravity (15/4°C)		1.01 - 1.06	1.04
Softening Point (R&B),	°C	50 - 58	51
Penetration @25°C,	0.1 mm	40 - 60	56
Ductility @25°C,	cm	Min. 100	100
Loss on heating,	wt%	Max. 0.2	+0.01
Drop in penetration,	%	Max. 110	20
Solubility in CCl_4,	wt%	Min. 99.0	99.9
Flash Point (COC),	°C	Min. 250	300

(3) HARD WAX

PROPERTIES		SPECIFICATION	ESTIMATED QUALITY
GRADE-140P			
Melting Point,	°C	59 - 62	60
Oil Content,	wt%	Max. 0.5	0.5
Colour		White	White
FDA Test		Pass	Pass
GRADE-150P			
Melting Point,	°C	64 - 67	66
Oil Content,	wt%	Max. 1.0	1.0
Colour		White	White
FDA Test		Pass	Pass

Table III-15 BY-PRODUCTS QUALITIES SUMMARY (Cont'd)

(4) TRANSPORTED OILS TO EXISTING REFINERY

	BANGCHAK CASE	SRIRACHA CASE
Visbreaker Naphtha		
Specific Gravity (15/4°C)	0.74	-
Sulfur, wt%	1.2	-
RON, P-1 clear	68	-
Hydrofinished Gas Oil		
Specific Gravity (15/4°C)	0.859	0.859
Sulfur	0.1	0.1
Light Vacuum Gas Oil		
Specific Gravity (15/4°C)	0.902	0.902
Sulfur, wt%	2.0	2.0
Viscosity @100°C, cst	2.6	2.6
Cetane No.	58	58
FCC Feedstock		
Specific Gravity (15/4°C)	-	0.896
Sulfur, wt%	-	1.8
Viscosity @50°C, cst	-	4.8
Thermal Cracker Feedstock		
Specific Gravity (15/4°C)	-	1.019
Sulfur, wt%	-	4.1
Viscosity @100°C, cst	-	600

Table III-16 INSTALLED CAPACITIES OF PROCESS UNITS

	BANGCHAK CASE				SRIRACHA CASE	
	BANGCHAK-A	BANGCHAK-AX	BANGCHAK-AY	BANGCHAK-B	SRIRACHA-A	SRIRACHA-B
Vacuum Distillation Unit, BPSD	22,100					
Propane Deasphalting Unit, BPSD	6,500					
Furfural Extraction Unit, BPSD	9,100	Same as	Same as	Same as	Same as	Same as
Hydrofinishing Unit, BPSD	6,100	BANGCHAK-A	BANGCHAK-A	BANGCHAK-A	BANGCHAK-A	BANGCHAK-A
MEK Dewaxing Unit, BPSD	6,000					
MEK Deoiling Unit, BPSD	-	600	-	-	-	-
Wax Hydrotreating Unit, BPSD	-	550	-	-	-	-
Visbreaker, BPSD	2,200	2,300	3,800	2,200	"	"
Asphalt Blowing Unit, BPSD	1,000	1,000	-	1,000	1,000	1,000
Sulfur Recovery Unit, TPSD-S	8	8	8	8	8	8
Foul Water Stripper, TPSD	460	460	460	460	450	450

Table III-17 ASSUMED OPERATION CYCLE

Mode	Duration (Days)
60N	2.6
150N	1.6
300N	2.7
500N	3.1
Bright Stock	3.0
500N	3.1
Bright Stock	3.0
500N	3.1
Bright Stock	3.0
500N	3.1
Bright Stock	3.0
300N	2.7

The above cycle is repeated 10 times a year.

Table III-18 TANKAGE SUMMARY

Service	Bangchak								Sriracha			
	Bangchak-A		Bangchak-AX		Bangchak-AY		Bangchak-all		Sriracha-A		Sriracha-B	
	No's	Capacity, Kl.	No's	Capacity, Kl.	No's	Capacity, Kl.	No's	Capacity, Kl.	No's	Capacity, Kl.	No's	Capacity, Kl.
1. Feedstock Tanks												
. Long Residue	1	13,000	1	13,000	1	13,000	-	-	1	13,000	-	-
2. Intermediate Tanks												
. Short Residue	2	6,300	2	6,300	2	6,300	2	6,300	2	6,300	2	6,300
. Vacuum Distillate - 60S	1	5,200	1	5,200	1	5,200	1	5,200	1	5,200	1	5,200
. Vacuum Distillate - 150N	1	3,000	1	3,000	1	3,000	1	3,000	1	3,000	1	3,000
. Vacuum Distillate - 300N	1	7,800	1	7,800	1	7,800	1	7,800	1	7,800	1	7,800
. Vacuum Distillate - 500N	1	9,200	1	9,200	1	9,200	1	9,200	1	9,200	1	9,200
. DAO	1	6,500	1	6,500	1	6,500	1	6,500	1	6,500	1	6,500
. VGO Surplus	2	4,400	2	4,400	2	4,400	2	4,400	2	4,400	2	4,400
. Raffinate - 60S	1	1,400	1	1,400	1	1,400	1	1,400	1	1,400	1	1,400
. Raffinate - 150N	1	1,400	1	1,400	1	1,400	1	1,400	1	1,400	1	1,400
. Raffinate - 300N	1	1,400	1	1,400	1	1,400	1	1,400	1	1,400	1	1,400
. Raffinate - 500N	1	1,200	1	1,200	1	1,200	1	1,200	1	1,200	1	1,200
. Raffinate - DS	1	1,000	1	1,000	1	1,000	1	1,000	1	1,000	1	1,000
. HP Raffinate - 60S	1	1,400	1	1,400	1	1,400	1	1,400	1	1,400	1	1,400
. HP Raffinate - 150N	1	1,400	1	1,400	1	1,400	1	1,400	1	1,400	1	1,400
. HP Raffinate - 300N	1	1,400	1	1,400	1	1,400	1	1,400	1	1,400	1	1,400
. HP Raffinate - 500N	1	1,200	1	1,200	1	1,200	1	1,200	1	1,200	1	1,200
. HP Raffinate - DS	1	1,000	1	1,000	1	1,000	1	1,000	1	1,000	1	1,000
. PDA Asphalt	2	1,800	2	1,700	2	1,800	2	1,800	2	2,000	2	2,000
. Light Extract	2	2,000	2	2,000	2	2,200	2	2,000	2	2,000	2	2,000
. Heavy Extract	2	2,000	2	2,000	-	-	2	2,000	2	2,000	2	2,000
. Asphalt Blowing Charge	2	800	2	800	-	-	2	800	2	800	2	800
. Visbreaking Charge	2	1,600	2	1,800	2	2,800	2	1,600	-	-	-	-
. Visbreaking Distillate & Residue	2	1,500	2	1,600	2	2,600	2	1,500	-	-	-	-
. Slack Wax - 300N	-	-	1	300	-	-	-	-	-	-	-	-
. Slack Wax - 500N	-	-	2	1,000	-	-	-	-	-	-	-	-
. Slack Wax	2	900	2	800	2	900	2	900	2	900	2	900
3. Product Tanks												
. Base Oil - 60S	1	2,900	1	2,900	1	2,900	1	2,900	1	2,900	1	2,900
. Base Oil - 150N	1	1,700	1	1,700	1	1,700	1	1,700	1	1,700	1	1,700
. Base Oil - 300N	2	3,000	2	3,000	2	3,000	2	3,000	2	3,000	2	3,000
. Base Oil - 500N (Straight)	2	2,800	2	2,800	2	2,800	2	2,800	2	2,800	2	2,800
. Base Oil - DS	2	2,200	2	2,200	2	2,200	2	2,200	2	2,200	2	2,200
. Base Oil - 500N (Blend)	2	3,500	2	3,500	2	3,500	2	3,500	2	3,500	2	3,500
. Semi-BlownAsphalt	2	800	2	800	-	-	-	-	2	800	-	-
. Heavy Fuel Oil	2	3,000	2	3,000	2	3,200	-	-	2	3,400	-	-
. Wax - 300N	-	-	2	300	-	-	-	-	-	-	-	-
. Wax - 500N	-	-	2	200	-	-	-	-	-	-	-	-
4. Other Service Tanks												
. Slop Oil	1	4,400	1	4,400	1	4,400	1	4,400	1	4,400	1	4,400
. Refinery Fuel Oil	1	3,000	1	3,000	1	3,000	1	3,000	1	3,400	1	3,400
Grand Total	50	142,700	57	146,200	44	141,400	45	122,100	46	138,100	41	116,700

Table III-19 BUILDING PLAN

Case / Building	New Company Case		Expansion Case	
	Bangchak-A Bangchak-AX* Bangchak-AY Siracha-A		Bangchak-B Siracha-B	
	Nos.	Total Floor Area (m^2)	Nos.	Total Floor Area (m^2)
Administ. Bldg.	1	3,000	1	300
Canteen	1	1,800		-
Technical Office	1	600		-
Work Shop	1	2,600		-
Warehouse	1	4,300		-
Laboratory	1	1,000	1	1,000
Fire Station	1	800		-
Gate House	1	200	1	100
Control Room	4	3,000	4	3,000
Substation	9	2,200	9	2,200
Total		19,500		6,600

Note: * In the wax production case, a wax molding and packing house, approximately 1,000m^2 is added.

Table III-20 UTILITY BALANCE (BANGCHAK-A CASE)

	Electric Power	Fuel	Steam		Cooling Water	Steam Condensate	B.F. Water	
			H.P	L.P			Cold	Hot
	KW	10^6 Kcal/H	Ton/H	Ton/H	Ton/H	Ton/H	Ton/H	Ton/H
Vacuum Distillation	813	21.3	14.0	1.1	1,054	-5.1	-	7.1
Propane Deasphalting	691	-	4.5	0.6	450	-3.9	-	1.2
Furfural Extraction	541	-	0.2	6.2	378	-	-	-
Hydrofinishing	952	5.2	1.8	3.1	613	-2.1	-	1.2
MEK Dewaxing	3,304	-	11.2	-4.5	627	-3.1	-	-
Visbreaking	98	2.4	1.5	0.7	27	-	-	2.1
Asphalt Blowing	84	0.3	1.1	1.7	29	-	-	0.4
Sulfur Recovery	86	0.5	0.1	-1.3	4	-	-	1.7
Hot Oil System	713	41.3	1.3	-	12	-	-	-
ON-SITE TOTAL	7,282	71.0	35.7	7.6	3,194	-14.2	-	13.7
OFF-SITE TOTAL	2,716	0.1	3.2	14.1	-	-9.0	-	-
River Water Intake	20	-	-	-	2	-	-	-
Raw Water Treatment	66	-	-	-	11	-	-	-
Demineralizer	23	-	-	-	6	-	-51.2	-
Deaerator	-	-	3.9	-3.9	16	25.4	51.2	-86.7
Steam Generator	130	45.1	-72.9	9.8	26	-	-	73.0
			5.1	-5.1				
Cooling Water	385	-	14.0	-14.0	-3,393	-	-	-
					28			
Air/Inert Gas	460	-	11.0	-11.0	110			
Fuel Oil	26			2.5		-2.2		
UTILITY TOTAL	1,110	45.1	-38.9	-21.7	-3,194	23.2	0	-13.7
PLANT TOTAL	11,108	116.2	0	0	0	0	0	0

Note) Positive value indicates consumption and negative value indicates generation.

Table III-21 UTILITY BALANCE (SRI RACHA-A CASE)

	Electric Power	Fuel	Steam		Cooling Water	Steam Condensate	B.F. Water	
			H.P	L.P			Cold	Hot
	KW	10^6 Kcal/H	Ton/H	Ton/H	Ton/H	Ton/H	Ton/H	Ton/H
Vacuum Distillation	813	21.3	14.0	1.1	1,054	-5.1	-	7.1
Propane Deasphalting	691	-	4.5	0.7	450	-3.9	-	1.2
Furfural Extraction	541	-	0.2	6.2	378	-	-	-
Hydrofinishing	952	5.2	1.8	3.1	613	-2.1	-	1.2
MEK Dewaxing	3,304	-	11.2	-4.5	627	-3.1	-	-
Asphalt Blowing	84	0.3	1.1	1.7	29	-	-	0.4
Sulfur Recovery	86	0.5	0.1	-1.3	4	-	-	1.7
Hot Oil System	713	41.3	1.3	-	12	-	-	-
ON-SITE TOTAL	7,184	68.6	34.2	7.0	3,167	-14.2	-	11.6
OFF-SITE TOTAL	2,679	0.1	3.2	13.8	-	-8.7	-	-
Sea Water Intake	110	-	-	-	-	-	-	-
Reservoir Water Storage	37	-	-	-	3	-	-	-
Desalinator	150	-	-	6.0	-	-6.0	-48.2	-
Deaerator	-	-	3.9	-3.9 9.8	16	31.1	48.2	-88.2
Steam Generator	130	47.3	-76.5 10.2	- -10.2	26	-	-	76.6
Cooling Water	385	-	14.0	-14.0	-3,350 28	-	-	-
Air/Inert Gas	460	-	11.0	-11.0	110	-	-	-
Fuel Oil	26	-	-	2.5	-	-2.2	-	-
UTILITY TOTAL	1,298	47.3	-37.4	-20.8	-3,167	22.9	0	-11.6
PLANT TOTAL	11,161	116.0	0	0	0	0	0	0

Note) Positive value indicates consumption and negative value indicates generation.

Table III-22 SUMMARY OF UTILITY REQUIREMENTS

	Unit	Bangchak				Siracha	
		Bangchak-A	Bangchak-AX	Bangchak-AY	Bangchak-B	Siracha-A	Siracha-B
Electricity	KW	11,000	12,000	11,000	10,000	11,000	10,000
Fuel	10^6Kcal/H	116	127	117	115	116	115
Steam	Ton/H	73	87	72	72	77	75
Cooling Water	Ton/H	3,400	3,600	3,400	3,400	3,400	3,400
Boiler Feed Water	Ton/H	87	101	87	86	88	87
River Water	Ton/H	150	165	150	145	-	-
Desalinated Water	Ton/H	-	-	-	-	48	48
Reservoir Water	Ton/H	-	-	-	-	85	85
Hydrogen	Nm^3/H	1,070	1,160	1,070	1,070	1,070	1,070
Air	Nm^3/H	8,000	8,000	8,000	8,000	8,000	8,000
Inert Gas	Nm^3/H	1,000	1,000	1,000	1,000	1,000	1,000

Table III-23 INSTALLATION SUMMARY OF UTILITY FACILITIES

	Bangchak								Siracha			
	Bangchak-A		Bangchak-AX		Bangchak-AY		Bangchak-B		Siracha-A		Siracha-B	
	Capacity	Nos.	Capacity	Nos.	Capacity	Nos.	Capacity	Nos.	Capacity	Nos.	Capacity	Nos.
1. Steam Generator	40 Ton/H	3	50 Ton/H	3	40 Ton/H	3	40 Ton/H	2	45 Ton/H	3	45 Ton/H	2
2. Power Receiving	16000 KW	1	17000 KW	1	16000 KW	1	15000 KW	1	16000 KW	1	15000 KW	1
3. River Water Intake	180 Ton/H	2	200 Ton/H	2	180 Ton/H	2	180 Ton/H	3	-		-	
4. Sea Water Intake	-		-		-		-		250 Ton/H	3	250 Ton/H	3
5. Clarifier	180 Ton/H	1	200 Ton/H	1	180 Ton/H	1	180 Ton/H	1	-		-	
6. Sand Filter	60 Ton/H	2	75 Ton/H	2	60 Ton/H	2	60 Ton/H	2	-		-	
7. Demineralizer	60 Ton/H	1	75 Ton/H	1	60 Ton/H	1	60 Ton/H	1	-		-	
8. Desalinator	-		-		-		-		700 Ton/D	3	700 Ton/D	3
9. Cooling Water System												
. Cooling Tower	1300Ton/H	4	1400Ton/H	4	1300Ton/H	4	1300Ton/H	4	1300Ton/H	4	1300Ton/H	4
. Circulation Pump	1300Ton/H	4	1400Ton/H	4	1300Ton/H	4	1300Ton/H	4	1300Ton/H	4	1300Ton/H	4
10. Water Tank												
. Raw Water Tank	2000 KL	2	2200 KL	2	2000 KL	2	2000 KL	2	-		-	
. Filtered Water Tank	1500 KL	1	1800 KL	1	1500 KL	1	1500 KL	1	-		-	
. Boiler Feed Water Tank	1000 KL	1	1200 KL	1	1000 KL	1	1000 KL	1	-		-	
. Reservoir Water Tank	-		-		-		-		2000 KL	2	2000 KL	2
. Desalinated Water Tank	-		-		-		-		700 KL	1	700 KL	1
11. Air Compressor	4000Nm^3/H	3	4000Nm^3/H	3	4000Nm^3/H	3	4000Nm^3/H	2	4000Nm^3/H	3	4000Nm^3/H	2
12. Inert Gas System	1000Nm^3/H	1	1000Nm^3/H	1	1000Nm^3/H	1	1000Nm^3/H	1	1000Nm^3/H	1	1000Nm^3/H	1
13. Instrument Air Dryer	2800Nm^3/H	1	2800Nm^3/H	1	2800Nm^3/H	1	2800Nm^3/H	1	2800Nm^3/H	1	2800Nm^3/H	1
14. Fuel Oil System												
. Fuel Oil Pump	20 m^3/H	2	20 m^3/H	2	20 m^3/H	2	20 m^3/H	2	20 m^3/H	2	20 m^3/H	2
. Fuel Oil Tank	1000 KL	1	1000 KL	1	1000 KL	1	1000 KL	1	1000 KL	1	1000 KL	1
15. Fuel Gas System												

Table III-24 SOURCE AND CONTROL OF WASTE FROM LUBE BASE OIL REFINERY

	Sources	Control Measure	Remarks
A. Air Emissions			
A.1 Sulfur oxides	- Heaters, Incinerators and Steam Boilers	- Use of tolerable Sulfur level fuel	- Maximum use of fuel gas
	- Flares	- Consideration of stack height and smokless type	- In only case of emergency
	- Sulfur Tailgas Incinerator	- Dilution with large quantity of flue gas from other heaters	
A.2 Nitrogen oxides	- Same to the above A.1	- Proper operation of excess air	
A.3 Hydrocarbon Fume	- Ejector condensers	- Burning in an incinerator or a heater	
	- H_2S contained vapor from sulfur pit	- Burning in the sulfur tailgas incinerator	
	- Product loading equipment	- Not to be considered	- Considered minimal because of heavy products
	- Waste effluent treating facilities	ditto	

Table III-24 SOURCE AND CONTROL OF WASTE FROM LUBE BASE OIL REFINERY (Cont'd)

		Sources	Control Measures	Remarks
B.	Liquid wastes			
B.1	Foul water from process units	- Hot well drums, stripper condenser, compressor suct. drum, Furfural water tower, HP/LP separators, O.H separator	- Treated by the foul water stripper, then further treated by W.W.T.	- Sour gas to be treated by the sulfur unit
B.2	Oil contaminated Water	- Pump cooling water from process units	- Treated by the oil effluent treating facilities	
		- Oil contaminated storm water	ditto	- first few hours of storm water to be stored in storm water surge pond
B.3	Sanitary Waste Water	- Buildings	- Treated by W.W.T.	
B.4	Non-oily waste water			
	- Spent caustic and acid	- Demineralizer	- Neutralization and then treated by the effluent treating facility	
	- Others	- Boiler blow-down	- Treated by the effluent treating facility	
		- Cooling tower blow-down	ditto	- Non chromic corrosing inhibitor to be used

Table III-24 SOURCE AND CONTROL OF WASTE FROM LUBE BASE OIL REFINERY (Cont'd)

		Sources	Control Measures	Remarks
C.	Solid Wastes			
C.1	Heavy metal catalyst particles	- H. F reactor, wax H.F reactor	- Reuse or recovery of heavy metal and sanitary fill	
C.2	Oil sediments and sludges	- Storage tanks, Slop tanks, pressure vessels during turn-around maintenance	- Natural drying and landfill	
C.3	Effluent treatment wastes	- CPI separator/storm water surge pond/retention pond bottom sediments	ditto	
		- Ash of biological soils from the sludge incinerator	- Landfill	
C.4	Others	- Sludge of cooling tower basin, raw water treatment unit, demineralizer	- Natural drying and landfill	

Table III-25 REQUIRED AREA FOR CONSTRUCTION

(Unit: m^2)

	Bangchak -A	Bangchak -AX	Bangchak -AY	Bangchak -B	Siracha -A	Siracha -B
1. Adm. Building Area	25,000	25,000	25,000	-	25,000	-
2. Work Shop Area	25,000	25,000	25,000	-	25,000	-
3. Process Unit	50,000	65,000	50,000	50,000	50,000	50,000
4. Offsite Area	150,000	175,000	150,000	160,000	150,000	150,000
5. Utility Area	40,000	40,000	40,000	40,000	40,000	40,000
6. Construction Area etc.	60,000	70,000	60,000	60,000	60,000	60,000
Total	350,000	400,000	350,000	310,000	350,000	300,000

Table III-26 MANPOWER MOBILIZATION

	Bang Chak B	Wax Product	No Asphalt	Bang Chak A	Sri Racha B	Sri Racha A	Remarks
a. Supervisor and Staff							
Total (Man-Month)	930	930	930	900	900	880	
Number at peak time (Man-Month/ Month)	47	47	47	47	47	47	
b. Labor in Direct Work							
Total (Man-Day)	1,020,000	1,100,000	1,020,000	880,000	960,000	800,000	
Number at peak time (Man-Day/ Day)	2,700	2,700	2,700	2,500	2,700	2,500	
c. Labor in Indirect Work							
Total (Man-Day)	105,000	105,000	105,000	98,000	100,000	98,000	
Number at peak time (Man-Day/ Day)	190	190	190	170	170	170	

Figure III-1 BLOCK FLOW DIAGRAM OF CONVENTIONAL SCHEME

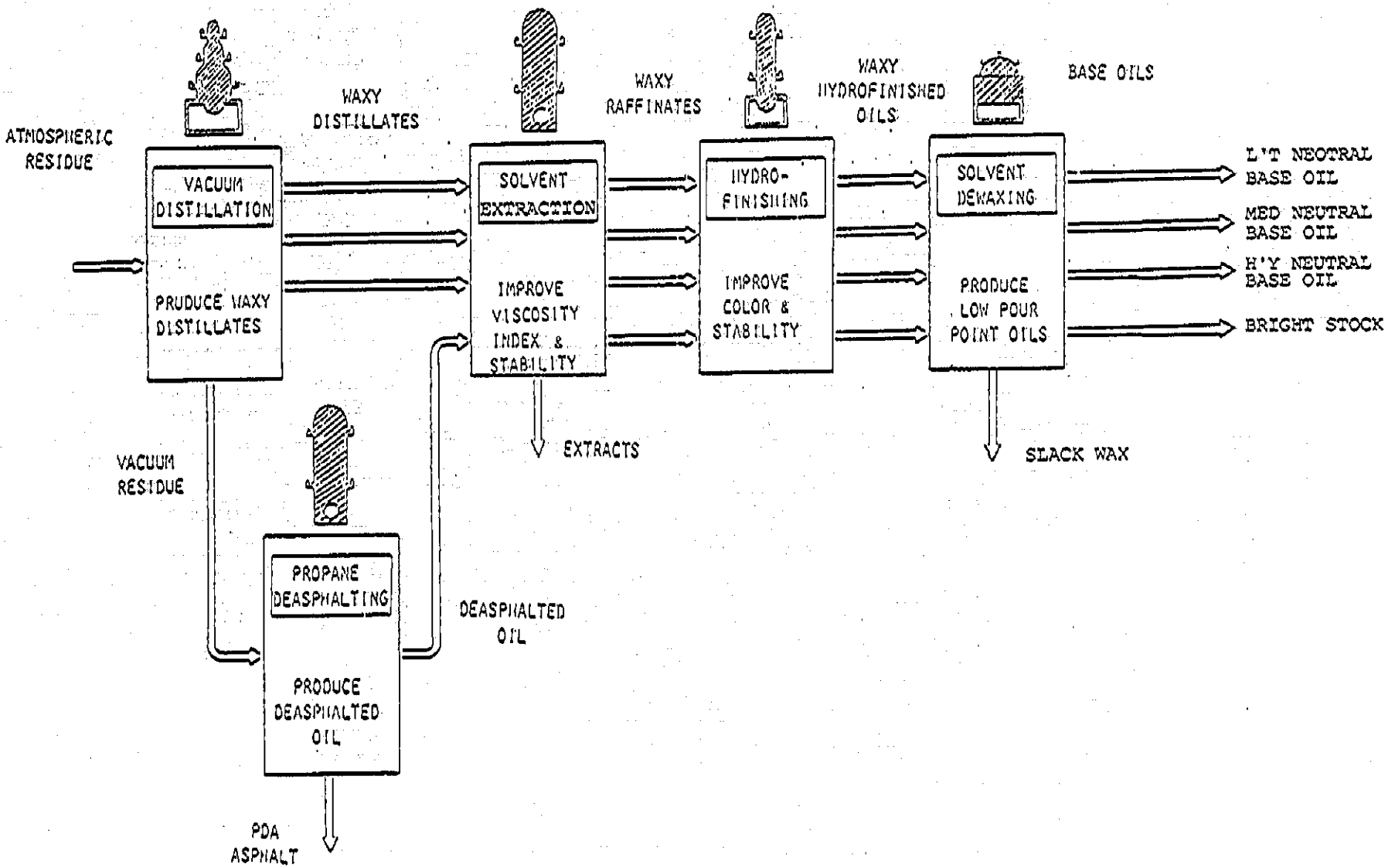


Figure III-2 BLOCK FLOW DIAGRAM OF HYDROTREATING SCHEME

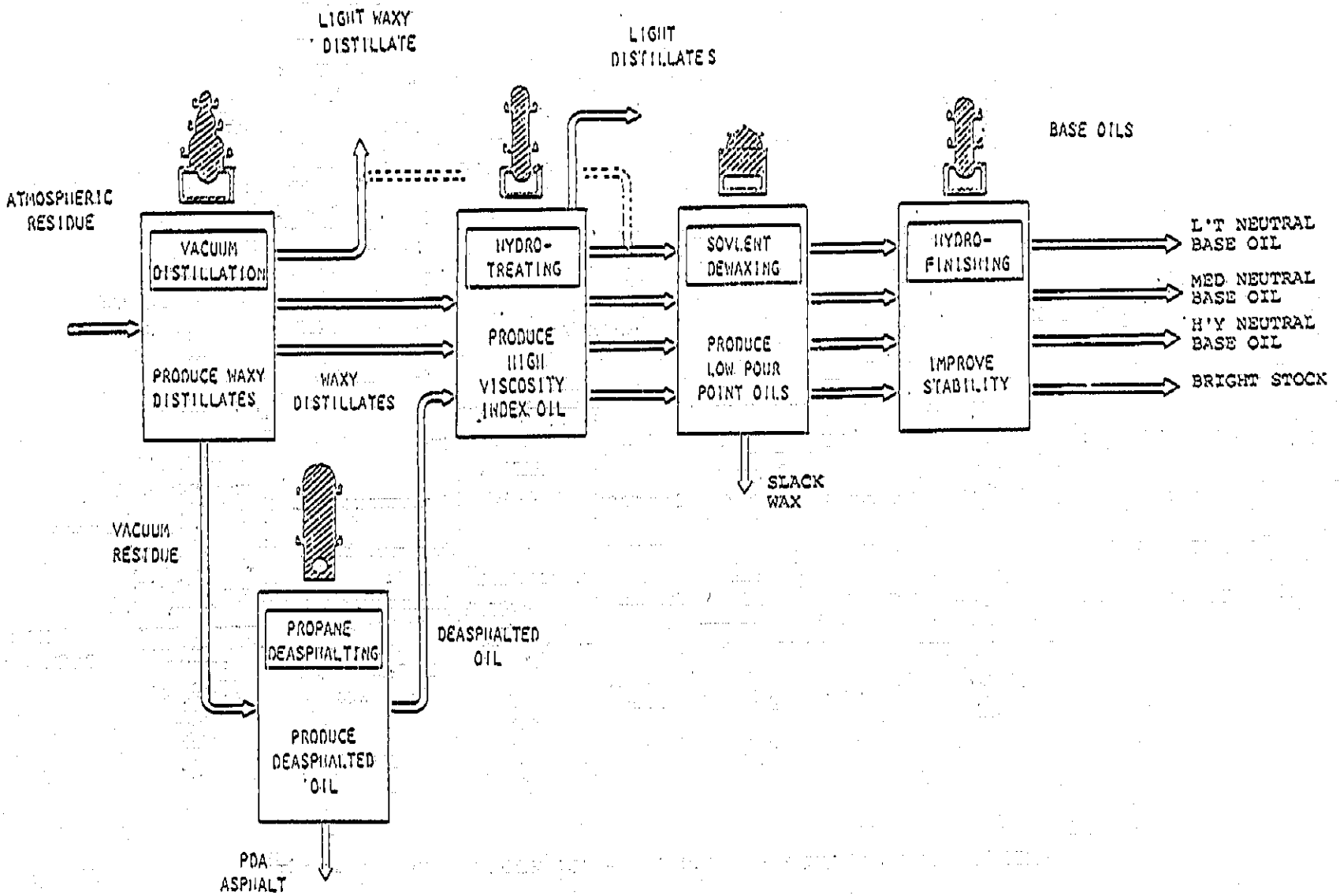
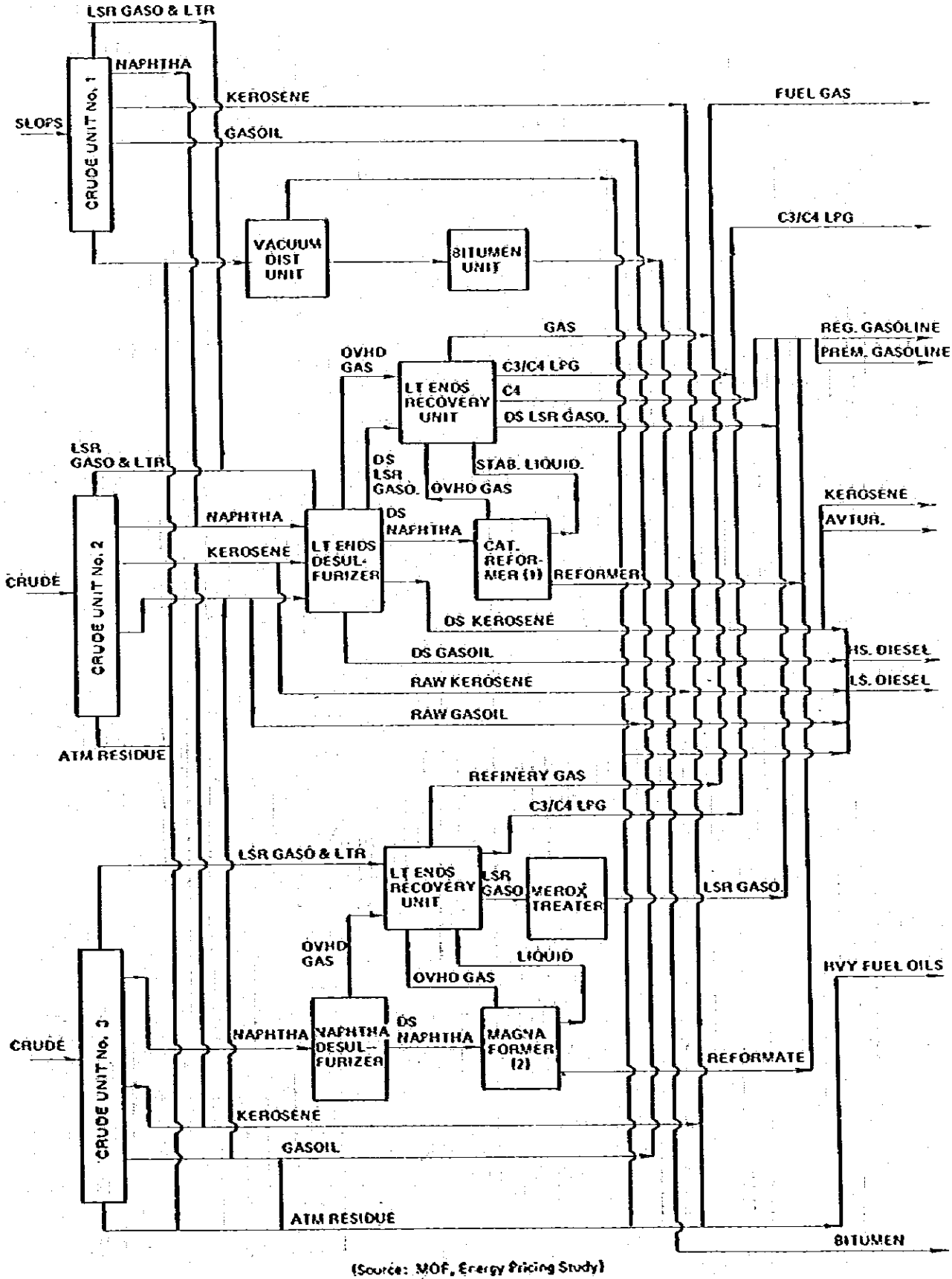
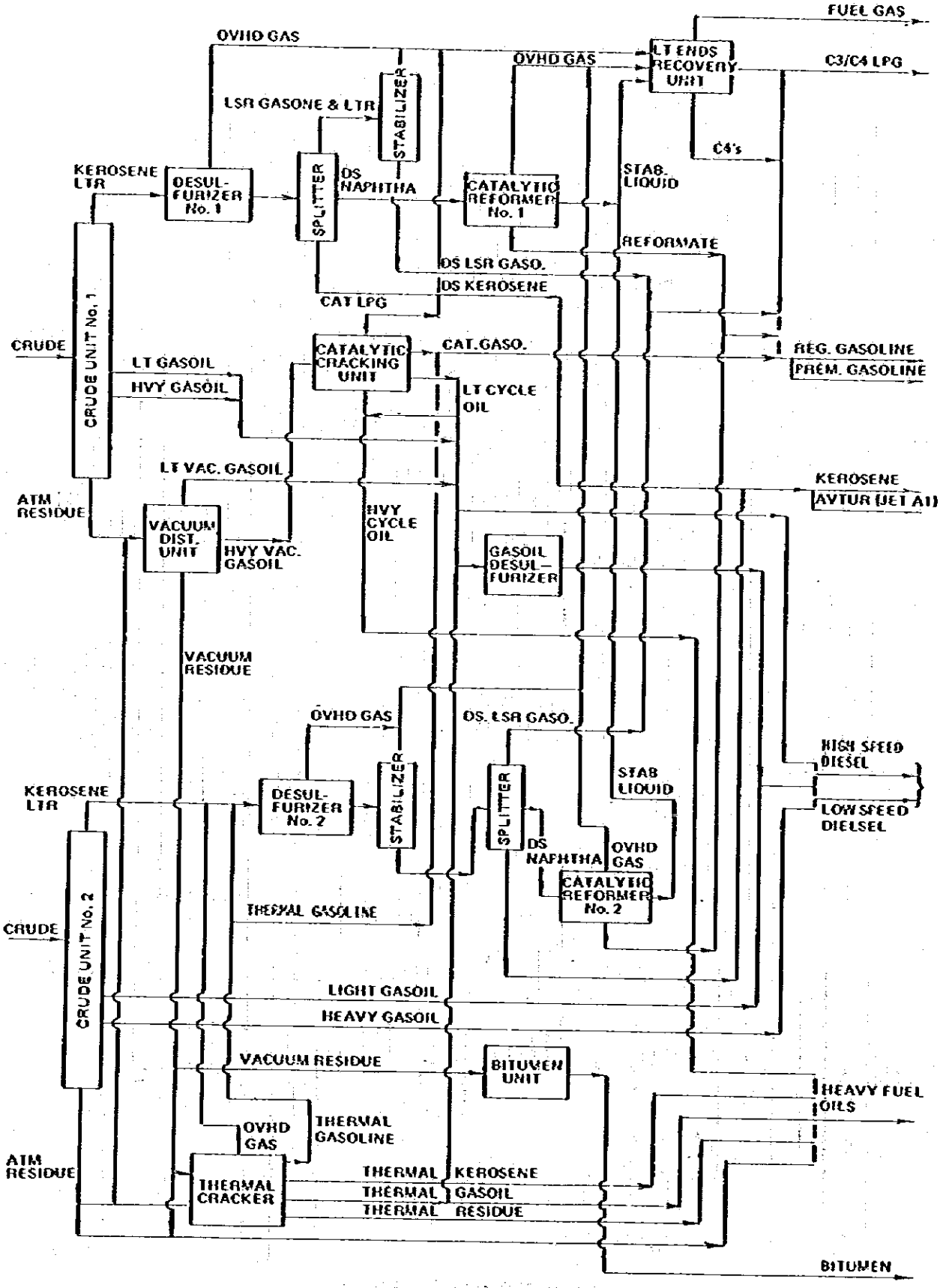


Figure III-3 BANGCHAK REFINERY FLOW DIAGRAM



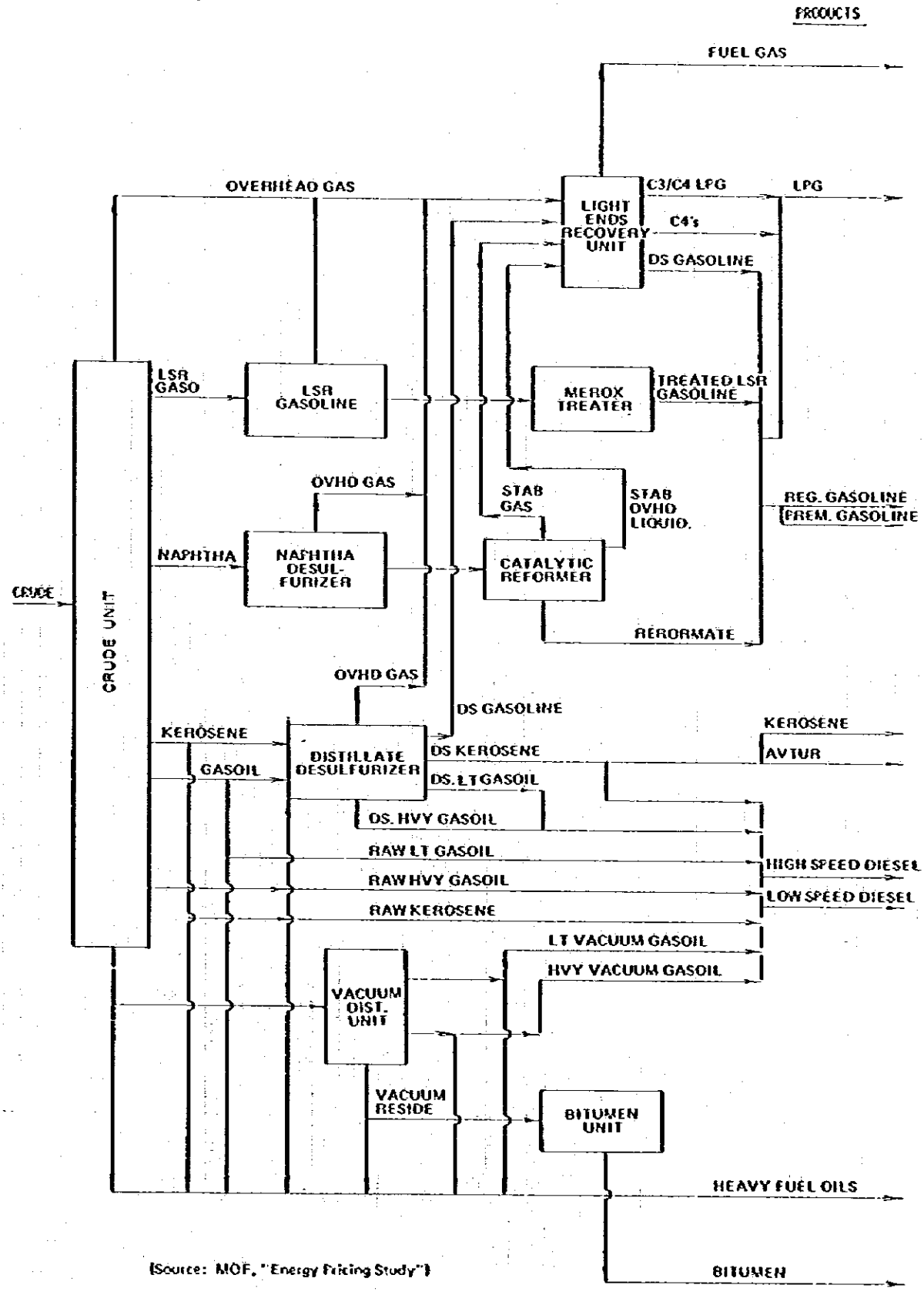
(Source: MOF, Energy Pricing Study)

Figure III-4 TORC REFINERY FLOW DIAGRAM



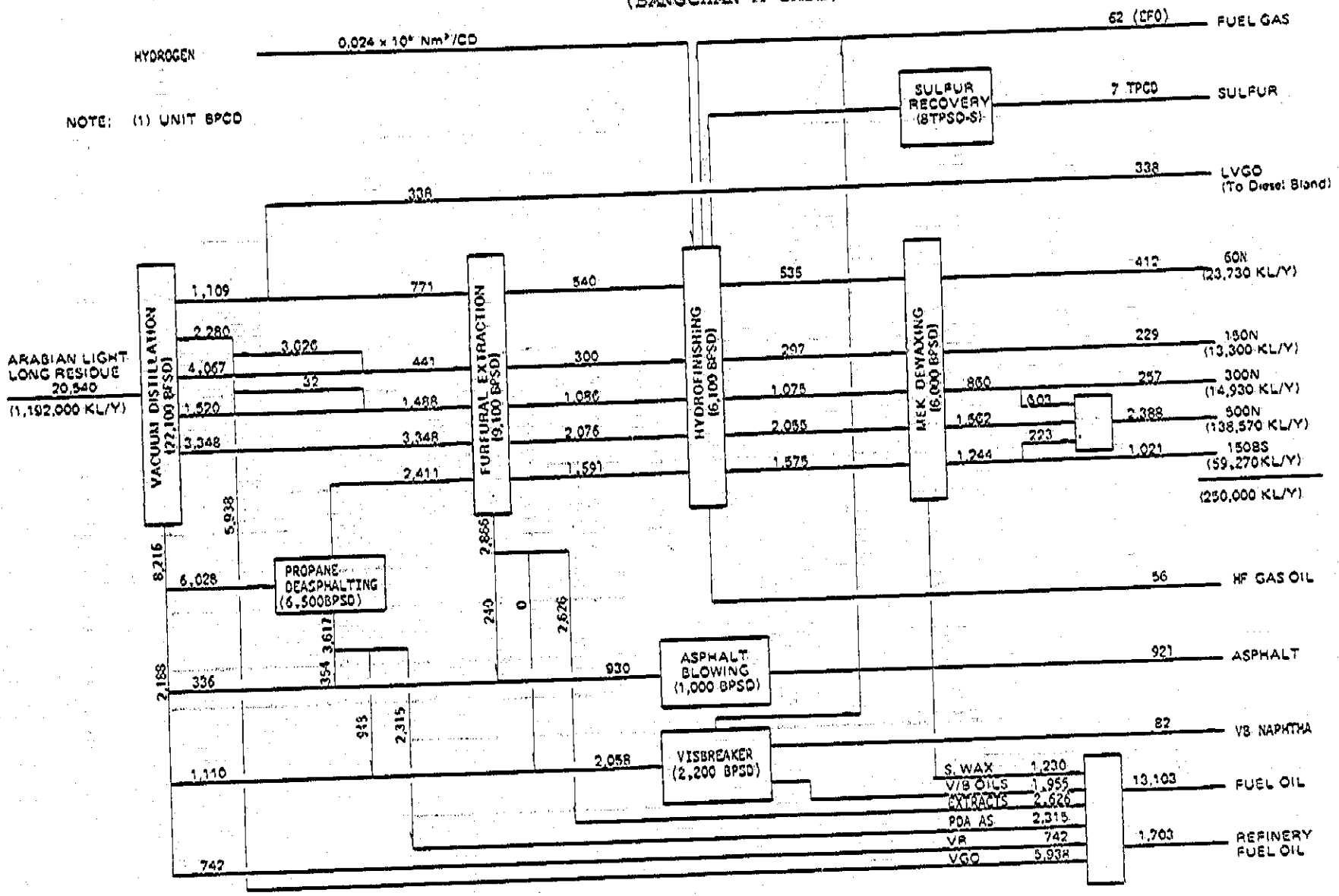
(Source: MOF, Energy Pricing Study)

Figure III-5 ESSO REFINERY FLOW DIAGRAM



(Source: MOF, "Energy Pricing Study")

Figure III-6 BLOCK FLOW DIAGRAM OF LUBE PLANT
(BANGCHAK-A CASE)



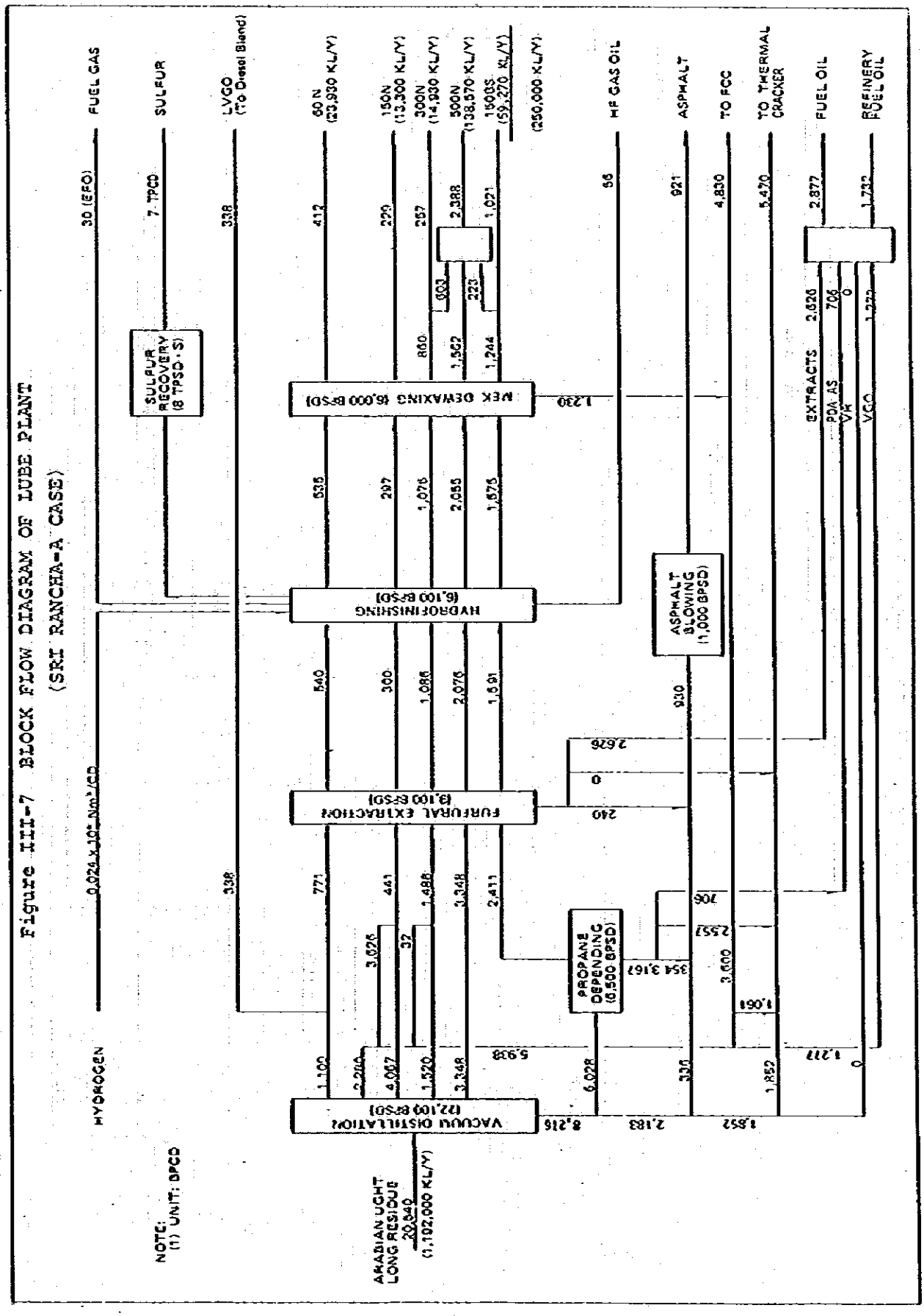


Figure III-7 BLOCK FLOW DIAGRAM OF LUBE PLANT
(SRI RANCHA-A CASE)
NOTE:
(1) UNIT: BPCD
ARABIAN LIGHT
LONG RESIDUE
20,840
(1,102,000 KL/Y)
VACUUM DISTILLATION
(22,100 B/SD)
HYDROGEN
FUEL GAS
SULFUR
LVGO
(To Diesel Blend)
SULFUR
RECOVERY
(8 TPSD - S)
FURFURAL EXTRACTION
(8,100 B/SD)
HYDROFINISHING
(6,100 B/SD)
MEK DEWAXING (6,000 B/SD)
PROPANE
DEPENDING
(8,500 BPSD)
ASPHALT
BLOWING
(1,000 BPSD)
60 N
(23,930 KL/Y)
150N
(13,300 KL/Y)
300N
(14,930 KL/Y)
500N
(138,670 KL/Y)
1500S
(59,270 KL/Y)
(250,000 KL/Y)
HF GAS OIL
ASPHALT
TO FCC
TO THERMAL
CRACKER
FUEL OIL
REFINERY
FUEL OIL
EXTRACTS
PDA AS
VR
VGO
30 (EFO)
7 TPSD
338
412
229
257
2,388
1,021
55
921
4,830
5,470
2,877
1,732
2,626
706
0
1,222
880
1,562
1,244
003
223
1230
535
297
1,076
2,055
1,575
540
300
1,088
2,075
1,591
930
240
771
441
1,488
3,348
2,411
3,625
32
1,100
2,200
4,007
1,520
3,348
5,938
6,028
330
1,852
2,183
8,216
706
2,527
3,167
354
3,600
1,061
1,277
0
1,852

Figure III-8 BLOCK FLOW DIAGRAM OF LUBE PLANT
(BANGCHAK-AX CASE)

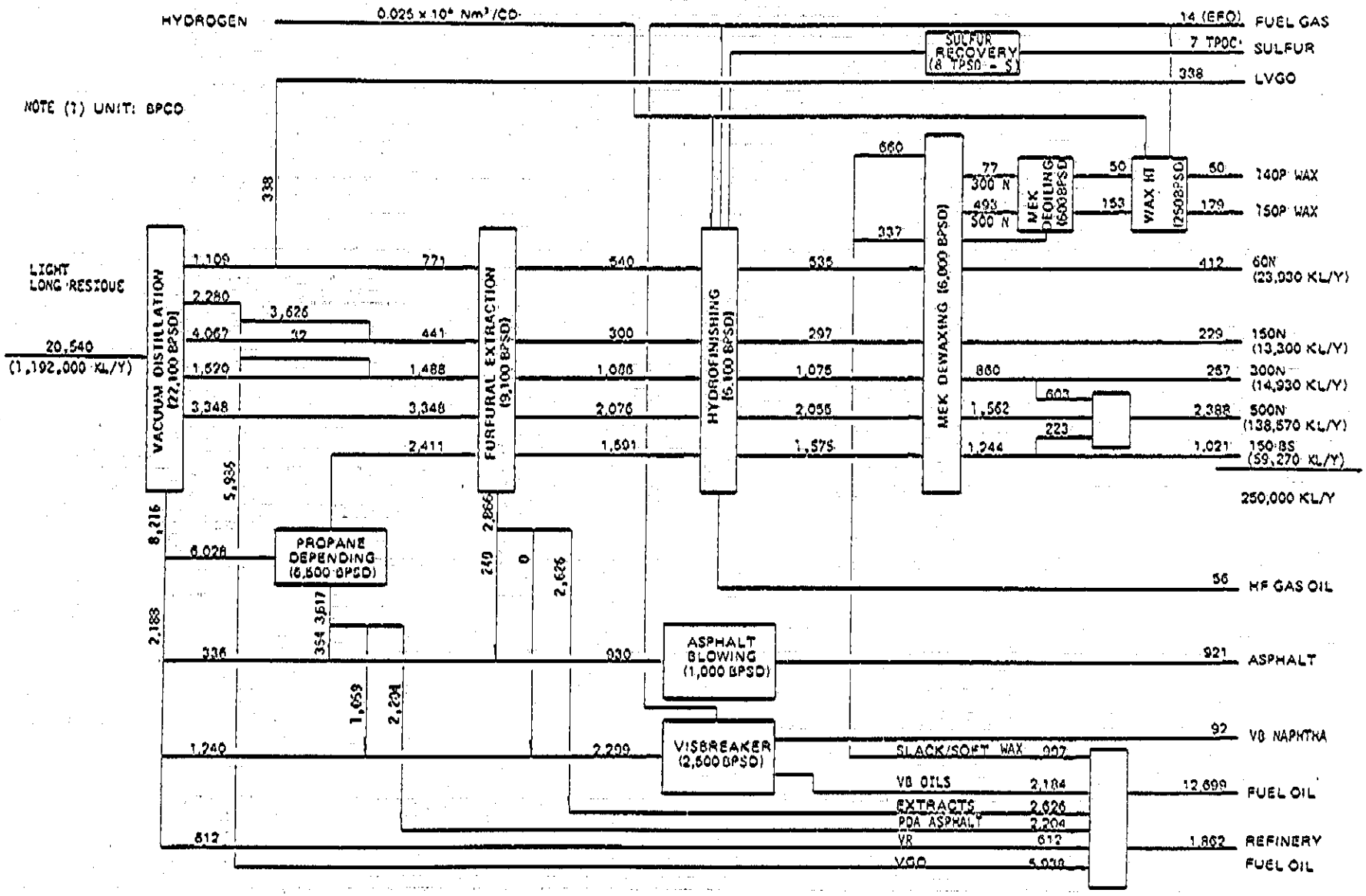


Figure III-9 BLOCK FOLW DIAGRAM OF LUBE PLANT
(BANGCHK-AY CASE)

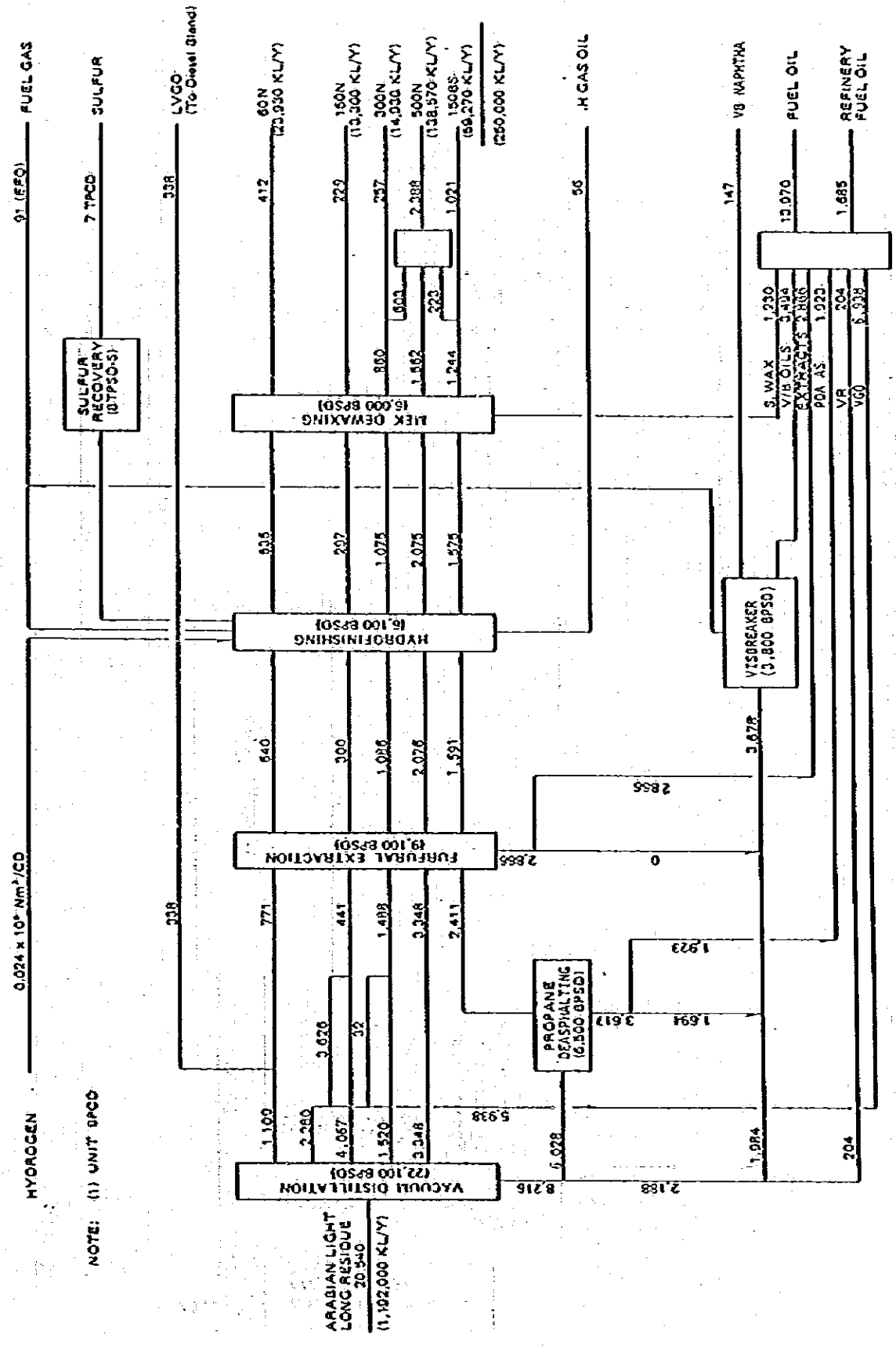


Figure III-10 BANGCHAK REFINERY COMBINATION BETWEEN LUBE COMPLEX AND FUEL REFINERY

(Unit: BPCD)

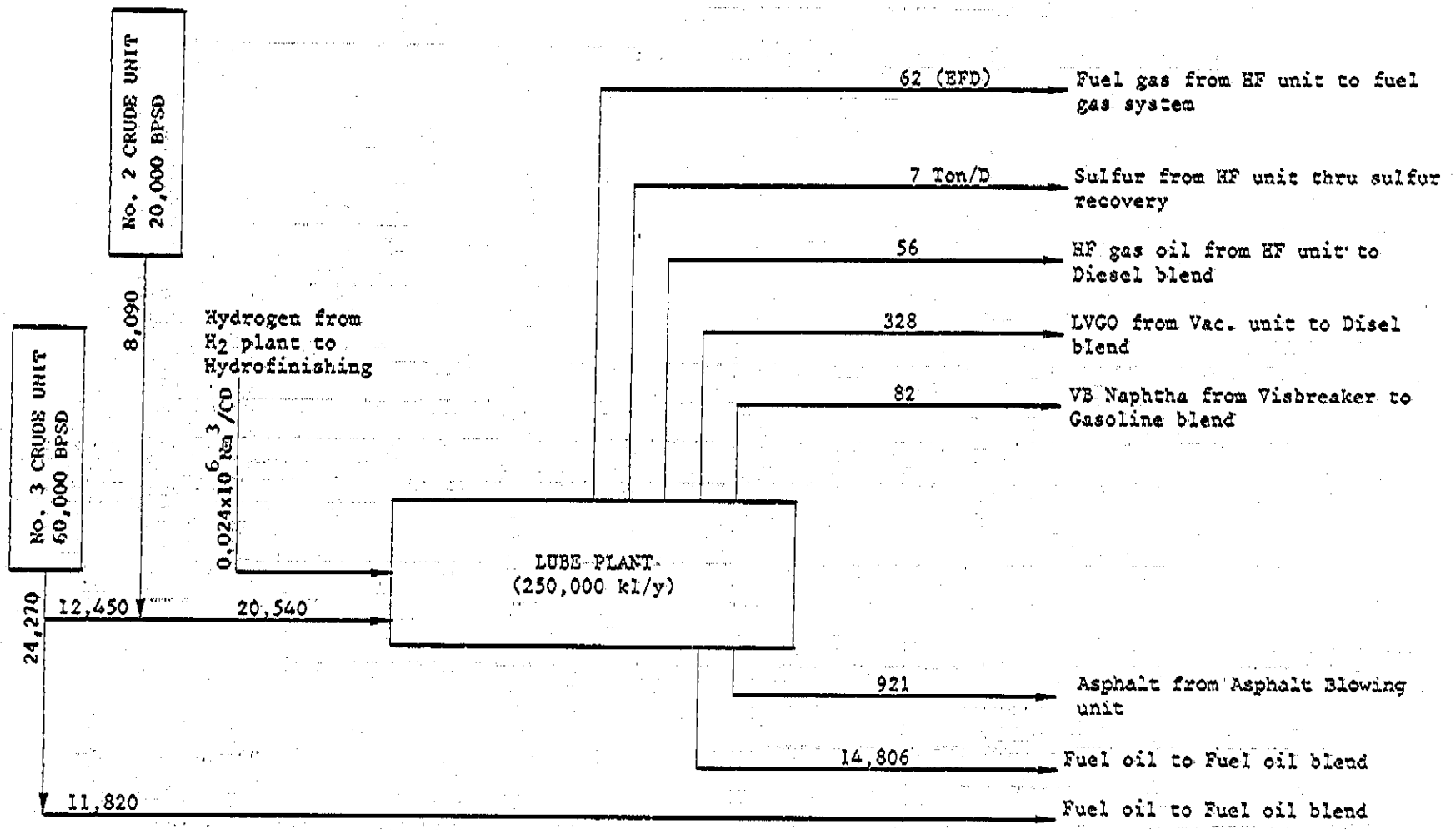


Figure III-11 SRI RACHA REFINERY COMBINATION BETWEEN LUBE COMPLEX AND FUEL REFINERY

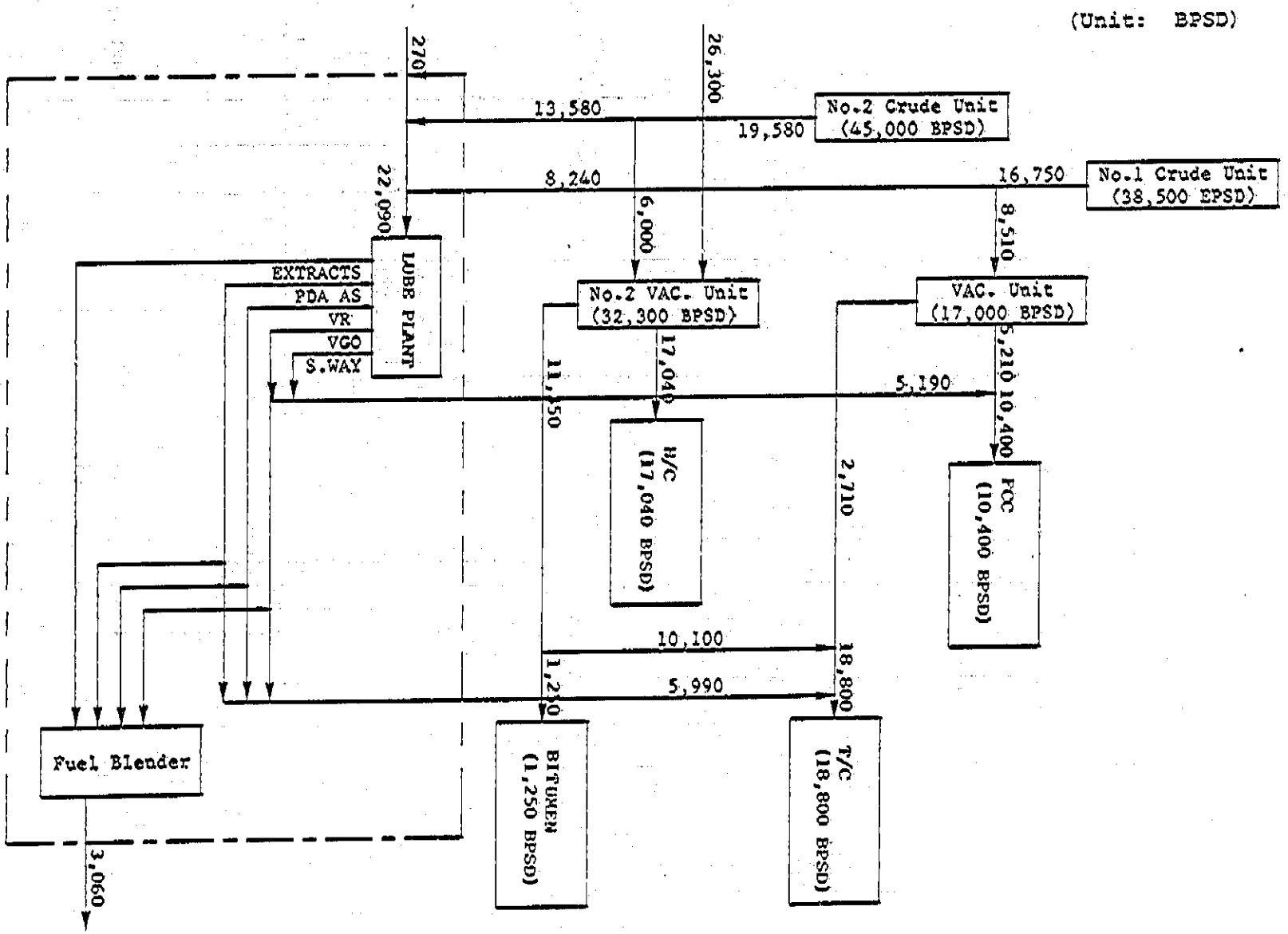


Figure III-12 SALABLE PRODUCTS FROM LUBE COMPLEX
(SRI RACHA CASE)

(Unit: BPCD)

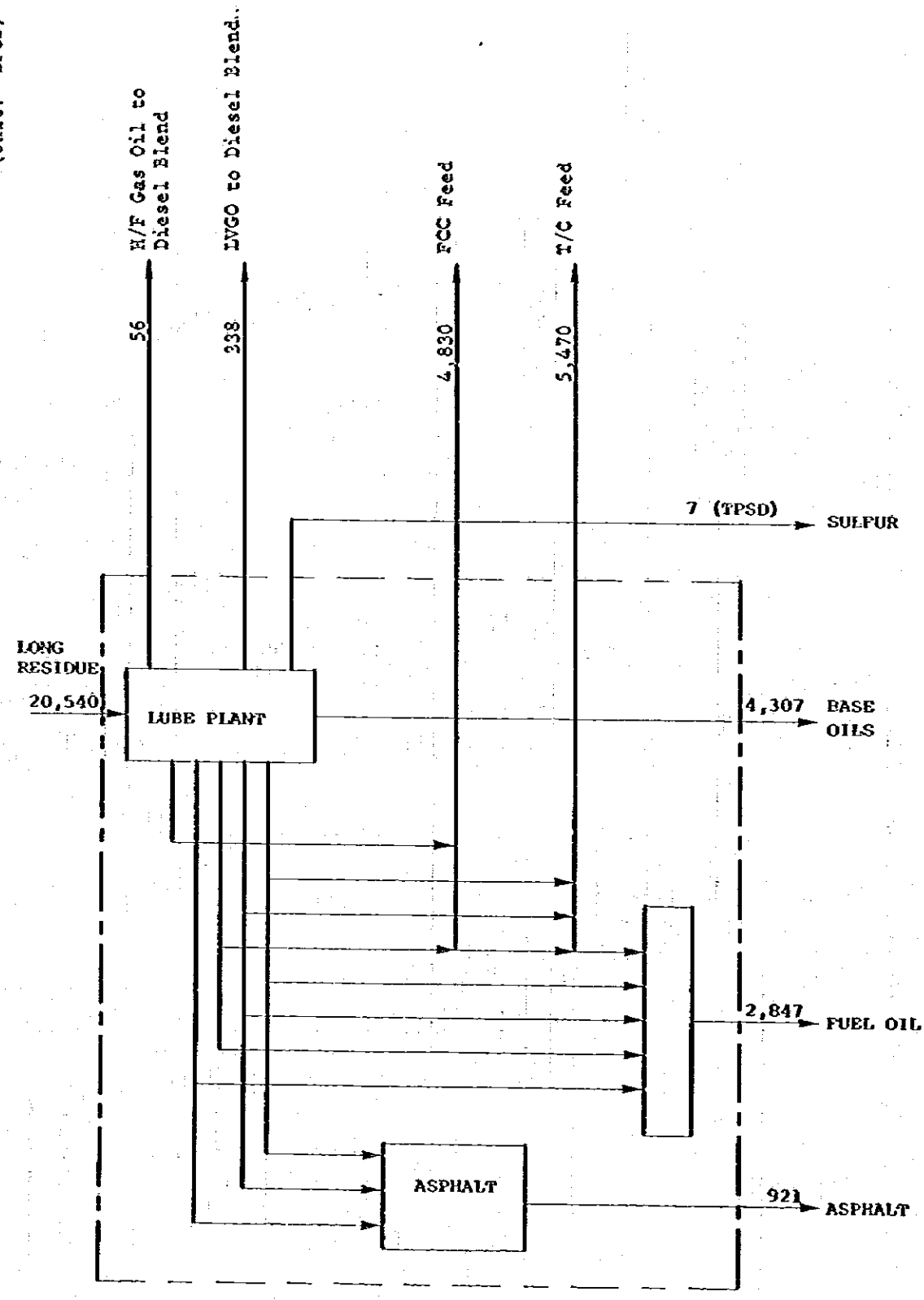


Figure III-13 RDC

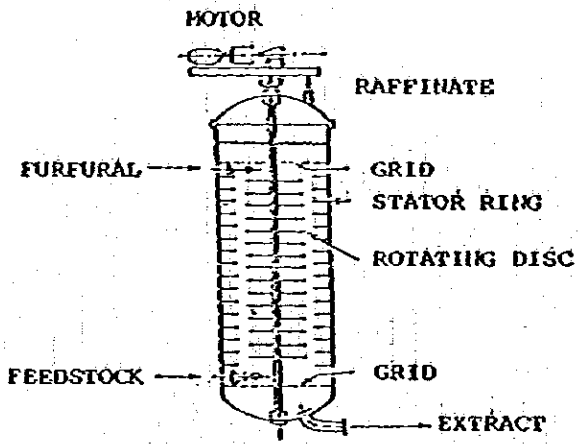


Figure III-14 ROTARY VACUUM FILTER

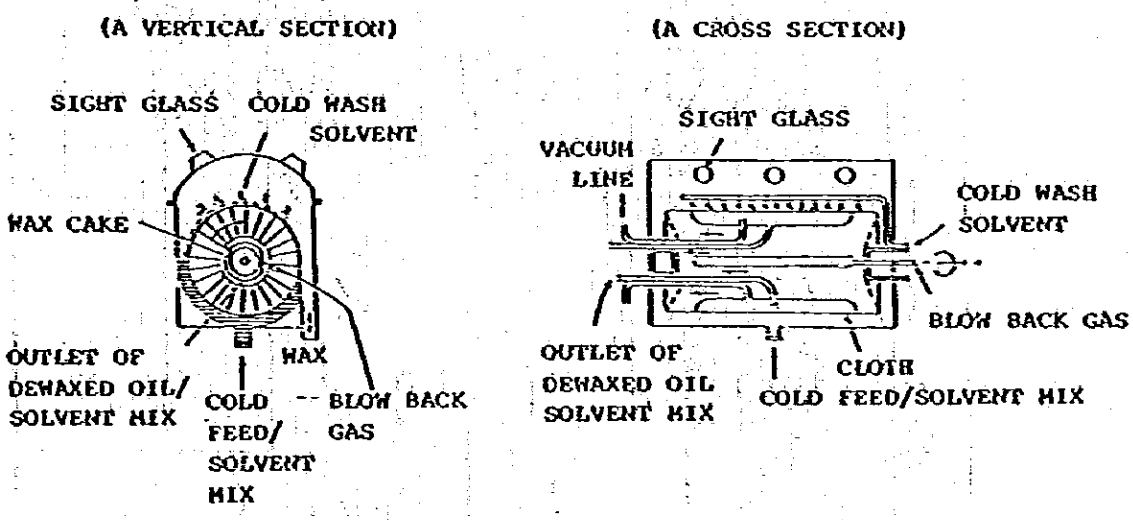


Figure III-15 TANK FLOW DIAGRAM
(BANGCHAK-A CASE)

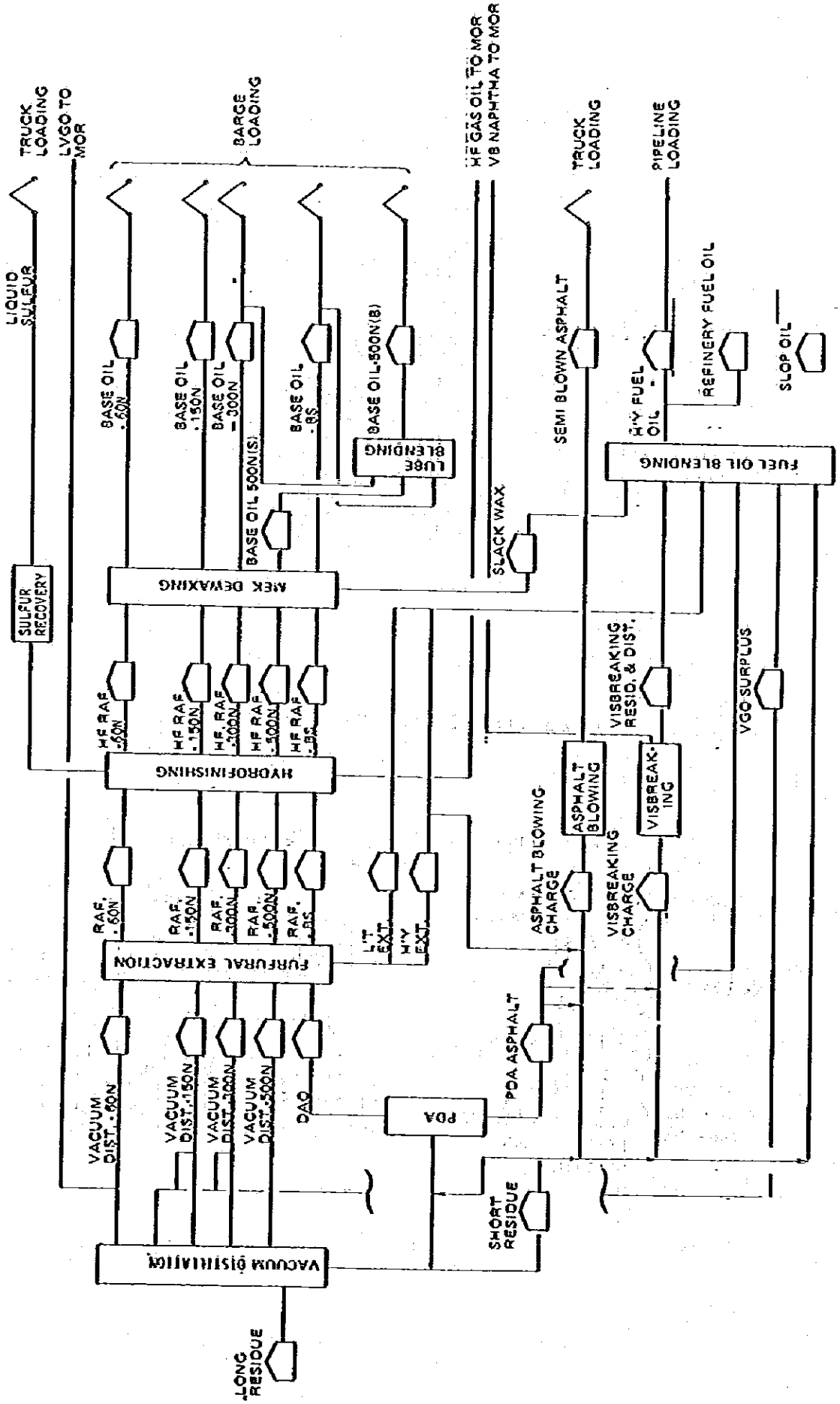


Figure III-16 TANK FLOW DIAGRAM
(SRI RACHA-A CASE)

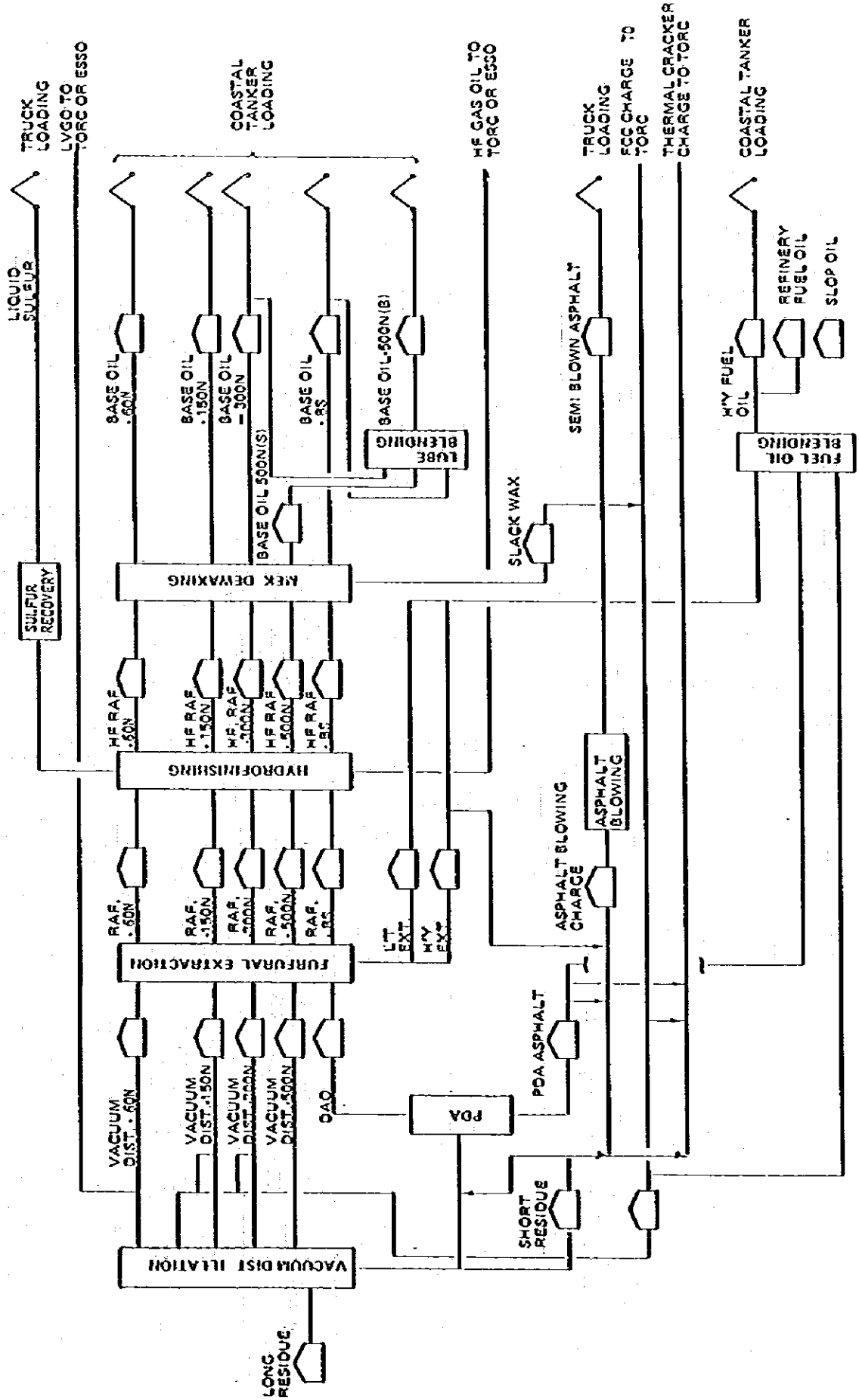


Figure III-17 WATER SYSTEM (Bagchak Case)

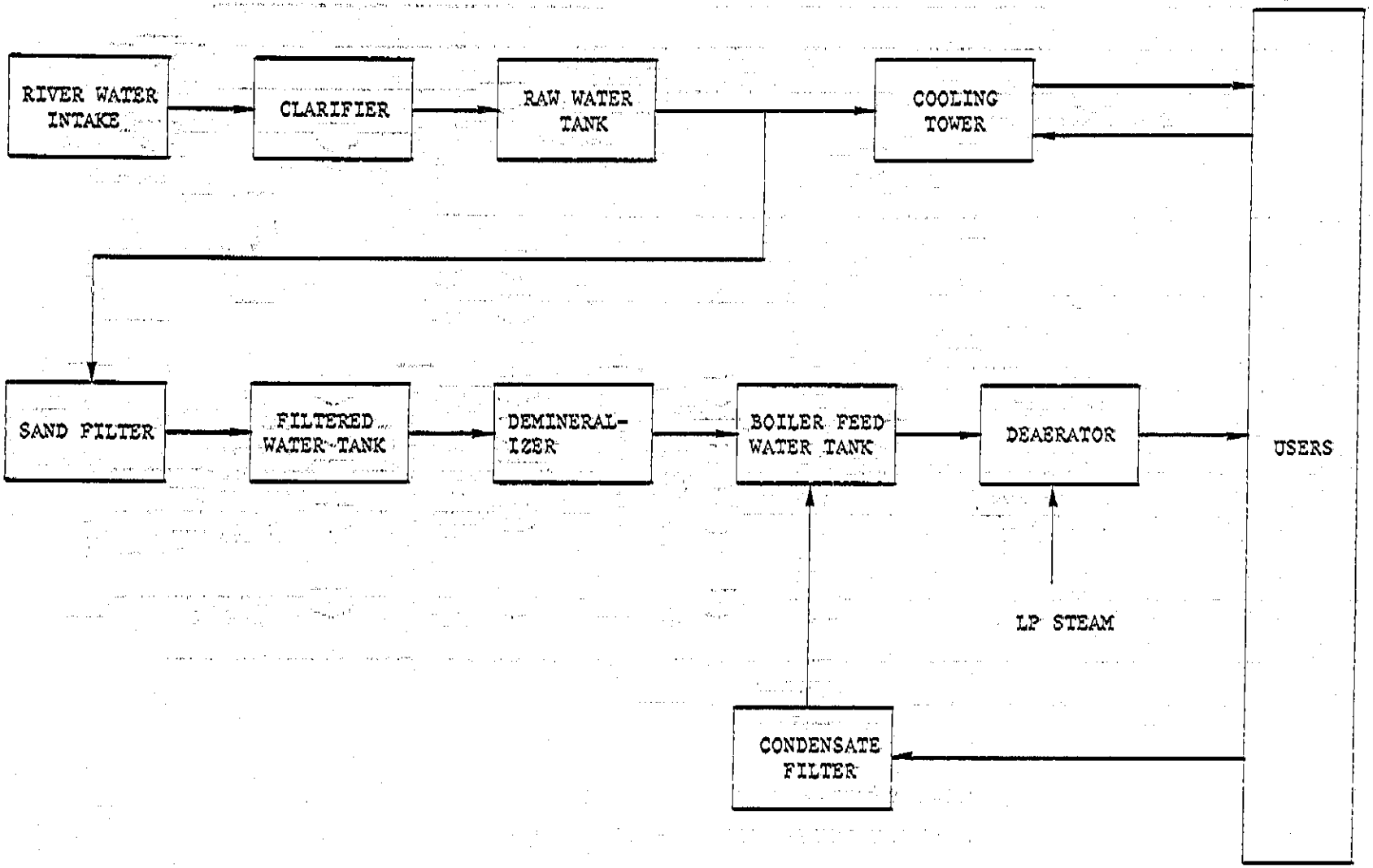


Figure III-18 WATER SYSTEM (Sri Racha Case)

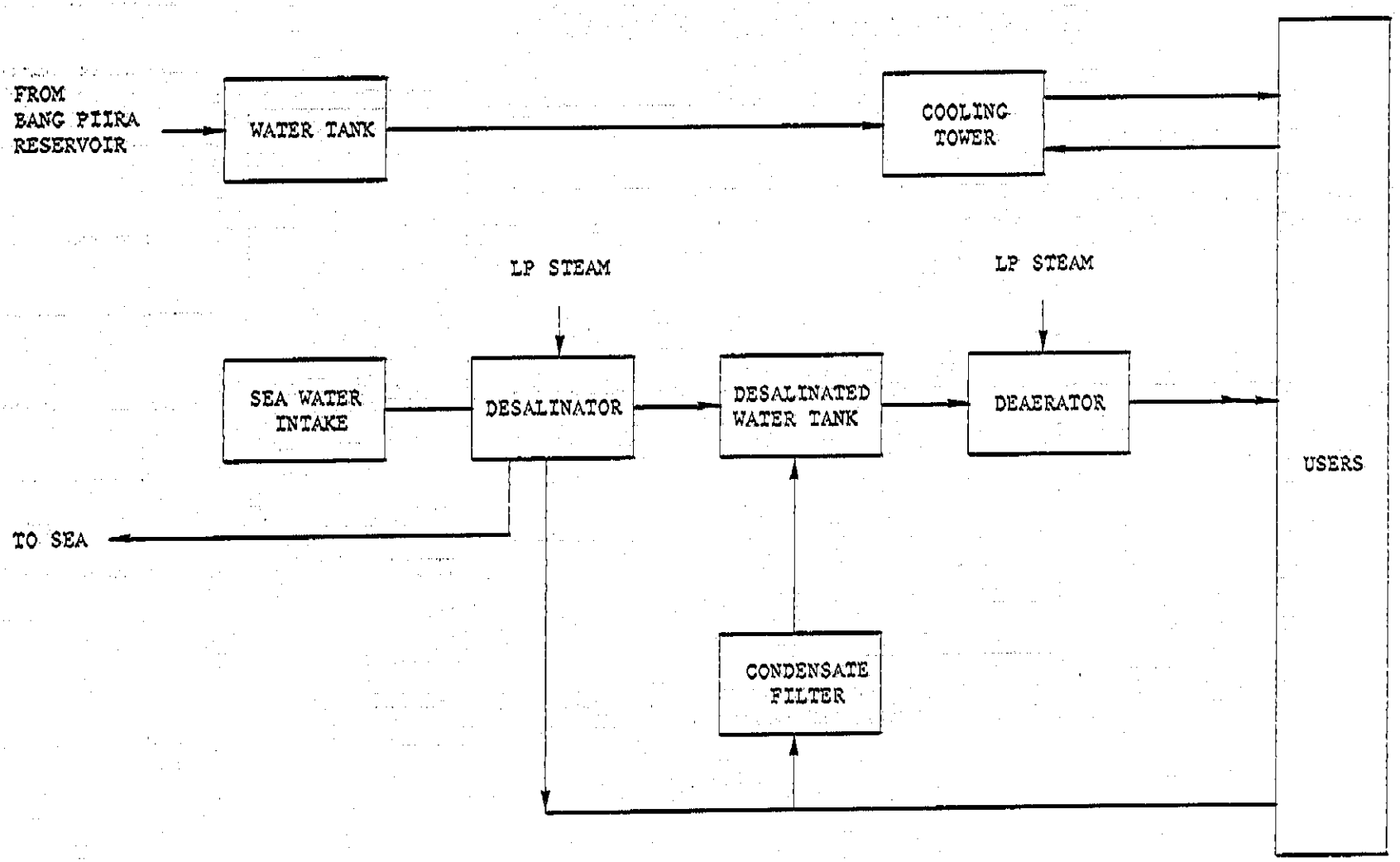
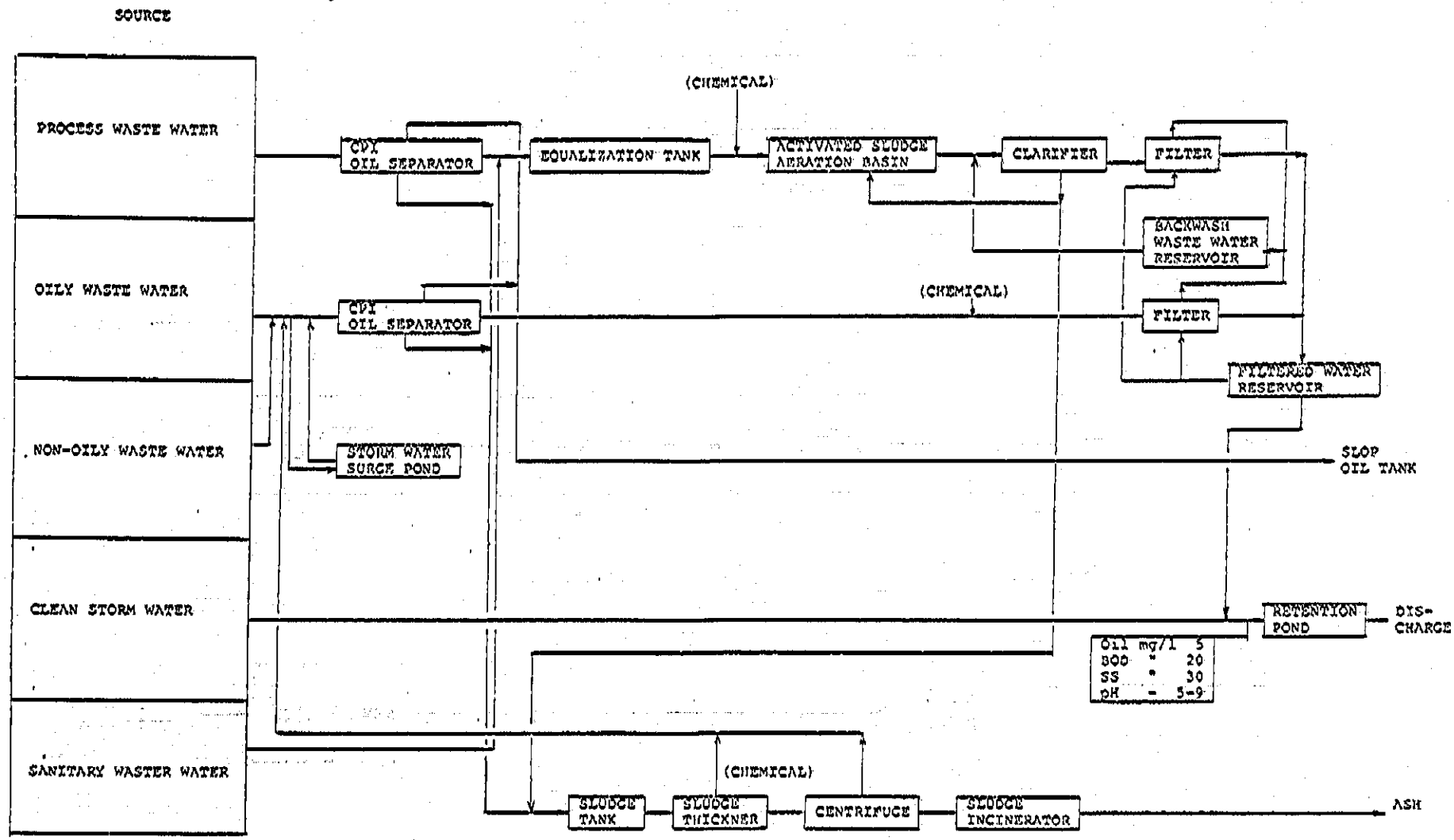
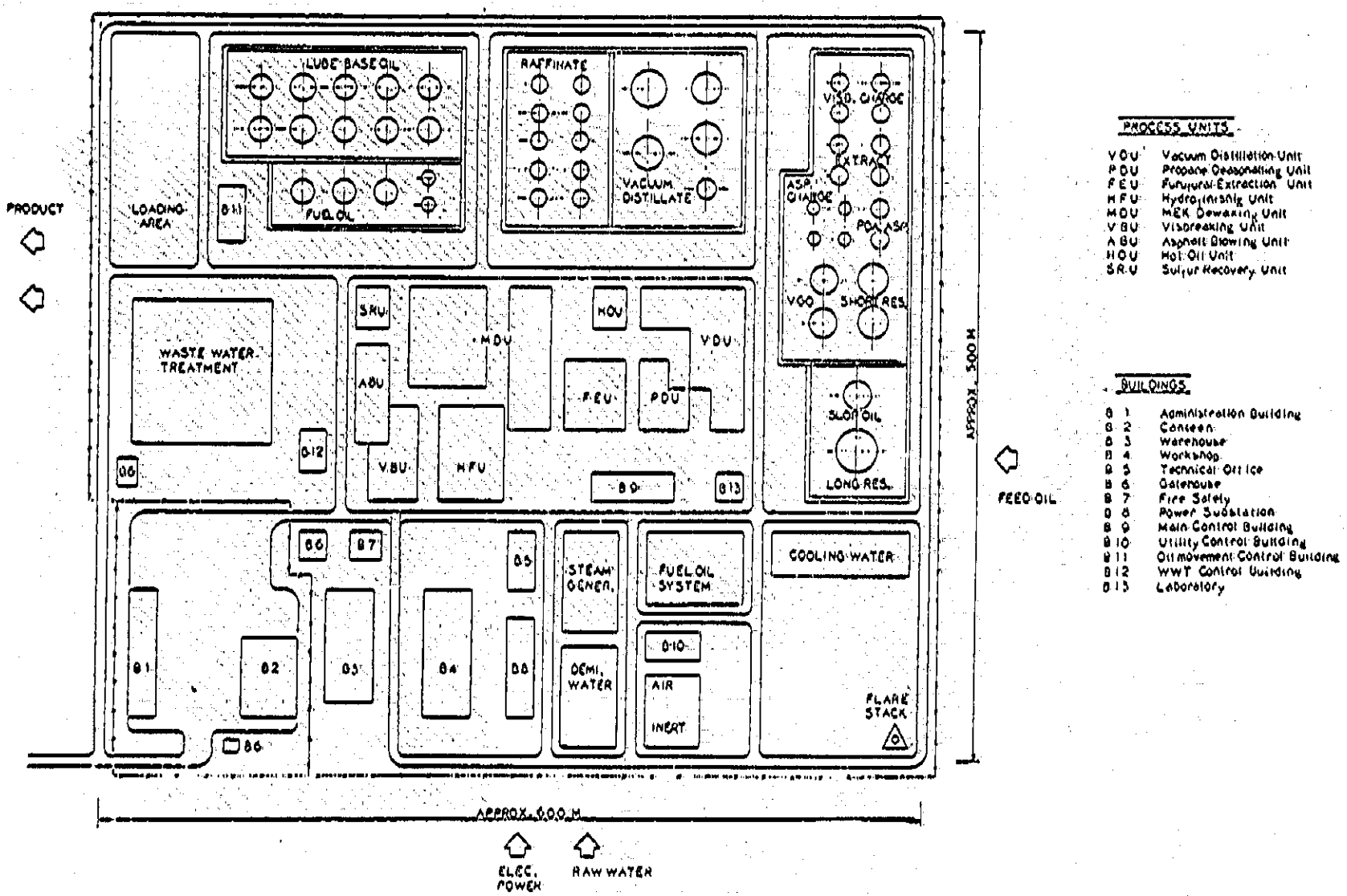


Figure III-19 BLOCK FLOW DIAGRAM OF WASTER EFFLUENT SYSTEM



Figuer III-20-1 GENERAL PLOT PLAN



PROCESS UNITS

VDU	Vacuum Distillation Unit
PDU	Propane Deasphalting Unit
FEU	Furfural Extraction Unit
HFU	Hydrofinishig Unit
MDU	MEK Dewaxing Unit
VBU	Visbreaking Unit
ABU	Asphalt Blowing Unit
HDU	Hot Oil Unit
SRU	Sulfur Recovery Unit

BUILDINGS

B 1	Administration Building
B 2	Canteen
B 3	Warehouse
B 4	Workshop
B 5	Technical Office
B 6	Gatehouse
B 7	Fire Safety
B 8	Power Substation
B 9	Main Control Building
B 10	Utility Control Building
B 11	Oil movement Control Building
B 12	WWT Control Building
B 13	Laboratory

Figure III-20-2 PLOT PLAN FOR LUBE OIL PLANT
(Bangchak-B)

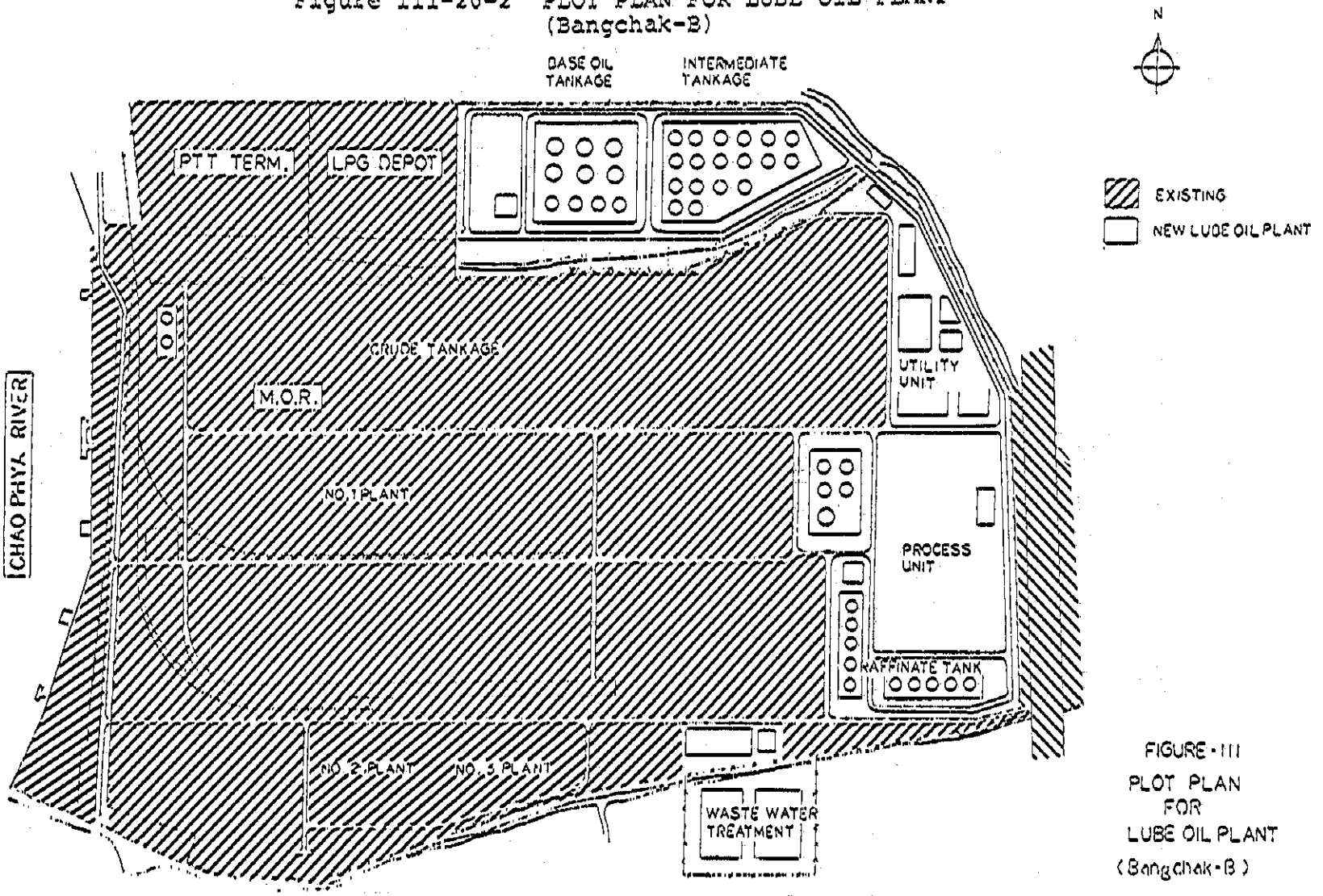


FIGURE - III
PLOT PLAN
FOR
LUBE OIL PLANT
(Bangchak-B)

Figure III-21 PROJECT CONSTRUCTION SCHEDULE OF THAI LUBE BASE OIL PROJECT

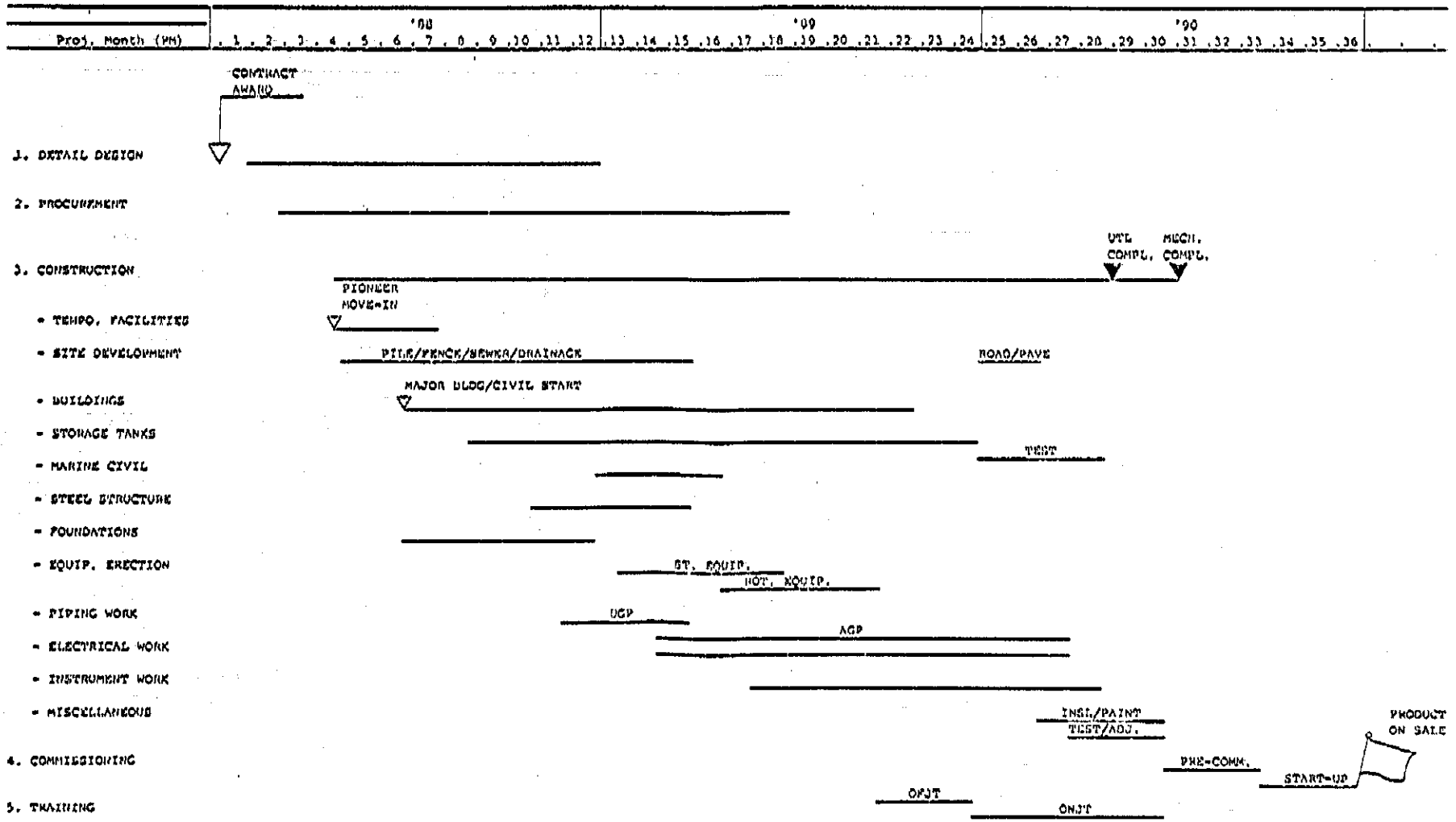
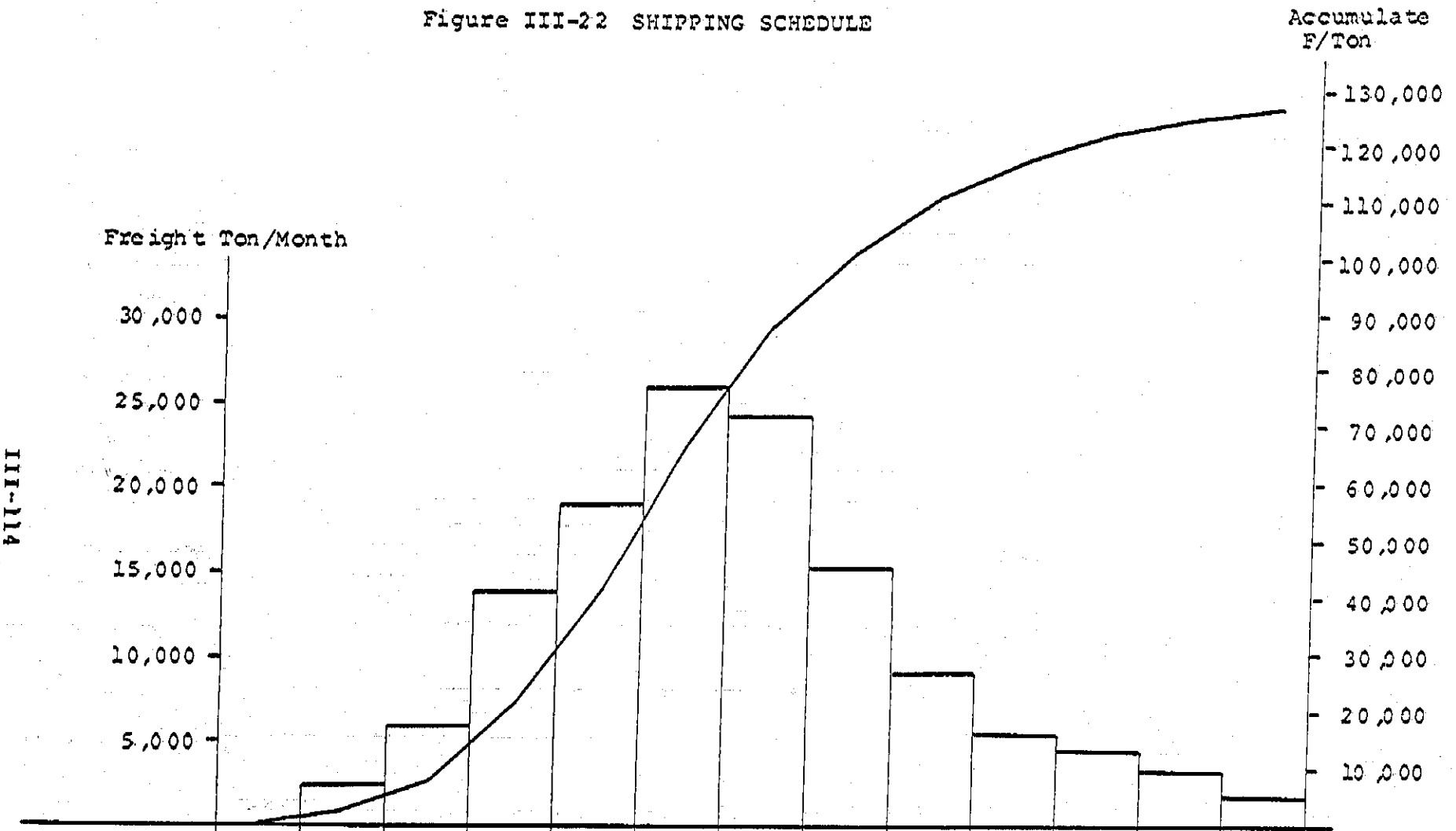
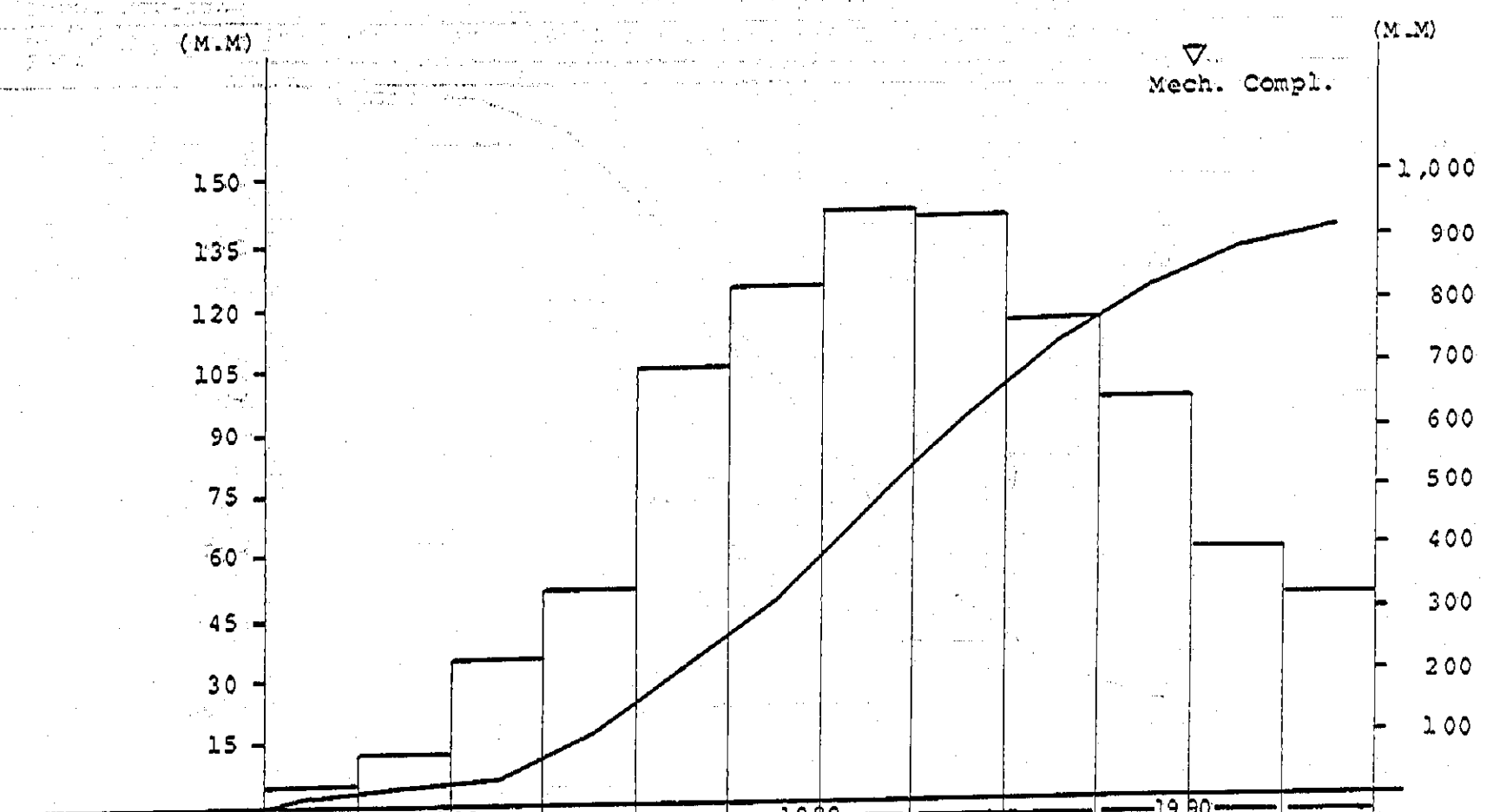


Figure III-22 SHIPPING SCHEDULE



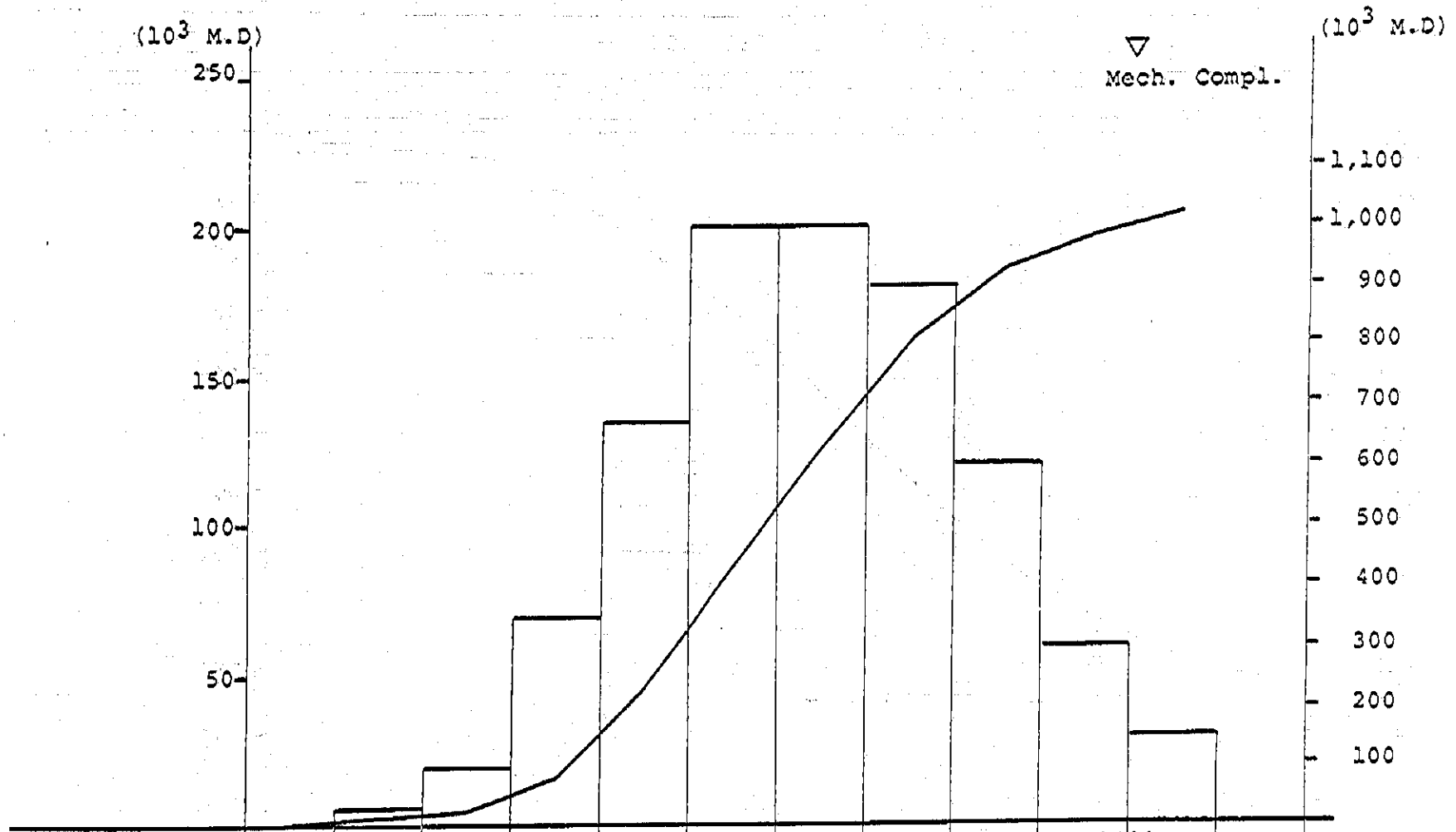
Month	1-2	3-4	5-6	7-8	9-10	11-12	13-14	15-16	17-18	19-20	21-22	23-24	25-26
1,000 Freight Ton/M	-	2.5	6.2	13.5	18.5	25.5	23.0	15.0	8.5	5.5	4.0	3.0	1.8
Accumulate 1,000 F/T	-	2.5	8.7	22.2	40.7	66.2	89.2	104.2	112.7	118.2	122.2	125.2	127.0

Figure III-23 CONSTRUCTION SUPERVISORY FORCE MOBILIZATION PLAN



Year / Month	1988 1-3	4-6	7-9	10-12	13-15	1989 16-18	19-21	22-24	25-27	1990 28-30	31-33	34-36	
Estimated M.M	3	9	36	54	105	123	141	138	117	96	60	48	930 M.M
Accumulate M.M	3	12	48	102	207	330	471	609	726	822	882	930	

Figure III-24 CONSTRUCTION LABOR MOBILIZATION PLAN



Year		1988				1989				1990		
Month	1-3	4-6	7-9	10-12	13-15	16-18	19-21	22-24	25-27	28-30	31-33	34-36
Labor Man-day 10^3 M.D/3M	-	5	20	70	135	200	200	180	120	60	30	-
Accumulate 10^3 M.D	-	5	25	95	230	430	630	810	930	990	1020	-

Figure III-25 HOME OFFICE ORGANIZATION

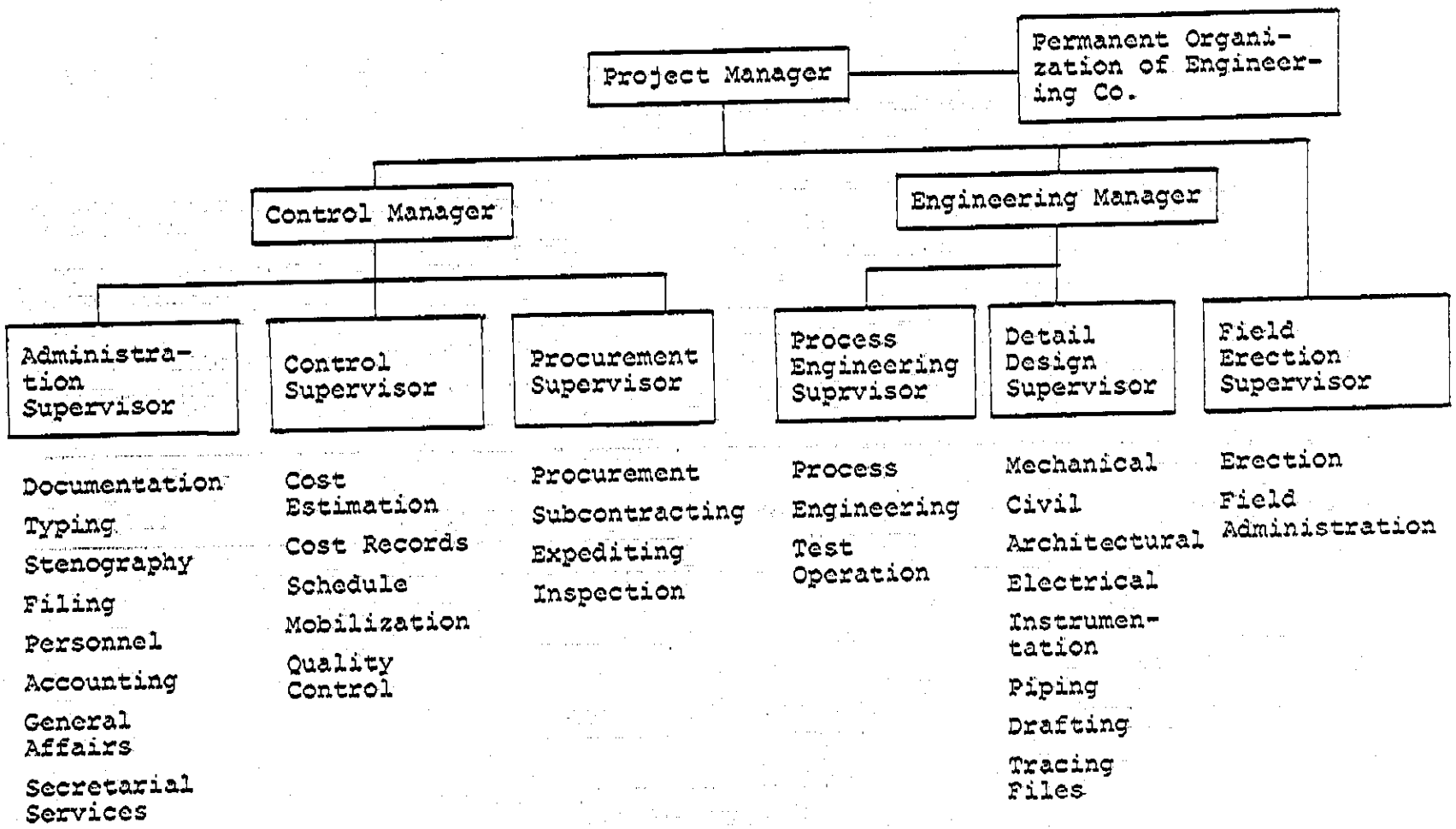
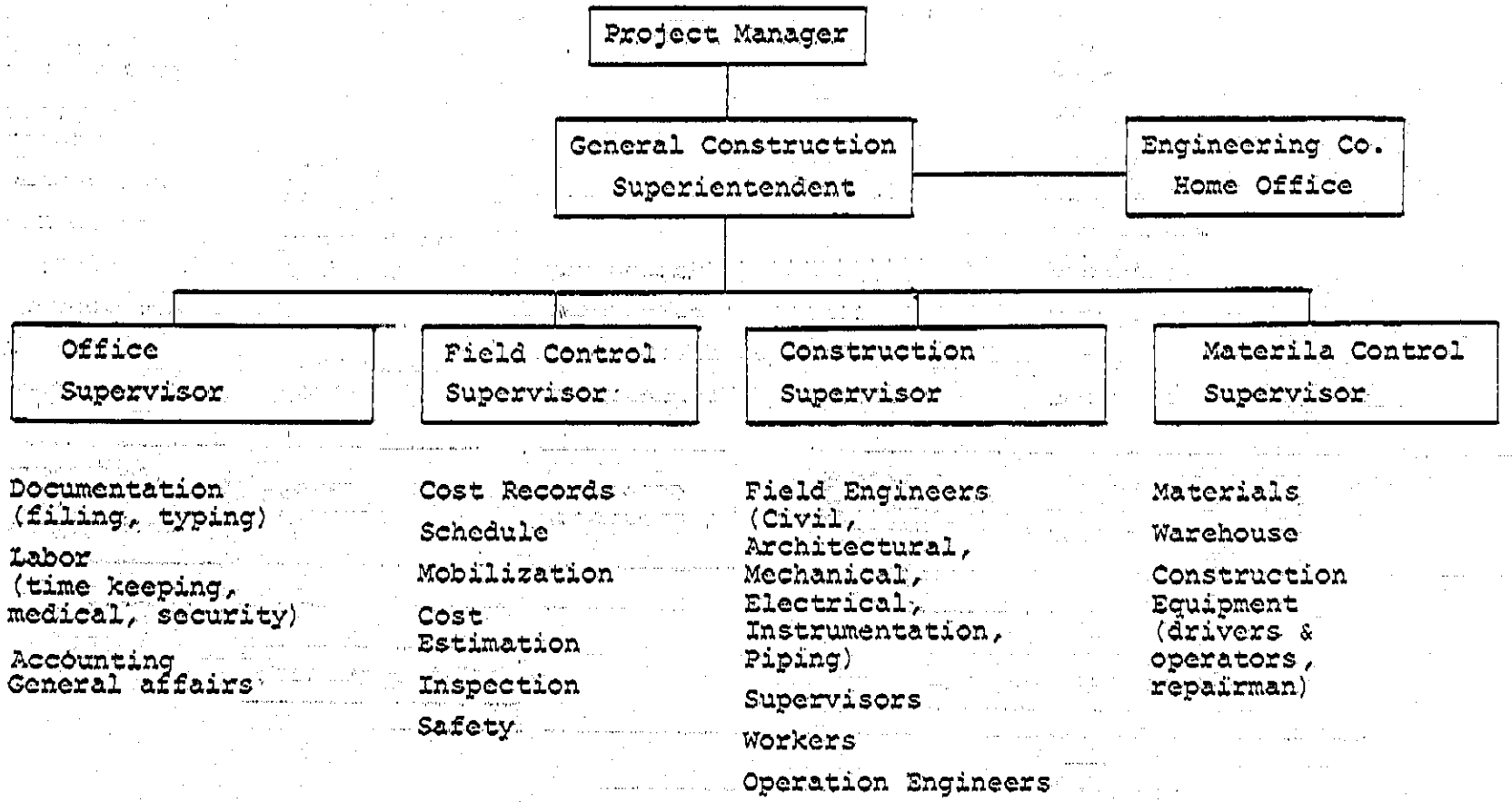


Figure III-26 FIELD ORGANIZATION



Part IV

PROJECT COST ESTIMATES AND FINANCIAL PLAN

Part IV PROJECT COST ESTIMATES AND FINANCING PLAN

Chapter 1 Project Cost Estimate

1-1 Major Assumption on Project Cost Estimation

In addition to the relevant conditions provided in the preceding Parts and Chapters, major assumptions for estimation of the project cost requirements are provided as follows:

1-1-1 Project Scheme Alternatives

Following five alternative schemes are selected for financial and economic analysis of which outline fre as specified in the Part III.

Case	Note
a. BANGCHAK-A	New Company
b. BANGCHAK-B	Expansion
c. SRI RACHA-A	New Company
d. SRI RACHA-B	Expansion
e. BANGCHAK-AX	New Company, Wax Production
f. BANGCHAK-AY	New Company, No Asphalt Production

1-1-2 Project Implementation Schedule

As a base for the study hereof, "PROJECT MASTER SCHEDULE FOR THAI LUBE BASE OIL PROJECT" (Figure IV-1) and "PROJECT CONSTRUCTION SCHEDULE OF THAI LUBE BASE OIL PROJECT" (Figure IV-2) attached hereto are assumed to be aplicable.

For realization of this project it is estimated to be required six to seven years from the beginning of the feasibility study up to the production of lube base oil.

One year of investment promotion activities could be omitted for the case of expansion of BANGCHAK and SRI RACHA .

The construction period of 36 months includes certain extent of extraordinary time allowance thus no further time contigency is required.

Further, for a "time of the essence" project it could be shortened by about 6 months from base schedule hereof, or more than that for a "crash schedule" project case. Major activities and key dates of the project are summarized as follows:

Project Implementation Schedule

	Activities	Duration (months)	Period From	Period To
1.	Feasibility Study and Project Appraisal	12 m	Jan. '84	Dec. '84
2.	Investment Promotion Activities	12 m	Jan. '85	Dec. '85
3.	Project Implementation Planning	6 m	Jan. '86	Jun. '86
4.	Basic Design & Engineering	6 m	Jul. '86	Dec. '86
5.	Tendering, Bidding and Contract to E.P.C Contractor	12 m	Jan. '87	Dec. '87
6.	Detail Design and Field Construction	30 m	Jan. '88	Jun. '90
7.	Pre-commissioning & Start-up	6 m	Jul. '90	Dec. '90
8.	Start of Commercial Operation	-	Jan. '91	
	Total	84 months (7 years)		

1-1-3 Currency and Exchange Rate

All costs, prices, fees and expenses related to this study are ultimately expressed in U.S. Dollars. Exchange rates to U.S. Dollars from other currencies applicable in this study are assumed as follows:

1.00 U.S. Dollar = 23 Thai Bahts
= 230 Japanese Yen

1-1-4 Price Escalation Factors

(1) General Assumption

Escalation factors applicable in this study throughout the end of the project life (i.e. 2010) are assumed to be maintained as nearly same level as an historical average through past twenty years (i.e. 1963-1983) in principle, regardless frequent fluctuations caused by change in economic circumstances. Average escalation of consumer price index in the major countries and area during past twenty years are as follows:

Thailand	6.6%
U.S.A.	6.2%
Japan	7.0%
G.F.R.	4.2%
Asia*	10.2%

* Weighted average of Asian countries except China

For the projection of price escalation rates after 1984, due to stagnant status of world economy in the recent years, price escalation for several years from now on are assumed to be kept lower level, then it may turn in up-trend to maintain average level in the long run. Price escalation in the recent years in the major countries are as follows.

Change in Consumer Prices 1978-1983

(Unit: %)

	Thailand	U.S.A.	Japan	G.F.R.	*) Asia (except China)
1978	8.7	7.7	3.8	2.7	5.6
1979	10.6	11.3	3.6	4.1	9.8
1980	19.7	13.5	8.0	5.5	15.9
1981	13.3	10.4	4.9	6.0	14.8
1982	5.3	6.2	2.6	5.3	9.9
1983	3.7	3.0	2.0	3.5	5.7
Average 1978-83	10.09	8.63	4.13	4.51	10.21
1963-83	6.59	6.11	6.93	4.18	10.21

Note: *) Weighted average of asian countries except China. Average of percentage changes for individual countries weighted by the average U.S. dollar value of their respective GNPs over the previous three years.

Source: World Economic Outlook, IMF (1983)
(OCCASIONAL PAPER 21)

(2) Escalation of General Foreign Currency Costs

The foreign currency costs involved in this project are mainly industrial outputs such as machinery, equipment, construction materials, industrial technologies, engineering services, chemicals, catalysts, and so on. Applicable escalation rates on such items are assumed on the basis of average value of exports by industrial countries. Change in unit value of exports by industrial countries are as follows.

Escalation in Recent Years

1978	5.7%
1979	11.9%
1980	11.9%
1981	6.3%
1982	3.3%
1983	3.0%

1963-1983 average: 5.76%
Source: World Economic Outlook (IMF-1983)

As is shown in the above figure comparing with the escalation rates of the consumer goods price which are dominated by domestic price level, price level of the industrial products are generally kept at lower level than that of consumer goods price level.

An assumed projection of escalation rates after 1984 and average escalation rate throughout the project life period are as follows.

1984	3.0%
1985	4.0%
1986	5.0%
1987 and onward	6.0%

Average (1984-2010): 5.78%

(3) Escalation of General Local Currency Costs

Local inflation, in principle, should follow international inflation trends, if local prices are assessed in terms of U.S. Dollars because such difference between local inflation and international inflation would be adjusted by devaluation or revaluation of foreign exchange rate when such unbalance is deemed to cause sufferings in national economic activities.

Nevertheless, in the country where local escalation of goods is generally higher than that of international level and where devaluation of local currency is neither enforced frequently nor timely because of fixed rate system, project budget for local currency portion which is estimated in terms of foreign currency subject to international escalation often cause budgetary deficit because of time lugs in adjustment for equilibrium of currency value. In such a case, therefore, an adequate adjustment or supplement in applicable escalation rate or in physical contingency may be required depending upon the foreign exchange control system in such country.

The past price escalation in Thailand has been kept lower among the asian countries, and its average escalation rate (consumer price) through past twenty years was 6.59 percent per annum in U.S. Dollar term.

Taking into account the above considerations, price escalation rates applicable to general local currency cost items are assumed as follows.

1984	3.5%
1985	4.5%
1986	5.5%
1987 and onward	7.0%

Average (1984-2010): 6.62%

(4) Escalation of Specific Items for the Project

1) Petroleum products and intermediates

Following petroleum products which are derived from the lube base oil refining plant and raw material (long residue) thereto are assumed to be escalated according to the linear equation formular with international crude oil price as variable. (See Chapter 4 of Part-II)

a. Long residue
b. Fuel oil
c. Asphalt
d. L.V.G.O.
e. V/B naphtha
f. FCC feeds
g. T/C feeds

2) Lube base oil

The lube base oil is assumed to be escalated according to the similar formular as other products as above 1) but with an additional variable cost element of ocean freight from Singapore to Bangkok which is assumed to be escalated by six percent (6%) per annum.

3) Sulfur

Sulfur price is assumed to be escalated according to international escalation rate in export trade market where five percent (5%) of escalation rate is applicable from 1984 through 1986 and six percent (6%) after 1987 through project life.

4) Wax

Refined wax price is assumed to be escalated according to the escalation rates for foreign currency cost in (2) hereabove.

(5) Deflator

Annual GNP deflators of the major countries and areas in the recent years and average in the past twenty years are as follows:

(Unit: %)

	Asia (excl. China)	Non-oil Developing Countries	U.S.A.	Japan	All Industrial Countries
1978	7.9	6.7	7.4	4.6	7.6
1979	3.3	6.1	8.6	2.6	8.0
1980	3.4	5.4	9.3	2.8	9.0
1981	5.8	5.4	9.4	2.6	8.6
1982	3.7	3.9	6.0	2.0	7.2
1983	4.9	4.6	4.1	1.7	5.6
Average 1978-83	4.82	5.35	7.45	2.71	7.66
1963-83	4.86	*5.05	5.53	5.48	6.42

Note: *Average of past 16 years (1968-1983)

Source: I.M.F.

An average deflator to be applicable for this project study is assumed to be an arbitral figure considering the general situation of Thailand in Asia, its past escalation rates, cost composition of this project, etc., as follows:

Year	Deflator (%)
1984	4.5
1985	4.5
1986	4.5
1987	5.0
1988 and onwards	5.0

Average (1984-2010): 4.94

1-1-5 Base Date for Project Cost Estimation

Estimation of the project costs are made on the base date of March 31, 1984. All costs obtained during this study are adjusted to the base date (called "Base Costs"), and they are escalated through each assumed disbursement time using escalation rates specified in paragraph 1-1-4

hereabove. The estimated incremental amounts by such escalation are called "price contingency".

In case the project implementation schedule is caused to be changed, therefore, estimated project cost could be re-adjusted in the same manner.

1-1-6 Physical Contingency

The physical contingency reflects expected price increases in the Base Cost Estimates, due to changes in quantities and methods of implementation judged necessary to take into account, as being caused by uncertainties related to the site conditions and other design bases, as well as the degree of precision applied in the estimation hereof.

(1) Method and Accuracy of Cost Estimate

An accuracy of plant construction cost estimation in this study will fall between:

σ +20% of the plant cost
σ -10% of the plant cost

The plant construction cost estimates are made based on experience in similar projects including number of similar type lube oil projects executed in Japan and abroad.

Price information on major machinery and equipment are adjusted in supply scope and updated according to the current price level in FOB Japanese port basis.

Miscellaneous supplies including bulk materials are estimated using factors practiced in the previous projects.

The field construction cost factors are modified with due attention of the local conditions in Thailand, especially on labor wages, labor quality and availability of local contractors.

(2) Rate of Physical Contingency

The expected accuracy of the estimates mentioned above is critical in determining the magnitude of the contingency.

The factors that may affect the magnitude of the contingency are:

- cost allowance for estimating techniques
- resource provision for unknown elements
- cost provision for items not specifically defined but which are known to be required to complete the work.

Assuming the accuracy of cost estimates hereabove, ten percent (10%) of physical contingency is estimated to be applicable.

1-1-7 Type of Contracts for Project Implementation

(1) Lump-sum Contract

It is basically understood that competitive lump-sum fixed contract will be the best way for this project since this type of project is technologically well established in the world and the competitive lump-sum contract may ultimately result in the lowest price for the project implementation.

Instead, cost-plus contract may require much manpower which will cause more project burdens mainly in terms of cost due to complicated responsible procedures for project management among parties involved.

(2) E.P.C Main Contract

Because it is well-established design, definition of the scope of work is not so difficult, therefore, it is evaluated that there is no incentive to employ Managing Contractor who fulfills both basic design and E.P.C contract.

Accordingly it is assumed that major contracts will be divided into the basic design contract and the E.P.C main contracts which should be performed by independent parties.

The types of major contracts of this project are summarized in Table IV-1.

1-1-8 Taxes and Duties

(1) Kind of Taxes and Duties

A. Stamp Duty
B. Contractor's Corporate Income Tax
C. Business Tax
D. Municipal Tax
E. Profit Remittance Tax
F. Import Duty
G. Personal Income Tax

(2) Assessment of Taxes and Duties

A. Stamp duty

One tenth percent (0.1%) on gross contract amount and four tenth percent (0.4% or 1/250) on insurance contract are taxed as stamp duty.

B. Contractor's corporate income tax

Contractor's corporate income tax will be imposed against declaration of profit or on the assessed profit level. For convenience of tax calculation in the study, corporate income tax is assumed to be imposed on the assessed profit basis, as follows.

Assessed Profit: 12.5% x Contract Amount
Corporate Income Tax: 12.5% x 40% = 5%

C. Business tax

Three percent (3%) of business tax on the gross contract amount excluding imported goods is imposed. Other rates of business tax rate are applied according to the REVENUE CODE (1983) and TARIFF CODE AND BUSINESS TAX (1983).

D. Municipal tax:

Ten percent (10%) of the business tax amount is imposed as municipal tax.

E. Profit remittance tax (on foreign contract)

Profit remittance tax is calculated as follows.

(12.5% - 5%) x 20/120 = 1.25%
(on amount of foreign contract)

F. Import duty

Import duties on imported equipment and materials are levied by ad-valorem percent on CIF value or by unit amount per volume.

Further for the imported equipment and materials are simultaneously levied by business tax and municipal tax of which tax rates are defferent depending on the items as specified in TARIFF CODE book.

For the purpose of this study, average taxes and duties on imported equipment and materials is assumed to be levied by thirty percent (30%) as assessed as follows.

Import duty

Average rate: 20% on CIF value

Business tax

Average standard profit: 11%
Average rate of business tax: 7%
Estimated tax: 9.3%
(1.2 + 1.2 x 0.11) x 0.07 = 0.09324

Municipal tax

(Business tax x 10%): 0.93%

Total taxes: 30.3% ≒ 30%

G. Personal income tax

All persons being involved in this project under the contract and agreement including expatriates who stay in Thailand more than six (6) months in aggregate through the tax year are liable to taxation of personal income tax.

Since unit local labor costs used for the base cost estimate herein are considered to be gross wage including personal

income tax, only duplicated tax payments by expatriated engineers are to be estimated supplementarily. Estimated tax level which is calculated on the other similar case is twelve percent (12%) on the advisory contract and four percent (4%) on the net amount of foreign currency portion of construction service.

1-2 Base Cost Estimate

Base Cost Estimate (B.C.E.) which is estimated on the basis of "base date" consist of following free cost items.

A. Land Acquisition and Site Preparation Costs
B. Plant Construction Cost
C. Pre-operational Expenses

Other two cost items as follows required for the project are estimated on 1990 basis including price contingency.

D. Initial Working Capital
E. Interest during Construction

Specific assumptions on estimation of above costs are as follows.

1-2-1 Land Acquisition and Site Preparation Costs

As it is assumed in Chapter 5 of Part-III, candidated project sites are limited to three i.e. Bangchak-MOR Refinery site, Sri Racha-TORC Refinery site and Sri Racha-Esso Refinery site. However, due to the same conditions of the location of two refineries of TORC and Esso (Sri Racha), those two cases are represented by "Sri Racha" case. Estimated base costs for acquisition of each project site and for preparation thereof are as follows.

Case	Land Area Requirement (m^2)	Base Cost Estimate: Land Acquisition Cost ('000 US$)	Site Preparation Cost ('000 US$)	Physical Contingency ('000 US$)	B.C.E. Total ('000 US$)
BANGCHAK-A	350,000	2,739	4,565	730	8,034
BANGCHAK-B	310,000	783*)	4,043	483	5,309
SRI RACHA-A	350,000	2,739	783	352	3,874
SRI RACHA-B	300,000	2,348	652	300	3,300
BANGCHAK-AX	400,000	3,130	5,217	835	9,182
BANGCHAK-AY	350,000	2,739	4,565	730	8,034

Note: *) This price represents for 100,000m^2 of land to be purchased outside the Bangchak Refinery while 210,000m^2 of land is to be secured within Bangchak Refinery site.

1-2-2 Plant Construction Cost

Table IV-2 show the base cost estimates excluding taxes and duties. Thirty percent (30%) of import duties are estimated on the values of imported equipment & materials, spare parts, catalyst & chemicals and ocean freight. Other various taxes including stamp duty, contractor's corporate income tax, business tax, municipal tax, etc. are assumed to be 6.45 percent on all items.

1-2-3 Pre-operational Expenses including Start-up Expenses

The pre-operational expenses include various direct expenses required for owner's undertakings throughout the project implementation stage, such as:

a. Project promotion and planning expenses
b. Administrative overhead including office supplies
c. Technical advisory fees and expenses
d. Training fees and expenses
e. Loss in test run
f. Institutional expenses
g. Physical contingencies
h. Taxes and Levies

(1) Project Promotion and Planning Expenses

This cost item consists mainly employees salary and other personnel costs including expatriates' remuneration. Disbursement schedule of this item is assumed to be started upon the time when the pilot company may be registered (for new company case) or when the project team may be organized (in case of additional investment by existing company). Personnel costs for newly recruited operator's and factory staff are also included in this item according to their grodual recruiting schedule.

(2) Administrative Overhead including Office Supplies

This cost item includes rental fee of office space (for new company case), office supplies, costs and expenses for overhead personnel, etc.

(3) Technical Advisory Fees and Expenses

This cost item is for expatriated professional consulting engineers who will be employed to assist owner as owner's engineers during implementation stage of the project. They will be organized in the owner's project team to supplement owner's own activities, particularly in the area of technical aspect.

(4) Training fees and expenses

This expenses are required in the later stage of construction period to train operators for the constructed plant. Training program will be prepared by process owner and contractor. Two types of training i.e. training at similar plant in abroad and on the job training at construction site will be prepared for trainees depending on the class of technical level and expected position in the new organization.

(5) Loss in Test Operation

This costs covers loss of utilities and relevant consumables to be required for test run period. It is assumed that expected test run period is three months, and loss of such utilities and consumables are equivalent to two month operation at full load capacity. No products output is assumed to be produced during the test run.

(6) Institutional Expenses

This expenses covers governmental formalities for permits, licence, registration, etc. including legal transactions.

(7) Phisical Contingencies

Ten percent (10%) of physical contingencies is estimated to cover unforeseen costs and expenses other than those estimated hereabove.

(8) Taxes and Levies

Expected taxes and levies on each cost and expenses are estimated on items.

Summary of pre-operational expenses base estimates and disbursement schedule are as per Table IV-3 and Table IV-4.

1-2-4 Initial Working Capital

Initial working capital is estimated on the following items:

a. Inventories of raw materials, semi-processed materials, intermediate products, and products.

b. Inventories of consumables including chemicals and catalyst.

c. Account receivable minus account payable

For convenience of estimation of above cost items, escalated prices instead of costs in the base year (i.e. 1984) are applied hereto.

Estimated initial working capital at 1990 basis are as follows, and of which details are as per Table IV-4, IV-5, IV-6, IV-7 and IV-8.

Initial Working Capital

('000 US$)

Case	Foreign Currency	Local Currency	Total
Bangchak-A	167	24,447	24,614
Bangchak-B	167	22,731	22,898
Sri Racha-A	162	23,508	23,670
Sri Racha-B	162	21,771	21,933
Bangchak-AX	167	25,430	25,597
Bangchak-AY	167	24,355	24,522

1-2-5 Interest during Construction

Interest during construction is calculated on the debt portion of disbursed capital expenditures in each year for the period from such disbursement time through the end of 1990. Debt portion of each disbursement is assumed to be sixty percent (60%). The capital disbursement schedule for interest calculation is prepared as base cost estimates plus price contingency through such expected disbursement time. Interest rate on the long-term loan is assumed to be eight percent (8%) per annum. Interest during construction calculated as above are as follows:

Case	Interest During Construction ('000 US$)
Bangchak-A	29,431
Bangchak-B	25,946
Sri Racha-A	28,499
Sri Racha-B	24,763
Bangchak-AX	32,962
Bangchak-AY	29,503

1-2-6 Estimated Total Project Cost

Total project cost including price contingency for each alternative case are as per Table IV-9, and its details are as per Table IV-10, IV-11, IV-12, IV-13, IV-14 and IV-15.

Chapter 2 Financing Plan

The total project cost estimated in the preceding chapter is assumed to be financed according to the following conditions.

2-1 Debt-Equity Ratio

The debt-equity ratio on total project cost is 60%:40% where the capital in debt is financed by foreign financing institutions with long-term loan.

Pay-in schedule for equity capital and borrowing schedule of long-term loan are in accordance with expected capital disbursement schedule (see Table IV-10 through 15) comprising forty percent (40%) and sixty percent (60%) respectively thereof.

2-2 Financing Terms on Long-Term Loan

Although the finance sources for the long-term loan requirements are indefinite it is assumed that the loan will be financed by certain international financing institutions in the form of suppliers' credit or in the other form of loans.

For the purpose of this study, the following financing terms commonly offered by Japanese contractors in the form of suppliers' credit with the Export and Import Bank of Japan are applied.

(1) Loan Repayment Schedule:

Loan principal is to be repaid in equally divided 10 annual installments of which first due comes at the end of first operating year of the project.

(2) Grace Period:

Full construction period (i.e. 3 years)

(3) Interest Rate:

Eight percent (8%) per annum

2-3 Financing Terms on Short Term Loan

When annual money flow is caused being deficient during the operating period of the project, short term loan by local financiers is assumed to be made at an annual interest rate of fifteen percent (15%).

Chapter 3 Project Operating Plan

3-1 Major Assumptions

3-1-1 Management and Organization

For the case of "A" including Bangchak-A, AX, AY and Sri Racha-A, management of the project is done by newly established organization, while only additional staff are employed under the existing organization for the case of "B" (i.e., Bangchak-B, Sri Racha-B).

Number of staff particularly employed for this project are as follows:

	Bangchak		Sri-Racha		Bangchak	
Department	A	B	A	B	AX	AY
Management	12	1	12	1	12	12
General Affairs	58	33	58	33	58	58
Technical Service	34	24	34	24	34	34
Maintenance	52	35	52	35	52	52
Production	138	138	138	138	160	138
Total	294	231	294	231	316	294

Anticipated organization for Case "A" and "B" is as per Figures IV-3, IV-4, IV-5, IV-6 and IV-7 attached hereto.

3-1-2 Delivery and Payment Terms on Supplies and Products

Long residue as the main raw material for the project is supplied from the petroleum refining plant adjacent to the lube base oil plant, while various intermediates such as LVGO, HFGO, V/B naphtha, etc. are fed back to the petroleum refining plant.

In the case of alternative "A" where lube base oil plant is operated by an independent company, such exchange of goods are commercially dealt between the parties, while in the case of "B" such exchange of goods

between two plants are free from commercial obligations though nominal prices of such items are assumed only for the convenience of this study.

Transportation of the products from the project is assumed to be made as follows:

Product	Bangchak Case	Sri Racha Case
Base Oil	River Barge (1,000 DWt)	Coastal Tanker (1,000 DWt)
Fuel Oil	Pipeline (to Power Station)	Coastal Tanker (1,000 DWt)
Asphalt, Sulfur	Tank Lorry	Tank Lorry
Wax	Truck	N.A.

Delivery term for sale of all products is at ex-refinery basis.

Payment term of the sale of all products, raw materials and intermediates, if applicable, is thirty (30) days sight payment after delivery.

All of other supplies including utilities and imported goods also are assumed to be dealt with the same condition as above.

3-1-3 Operation System and Standard Operating Days

Operation of the lube base oil plant is assumed to be made under three-shift continuous operation system. Annual operating days for design basis is 340 days per annum.

3-2 Production, Inventory and Revenue Schedule

3-2-1 Production Schedule

(1) Production Capacity

Designed production capacity of product outputs are as shown in Table IV-16.

(2) Capacity Utilization Schedule

Subject to the demand projection of lube oil in Thailand studied in Part II, capacity utilization rates are assumed to be achieved according to the following schedule.

1991	80%
1992	90%
1993	95%
1994	100%

3-2-2 Inventory Schedule

Inventory of the raw material, consumables and products is assumed as per Table IV-17 and Table IV-18.

3-2-3 Selling Price of the Products

(1) Lube Base Oil

Based on the CIF Bangkok price of the lube base oil imported from Singapore as projected in Chapter 4 of Part II hereof, selling price of the products are assumed as matching with imported-duty paid base oil in Thailand.

Weighted average lube base oil selling price (ex-refinery) is calculated as follows:

Imported Base Oil Price:

CIF Bangkok (1991)	US$563.01
Taxes and Duties	US$179.46
Total Imported Price:	US$742.47
Taxes on Doemstic Product:	US$53.08
Domextic Selling Price excl. Taxes:	US$689.39

Selling price (ex-refinery) of base oil from the Sri Racha plant is assumed to be lower than that from Bangchak plant by 1.34 U.S. Dollars per kilo-liter because of difference in transportation cost to blenders.

Selling price of base oil is calculated in accordance with the following formula:

$P = 66.44 + 2.19x + 21.76 \times (1+0.06)^n$ (Bangchak)

$P = 66.44 + 2.185x + 21.76 \times (1+0.06)^n$ (Sri Racha)

Where: x = Crude oil price (Arabian Light)
n = Number of year (1991: n=0)

(2) Other Products

Selling price projection formula for the other prod ucts are as follows:

1) Fuel Oil:

Bangchak: $P = 8.1734 + 0.8497x$
Sri Racha: $P = 8.0521 + 0.8332x$

2) Asphalt: $P = 5.80183 + 0.87686x$

3) Sulphur: $P = 232.40 \times (1+0.06)^n$
(1991: n=0)

4) Refined Wax: $P = 1,035.11 \times (1+0.06)^n$
(1991: n=0)

Where: x = Crude oil price (Arabian Light)

(3) Intermediates

1) LVGO/HFGO: $P = 1.2812x - 1.227$

2) V/B Naphtha: $P = 10.9436 + 1.0425x$

3) FCC Feeds: $P = 7.9606 + 0.999x$

4) T/C Feeds: $P = 6.6329 + 0.6895x$

Where: x = Crude oil price (Arabian Light)

3-3 Operating Costs

3-3-1 Variable Costs

(1) Long Residue (Unit Price)

Price of long residue is estimated by following formula which is assumed in Chapter 4 of Part II.

$P = 8.175 + 0.8499x$

Where: x = Crude oil price (Arabian Light)

(2) Utilities (Unit Price)

1) Electricity:

1991 Price:	US$0.1094/kWh
Annual Escalation Rate:	7%

2) Hydrogen:

1991 Price:	US$0.2803/$Nm^3$
Annual Escalation Rate:	7%

3) Industrial Water (Only for Sri Racha Case):

1991 Price:	US$0.0935/ton
Annual Escalation Rate:	7%

(3) Other Supplies (Unit Price)

Consumables		Price in 1991 (US$)	Annual Escalation Rate
1) H.P.Catalyst	(F)	12.3/kg	6.0%
2) W.H.T.Catalyst	(F)	20.5/kg	6.0%
3) Furfural	(F)	2,950/kl	6.0%
4) MEK	(F)	1,640/kl	6.0%
5) MEA	(F)	2.87/kg	6.0%
6) Toluene	(L)	667/kl	7.0%
7) Propane	(L)	0.534/kg	7.0%
8) Chemical for	(F)	246,000/year*	6.0%
Utilities	(L)	200,000/year*	7.0%
	(F)	164,000/year**	6.0%
	(L)	133,000/year**	7.0%
9) Chemicals for	(F)	123,000/year*	6.0%
WWT	(L)	100,000/year*	7.0%
	(F)	123,000/year**	6.0%
	(L)	100,000/year**	7.0%

Notes: * Bangchak Case annual cost
** Sri Racha Case annual cost

(4) Consumption Figures and Annual Cost

Assumed consumption figures and estimated amount of variable cost per one unit volume (kl) of lube base oil are as per Table IV-19.

3-3-2 Fixed Costs

(1) Labor Costs and fringe benefit

Direct labor cost including bonus of two months equivalent salary is assumed based on the wage investigation report by Japanese Chamber of Commerce is Bangkok, June, 1983.

Wage level (direct salary) of workers including management staff are assumed as follows:

Class	Wage Rate in 1991	
	Monthly Rate	Annual Rate
A (Managers, Administrators)	US$1,794	US$21,523
B (Superintendent, Senior Engineers)	US$1,363	US$16,357
C (Forman, Engineers)	US$538	US$6,457
D (Skilled Workers, Operators)	US$395	US$4,735
E (Semi-skilled Workers)	US$330	US$3,960

Total direct labor cost in 1991 is as shown in Table IV-20, which is to be escalated by seven percent (7%) per annum for the following years.

Indirect salaries including fring benefit is assumed to be thirty percent (30%) of the direct labor cost.

(2) Administrative Overhead

Administarative overhead including following items is assumed to be forty percent (40%) of direct salary plus fringe benefit or fifty-two percent (52%) of the direct labor cost.

1) Director's expense
2) Lawyer's doctor's expense
3) Trip and communication
4) Office supplies

5) Sales and Marketing
6) Public relations and employee relations including training
7) Safety and fire prevention
8) First aids, medical supplies
9) Waste disposal and oil loss control
10) Labo expense and test/inspection
11) Workshop/warehouse expense
12) In-plant transportation
13) Technical service
14) Computer/printing/library

(3) Maintenance Costs

Maintenance cost including scheduled shut-down maintenance is assumed to be;

4% on Process Plant
2% on Offsites, Utilities and Buildings

Average rate of maintenance cost is estimated as 2.76 percent on total depreciable assets. It is assumed also that the maintenance cost is escalated at seven percent (7%) per annum throughout the project life.

(4) Operating Supplies

Operating supplies including natural wear spare parts is estimated as fifteen percent (15%) of maintenance material cost which is a assumed to be forty percent (40%) of total maintenance cost. Two year use of spare parts is budgeted in the plant construction cost as initial inventory.

(5) Depreciation

The constructed plant cost (depreciable assets) is depreciated according to the following rule:

a. Mode of depreciation: Straight line

b. Salvage value: zero

c. Depreciated period:

Plant facilities: 10 years

buildings: 20 years

(6) Amortization

Preoperational expenses and interest during construction are amortized equally for first five (5) years.

(7) Local Taxes and Insurance

Equivalent to one percent (1%) of the initial constructed plant cost is assumed to be required for local taxes and insurance premium for plant operation.

3-3-3 Other Account Items

(1) Sales Expenses

One-tenth percent (0.1%) of the total sales revenue is assumed to be the sales expenses for all products.

(2) Corporate income tax

Thirty percent (30%) of taxable income is assumed to be imposed as corporate income tax.

(3) Dividend

No dividend payment is considered in this study, and all of net profits are retained throughout the project life.

Table IV-1 TYPE OF CONTRACTS FOR PROJECT IMPLEMENTATION

Items	Type of Bid	Type of Contract	Remarks
1) Basic Design and Royalities	NB or CB	LS	Basic design contractor
2) Assistance for company's supervision	Ditto	LS or PD	By the basic contractor and/or advisor
3) Technical Advisory	Ditto	Ditto	Ditto
4) Soil Investigation	Ditto	LS	Local contractor
5) Site Preparation	CB	LS	ditto
6) E.P.C Main Contract	CB	LS	International bid
7) Start-up Assistance	NB	LS or PD	Included in main contract
8) Operator's Training	NB or CB	LS or PD	By main contractor and nominated third party

Note:

NB : Negotiative Bid
CB : Competitive Bid
LS : Lump-sum Fixed Contract
PD : Per Diem Contract

Table IV-2 BASE COST ESTIMATE FOR PLANT CONSTRUCTION COST

(Unit: '000 US$)

	Bangchak-A F	Bangchak-A L	Bangchak-B F	Bangchak-B L	Sri Racha-A F	Sri Racha-A L	Sri Racha-B F	Sri Racha-B L	Bangchak-AX F	Bangchak-AX L	Bangchak-AY F	Bangchak-AY L
1. Plant Direct Costs	77.217	37.696	70.566	29.478	79.435	35.347	70.609	26.565	88.956	40.870	76.565	37.957
1-1 -Equipment & Materials (FOB)	69.652	25.522	63.870	19.000	71.826	23.913	64.000	17.087	80.478	27.696	69.000	25.783
1-2 -Spare Parts (FOB)	6.652	-	5.783	-	6.696	-	5.696	-	7.565	-	6.652	-
1-3 -Catalyst & Chemicals (FOB)	913	*) 217	913	*) 217	913	*) 217	913	*) 217	913	*) 217	913	*) 217
1-4 -Construction Labor	-	11.957	-	10.261	-	11.217	-	9.261	-	12.957	-	11.957
2. Plant Indirect Costs	30.739	6.173	26.697	5.434	30.739	6.129	26.001	5.260	34.695	6.999	30.565	6.174
2-1 -Ocean Freight	5.522	-	4.783	-	5.522	-	4.652	-	6.217	-	5.478	-
2-2 -Inland Transportation	-	478	-	435	-	478	-	435	-	565	-	478
2-3 -Field Expenses	5.652	2.435	4.913	2.130	5.652	2.391	4.783	2.043	6.391	2.739	5.609	2.435
2-4 -Temporary Facilities	478	1.826	435	1.609	478	1.826	391	1.565	522	2.087	435	1.870
2-5 -Construction Equipment	5.522	1.391	4.783	1.217	5.522	1.391	4.696	1.174	6.261	1.565	5.522	1.348
2-6 -Pre-commissioning Expenses	2.261	43	1.957	43	2.261	43	1.913	43	2.565	43	2.261	43
2-7 -Engineering Fee	8.043	-	7.000	-	8.043	-	6.826	-	9.087	-	8.043	-
2-8 -Home Office Expenses	2.304	-	2.000	-	2.304	-	1.957	-	2.609	-	2.304	-
2-9 -Insurance Premium	957	-	826	-	957	-	783	-	1.043	-	913	-
Total Plant Construction Cost	107.956	43.869	97.263	34.912	110.174	41.476	96.610	31.825	123.651	47.869	107.130	44.131
	151.825		132.175		151.650		128.435		171.520		151.261	
Percentage of local currency	29		26		27		25		28		29	

Notes: F: Foreign Currency Portion
L: Local Currency Portion (Refer ANNEX IV-1 where possible local supplies and services are specified.)

*) Chemicals locally supplied ····· delivered at project site basis

Table IV-3 PREOPERATIONAL EXPENSES SUMMARY

(Unit: US$)

		1985	1986	1987	1988	1989	1990	Total
Bangchak-A	F	0	518,400	734,400	1,036,800	2,010,500	1,823,500	6,123,600
	L	34,784	344,124	440,510	605,049	823,047	5,808,249	8,055,763
	Total	34,784	862,524	1,174,910	1,641,849	2,833,547	7,631,749	14,179,363
Bangchak-B	F	0	518,400	734,400	1,036,800	1,969,300	1,823,500	6,082,400
	L	17,392	275,724	372,110	521,849	731,846	5,708,249	7,627,170
	Total	17,392	794,124	106,510	1,558,649	2,701,146	7,531,749	13,709,570
Sri Racha-A	F	0	518,400	734,400	1,036,800	2,010,500	1,819,200	6,119,300
	L	34,784	344,124	440,510	605,049	823,047	5,869,149	8,116,663
	Total	34,784	862,524	1,174,910	1,641,849	2,833,547	7,688,349	14,235,963
Sri Racha-B	F	0	518,400	734,400	1,036,800	1,969,300	1,819,200	6,078,100
	L	17,392	275,724	372,110	521,849	731,846	5,747,349	7,666,270
	Total	17,392	794,124	1,106,510	1,558,649	2,701,146	7,566,549	13,744,370
Bangchak-AX	F	0	518,400	734,400	1,036,800	2,010,500	1,827,900	6,128,000
	L	34,784	344,124	440,510	605,049	880,247	6,220,749	8,525,463
	Total	34,784	862,524	1,174,910	1,641,849	2,890,747	8,048,649	14,653,463
Bangchak-AY	F	0	518,400	734,400	1,036,800	2,010,500	1,823,500	6,123,600
	L	34,784	344,124	440,510	605,049	823,047	5,777,849	8,025,363
	Total	34,784	862,524	1,174,910	1,641,849	2,833,547	7,601,349	14,148,963

Notes: F: Foreign Currency Portion
L: Local Currency Portion

Table IV-4 PREOPERATIONAL EXPENSES

(Unit: '000 US$)

		Investment Promotion Expenses	Technical Advisory Fee	Training Costs	Personnel Costs and Overhead	Start-up Expenses	Price Contingency	Total
Bangchak-A	F	-	4,363	974	-	787	1,646	7,770
	L	35	1,947	104	1,608	4,362	3,069	11,125
	Total	35	6,310	1,078	1,608	5,149	4,715	18,895
Bangchak-B	F	-	4,363	933	-	787	1,634	7,717
	L	17	1,947	100	1,302	4,262	2,954	10,582
	Total	17	6,310	1,033	1,302	5,049	4,588	18,299
Sri Racha-A	F	-	4,363	974	-	782	1,645	7,764
	L	35	1,947	104	1,608	4,422	3,097	11,213
	Total	35	6,310	1,078	1,608	5,204	4,742	18,977
Sri Racha-B	F	-	4,363	933	-	782	1,633	7,711
	L	17	1,947	100	1,302	4,301	2,971	10,638
	Total	17	6,310	1,033	1,302	5,083	4,604	18,349
Bangchak-AX	F	-	4,363	974	-	791	1,648	7,776
	L	35	1,947	104	1,777	4,662	3,269	11,794
	Total	35	6,310	1,078	1,777	5,453	4,917	19,570
Bangchak-AY	F	-	4,363	974	-	787	1,646	7,770
	L	35	1,947	104	1,608	4,331	3,057	11,082
	Total	35	6,310	1,078	1,608	5,118	4,703	18,852

Table IV-5 WORKING CAPITL

(Unit: '000US$)

		Bangchak-A	Bangchak-B	Sri Racha-A	Sri Racha-B	Bangchak-AX	Bangchak-AY	Note (Tax)
1.	Feeds, Intermediates and Products							
1-1	-Process Unit	412	412	391	391	434	412	
1-2	-Feed Stock Storage	1,758	-	1,758	-	1,758	1,758	
1-3	-Intermediates Tankage	11,635	11,635	10,868	10,868	11,973	11,635	
1-4	-Products Tankage	9,000	8,238	9,087	8,281	9,373	8,932	
	Sub-total (1)	22,805	20,285	22,104	19,540	23,538	22,737	
	Initial Inventory: (1) x 0.8	18,244	16,228	17,683	15,632	18,830	18,190	
	Other Consumables	245	245	233	233	245	245	
	Total of Item 1	18,489	16,473	17,916	15,865	19,075	18,435	
2.	A/C Receivable (-) Payable	6,125	6,425	5,754	6,068	6,522	6,087	
	Total	24,614	22,898	23,670	21,933	25,597	24,522	
	Foreign Currency (F)	167	167	162	162	167	167	
	Local Currency (L)	24,447	22,731	23,508	21,771	25,430	24,355	

Table IV-6 INVENTORY SCHEDULE OF FEEDS, INTERMEDIATS AND PRODUCTS (CAPACITY OF STORAGES)

		*1 Unit Price US$/kl	Bangchak-A		Bangchak-B		Sri Racha-A		Sri Racha-B		Bangchak-AX		Bangchak-AY	
			Volume kl	Amount '000 US$	Volume kl	Amount '000 US$	Volume kl	Amount '000 US$	Volume kl	Amount '000 US$	Volume kl	Amount '000 US$	Volume kl	Amount '000 US$
1.	Process Unit	217	1.900	412	1.900	412	1.800	391	1.800	391	2.000	434	1.900	412
2.	Feed Stock Storage	217	8.100	1.758	-	-	8.100	1.758	-	-	8.100	1.758	8.100	1.758
3.	Intermediate Tankage	307	37.900	11.635	37.900	11.635	35.400	10.868	35.400	10.868	39.000	11.973	37.800	11.635
	-1 Short Residue		3.900		3.900		3.900		3.900		3.900		3.900	
	-2 VDU Distillates		11.700		11.700		11.700		11.700		11.700		11.700	
	-3 DAO		3.100		3.100		3.100		3.100		3.100		3.100	
	-4 VGO Sulfur		4.000		4.000		4.000		4.000		4.000		4.000	
	-5 Raffinate		3.000		3.000		3.000		3.000		3.000		3.000	
	-6 HF Raffinate		2.900		2.900		2.900		2.900		2.900		2.900	
	-7 Asphalt and Fuel		8.500		8.500		6.000		6.000		8.800		8.400	
	-8 Slack Wax		800		800		800		800		1.600		800	
4.	Product Tankage		17.800	9.000	14.300	8.238	18.200	9.087	14.500	8.281	18.200	9.373	17.500	8.932
	-1 Base Oil	615	12.900	7.934	12.900	7.934	12.900	7.934	12.900	7.934	12.900	7.934	12.900	7.934
	-2 Asphalt	222	600	133	-	-	600	133	-	-	600	133	-	-
	-3 Fuel Oil	217	4.300	933	1.400	304	4.700	1.020	1.600	347	4.300	933	4.600	998
	-4 Wax	932	-	-	-	-	-	-	-	-	400	373	-	-
	TOTAL		65.700	22.805	54.100	20.285	63.500	22.104	51.700	19.540	67.300	23.538	65.300	22.737
	(80%)			(18.244)		(16.228)		(17.683)		(15.632)		(18.830)		18.190)

Notes: *1 Selling Price x 0.9

Initial inventory value which is to be budgeted as a part of initial working capital is assumedto be 80% of the above Total amount.

Table IV-7 INVENTORY OF OTHER CONSUMABLES (Mid. '91) (BANGCHAK CASE)

		(Mid. '91) Unit Price US$	Volume of Inventory	Amount US$	Note
1. Hydrofinishing Catalyst F (CIF)	F	12.3098/kg	-	-	No inventory is required except initial charges which are included in the plant cost.
2. Wax Hydrotreating Catalyst (CIF)	F	20.5165/kg	-	-	
3. Furfural (CIF)	F	2.9544/lit.	54kl	159.538	For 6 months
4. MEK (CIF)	F	1.6414/lit.	15.625kl	25.647	For 6 months
5. MEA (CIF)	F	2.8722/kg	565kg	1.623	For 6 months
6. Toluene (As delivered)	L	0.6674/lit.	3.604kl	2.405	For 1 month
7. Propane (As delivered)	L	0.5339/kg	-	-	Always available from refinery.
8. Chemicals for Utilities (CIF)	F	246.195/y	for 1-month	20.516	For 1 month
(As delivered)	L	200.211/y	for 1-month	16.684	For 1 month
9. Chemicals for WWT (CIF)	F	123.098/y	for 1-month	10.258	For 1 month
(As delivered)	L	100.105/y	for 1-month	8.342	For 1 month
Total	F	-	-	217.582	incl. 30/130 tax
	L	-	-	27.431	no tax
Taxes and Duties Compornent	L			(50.211)	20.5% x Total
Grand Total	F	-	-	167.371	Taxes adjusted prices
	L	-	-	77.642	
	Total	-	-	245.013	

Notes: F: Foreign Currency Portion
L: Local Currency Portion

Table IV-8 INVENTORY OF OTHER CONSUMABLES (Mid. '91) (SRI RACHA CASE)

		(Mid. '91) Unit Price US$	Volume of Inventory	Amount US$	Note
1. Hydrofinishing Catalyst (CIF)	F	12.3098/kg	-	-	No inventory is required except initial charges which are included in the plant cost.
2. Wax Hydrotreating Catalyst (CIF)	F	20.5165/kg	-	-	
3. Furfural (CIF)	F	2.9544/Lit.	54kl	159.538	For 6 months
4. MEK (CIF)	F	1.6414/lit.	15.625kl	25.647	For 6 months
5. MEA (CIF)	F	2.8722/kg	565kg	1.623	For 6 months
6. Toluene (As delivered)	L	0.6674/lit.	3.064l	2.405	For 1 month
7. Propane (As delivered)	L	0.5339/kg	-	-	Always available from refinery.
8. Chemicals for Utilities (CIF)	F	164.160/y	for 1-month	13.678	For 1 month
(As delivered)		133.474/y	for 1-month	11.123	For 1 month
9. Chemical for WWT (CIF)	F	123.098/y	for 1-month	10.258	For 1 month
(As delivered)	L	100.105/y	for 1-month	8.342	For 1 month
Total	F			210.744	incl. 30/130 tax
	L			21.870	no tax
Taxes and Duties Component (Included in Total)	L			(48.633)	20.9% x Total
Grand Total	F			162.111	Taxes adjusted prices.
	L			70.503	
	Total			232.614	

Notes: F: Foreign Currency Portion
L: Local Currency Portion

Table IV-9 ACCOUNT PAYABLE/RECEIVABLE

(Unit: '000 US$)

	A/C Receivable (A) 30 days	A/C Payable (B) 30 days	(A)-(B)
Bangchak-A	31,503	25,378	6,125
Bangchak-B	30,718	24,293	6,425
Sri Racha-A	31,128	25,374	5,754
Sri Racha-B	18,698	12,630	6,068
Bangchak-AX	32,002	25,480	6,522
Bangchak-AY	31,464	25,377	6,087

Table IV-10 TOTAL PROJECT COST (SUMMARY)

(Unit: '000 US$)

		Bangchak-A	Bangchak-B	Sri Racha-A	Sri Racha-B	Bangchak-AX	Bangchak-AY
1.	Land Acquisition and Site Preparation	9,900	6,648	4,625	3,939	11,314	9,900
2.	Plant Construction Cost	266,505	233,565	267,058	227,780	301,896	265,314
3.	Pre-operational Expenses	18,895	18,299	18,977	18,349	19,570	18,852
4.	Interest During Construction	29,431	25,450	28,499	24,519	32,962	29,503
5.	Initial Working Capital	24,614	22,898	23,670	21,933	25,597	24,522
	Total	349,345	306,860	342,829	296,520	391,339	348,091

Table IV-11 PROJECT COST DISBURSEMENT SCHEDULE (BANGCHAK-A)

(Unit: '000US$)

	Currency	1985	1986	1987	1988	1989	1990	Total
Land Acquisition and Site Preparation	F		-	-	-	-	-	
	L		3,534	6,366	-	-	-	9,900
	Total		3,534	6,366	-	-	-	9,900
Plant Construction Cost	F		2,280		57,579	84,853	9,092	153,804
	L		220		42,343	62,989	6,749	112,701
	Total		2,500		100,322	147,842	15,841	266,505
Pre-operational Expenses	F	-	565	845	1,264	2,598	2,498	7,770
	L	37	379	516	758	1,103	8,332	11,125
	Total	37	944	1,361	2,022	3,701	10,830	18,895
Initial Working Capital	F						167	167
	L						24,447	24,447
	Total						24,614	24,614
Sub-total	F	-	2,845	845	58,843	87,451	11,757	161,741
	L	37	4,133	6,882	43,501	64,092	39,528	158,173
	Total	37	6,978	7,727	102,344	151,543	51,285	319,914
Interest During Construction	F						29,431	29,431
	L						-	-
	Total						29,431	29,431
Total	F	-	2,845	845	58,843	87,451	41,188	191,172
	L	37	4,133	6,882	43,501	64,092	39,528	158,173
	Total	37	6,978	7,727	102,344	151,543	80,716	349,345

Notes: F: Foreign Currency Portion
L: Local Currency Portion

Table IV-12 PROJECT COST DISBURSEMENT SCHEDULE (BANGCHAK-B)

(Unit: '000US$)

	Currency	1985	1986	1987	1988	1989	1990	Total
Land Acquisition and Site Preparation	F		-	-	-	-	-	-
	L		1,010	5,638	-	-	-	6,648
	Total		1,010	5,638	-	-	-	6,648
Plant Construction Cost	F		2,280		51,877	76,451	8,191	138,799
	L		220		35,927	52,946	5,673	94,766
	Total		2,500		87,804	129,397	13,864	233,565
Pre-operational Expenses	F	-	565	845	1,264	2,545	2,498	7,717
	L	18	304	436	654	981	8,189	10,582
	Total	18	869	1,281	1,918	3,526	10,687	18,299
Initial Working Capital	F						167	167
	L						22,731	22,731
	Total						22,898	22,898
Sub-total	F	-	2,845	845	53,141	78,996	10,856	146,683
	L	18	1,534	6,074	36,581	53,927	36,593	134,727
	Total	18	4,379	6,919	89,722	132,923	47,449	281,410
Interest During Construction	F						25,450	25,450
	L						-	-
	Total						25,450	25,450
Total	F	-	2,845	845	53,141	78,996	36,306	172,133
	L	18	1,534	6,074	36,581	53,927	36,593	134,727
	Total	18	4,379	6,919	89,722	132,923	72,899	306,860

Notes: F: Foreign Currency Portion
L: Local Currency Portion

Table IV-13 PROJECT COST DISBURSEMENT SCHEDULE (SRI RACHA-A)

(Unit: '000US$)

	Currency	1985	1986	1987	1988	1989	1990	Total
Land Acquisition and Site Preparation	F		-	-	-	-	-	-
	L		3,534	1,091	-	-	-	4,625
	Total		3,534	1,091	-	-	-	4,625
Plant Construction Cost	F		2,280		58,763	86,598	9,279	156,920
	L		220		41,769	61,554	6,595	110,138
	Total		2,500		100,532	148,152	15,874	267,058
Pre-operational Expenses	F	-	565	845	1,264	2,598	2,492	7,764
	L	37	379	516	758	1,103	8,420	11,213
	Total	37	944	1,361	2,022	3,701	10,912	18,977
Initial Working Capital	F						162	162
	L						23,508	23,508
	Total						23,670	23,670
Sub-total	F	-	2,845	845	60,027	89,196	11,933	164,846
	L	37	4,133	1,607	42,527	62,657	38,523	149,484
	Total	37	6,978	2,452	102,554	151,853	50,456	314,330
Interest During Construction	F						28,499	28,499
	L						-	-
	Total						28,499	28,499
Total	F	-	2,845	845	60,027	89,196	40,432	193,345
	L	37	4,133	1,607	42,527	62,657	38,523	149,484
	Total	37	6,978	2,452	102,554	151,853	78,955	342,829

Notes: F: Foreign Currency Portion
L: Local Currency Portion

Table IV-14 PROJECT COST DISBURSEMENT SCHEDULE (SRI RACHA-B)

(Unit: '000US$)

	Currency	1985	1986	1987	1988	1989	1990	Total
Land Acquisition and Site Preparation	F		-	-	-	-	-	
	L		3,030	909	-	-	-	3,939
	Total		3,030	909	-	-	-	3,939
Plant Construction Cost	F		2,280		51,529	75,937	8,136	137,882
	L		220		34,078	50,220	5,380	89,898
	Total		2,500		85,607	126,157	13,516	227,780
Pre-operational Expenses	F	-	565	845	1,264	2,545	2,492	7,711
	L	18	304	436	654	981	8,245	10,638
	Total	18	869	1,281	1,918	3,526	10,737	18,349
Initial Working Capital	F						162	162
	L						21,771	21,771
	Total						21,933	21,933
Sub-total	F	-	2,845	845	52,793	78,482	10,790	145,755
	L	18	3,554	1,345	34,732	51,201	35,396	126,246
	Total	18	6,399	2,190	87,525	129,683	46,186	272,001
Interest During Construction	F						24,519	24,519
	L						-	-
	Total						24,519	24,519
Total	F	-	2,845	845	52,793	78,482	35,309	170,274
	L	18	3,554	1,345	34,732	51,201	35,396	126,246
	Total	18	6,399	2,190	87,525	129,683	70,705	296,520

Notes: F: Foreign Currency Portion
L: Local Currency Portion

Table IV-15 PROJECT COST DISBURSEMENT SCHEDULE (BANGCHAK-AX)

(Unit: '000US$)

	Currency	1985	1986	1987	1988	1989	1990	Total
Land Acquisition and Site Preparation	F							-
	L		4,039	7,275	-	-	-	11,314
	Total		4,039	7,275	-	-	-	11,314
Plant Construction Cost	F		2,746		65,952	97,192	10,413	176,303
	L		265		47,625	70,184	7,519	125,593
	Total		3,011		113,577	167,376	17,932	301,896
Pre-operational Expenses	F	-	565	845	1,264	2,598	2,504	7,776
	L	37	379	516	758	1,180	8,924	11,794
	Total	37	944	1,361	2,022	3,778	11,428	19,570
Initial Working Capital	F	-	3,311	845	67,216	99,790	12,917	184,079
	L	37	4,683	7,791	48,383	71,364	16,443	148,701
	Total	37	7,994	8,636	115,599	171,154	29,360	332,780
Sub-total	F	-	3,311	845	67,216	99,790	13,084	184,246
	L	37	4,683	7,791	48,383	71,364	41,873	174,131
	Total	37	7,994	8,636	115,599	171,154	54,957	358,377
Interest During Construction	F						32,962	32,962
	L						-	-
	Total						32,962	32,962
Total	F	-	3,311	845	67,216	99,790	46,046	217,208
	L	37	4,683	7,791	48,383	71,364	41,873	174,131
	Total	37	7,994	8,636	115,599	171,154	87,919	391,339

Notes: F: Foreign Currency Portion
L: Local Currency Portion

Table IV-16 PROJECT COST DISBURSEMENT SCHEDULE (BANGCHAK-AY)

(Unit: '000US$)

	Currency	1985	1986	1987	1988	1989	1990	Total
Land Acquisition and Site Preparation	F		-	-	-	-	-	-
	L		3,534	6,366	-	-	-	9,900
	Total		3,534	6,366	-	-	-	9,900
Plant Construction Cost	F		2,194		57,140	84,207	9,022	152,563
	L		229		42,758	63,012	6,752	112,751
	Total		2,423		99,898	147,219	15,774	265,314
Pre-operational Expenses	F	-	565	845	1,264	2,598	2,498	7,770
	L	37	379	516	758	1,103	8,289	11,082
	Total	37	944	1,361	2,022	3,701	10,787	18,852
Initial Working Capital	F						167	167
	L						24,355	24,355
	Total						24,522	24,522
Sub-total	F	-	2,759	845	58,404	86,805	11,687	160,500
	L	37	4,142	6,882	43,516	64,115	39,396	158,088
	Total	37	6,901	7,727	101,920	150,920	51,083	318,588
Interest During Construction	F						29,503	29,503
	L						-	-
	Total						29,503	29,503
Total	F	-	2,759	845	58,404	86,805	41,190	190,003
	L	37	4,142	6,882	43,516	64,115	39,396	158,088
	Total	37	6,901	7,727	101,920	150,920	80,586	348,091

Notes: F: Foreign Currency Portion
L: Local Currency Portion

Table IV-17 PRODUCTION CAPACITY

	UNIT	BANGCHAK A/B	SRIRACHA A/B	BANGCHAK AX	BANGCHAK AY
FEEDSTOCK					
Arabian L't Long Residue	10^3KL/Y	1,192	1,192	1,192	1,192
PRODUCTS					
(1) Lube Base Oil	10^3KL/Y	250.0	250.0	250.0	250.0
60 Neutral	10^3KL/Y	23.9	23.9	23.9	23.9
150 Neutral	10^3KL/Y	13.3	13.3	13.3	13.3
300 Neutral	10^3KL/Y	14.9	14.9	14.9	14.9
500 Neutral	10^3KL/Y	138.6	138.6	138.6	138.6
Bright Stock	10^3KL/Y	59.3	59.3	59.3	59.3
(2) By-Products					
Wax	10^3TON/Y	-	-	11.1	-
Fuel Oil	10^3KL/Y	760.4 (*1)	167.0 (*1)	737.0	810.7
Asphalt	10^3TON/Y	55.6	55.6	55.6	-
Suflur	10^3TON/Y	2.6	2.6	2.6	2.6
(3) Intermediates					
L't Vacuum Gas Oil	10^3KL/Y	19.6	19.6	19.6	19.6
Hydrofinishing Gas Oil	10^3KL/Y	3.2	3.2	3.2	3.2
Visbreaker Naphtha	10^3KL/Y	4.8	-	5.3	8.5
FCC Feedstock	10^3KL/Y	-	280.3	-	-
Thermal Cracker Feedstock	10^3KL/Y	-	317.5	-	-
		761.0 (*2)	167.8 (*2)		

Note: (*1) for B
(*2) for A

Table IV-18 RAW MATERIAL AND PRODUCTS - PRODUCTION CAPACITY AND INVENTORY

			BANGCHAK-A	BANGCHAK-B	SRIRACHA-A	SRIRACHA-B	BANGCHAK-AX	BANGCHAK-AY
RAW MATERIAL	Long Residue	A. Production (KL/Y)	1,192,000	1,192,000	1,192,000	1,192,000	1,192,000	1,192,000
		B. Inventory (KL)	10,000	1,900	9,900	1,800	10,100	10,000
		(B/A)	(0.0084)	(0.0016)	(0.0083)	(0.0015)	(0.0085)	(0.0084)
PRODUCTS	Lube Base Oil	A. Production (KL/Y)	250,000	250,000	250,000	250,000	250,000	250,000
		B. Inventory (KL)	12,900	12,900	12,900	12,900	12,900	12,900
		(B/A)	(0.0516)	(0.0516)	(0.0516)	(0.0516)	(0.0516)	(0.0516)
	Fuel Oil	A. Production (KL/Y)	760,400	761,000	167,000	167,800	737,000	810,700
		B. Inventory (KL)	4,300	1,400	4,700	1,600	4,300	4,600
		(B/A)	(0.0057)	(0.0018)	(0.0281)	(0.0096)	(0.0058)	(0.0057)
	Wax	A. Production (T/Y)	Nil	Nil	Nil	Nil	11,100	Nil
		B. Inventory (T)	-	-	-	-	400	-
		(B/A)	-	-	-	-	(0.036)	-
	Asphalt	A. Production (KL/Y)	55,600	55,600	55,600	55,600	55,600	Nil
		B. Inventory (KL)	600	Nil	600	Nil	600	Nil
		(B/A)	(0.0108)	-	(0.0108)	-	(0.0108)	-
	Sulfur	A. Production (T/Y)	2,600	2,600	2,600	2,600	2,600	2,600
		B. Inventory (T)	108	108	108	108	108	108
		(B/A)	(0.0415)	(0.0415)	(0.0415)	(0.0415)	(0.0415)	(0.0415)

Table IV-19 INVENTORY OF CONSUMABLE

Consumables		Inventory Volume BANGCHAK	Inventory Volume SRIRACHA	Note
1 Hydrofinishing Catalyst	F	Nil	Nil	No inventory is required.
2 Wax Hydro-treating catalyst	F	Nil	Nil	
3 Furfural	F	54 Kl	54 Kl	For 6 months
4 NFK	F	15.625Kl	15.625Kl	For 6 months
5 MEA	F	565 Kg	565 Kg	For 6 months
6 Toluen	L	3.604Kl	3.604Kl	For 1 month
7 Propane	L	Nil	Nil	Available from refinery
8 Chemicals for Utilities	F L	in value	in value	for one month use
9 Chemicals for WWT	F L	in value	in value	

Table IV-20 CONSUMPTION FIGURE OF VARIABLE COST ITEMS

		BANGCHAK-A	BANGCHAK-B	SRI RACHA-A	SRI RACHA-B	BANGCHAK-AX	BANGCHAK-AY
Long Residue	kl/kl	4.77	4.77	4.77	4.77	4.77	4.77
Utilities							
- Electricity	kWh/kl	369	340	372	340	396	369
- Hydrogen	NM^3/kl	35.0	35.0	35.0	35.0	36.5	35.0
- Raw Water	ton/kl	* -	* -	3.07	3.07	* -	* -
Catalysts & Chemicals							
- Hydrotinishing Catalyst	g/kl	35.0	35.0	35.0	35.0	35.0	35.0
- Wax Hydrotreating Catalyst	g/kl	-	-	-	-	2.12	-
- Furfural	ml/kl	432	432	432	432	432	432
- MEK	ml/kl	125	125	125	125	125	125
- Toluene	ml/kl	173	173	173	173	173	173
- Propane	g/kl	47.6	47.6	47.6	47.6	47.6	47.6
- MEA	g/kl	4.52	4.52	4.52	4.52	4.52	4.52
Chemicals for Utilities	in value	-	-	-	-	-	-
Chemicals for WWT	in value	-	-	-	-	-	-

Note: * Since raw water is vailable from the river at free cost, it is not conted in variable cost items.

Table IV-21 DIRECT LABOR COST (1991)

(Unit: US$1,000)

CLASS OF EMPLOYEE AND UNIT SALARY RATE	BANGCHAK - A		BANGCHAK - B		SRIRACHA - A		SRIRACHA - B		BANGCHAK - AX		BANGCHAK- AY	
	Nos.	Total Amount	Nos.	Total Amount	Nos.	Total Amount	Nos.	Total Amount	Nos.	Total Amount	Nos.	Total Amount
A. @$21,523/M.Y.	7	151	1	22	7	151	1	22	7	151	7	151
B. @$16,357/M.Y.	18	294	8	131	18	294	8	131	18	294	18	294
C. @$ 6,457/M.Y.	27	174	16	103	27	174	16	103	27	174	27	174
D. @$ 4,735/M.Y.	120	568	103	487	120	568	103	487	132	625	120	568
E. @$ 3,960/M.Y.	118	467	103	408	118	467	103	408	128	507	118	467
TOTAL	290	1,654	231	1,151	290	1,654	231	1,151	316	1,751	290	1,654

Figure IV-1 PROJECT IMPLEMENTATION MASTER SCHEDULE FOR THAI LUBE BASE OIL PROJECT

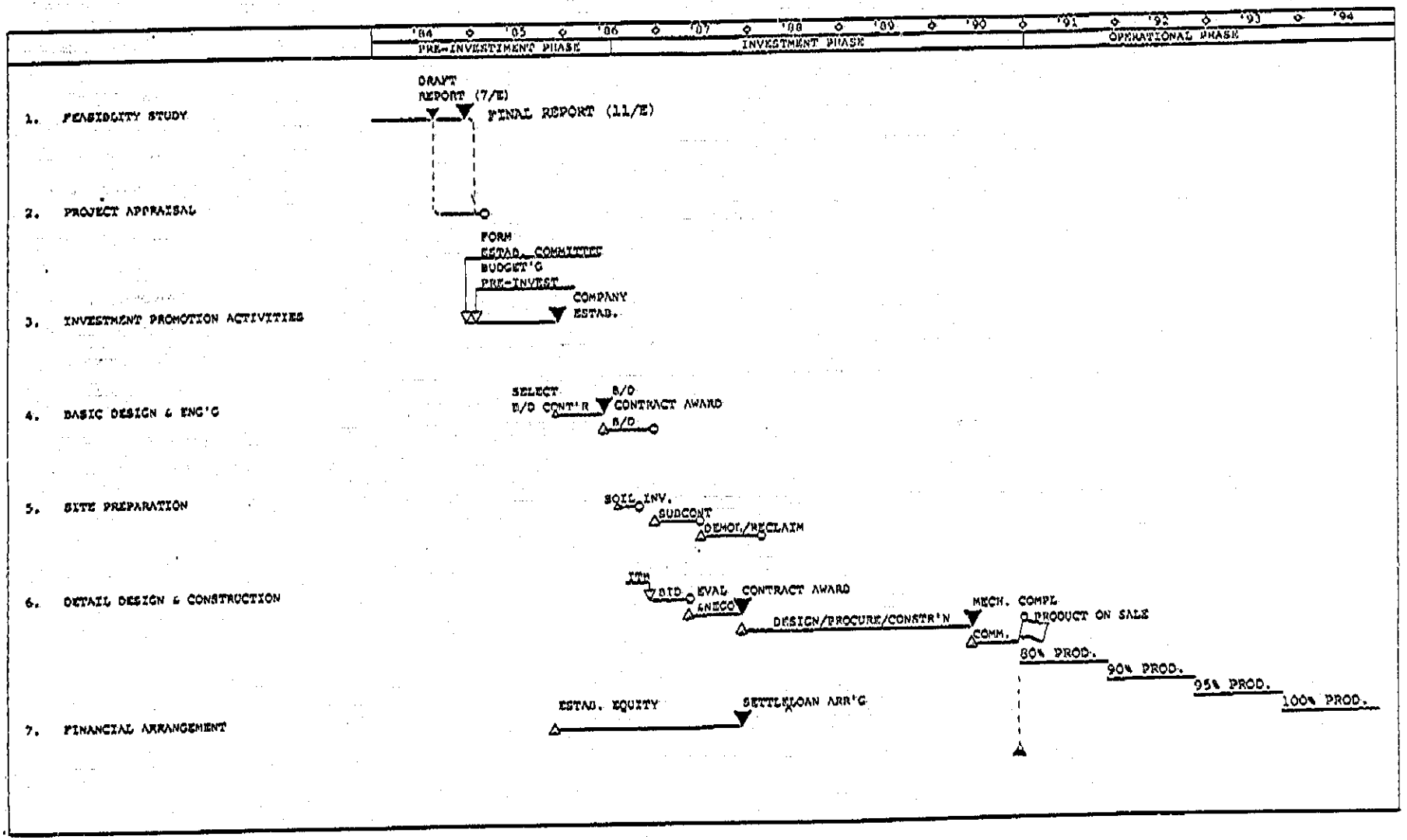


Figure IV-2 PROJECT CONSTRUCTION SCHEDULE OF THAI LUBE BASE OIL PROJECT

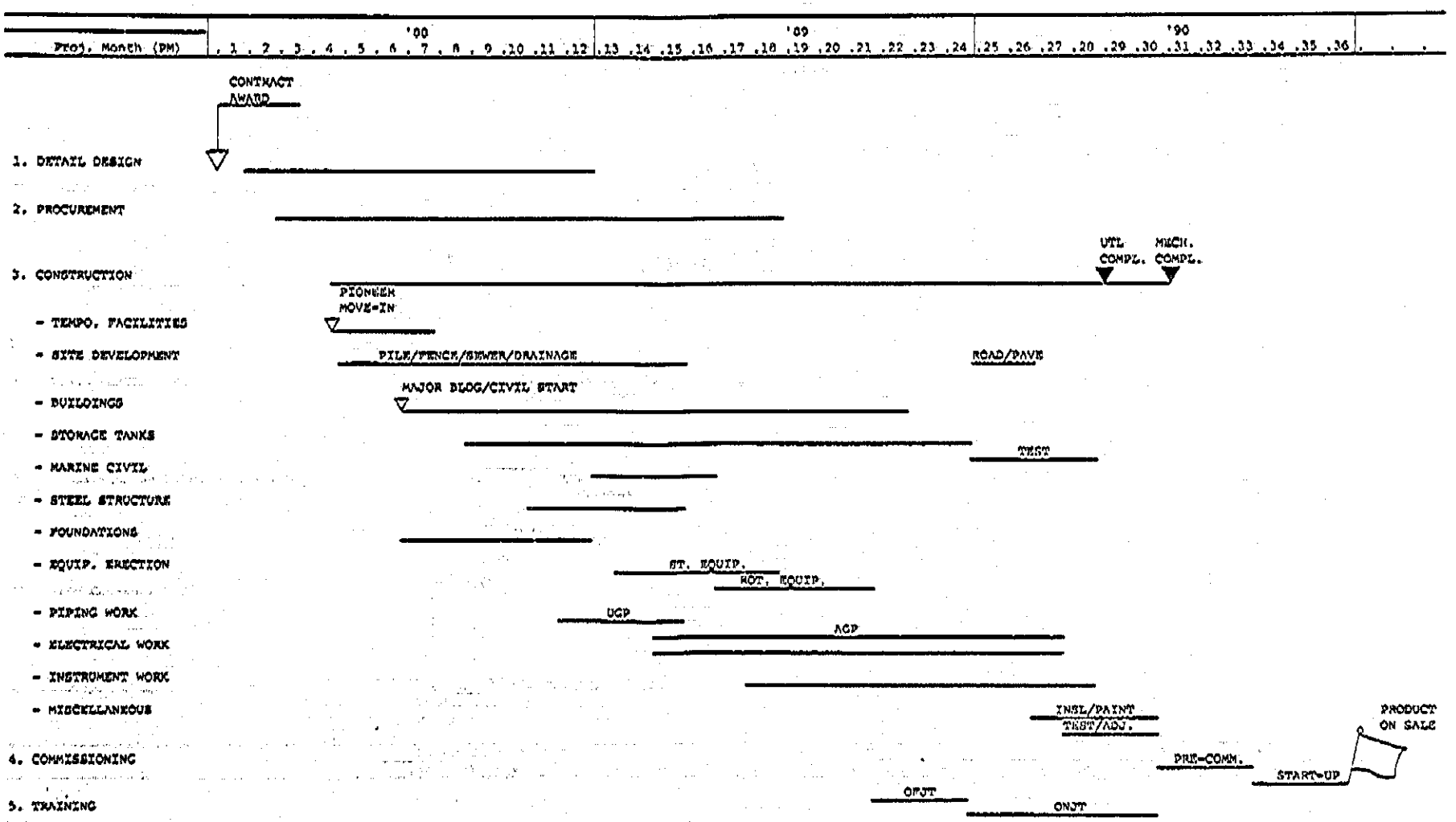
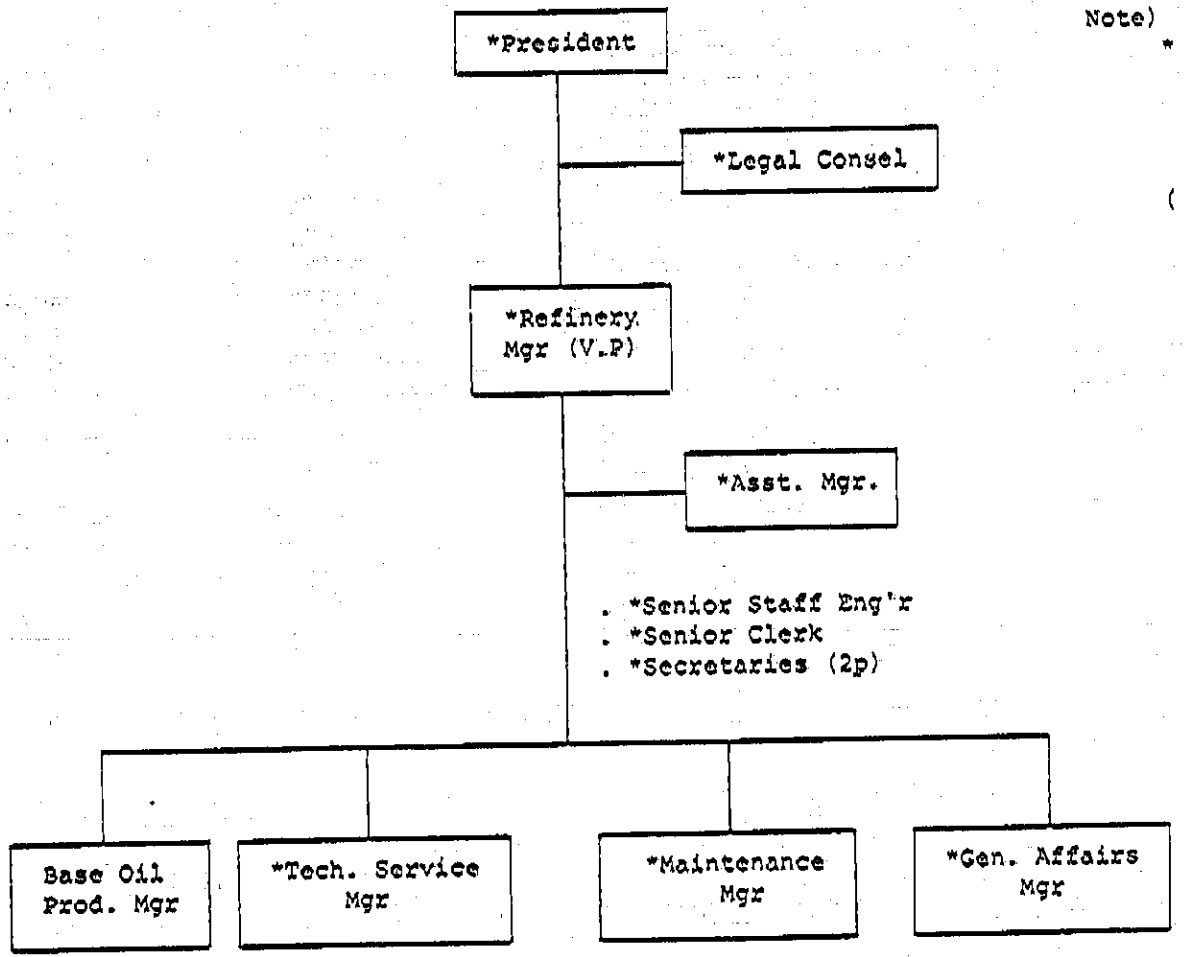


Figure IV-3 MANAGEMENT & STAFF 12 (1)



Note)
* necessary person
for the case of new company
( ) Additional person
for expansion case

Figure IV-4 GENERAL AFFAIRS 58(18)

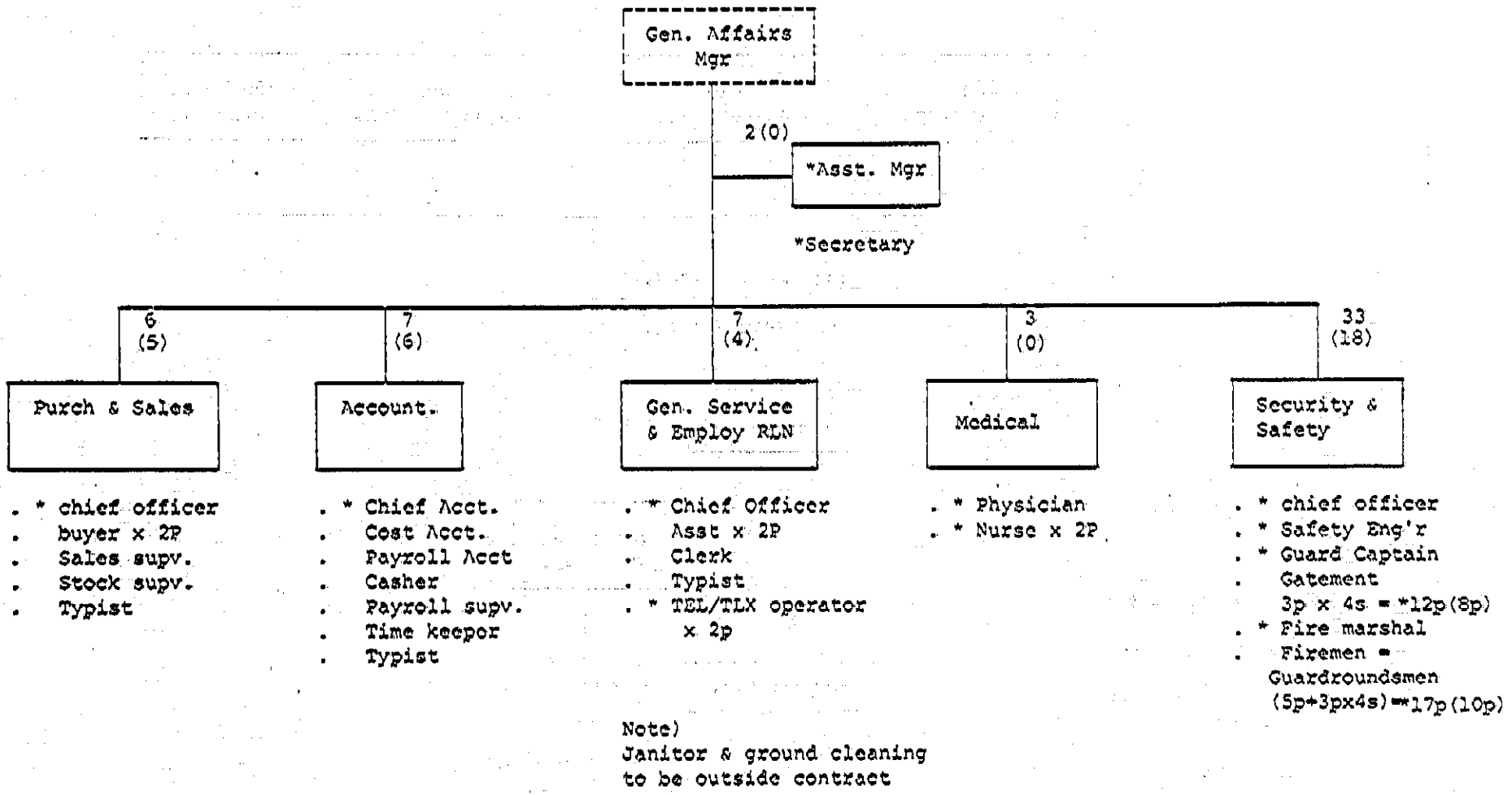


Figure IV-5 TECHNICAL SERVICE 34 (18)

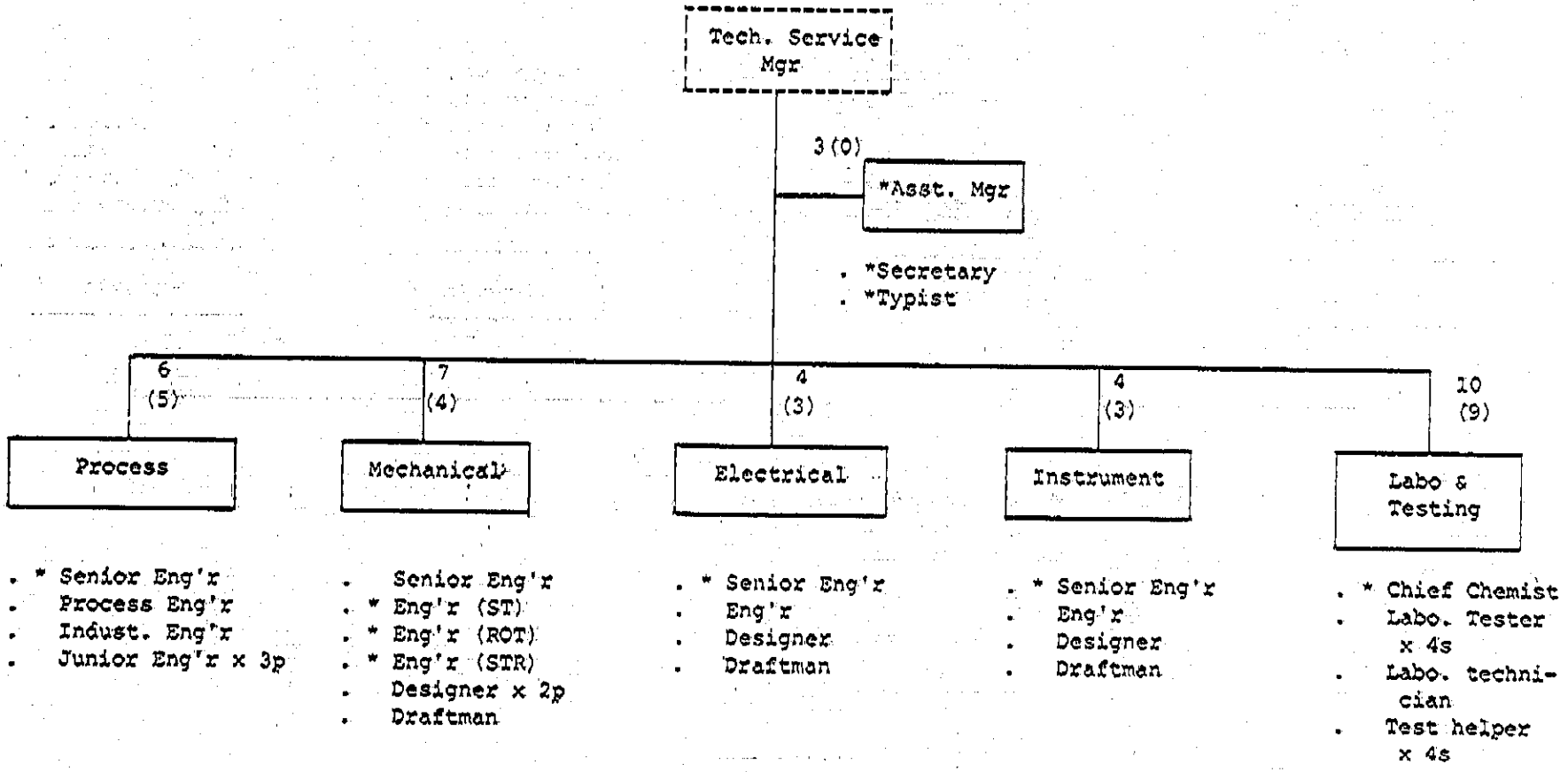


Figure IV-6 MAINTENANCE 52 (18)

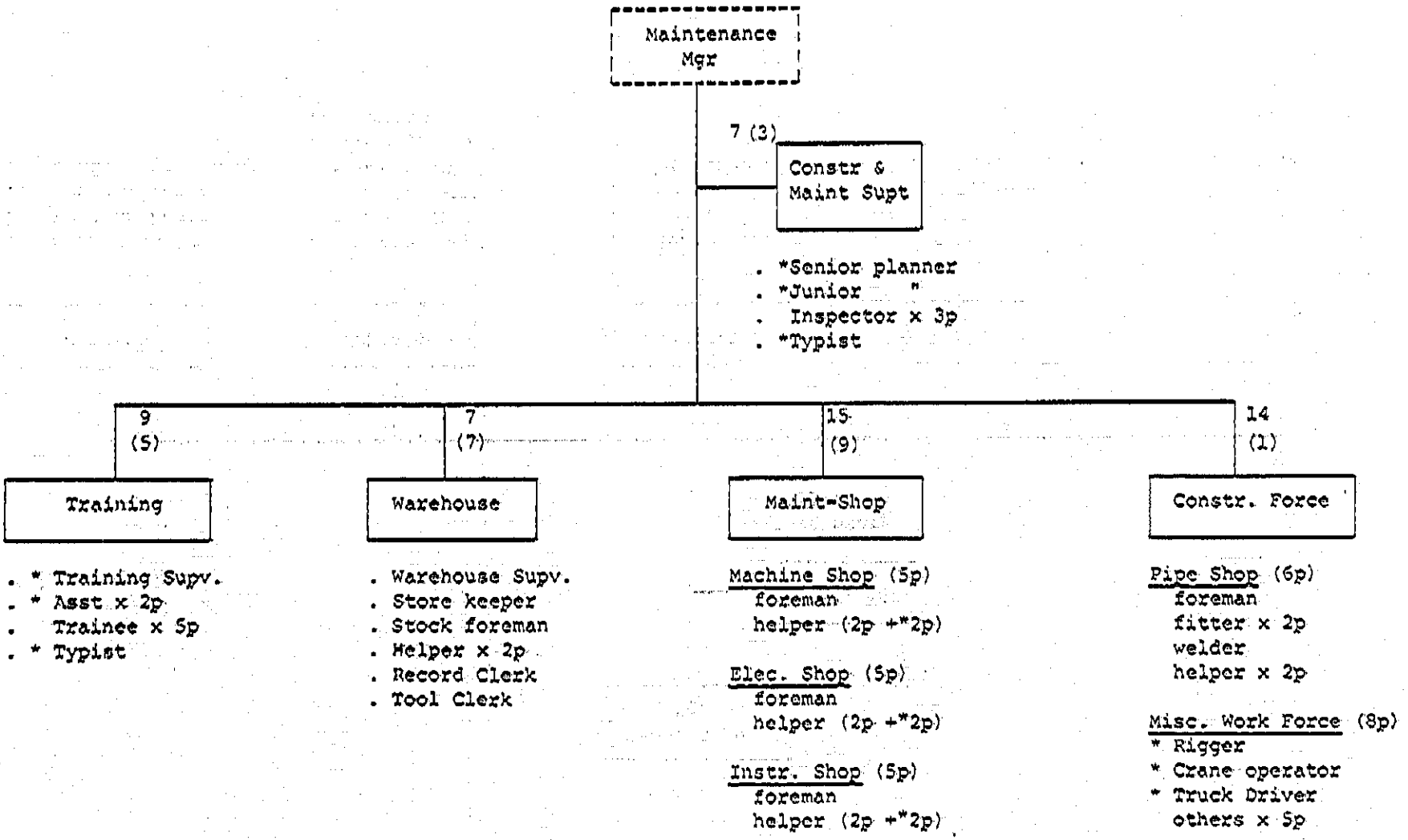
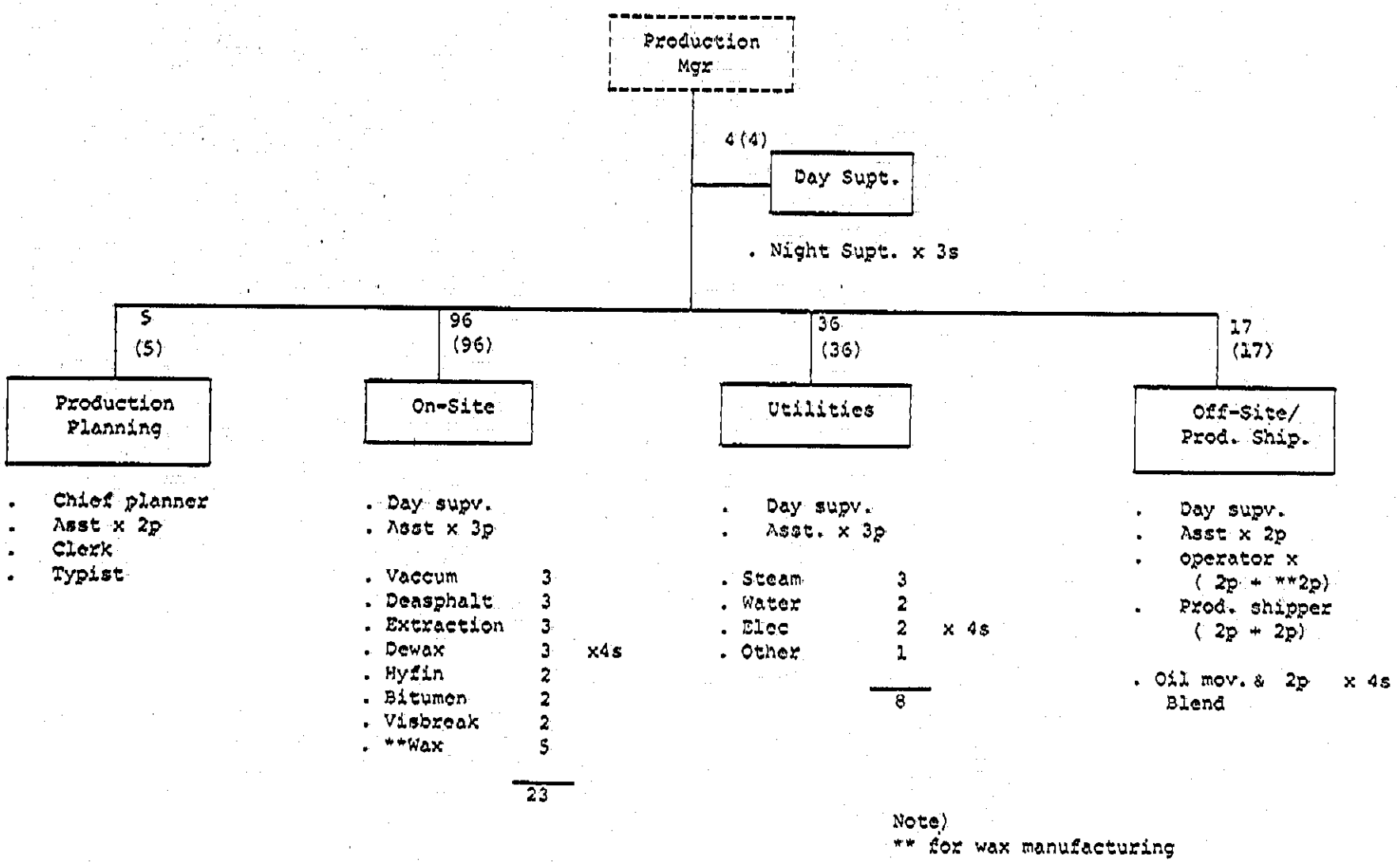


Figure IV-7 PRODUCTION 158(150)



Part V

FINANCIAL AND ECONOMIC ANALYSIS AND EVALUATION

PART V FINANCIAL AND ECONOMIC ANALYSIS AND EVALUATION

Chapter 1 Financial Analysis

1-1 Introduction

It is understood that the essential requirements for financial analysis in this project study is to justify its financial viability through clarifications of interested charactoristics of the project economy as follows:

a. Financial vaibility of the lube base oil refining project in Thailand, in general

b. Difference of financial viability in different project site

c. Difference of financial viability in different form of incorporation

d. Effect of different by-product production in addition to the lube base oil production

e. Sensitivity analysis on major parameter which may affect project economy.

Six alternative project schemes were so set up to fullful the above purpose, therefore, it is expected to clarify general characteristics in financial aspects of this project by analytical studies of the each particular case.

There exist methodological restrictions in financial analysis, because:

- this project is planned to implement on the future basis where the modification of the existing petroleum refineries are assumed to be completed, and

- the intermediate products derived in the processing stage of lube base oil which are practically fed back to the petroleum refinery as a part of feeds are not marketable commodity thus certain justifiable values are caused to be assumed.

In this consequence, it is dificult to apply "With"-"Without" evaluation method due to difficulty to make consolidated financial projection with consistency in common assumptions applied in the two of different implementation schemes in the future,and tentative commercial value must be given for the intermediates on the certain assumption such as viscosity index.

In order to fullfill the initial objectives for this financial analysis under the circumstances as above, it may be effective to apply certain supplemental methods such as sensitivity analysis.

1-2 Major Assumptions on Financial Analysis

1-2-1 Economic Life Span of the Project

The economic life span of the project is assumed to be twenty (20) years from the starting date of commercial operation of the plant in 1991 provided that no substantial modification, renovation or additional investment is made on the initial facilities.

1-2-2 Base Cost for Financial Projections

All financial projections are made in U.S. Dollar current term basis, and such projections are made according to relevant escalation rates specified in the paragraph 1-1-4 of Part-IV.

1-2-3 Methodology of Financial Analysis

Financial analysis is made mainly by means of various financial and operating ratio analysis and financial internal rate of retun (FIRR) by discount cash flow method.

Two kinds of financial internal rate of return are calculated namely, current term FIRR and real term (or constant term) FIRR which is obtained as current term cash flow adjusted by deflator.

1-3 Result of Financial Analysis

Based on the assumptions as above, following financial papers are prepared as attached in Annex V.

a. Production and sales plan
b. Production cost statements
c. Working capital statements
d. Income statements
e. Funds flow statements
f. Balance sheet
g. Long term debt repayment schedule

The result of financial analysis on the basis of above financial papers are as follows:

1-3-1 Internal Rate of Return (FIRROI)

Financial internal rate of return on investment are as follows:

Case	Current Term		Constant Term	
	Before Tax (%)	After Tax (%)	Before Tax (%)	After Tax (%)
Bangchak-A (Base Case)	21.24	18.46	15.69	13.09
Bangchak-B	23.73	20.59	18.05	15.11
SRI RACHA-A	20.06	17.96	15.07	12.60
SRI RACHA-B	23.15	20.07	17.53	14.65
BANGCHAK-AX	20.21	17.59	14.70	12.26
BANGCHAK-AY	21.19	18.42	15.65	13.05

1-3-2 Sensitivity Analysis

Sensitivity of financial viability on major parameters are studied on the Base Case (i.e. BANGCHAK-A). Result of sensitivity analysis are as shown in Table V-1 and Figure V-1 and V-2.

1-3-3 Financial Indicators

Various financial indicators including ratio analysis are as per Annex V-1.

1-3-4 Production Cost Analysis

Analysis on production cost component are as per Table V-2.

1-4 Analytical Comments on Financial Indicators (Base Case B-A)

Major financial indicators on BANGCHAK-A case are as per Table V-3 attached hereto.

1-4-1 Profitability Analysis

"After Tax Profit to Sales Revenue" rate show marginal percentages in the early stage of operation, but it steadily increases through 2001 or eleventh year reaching at 11.6 percent which is will be fairly attractive rate as that of similar industry.

"After Tax Profit to Share Holders Equity" rate in the analysis will not have significant meaning because of continuous accumulation of retained earnings into share-holders equity due to no dividend policy.

"Before Tax Profit to Investment" rate show extreamly rapid increase through project life because of escalation applied to the cost items and products while the investment cost is fixed before start of operation. Therefore, it is rather adequate to justify by FIRR on Investment instead of this rate.

"After Tax Profit to Shared Capital" rate show unrealistic figures due to the same reason as above. If it is required to study the similar profitability "FIRR on Equity" could be adequate indicator to substitute.

1-4-2 Financial Stability Analysis

"Current Ratio" show rather steady rates of more than 1.0 where that in the initial three years of 1.01, 1.12 and 1.18 respectively seem rather low though they are not critical. Average (weighted) rate of 1.69 is not too high but fairly good.

"Quick Ratio" show rather low rates below 1.0 for the first nine years, while after tenth year the quick ratio is improved to 1.24 through the end of project life. These lower rates for the first ten years are explained being caused by current portion of long term debt which account for 51.0% in 1991 and 30.7% in 1999 of current liability respectively. However, there is no problem in cash availability in the operating years where amount of annual depreciation account for 85.7% in 1991 and 51.6% in 1999 of current liability, besides there will be less risks in timely collection of accout receivable from major consumers of base oil.

Assurance on the above lower quick ratio is given by "Debt Service Ratio" which represent financial stability in repayment of long term dept including interest thereof. "Debt Service Ratio" shows ample ability to pay outstanding long term debt.

"Long Term Debt to Share Holders Equity" show 50:50 in the second operating year (1992), and the figures are improved every year. No specific problem is expected.

1-4-3 Break Even Analysis

"Profit Break Even Point - Capacity utilization Rate" show a crytical figure in 1991 where 98.1% of break-even point exceeds expected (or scheduled) operational rate of 80%. In the second year, however, break

even point (79.9%) is assumed within the scheduled capacity utilization rate (90%), and no critical figures will appare thereafter.

"Cash break Even Point - Sales Price" show nearly the same result as above, as follows:

	Unit Sales Price (A)*	B.E. Sales price (B)*	(B)/(A)
1991	1,447.2	1,547.6	1.0477
1992	1,633.1	1,541.8	0.9441
1993	1,766.1	1,628.5	0.9221
1994	1,908.0	1,730.6	0.9070
1995	2,064.2	1,848.8	0.8956
2000	3,052.2	2,644.8	0.8665
2005	4,536.0	3,796.1	0.8369
2010	6,764.6	5,655.7	0.8361

Note: * US$/kl

"Cash Break Even Point - Capacity Utilization Rate" show soundness of the operation in the security of cash concerned.