ANNEX II-2

PRICE INFORMATION AND PROJECTION FOR CRUDE OIL, PETROLEUM PRODUCTS AND ITS DERIVATIVES INCLUDING BASE OIL

Table AII-2-1 ARABIAN LIGHT-34 FOB RAS TANURA PRICE (1975 - 1983)

Year	US$/BBL	US$/kl
1975	11.32	71.20
1976	11.51	72.39
1977	12.40	77.99
1978	12.70	79.88
1979	17.26	108.56
1980	28.68	180.39
1981	32.50	204.42
1982	34.00	213.85
1983	29.81	187.50

Table AII-2-2 PROJECTED ARABIAN LIGHT-34 FOB RAS TANURA PRICE (1984 - 2010)

Year	US$/BBL	US$/kl
1984	29.00	182.40
1985	29.00	182.40
1986	29.00	182.40
1987	31.47	197.94
1988	34.14	214.73
1989	37.04	232.97
1990	40.19	252.78
1991	43.61	274.29
1992	47.31	297.57
1993	51.33	322.85
1994	55.70	350.34
1995	60.43	380.09
1996	65.57	412.42
1997	71.14	447.45
1998	77.19	485.50
1999	83.75	526.76
2000	90.87	571.55
2001	98.59	620.10
2002	106.97	672.81
2003	116.07	730.05
2004	125.93	792.06
2005	136.64	859.42
2006	148.25	932.45
2007	160.85	1011.70
2008	174.52	1097.68
2009	189.36	1191.02
2010	205.45	1292.22

Assumptions:

(Unit: % per annum)

	1983-1986	1986-2010
Crude Oil:		
Real:	-5.0	2.5
Current:	0	8.5
Inflation:	5.0	6.0

Table AII-2-3 PETROLEUM PRODUCT CIF THAILAND PRICES (1979 - 1982)

(Unit: US$/kl)

Year	Premium Gasoline	Regular Gasoline	Kerosene	HSD	LSD	Fuel Oil
1979	115.84	115.84	112.13	104.94	104.94	75.79
1980	272.37	272.37	262.60	266.54	266.54	180.86
1981	270.37	270.37	283.34	266.33	266.33	204.77
1982	405.86	405.86	293.58	279.78	279.78	186.33

Source: Oil and Thailand 1982

Table AII-2-4 PETROLEUM PRODUCT FOB SINGAPORE PRICES (1975 - 1983)

(Unit: US$/kl)

Year	Premium Gasoline	Regular Gasoline	Kerosene	HSD	LSD	Fuel Oil	Bitumen
1975	112.67	112.67	91.70	82.79	82.79	72.82	91.78
1976	121.69	121.69	97.63	94.06	94.06	73.78	88.52
1977	132.89	132.89	106.07	103.12	103.12	81.63	94.34
1978	138.12	138.12	115.90	110.38	110.38	85.52	108.80
1979	164.47	152.12	144.45	140.70	140.70	103.35	135.18
1980	259.33	237.14	241.61	234.54	234.54	172.92	210.30
1981	290.15	271.08	285.35	266.59	266.59	213.51	255.58
1982	269.84	249.86	269.16	256.05	256.05	201.89	238.22
1983	256.30	230.84	243.89	234.74	234.74	187.85	212.75

Source: Singapore Trade Statistics

Table AII-2-5 PETROLEUM PRODUCT THAI EX-REFINERY PRICES (1975 - 1983) (1)

(Unit: Baht/lit.)

Year Date	Arab Light (US$/BBL)	Premium Gasoline	Regular Gasoline	JP4	JP1	Kerosene	HSO	LSO	FO600"	FO1200"	FO1500"	FO2000"	FO2500"	Bitumen (Baht/kg)
1975 Jan. 1	10.463	2.1159	1.8744	1.7651	1.9613	1.8821	1.7587	1.6591	1.3964	1.3564	1.3433	-	-	1.1964
1975 Oct. 1	11.510	2.1159	1.8744	1.7651	1.9613	1.8821	1.7587	1.6591	1.3964	1.3564	1.3433	-	-	1.1964
1975 Dec. 1	11.510	2.2802	2.0378	1.9080	2.0941	2.0302	1.9495	1.8471	1.5237	1.4765	1.4610	-	-	1.1964
1977 Jan. 1	12.090	2.2802	2.0378	1.9080	2.0941	2.0302	1.9495	1.8471	1.5237	1.4765	1.4610	-	-	1.1964
1977 Mar. 2	12.090	2.3833	2.1305	1.9878	2.1207	2.0702	2.0322	1.9272	1.5813	1.5418	1.5289	-	-	1.1964
1977 Jul. 1	12.704	2.3833	2.1305	1.9878	2.1207	2.0702	2.0322	1.9272	1.5813	1.5418	1.5289	-	-	1.1964
1977 Sep. 1	12.704	2.4275	2.1877	2.0433	2.2006	2.1516	2.1085	2.0681	1.6712	1.6304	1.6174	-	-	1.1964
1979 Jan. 1	13.339	2.4275	2.1877	2.0433	2.2006	2.1516	2.1085	2.0681	1.6712	1.6304	1.6174	-	-	1.1964
1979 Feb. 1	13.339	2.6407	2.3977	-	-	2.3118	2.2264	2.2074	1.6956	1.6346	1.6147	-	-	1.1964
1979 Apr. 1	14.546	2.6407	2.3977	-	-	2.3118	2.2264	2.2074	1.6956	1.6346	1.6147	-	-	1.1964
1979 May 1	14.546	3.1528	2.9047	-	-	2.9284	2.7845	2.7547	2.0798	1.9975	1.9707	-	-	1.7485
1979 Jun. 1	18.000	3.1528	2.9047	-	-	2.9284	2.7845	2.7547	2.0798	1.9975	1.9707	-	-	1.7485
1979 Jul.14	18.000	3.7286	3.5564	-	-	3.5699	3.4282	3.3795	2.6584	2.5684	2.5387	-	-	2.2731
1979 Nov. 1	24.000	3.7286	3.5564	-	-	3.5699	3.4282	3.3795	2.6584	2.5684	2.5387	-	-	2.2731
1980 Jan. 1	26.000	3.7286	3.5564	-	-	3.5699	3.4282	3.3795	2.6584	2.5684	2.5387	-	-	2.2731
1980 Feb. 9	26.000	4.4875	4.5932	-	-	4.9121	4.7037	4.6417	3.3780	3.2562	3.2156	-	-	2.5488
1980 Mar.19	26.000	4.8475	4.5932	-	-	4.9121	4.7037	4.6417	3.3780	3.2562	3.2156	-	-	2.5488
1980 Apr. 1	28.000	4.8475	4.5932	-	-	4.9121	4.7037	4.6417	3.3780	3.2562	3.2156	-	-	2.5488
1980 May 23	28.000	5.0797	4.6698	-	-	5.3843	5.0227	4.8491	3.5150	3.3383	3.2813	-	-	2.5488
1980 Jun.16	28.000	5.2890	4.8785	-	-	5.3862	5.1369	5.0419	3.5126	3.3383	3.2825	-	-	2.5488
1980 Jul.21	28.000	5.3096	5.0564	-	-	5.6720	5.2502	5.2053	3.5706	3.3846	3.3245	-	-	2.5488
1980 Aug. 1	30.000	5.3096	5.0564	-	-	5.6720	5.2502	5.2053	3.5706	3.3846	3.3245	-	-	2.5488
1980 Aug. 6	30.000	5.4483	5.1912	-	-	5.6773	5.3966	5.2820	3.5974	3.4064	3.3437	-	-	2.7945
1980 Nov. 1	32.000	5.4483	5.1912	-	-	5.6773	5.3966	5.2820	3.5974	3.4064	3.3437	-	-	2.7945
1980 Nov. 7	32.000	5.5194	5.2164	-	-	5.7049	5.4363	5.3205	3.9233	3.7648	3.7134	-	-	3.3120
1980 Dec. 2	32.000	5.5606	5.2215	-	-	5.7105	5.4616	5.3449	4.1868	4.0552	4.0128	-	-	3.7278
1981 Jan.21	32.000	5.5606	5.2215	-	-	5.7105	5.4616	5.3449	4.1868	4.0552	4.0128	3.9695	3.9235	3.7278
1981 Feb. 5	32.000	5.8802	5.5199	-	-	6.2458	5.8439	5.7193	4.6876	4.5706	4.5323	4.4932	4.4536	4.3022
1981 Apr.30	32.000	5.9079	5.5258	-	-	6.1662	5.8591	5.7486	4.6882	4.5667	4.5278	4.4880	4.4465	4.2896
1981 Jun.30	32.000	5.8795	5.5296	-	-	6.0612	5.8522	5.7372	4.6420	4.5179	4.4773	4.4357	4.3925	4.2258
1981 Jul.31	32.000	6.4395	6.0246	-	-	6.6371	6.3841	6.2811	5.0342	4.8911	4.8457	4.7983	4.7495	4.5520
1981 Sep.16	32.000	6.4361	6.0180	-	-	6.6300	6.3766	6.2743	5.0230	4.8801	4.8347	4.7873	4.7372	4.5400
1981 Oct. 1	34.000	6.4361	6.0180	-	-	6.6300	6.3766	6.2743	5.0230	4.8801	4.8347	4.7873	4.7372	4.5400
1981 Nov.26	34.000	6.4367	6.0156	-	-	6.6300	6.3772	6.2737	4.7792	4.6091	4.5536	4.4962	4.4374	4.1367
1981 Dec. 2	34.000	6.4738	6.0156	-	-	6.6900	6.4073	6.2737	4.7377	4.5632	4.5063	4.4475	4.3872	4.0614
1982 Feb.18	34.000	6.2904	5.8352	-	-	6.6900	6.4073	6.2743	4.6015	4.4112	4.3496	4.2868	4.2209	3.8342
1982 Apr.30	34.000	6.0685	5.6010	-	-	6.4711	6.1691	6.0951	4.4495	4.2606	4.2008	4.1377	4.0732	3.7234
1982 Jul. 7	34.000	6.1134	5.6010	-	-	6.4711	6.1691	6.0951	4.4495	4.2606	4.2008	4.1377	4.0732	3.7234
1982 Aug. 1	34.000	6.0581	5.5918	-	-	6.4684	6.1660	6.0921	4.4472	4.2595	4.1991	4.1364	4.0717	3.7204
1983 Mar.14	29.000	6.0581	5.5918	-	-	6.4684	6.1660	6.0921	4.4472	4.2595	4.1991	4.1364	4.0717	3.7204
1983 Apr.11	29.000	5.3220	4.8587	-	-	5.6803	5.2288	5.1113	3.9304	3.7955	3.7518	3.7071	3.6606	3.5085

Source: Oil and Thailand 1982

Table AII-2-5 PETROLEUM PRODUCT THAI EX-REFINERY PRICES (1975 - 1983) (2)

(Unit: US$/kl)

Year Date	Exchange Rate (Baht/US$)	Arab Light (US$/BBL)	Premium Gasoline	Regular Gasoline	JP4	JP1	Kerosene	HSD	LSD	FO600*	FO1200*	FO1500*	FO2000*	FO2500*	Bitumen (US$/MT)
1975 Jan. 1	20.355	10.463	103.9	92.1	86.7	96.4	92.5	86.4	81.5	68.6	66.6	66.0	-	-	58.8
1975 Oct. 1	20.355	11.510	103.9	92.1	86.7	96.4	92.5	86.4	81.5	68.6	66.6	66.0	-	-	58.8
1975 Dec. 1	20.355	11.510	112.0	100.1	93.7	102.9	99.7	95.8	90.7	74.9	72.5	71.8	-	-	58.8
1977 Jan. 1	20.375	12.090	111.9	100.0	93.6	102.8	99.6	95.7	90.7	74.8	72.5	71.7	-	-	58.7
1977 Mar. 2	20.375	12.090	117.0	104.6	97.6	104.1	101.6	99.7	94.6	77.6	75.7	75.0	-	-	58.7
1977 Jul. 1	20.375	12.704	117.0	104.6	97.6	104.1	101.6	99.7	94.6	77.6	75.7	75.0	-	-	58.7
1977 Sep. 1	20.375	12.704	119.1	107.4	100.3	108.0	105.6	103.5	101.5	82.0	80.0	79.4	-	-	58.7
1979 Jan. 1	20.45	13.339	118.7	107.0	99.9	107.6	105.2	103.1	101.1	81.7	79.7	79.1	-	-	58.5
1979 Feb. 1	20.45	13.339	129.1	117.2	-	-	113.0	108.9	107.9	82.9	79.9	79.0	-	-	58.5
1979 Apr. 1	20.45	14.546	129.1	117.2	-	-	113.0	108.9	107.9	82.9	79.9	79.0	-	-	58.5
1979 May 1	20.45	14.546	154.2	142.0	-	-	143.2	136.2	134.7	101.7	97.7	96.4	-	-	85.5
1979 Jun. 1	20.45	18.000	154.2	142.0	-	-	143.2	136.2	134.7	101.7	97.7	96.4	-	-	85.5
1979 Jul.14	20.45	18.000	182.3	173.9	-	-	174.6	167.6	165.3	130.0	125.6	124.1	-	-	111.2
1979 Nov. 1	20.45	24.000	182.3	173.9	-	-	174.6	167.6	165.3	130.0	125.6	124.1	-	-	111.2
1980 Jan. 1	20.59	26.000	181.1	172.7	-	-	173.4	166.5	164.1	129.1	124.7	123.3	-	-	110.4
1980 Feb. 9	20.59	26.000	217.9	223.1	-	-	238.6	228.4	225.4	164.1	158.1	156.2	-	-	123.8
1980 Mar.19	20.59	26.000	235.4	223.1	-	-	238.6	228.4	225.4	164.1	158.1	156.2	-	-	123.8
1980 Apr. 1	20.59	28.000	235.4	223.1	-	-	238.6	228.4	225.4	164.1	158.1	156.2	-	-	123.8
1980 May 23	20.59	28.000	246.7	226.8	-	-	261.5	243.9	235.5	170.7	162.1	159.4	-	-	123.8
1980 Jun.16	20.59	28.000	256.9	236.9	-	-	261.6	249.5	244.9	170.6	162.1	159.4	-	-	123.8
1980 Jul.21	20.59	28.000	257.9	245.6	-	-	275.5	255.0	252.8	173.4	164.4	161.5	-	-	123.8
1980 Aug. 1	20.59	30.000	257.9	245.6	-	-	275.5	255.0	252.8	173.4	164.4	161.5	-	-	123.8
1980 Aug. 6	20.59	30.000	264.6	252.1	-	-	275.7	262.1	256.5	174.7	165.4	162.4	-	-	135.7
1980 Nov. 1	20.59	32.000	264.6	252.1	-	-	275.7	262.1	256.5	174.7	165.4	162.4	-	-	135.7
1980 Nov. 7	20.59	32.000	268.1	253.3	-	-	277.1	264.0	258.4	190.5	182.8	180.3	-	-	160.9
1980 Dec. 2	20.59	32.000	270.1	253.6	-	-	277.3	265.3	259.6	203.3	196.9	194.9	-	-	181.0
1981 Jan.21	23.05	32.000	241.2	226.5	-	-	247.7	236.9	231.9	181.6	175.9	174.1	172.2	170.2	161.7
1981 Feb. 5	23.05	32.000	255.1	239.5	-	-	271.0	253.5	248.1	203.4	198.3	196.6	194.9	193.2	186.6
1981 Apr.30	23.05	32.000	256.3	239.7	-	-	267.5	254.2	249.4	203.4	198.1	196.4	194.7	192.9	186.1
1981 Jun.30	23.05	32.000	255.1	239.9	-	-	263.0	253.9	248.9	201.4	196.0	194.2	192.4	190.6	183.3
1981 Jul.31	23.05	32.000	279.4	261.4	-	-	287.9	277.0	272.5	218.4	212.2	210.2	208.2	206.1	197.5
1981 Sep.16	23.05	32.000	279.2	261.1	-	-	287.6	276.6	272.2	217.9	211.7	209.7	207.7	205.5	197.0
1981 Oct. 1	23.05	34.000	279.2	261.1	-	-	287.6	276.6	272.2	217.9	211.7	209.7	207.7	205.5	197.0
1981 Nov.26	23.05	34.000	279.2	261.0	-	-	287.6	276.7	272.2	207.3	200.0	197.6	195.1	192.5	179.5
1981 Dec. 2	23.05	34.000	280.9	261.0	-	-	290.2	278.0	272.2	205.5	198.0	195.5	193.0	190.3	176.2
1982 Feb.18	23.05	34.000	272.9	253.2	-	-	290.2	278.0	272.2	199.6	191.4	188.7	186.0	183.1	166.3
1982 Apr.30	23.05	34.000	263.3	243.0	-	-	280.7	267.6	264.4	193.0	184.8	182.2	179.5	176.7	161.5
1982 Jul. 7	23.05	34.000	265.2	243.0	-	-	280.7	267.6	264.4	193.0	184.8	182.2	179.5	176.7	161.5
1982 Aug. 1	23.05	34.000	262.8	242.6	-	-	280.6	267.5	264.3	192.9	184.8	182.2	179.5	176.6	161.4
1983 Mar.14	23.05	29.000	262.8	242.6	-	-	280.6	267.5	264.3	192.9	184.8	182.2	179.5	176.6	161.4
1983 Apr.11	23.05	29.000	230.9	210.8	-	-	243.0	226.8	221.7	170.5	164.7	162.8	160.8	158.8	152.2

Source: Table AII-2-5 (1)

Table AII-2-6 LUBRICATING OIL AND BASE OIL PRICES/CIF THAILAND AND FOB SINGAPORE (1975 - 1983)

		CIF Thailand								FOB Singapore
	Exchange Rate	Lubricating Oil				Base Oil				Lubricating Oil
	(Baht/US$)	kl	1,000 Baht	1,000 US$	US$/kl	kl	1,000 Baht	1,000 US$	US$/kl	(US$/kl)
1975	20.355	62,885	335,525	16,484	262.1	0	0	0	-	195.51
1976	20.375	78,393	433,562	21,279	271.4	0	0	0	-	219.16
1977	20.375	64,757	431,486	21,177	327.0	96,894	416,030	20,419	210.7	247.66
1978	20.315	64,045	366,045	18,019	281.3	71,696	309,784	15,249	212.7	268.77
1979	20.450	54,514	352,464	17,235	316.2	106,797	586,681	28,689	268.6	302.53
1980	20.590	29,190	292,492	14,206	486.7	132,029	1,074,607	52,191	395.3	492.81
1981	23.050	31,508	309,670	13,435	426.4	127,883	1,286,997	55,835	436.6	569.27
1982	23.050	52,060	615,196	26,690	512.7	78,480	849,603	36,859	469.7	527.60
1983										491.77

Sources: Oil and Thailand 1982, Singapore Trade Statistics

Table AII-2-7 BASE OIL PRICES BY TYPE/FOB SINGAPORE (1979 - 1984)

Year	Date	Arab Light (US$/BBL)	US Cent/gallon			US$/kl		
			150N	500N	150BS	150N	500N	150BS
1979	Jan.1	13.339	71.75	75.75	89.25	189.6	200.1	235.8
1979	Apr.1	14.546	76.75	81.25	95.00	202.8	214.7	251.0
1979	Jul.1	18.000	86.25	91.25	104.75	227.9	241.1	276.8
1979	Oct.1	18.000	106.00	111.50	124.50	280.1	294.6	328.9
1980	Jan.1	26.000	112.75	118.50	133.00	297.9	313.1	351.4
1980	Apr.1	28.000	129.50	143.50	161.50	342.1	379.1	426.7
1980	Jul.1	28.000	134.00	150.00	169.00	354.0	396.3	446.5
1980	Oct.1	30.000	134.00	150.00	169.00	354.0	396.3	446.5
1981	Jan.1	32.000	141.00	158.25	179.00	372.5	418.1	472.9
1981	Apr.1	32.000	154.50	173.25	195.50	408.2	457.7	516.5
1981	Jul.1	32.000	148.50	167.75	191.25	392.3	443.2	505.3
1981	Oct.1	34.000	148.50	167.75	191.25	392.3	443.2	505.3
1982	Jan.1	34.000	142.50	162.25	186.25	376.5	428.7	492.1
1982	Apr.1	34.000	142.50	162.25	186.25	376.5	428.7	492.1
1982	Jul.1	34.000	136.00	155.75	179.50	359.3	411.5	474.2
1982	Oct.1	34.000	133.50	152.25	176.00	352.7	402.2	465.0
1983	Jan.1	34.000	133.50	152.25	176.00	352.7	402.2	465.0
1983	Apr.1	29.000	129.00	147.75	171.50	340.8	390.4	453.1
1983	Jul.1	29.000	129.00	147.75	171.50	340.8	390.4	453.1
1983	Oct.1	29.000	129.00	147.75	171.50	340.8	390.4	453.1
1984	Jan.1	29.000	129.00	147.75	171.50	340.8	390.4	453.1

Source: Platt's Oilgram Price Report

Table AII-2-8   RELATION BETWEEN PETROLEUM PRODUCT PRICES AND CRUDE OIL PRICE

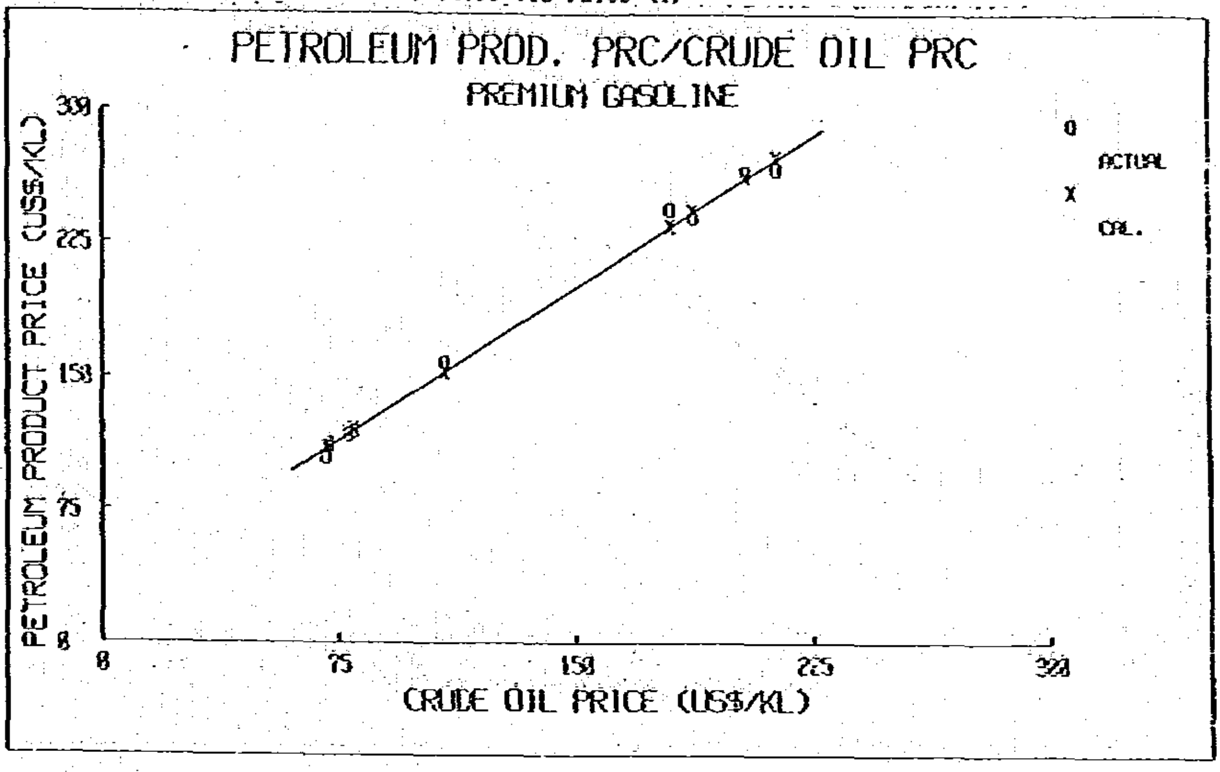
Regression Formula: y = a + b x
Where: y = Petroleum Product Thai Ex-refinery Price or FOB Singapore Price
x = Arab Light-34 FOB Ras Tanura Price
rr, r = Correlation Factor

	a	b	rr	r
Thai Ex-refinery Price				
Premium Gasoline	27.63160	1.152100	0.995441	0.997718
Regular Gasoline	20.10320	1.192650	0.989346	0.994659
Kerosene	-1.62640	1.360530	0.997914	0.998956
High Speed Diesel	0.41000	1.283850	0.997623	0.998811
Low Speed Diesel	-2.86441	1.278470	0.997243	0.998621
Fuel Oil 600"	7.29460	0.915455	0.991692	0.995837
Fuel Oil 1200"	8.00183	0.876861	0.989137	0.994554
Fuel Oil 1500"	8.30884	0.863767	0.988217	0.994091
Bitumen	-4.29613	0.915636	0.968501	0.984125
Bitumen *1	5.79817	0.876861	-	-
FOB Singapore Price				
Base Oil 150N	72.64960	1.441770	0.921062	0.959720
Base Oil 500N	48.35320	1.800550	0.923277	0.960873
Base Oil 150BS	59.52410	2.041200	0.923220	0.960844

Notes: 1. Thai Ex-refinery Price: See Table II-10.
FOB Singapore Price: See Table II-13.
Crude Oil Price (Arab Light-34 FOB Ras Tanura): See Tables II-10, Table AII-2-1.

*1 Adjusted by using equation of Fuel Oil 1200" and Bitumen price in 1975.

Figure AII-2-1 RELATION BETWEEN PETROLEUM PRODUCT EX-REFINERY PRICE AND CRUDE OIL PRICE (1)



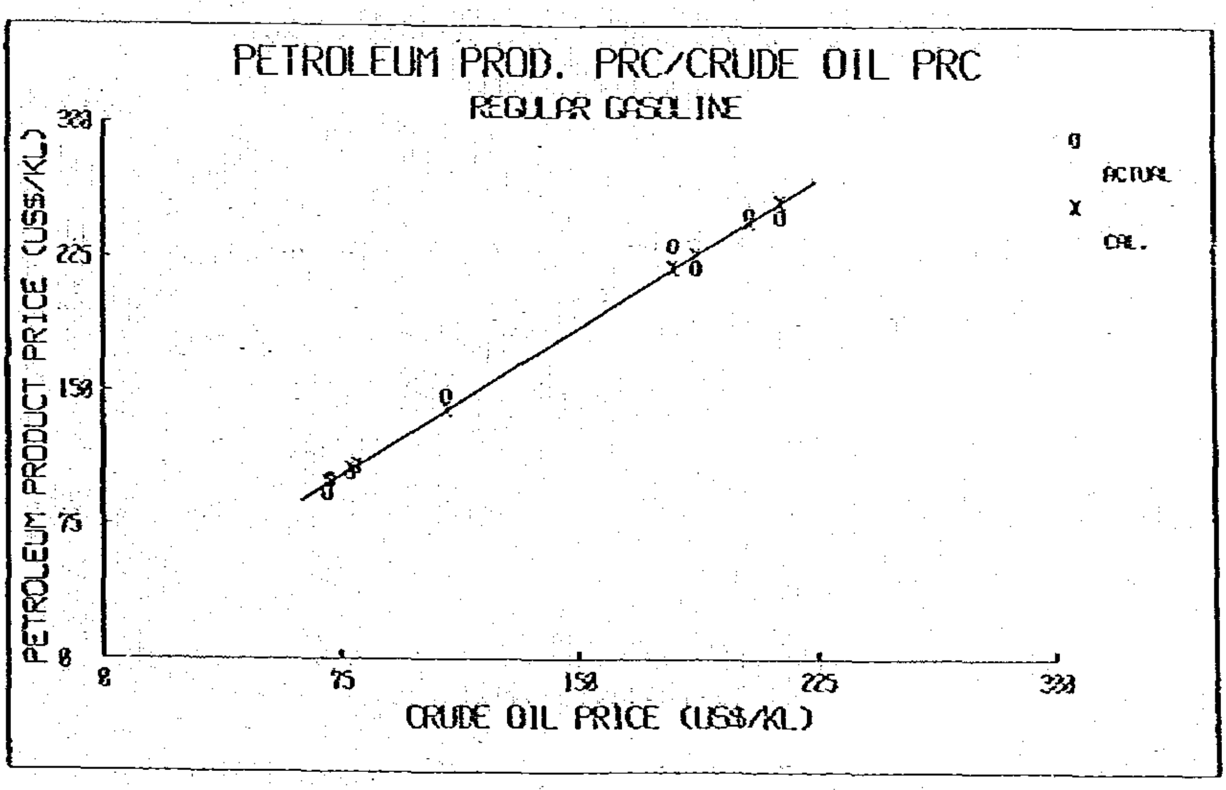


Figure AII-2-1 RELATION BETWEEN PETROLEUM PRODUCT EX-REFINERY PRICE AND CRUDE OIL PRICE (2)

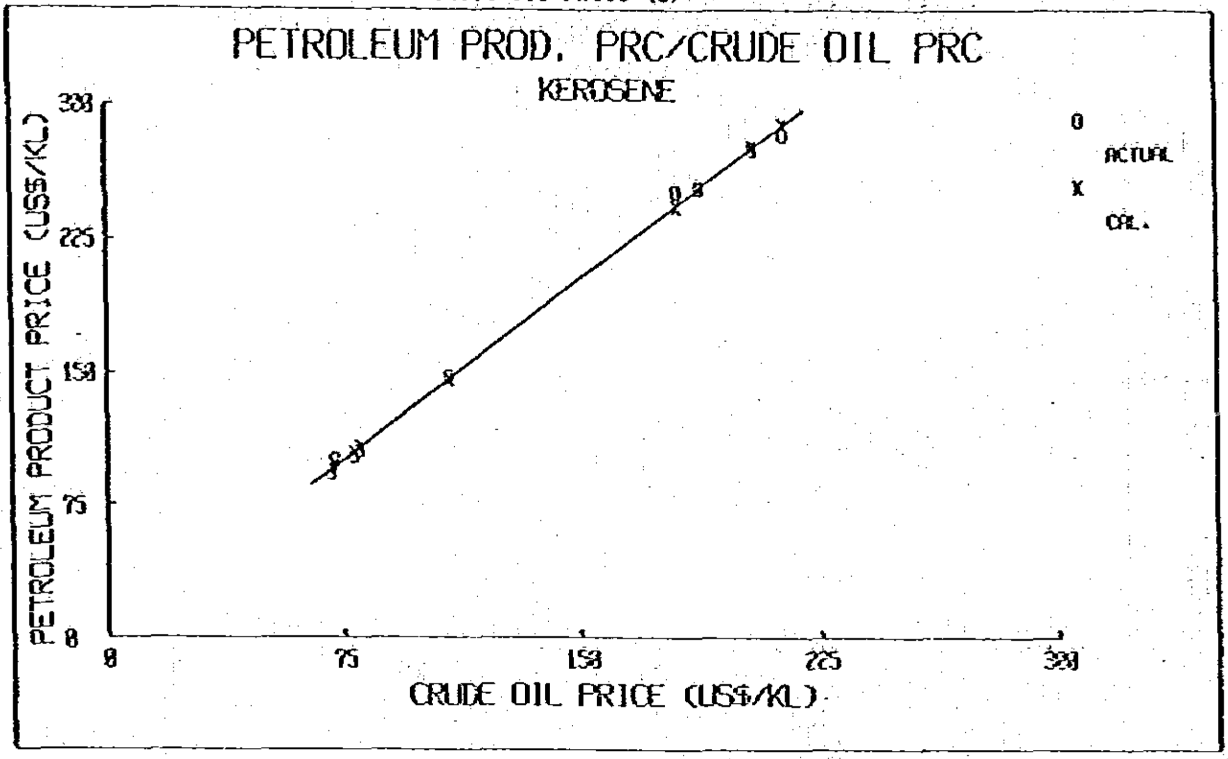
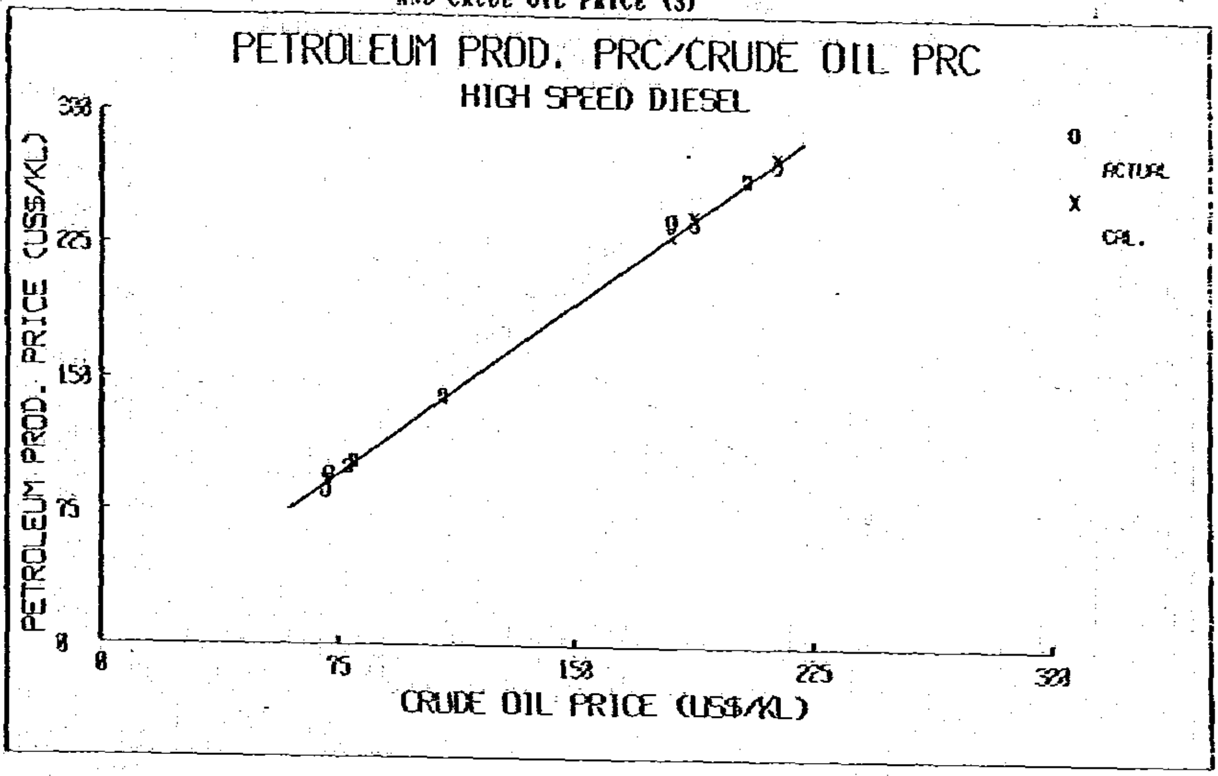


Figure AII-2-1 RELATION BETWEEN PETROLEUM PRODUCT EX-REFINERY PRICE AND CRUDE OIL PRICE (3)



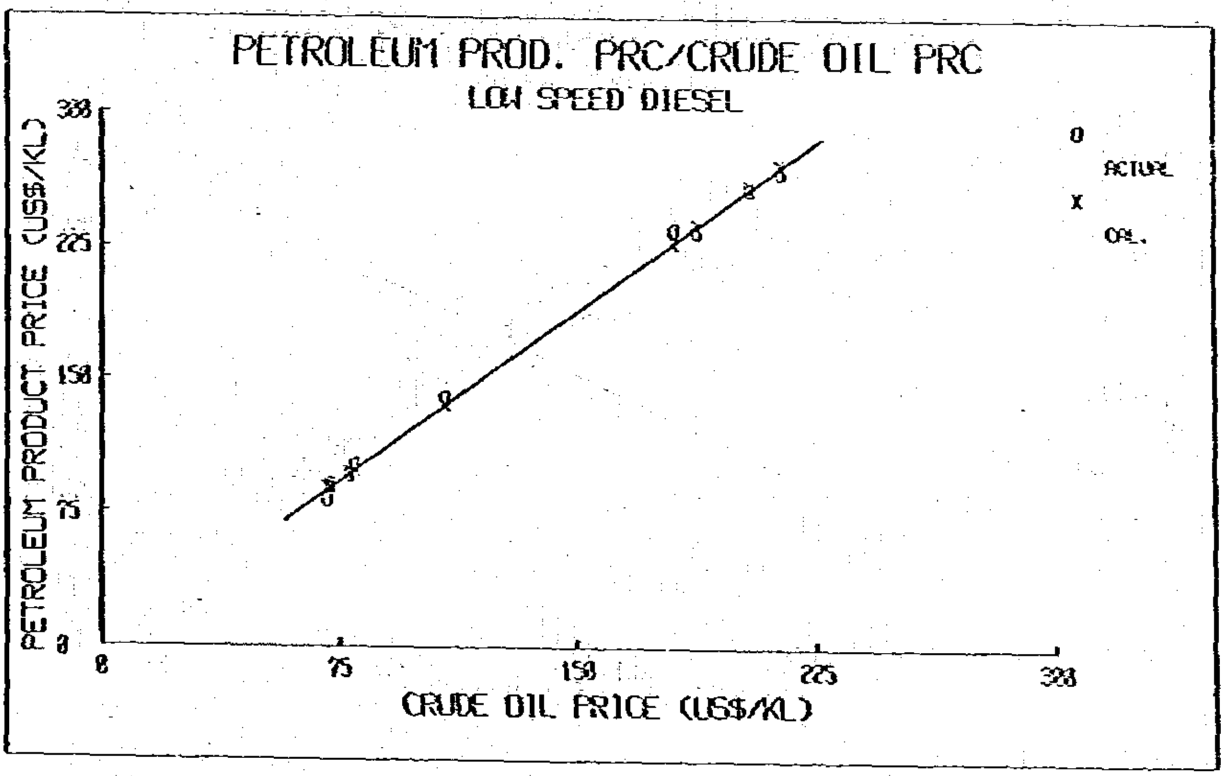
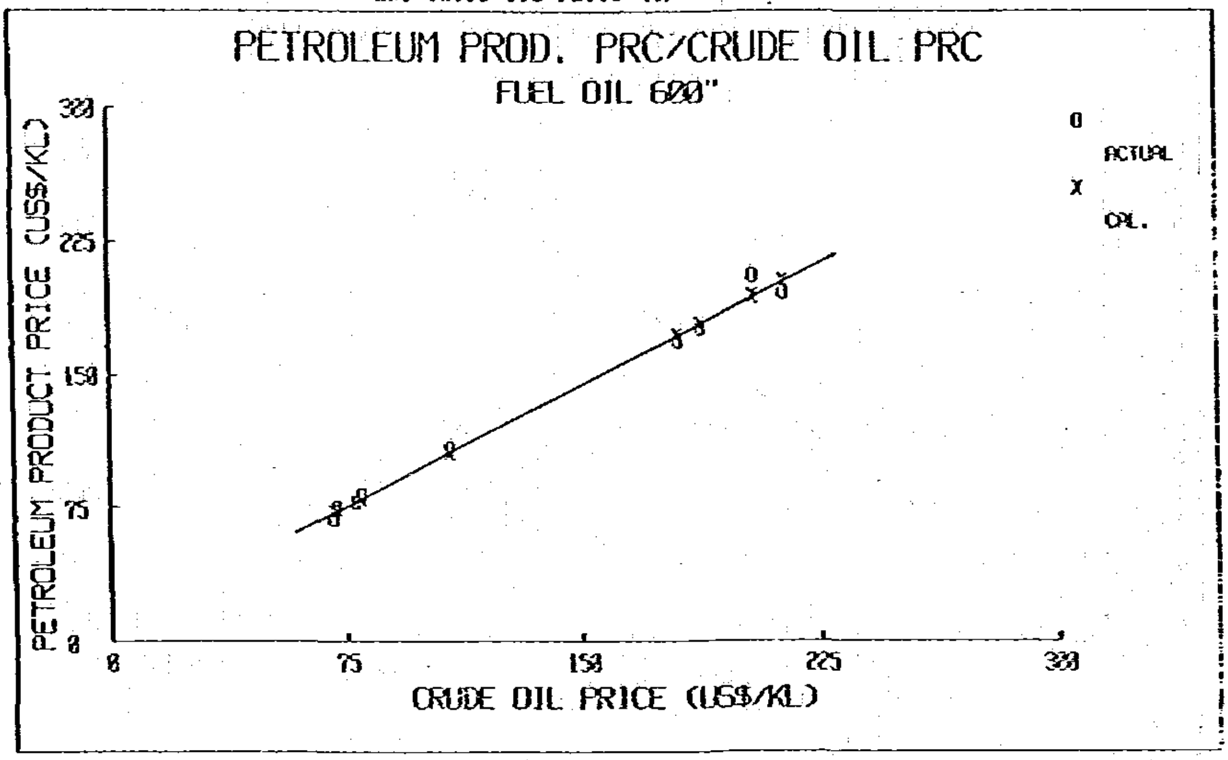


Figure AII-2-1 RELATION BETWEEN PETROLEUM PRODUCT EX-REFINERY PRICE AND CRUDE OIL PRICE (4)



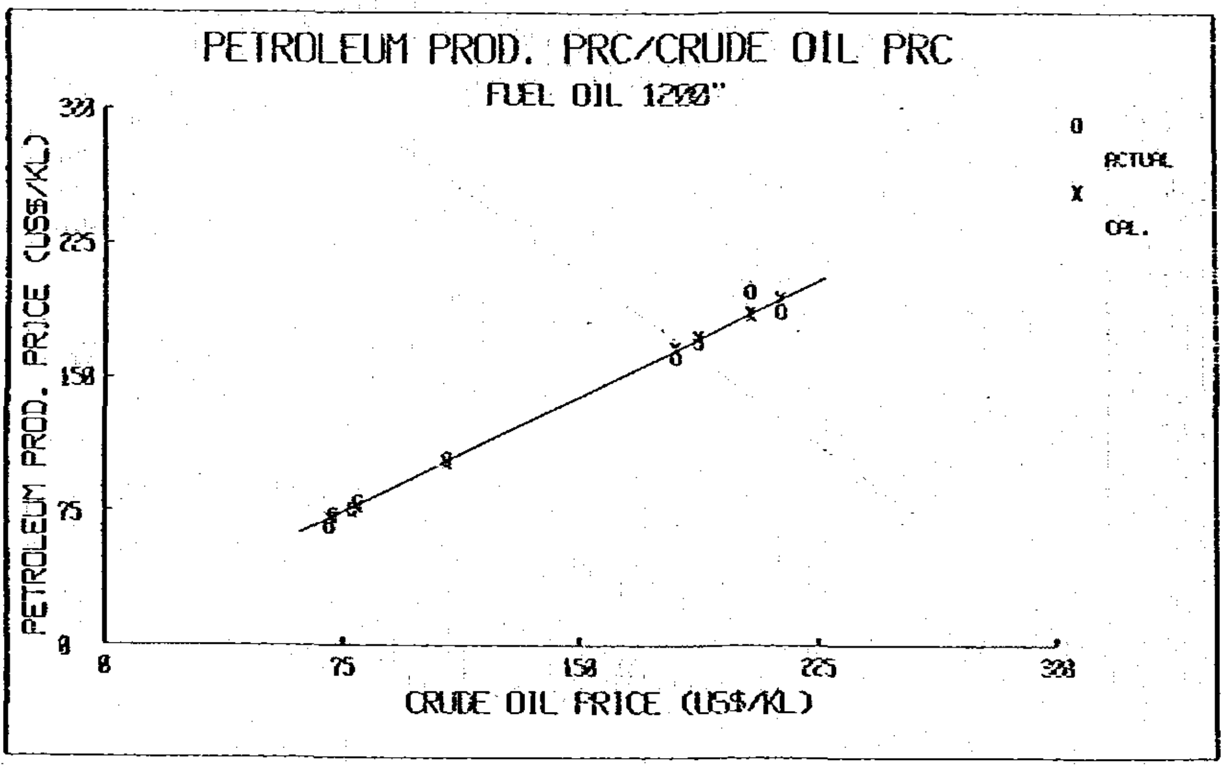
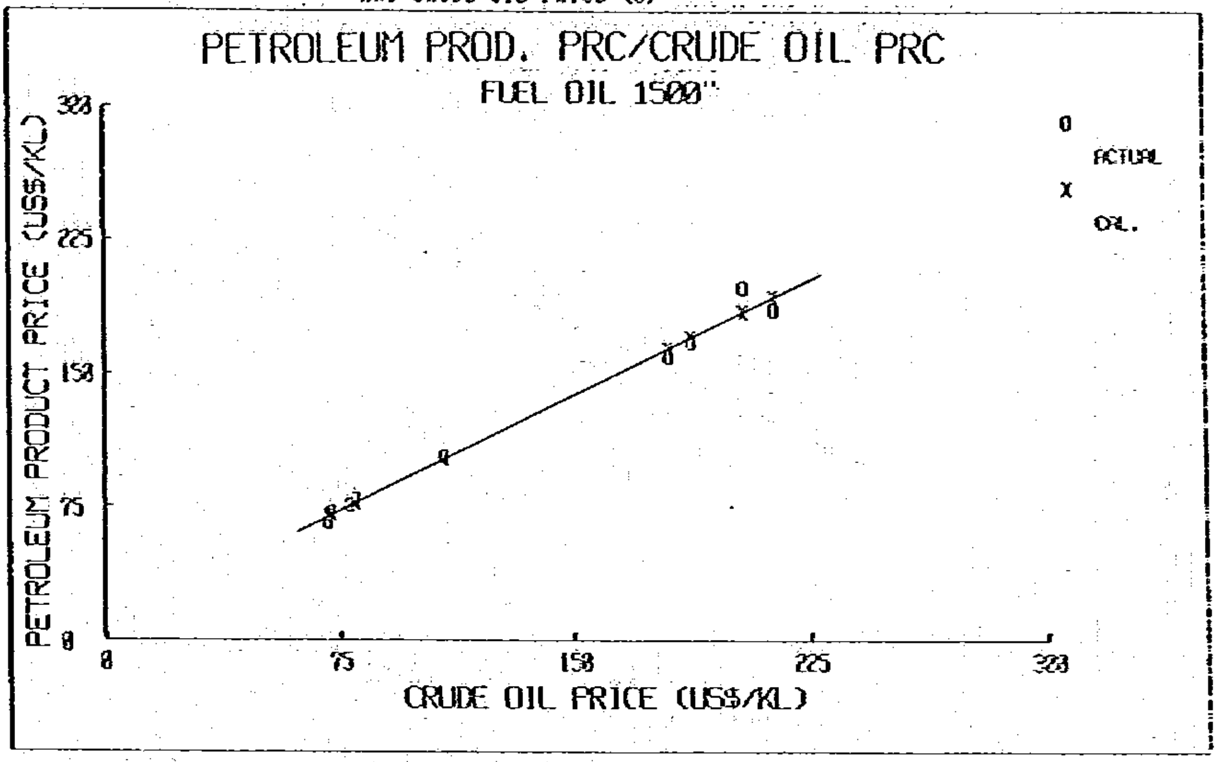


Figure AII-2-1 RELATION BETWEEN PETROLEUM PRODUCT EX-REFINERY PRICE AND CRUDE OIL PRICE (5)



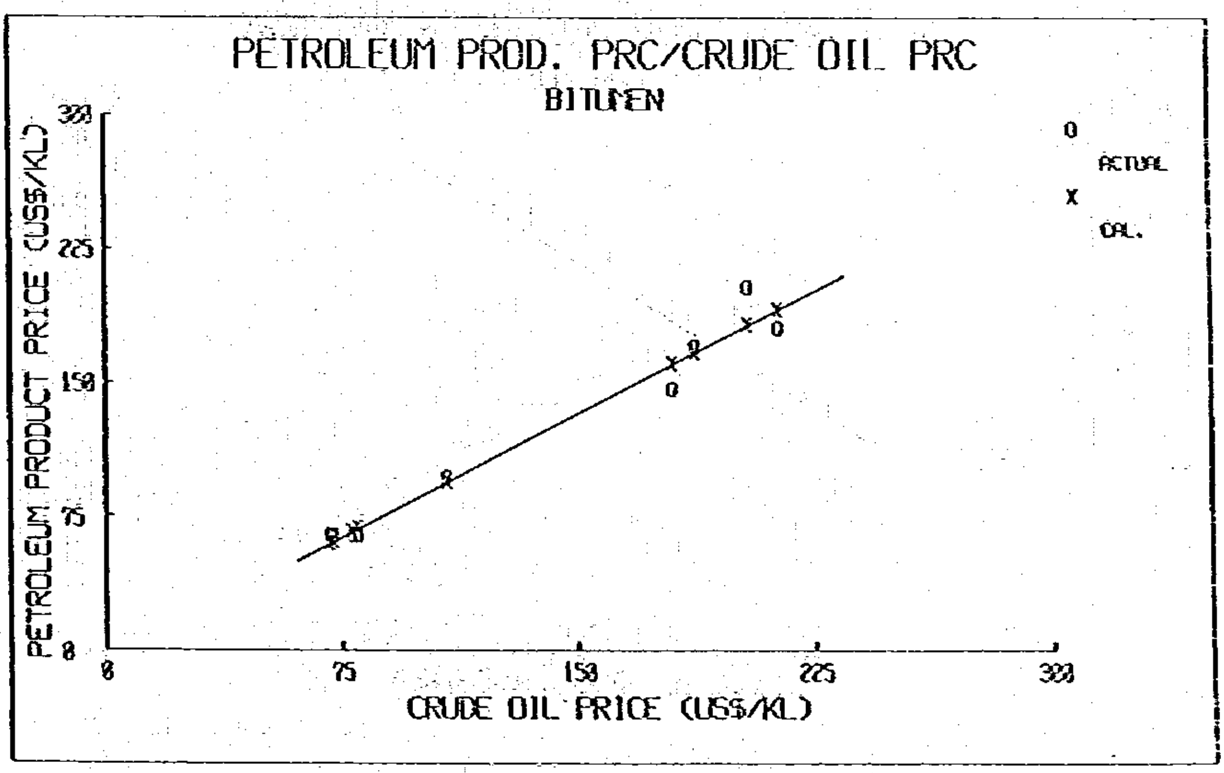
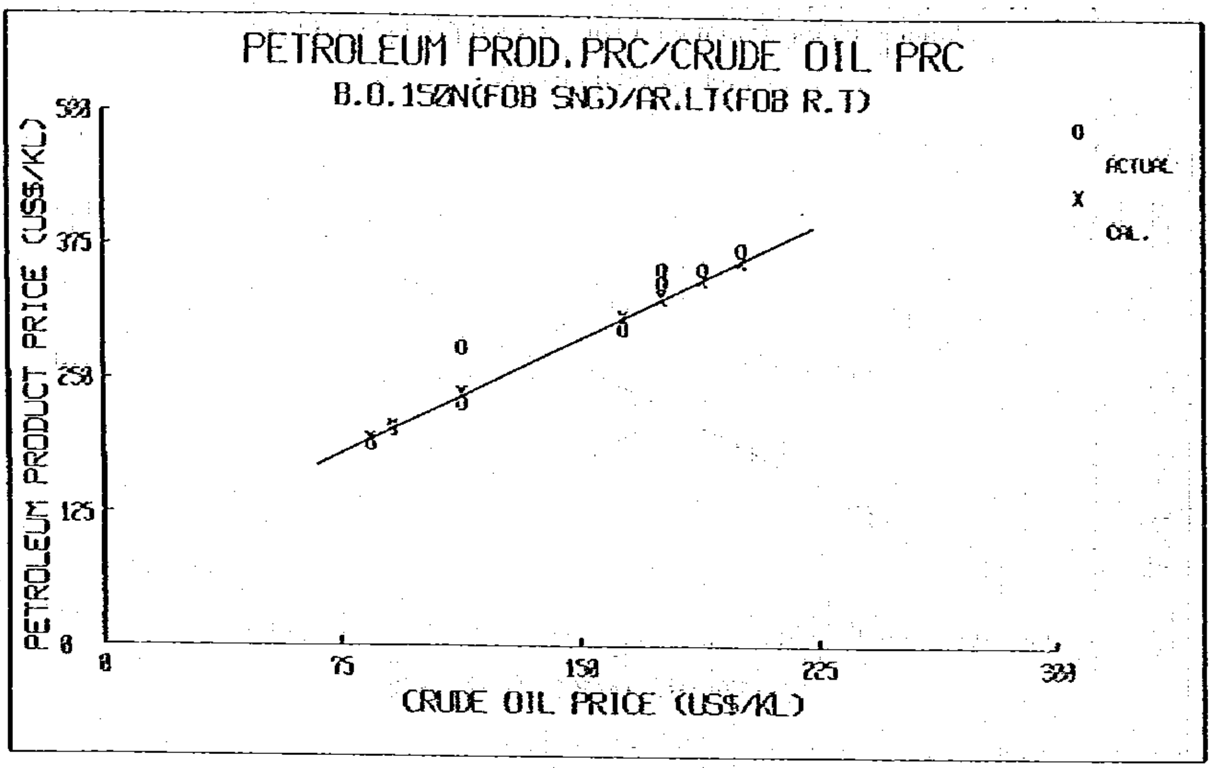


Figure AII-2-2 RELATION BETWEEN PETROLEUM PRODUCT FOB SINGAPORE AND CRUDE OIL PRICE (1)



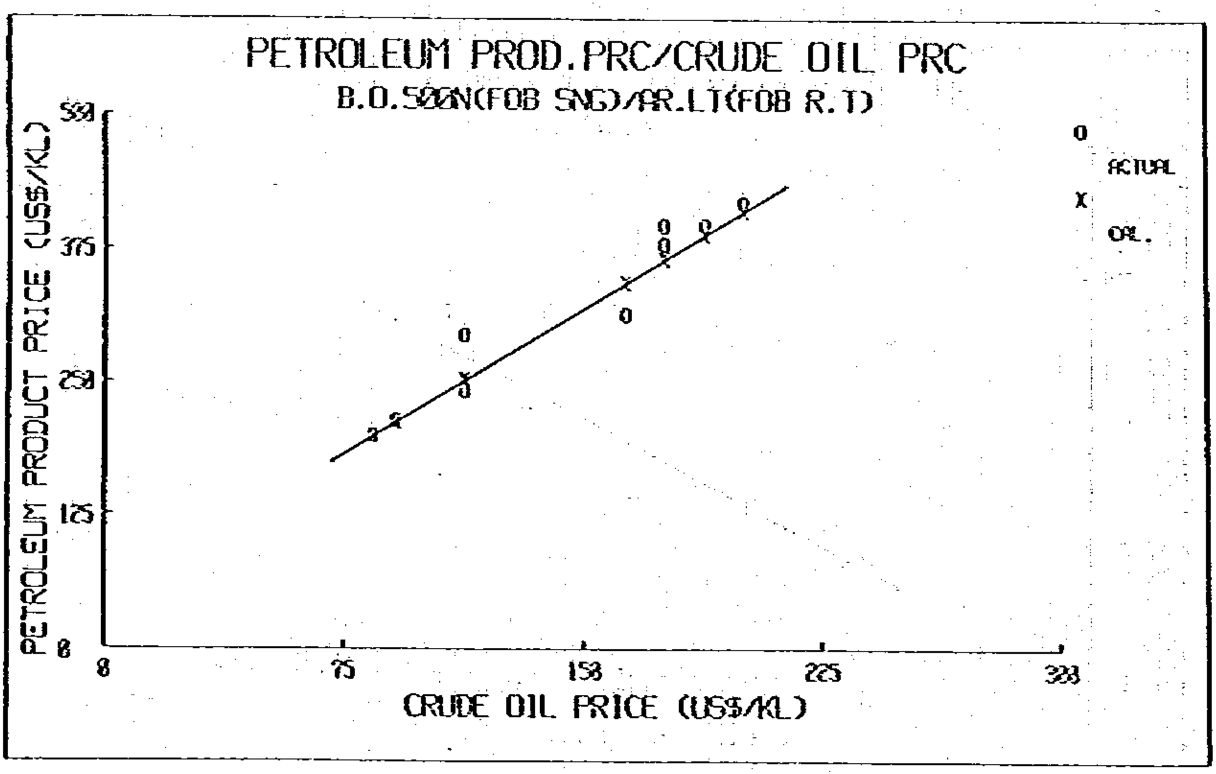


Figure AII-2-2 RELATION BETWEEN PETROLEUM PRODUCT FOB SINGAPORE AND CRUDE OIL PRICE (2)

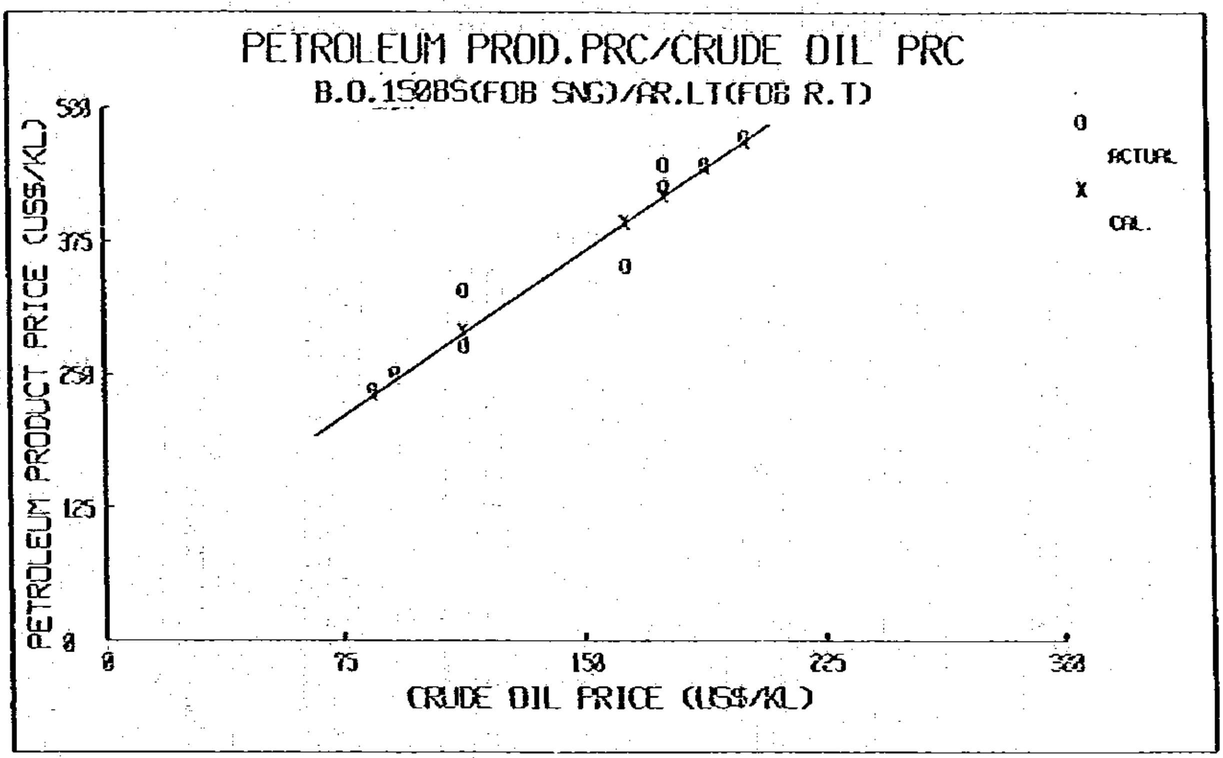


Table AII-2-9 PROJECTED BASE OIL PRICES/FOB SINGAPORE (1984 - 2010)

(Unit: US$/kl)

Year	Arab Lt. (US$/kl)	60S	150N	300N	500N	150BS
1984	182.40	326.1	335.6	355.7	376.8	431.8
1985	182.40	326.1	335.6	355.7	376.8	431.8
1986	182.40	326.1	335.6	355.7	376.8	431.8
1987	197.94	347.8	358.0	382.1	404.8	463.6
1988	214.73	371.3	382.2	410.6	435.0	497.8
1989	232.97	396.9	408.5	441.6	467.8	535.1
1990	252.78	424.7	437.1	475.3	503.5	575.5
1991	274.29	454.8	468.1	511.8	542.2	619.4
1992	297.57	487.5	501.7	551.4	584.1	666.9
1993	322.85	522.8	538.1	594.4	629.7	718.5
1994	350.34	561.4	577.8	641.2	679.2	774.6
1995	380.09	603.1	620.7	691.7	732.7	835.4
1996	412.42	648.3	667.3	746.6	790.9	901.4
1997	447.45	697.4	717.8	806.2	854.0	972.9
1998	485.50	750.7	772.6	870.8	922.5	1050.5
1999	526.76	808.5	832.1	941.0	996.8	1134.7
2000	571.55	871.2	896.7	1017.2	1077.5	1226.2
2001	620.10	939.2	966.7	1099.7	1164.9	1325.3
2002	672.81	1013.1	1042.7	1189.3	1259.8	1432.9
2003	730.05	1093.2	1125.2	1286.5	1362.8	1549.7
2004	792.06	1180.1	1214.6	1391.9	1474.5	1676.3
2005	859.42	1274.4	1311.7	1506.4	1595.8	1813.8
2006	932.45	1376.8	1417.0	1630.6	1727.3	1962.8
2007	1011.70	1487.8	1531.3	1765.3	1870.0	2124.6
2008	1097.68	1608.3	1655.3	1911.4	2024.8	2300.1
2009	1191.02	1739.0	1789.8	2070.0	2192.8	2490.6
2010	1292.22	1880.7	1935.7	2242.1	2375.1	2697.2

Table AII-2-10 PROJECTED FREIGHT RATE OF BASE OIL, SINGAPORE - THAILAND (1984 - 2010)

(Unit: US$/kl)

Year	Escalation Rate	60S	150N	300N	500N	150BS
1983 *1		15.00	15.00	15.00	15.00	15.00
S.G. *2		0.864	0.865	0.879	0.885	0.900
1983 *3		12.96	12.98	13.19	13.28	13.50
1984	1.0000	12.96	12.98	13.19	13.28	13.50
1985	1.0000	12.96	12.98	13.19	13.28	13.50
1986	1.0000	12.96	12.98	13.19	13.28	13.50
1987	1.0600	13.74	13.76	13.98	14.08	14.31
1988	1.1236	14.56	14.58	14.82	14.92	15.17
1989	1.1910	15.44	15.46	15.71	15.82	16.08
1990	1.2625	16.36	16.39	16.65	16.77	17.04
1991	1.3383	17.34	17.37	17.65	17.77	18.07
1992	1.4186	18.39	18.41	18.71	18.84	19.15
1993	1.5037	19.49	19.52	19.83	19.97	20.30
1994	1.5939	20.66	20.69	21.02	21.17	21.52
1995	1.6895	21.90	21.93	22.28	22.44	22.81
1996	1.7909	23.21	23.25	23.62	23.78	24.18
1997	1.8984	24.60	24.64	25.04	25.21	25.63
1998	2.0123	26.08	26.12	26.54	26.72	27.17
1999	2.1330	27.64	27.69	28.13	28.33	28.80
2000	2.2610	29.30	29.35	29.82	30.03	30.52
2001	2.3967	31.06	31.11	31.61	31.83	32.36
2002	2.5405	32.92	32.98	33.51	33.74	34.30
2003	2.6929	34.90	34.95	35.52	35.76	36.35
2004	2.8545	36.99	37.05	37.65	37.91	38.54
2005	3.0258	39.21	39.27	39.91	40.18	40.85
2006	3.2073	41.57	41.63	42.30	42.59	43.30
2007	3.3997	44.06	44.13	44.84	45.15	45.90
2008	3.6037	46.70	46.78	47.53	47.86	48.65
2009	3.8199	49.51	49.58	50.38	50.73	51.57
2010	4.0491	52.48	52.56	53.41	53.77	54.66

Notes: *1 US$/MT
*2 Specific Gravity
*3 US$/kl

ANNEX III

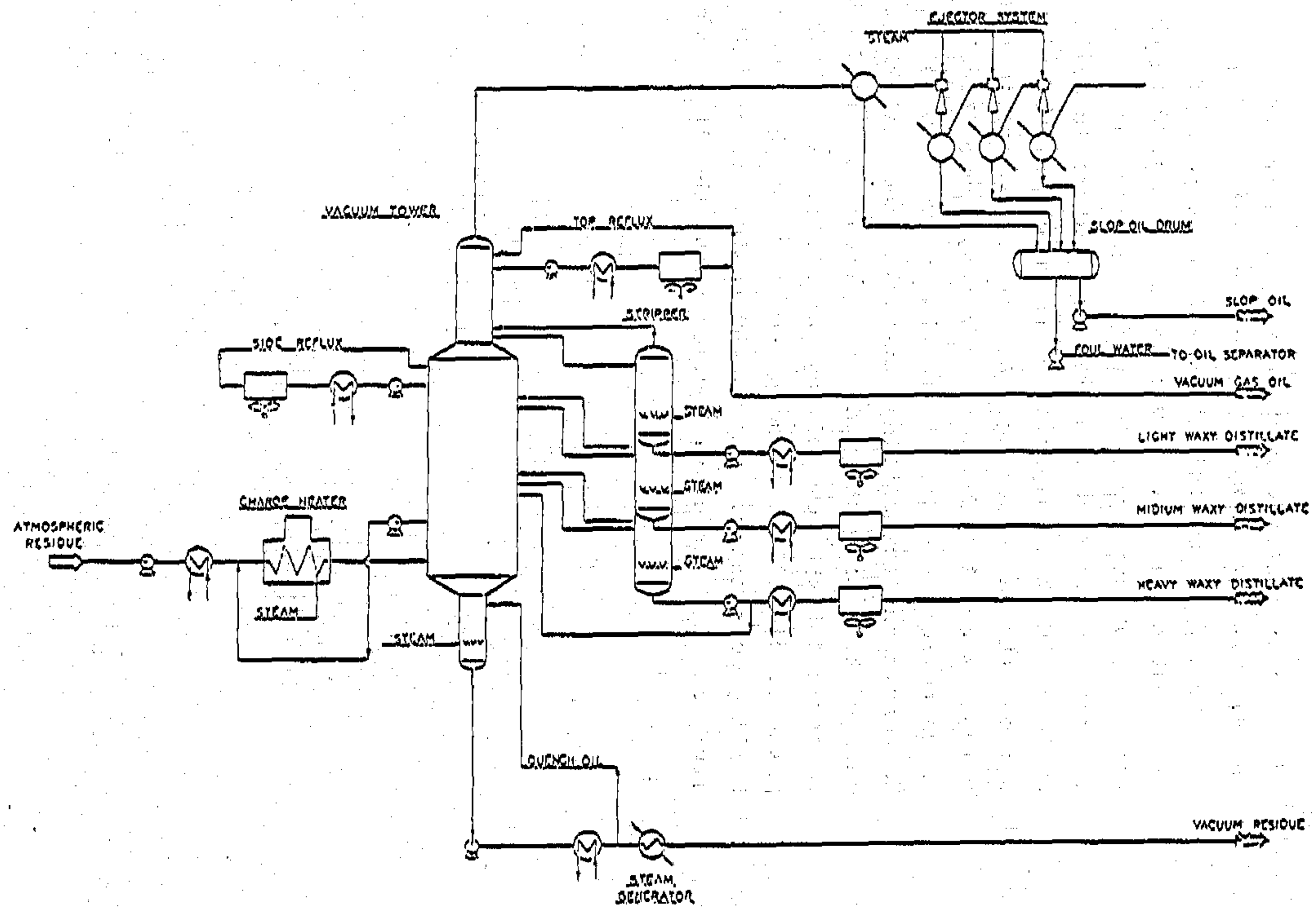
ANNEX III-1

PROCESS FLOW SCHEME

(1) Vacuum Distillation Unit (Figure III-1-1)

The feed atmospheric residue is heated in the furnace and flow into the flash zone of the column. The steam is injected to the coil in the furnace to assist the vaporization of oil. A vacuum is maintained in the flash zone by a vacuum system connected to the top of the column. By reducing the pressure, materials boiling up to 550°C at atmospheric pressure can be vaporized without thermal cracking. At various points in the column, special trays (draw off trays) are installed which collect the distillate and remove from the column. To remove the low boiling materials, the distillate is charged to a side stripper where steam is introduced to strip out the low boiling materials. The flash point of distillate is adjusted by removing these low boiling components. The vacuum residue is also steam stripped in a stripping section below the flash zone.

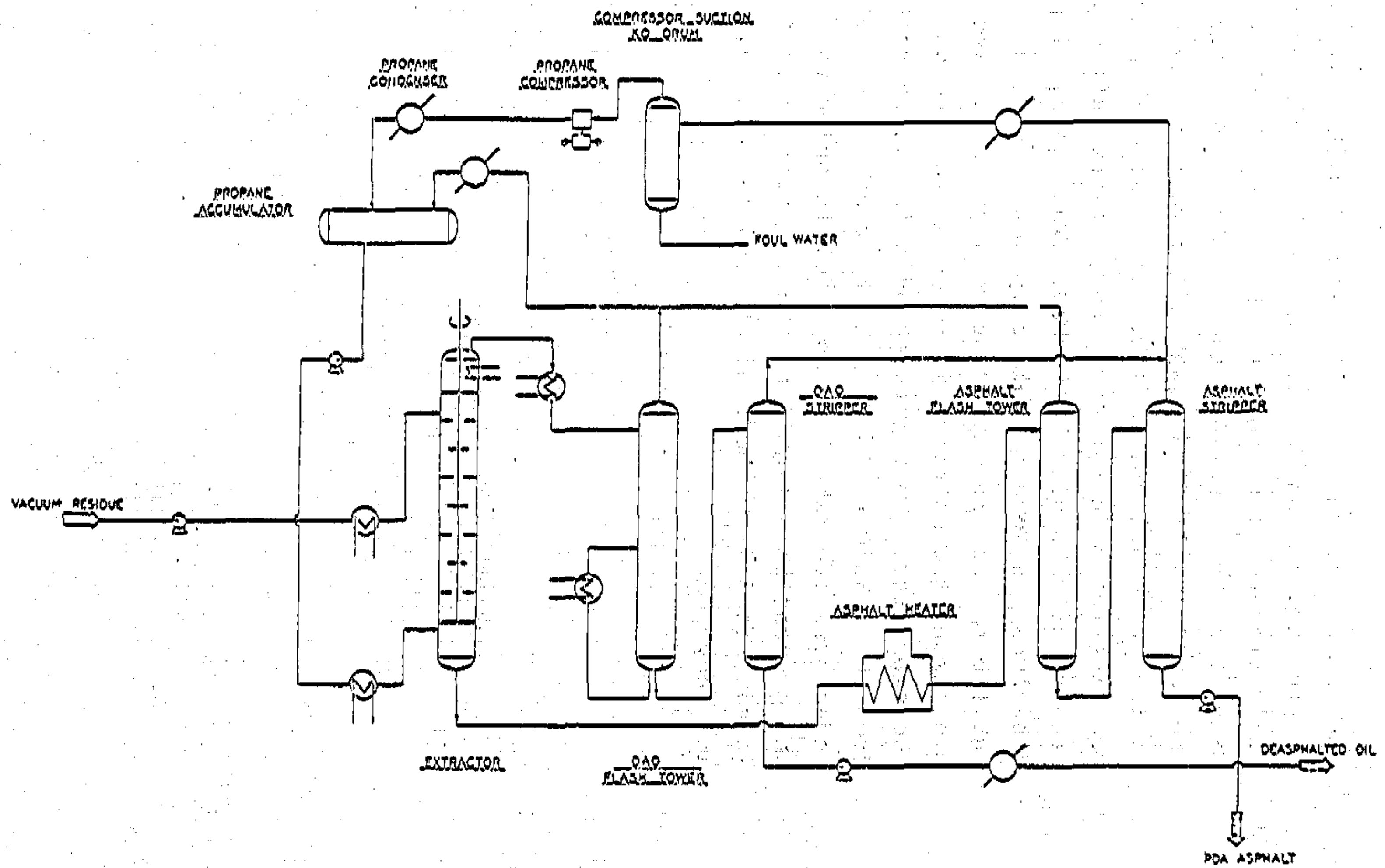
Figure III-1-1 SIMPLIFIED PROCESS FLOW SCHEME FOR VACUUM DISTILLATION UNIT



(2) Propane Deasphalting Unit (Figure III-1-2)

The vacuum residue, usually diluted with a small amount of propane, is charged to the middle of the extractor, while propane is charged to the bottom of the extractor. Since the vacuum residue is more dense than the propane, the residue will flow down the extractor, the propane rising up in a counter flow. The mixing is provided by some internals in the extractor, either baffle plates or a rotor with discs attached. The rising propane dissolves the more soluble components which are carried out the top of the extractor with propane. The insoluble, asphaltic material is removed from the bottom of the extractor. Temperatures used in the extractor range from about 50°C to 80°C. The extractor must be operated under pressure (about 35 kg/cm^2G) in order to maintain the propane as a liquid at the temperature used. Propane is vaporized from the products and is then recovered and recycled.

Figure III-1-2 SIMPLIFIED PROCESS FLOW SCHEME FOR PROPANE DEASPHALTING UNIT

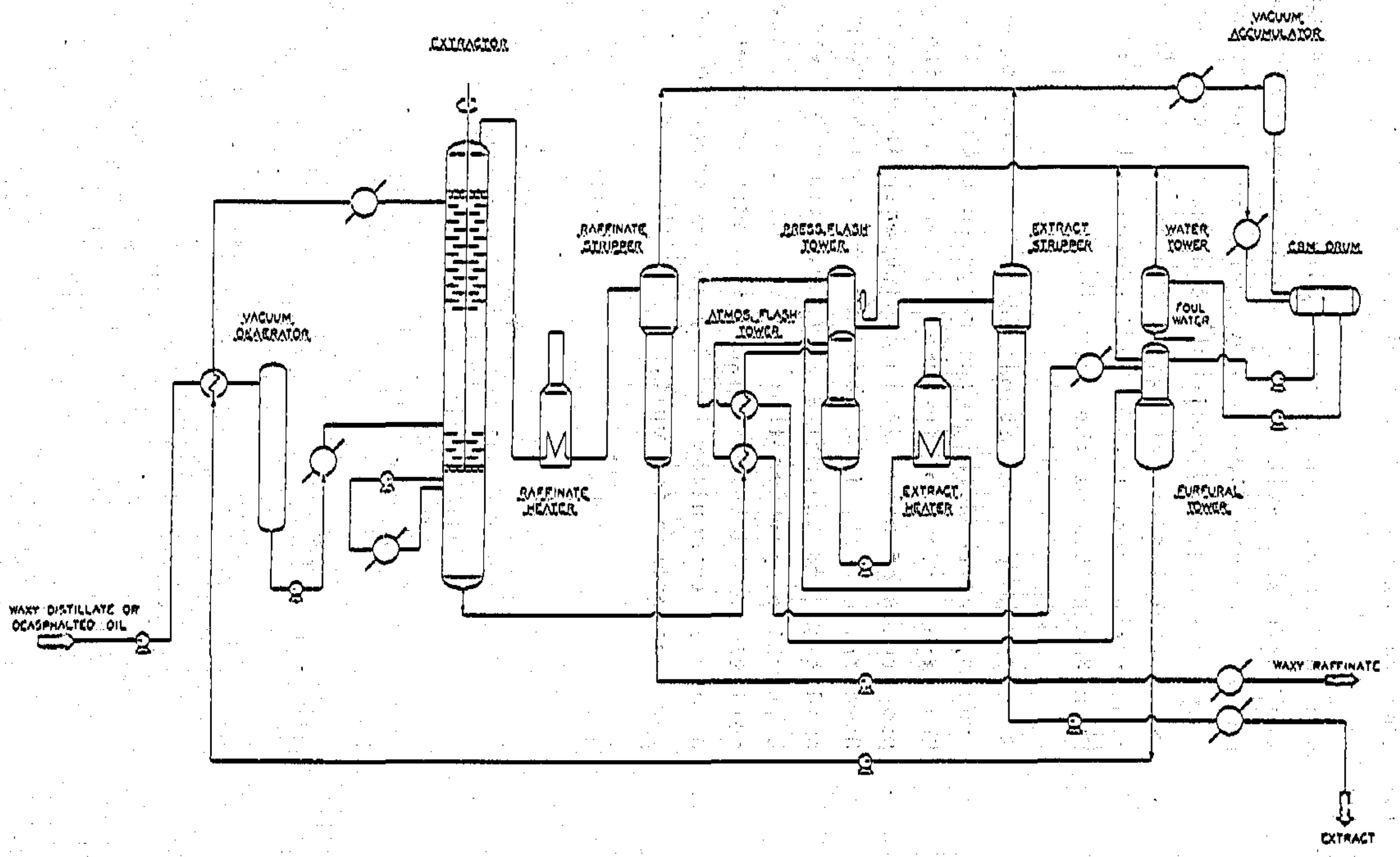


(3) Furfural Extraction Unit (Figure III-1-3)

The feed is charged to the middle of the extractor, the furfural near the top. The density difference causes a counterflow in the extractor; the downward flowing furfural dissolves the aromatic compounds. The furfural raffinate rises and is removed from the top of the extractor. The furfural extract is removed from the bottom of the extractor.

Each of the product is passes to its solvent recovery system, the furfural being recycled back to the extractor. The major effect of furfural extraction on the physical properties of base oil is an increase in viscosity index. However, equally important are the improvements of oxidation and thermal stability, although there is no physical properties that can be related to these characteristics. Therefore viscosity index is sometimes used as a meas to monitor the day to day operations of a furfural extraction unit.

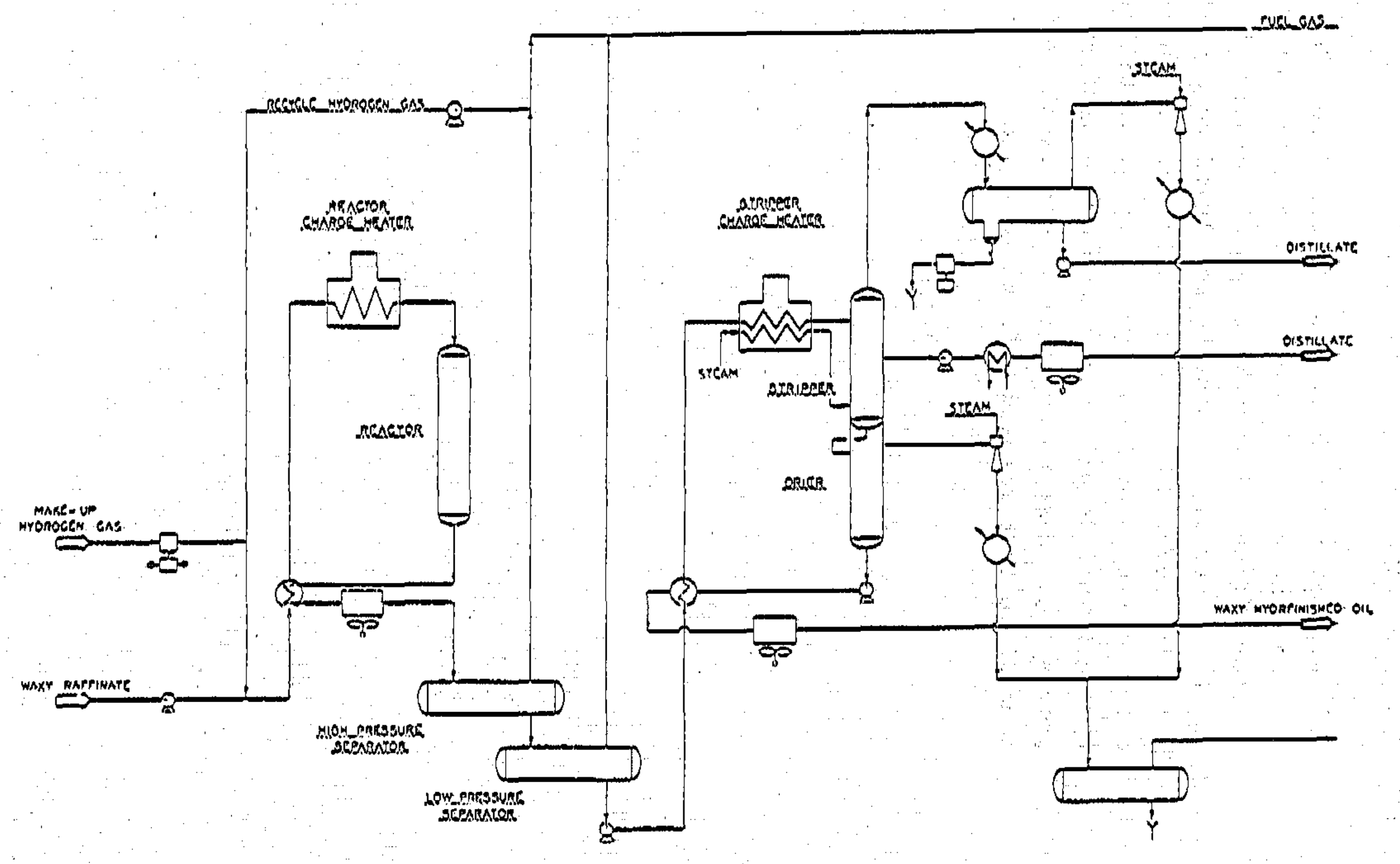
Figure III-1-3 SIMPLIFIED PROCESS FLOW SCHEME FOR FURFURAL EXTRACTION UNIT



(4) Hydrofinishing Unit (Figure III-1-4)

The feed oil and recycle gas are combined and preheated, and the mixture is passed through the reactor. The reactor effluent is separated into hydrofinished oil and a gas stream, consisting mostly of unreacted hydrogen which is recycled back to the reactor. The hydrofinished oil is stripped of light hydrocarbons, distillate, and hydrogen sulfide and pumped to storage or further processing. Make-up hydrogen is constantly added to compensate that reacted with the oil and solution loss.

Figure III-1-4 SIMPLIFIED PROCESS FLOW SCHEME FOR HYDROFINISHING UNIT



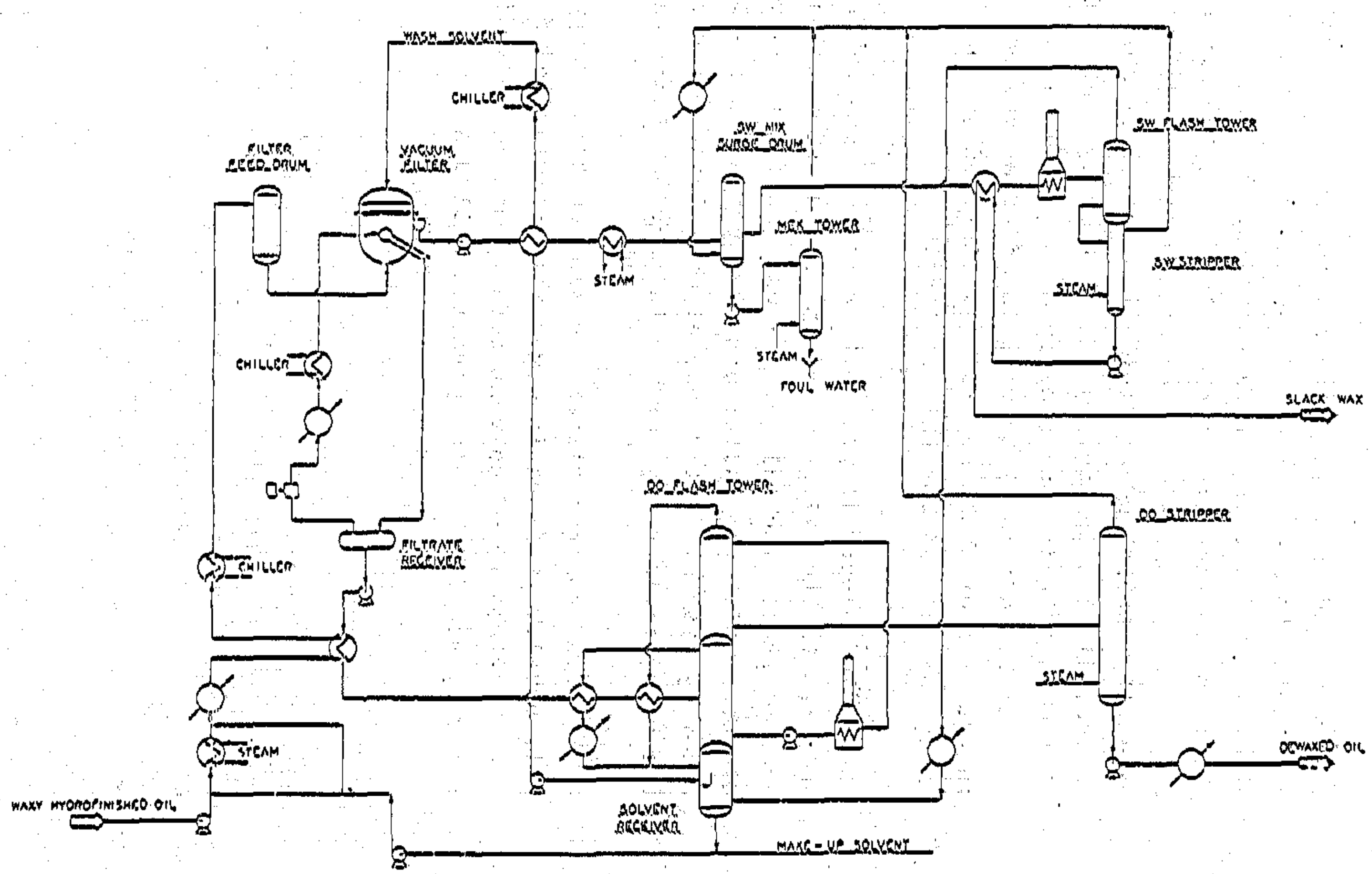
(5) MBK Dewaxing Unit (Figure III-1-5)

The waxy feed, hydrofinished oil is mixed with solvent and heated to a temperature high enough to dissolve all waxes. The purpose of this step is to dissolve all the crystals that are in the oil so that the crystals that will be separated at the filter are formed under carefully controlled conditions. The solution is then cooled, first with cooling water, then by heat exchange with cold filtrate and finally by a refrigerant. In some cases additional solvent is added at various points in the step of chilling process. Scraped surface exchangers are used for this cooling.

The cooled slurry is passed to a filter feed surge drum and them to the filter where the actual separation is accomplished. The oil and solvent are filtrated continuously with the filter and then pumped to a solvent recovery system. After removal of solvent for recycle, the base oil is ready for use in many applications.

As the wax from the filter contains certain amount of oil, usually it is again mixed with solvent and filtrated for the recovery of solvent before pumping to a solvent recovery section. This operation called a repulping.

Figure III-1-5 SIMPLIFIED PROCESS FLOW SCHEME FOR MEK DEWAXING UNIT



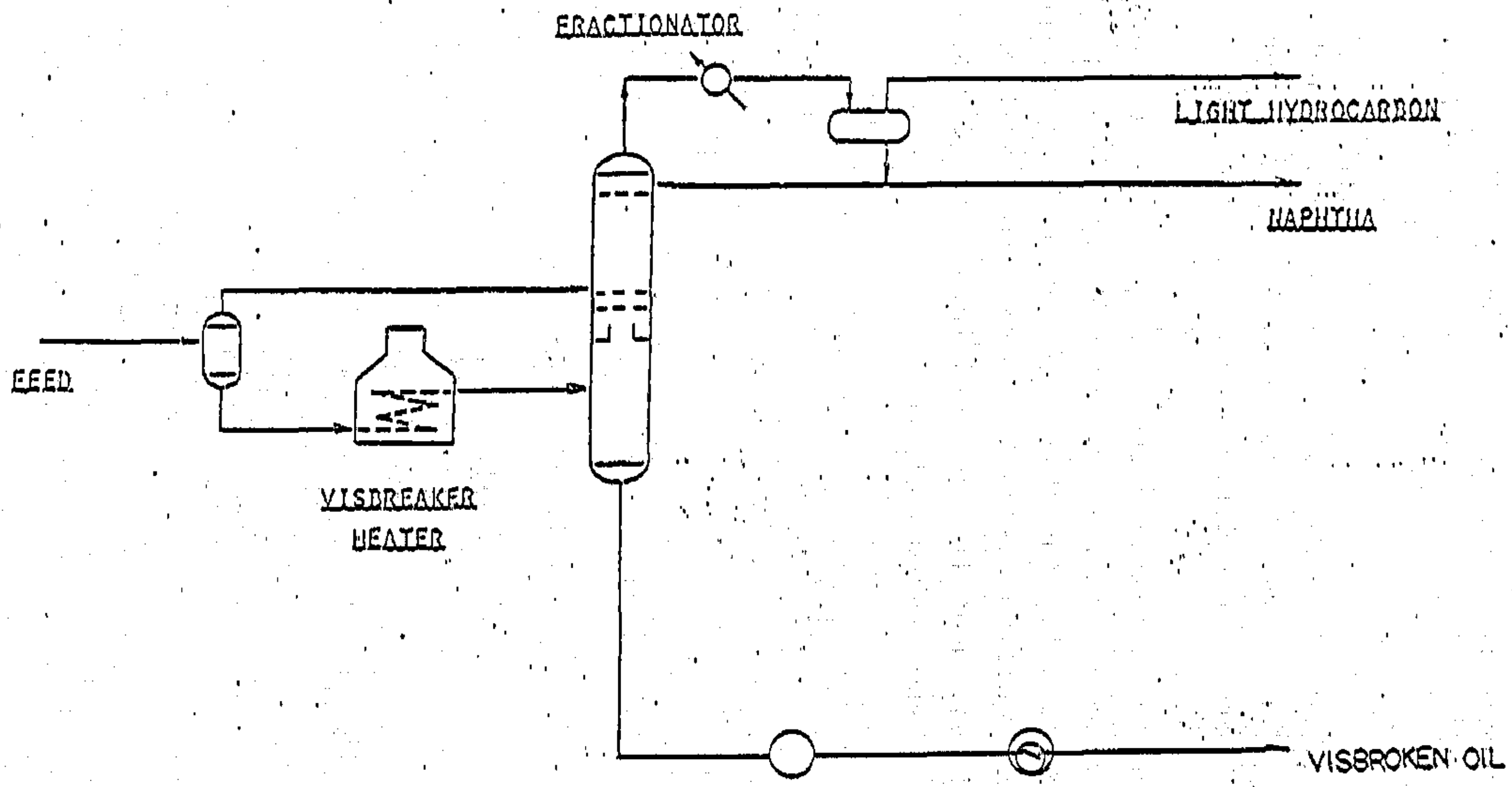
(6) Visbreaking Unit (Figure III-1-6)

The feedstock is pumped by the Visbreaker Heater Charge Pump and preheated by exchange with fractionator bottom product.

The preheated feedstock is charged to Visbreaker Heater where the visbreaking is carried out under specified conditions or residence time and temperature.

In the fractionator system. there are some provisions such as overhead reflux, steam stripping system and bottom circuits involving quenching, heat recovery and rundown cooling systems. By the above systems, the heater effluent is separated into the off gas, cracked naphtha and visbroken oil.

FIGURE III-1-6 SIMPLIFIED PROCESS FLOW SCHEME OF VISBREAKING PROCESS

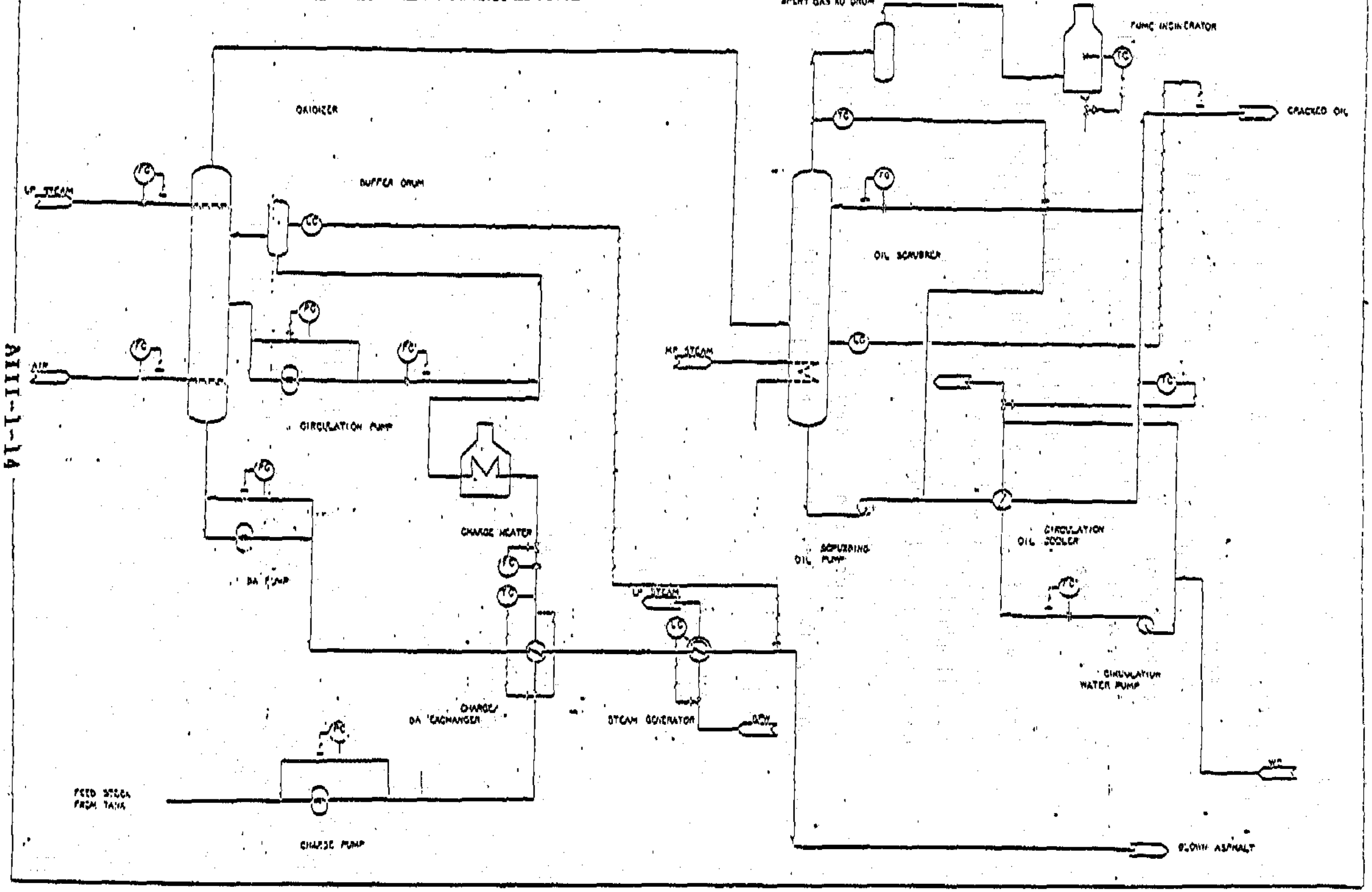


(7) Asphalt Blowing Unit (Figure III-1-7)

The mixed feed asphalt is charged to the oxidizer after being heated up to the specified reaction temperature via heat exchanger and charge heater. Air required for reaction is introduced into the oxidizer under flow rate control. The product asphalt is drawn from the bottom of the oxidizer and run down to the tankage after being heat recovered and cooled down. The overhead vapor from the oxidizer is sent to the oil scrubber for recovery of oil fraction contained. The recovered oil is cooled down, a part of it is used as a scrubbing oil, and sent to the storage.

The oil scrubber overhead vapor consisting of combustible gases, steam and unused air is burned in the fume incinerator.

FIGURE III-1-7 SIMPLIFIED PROCESS FLOW SCHEME FOR ASPHALT BLOWING UNIT



ANNEX III-2

MAJOR EQUIPMENT LIST

(1) Vacuum Distillation Unit

Vacuum Tower
L't Waxy Distillate Stripper
Med. Waxy Distillate Stripper
H'y Waxy Distillate Stripper
Slop Oil Drum
Vacuum Charge Heater
Sour Water Stripper
Sour Water Surge Drum
Acid Gas KO Drum

(2) Propane Deasphalting Unit

Extractor
DAO Flash Tower
DAO Stripper
Asphalt Flash Tower
Asphalt Stripper
Propane Accumulator
Compressor Suction KO Drum
Blowdown Drum
Surge Drum
Propane Compressor
Asphalt Heater

(3) Furfural Extraction Unit

Extractor
Raffinate Stripper
Raffinate Flash Tower
Extract Stripper
Extract Atmos. Flash Tower
Extract Press. Flash Tower
Furfural Tower
Water Tower
CBM Drum
Vacuum Accumulator
Furfural Tank
Inert Gas Holder

(4) Hydrofinishing Unit

Reactor
Stripper
Dryer
MEA Absorber
MEA Regenerator
High Pressure Separator
Low Pressure Separator
Hot Well Drum
Surge Drum
Make-up Gas Suction Drum
Recycle Gas Suction Drum
MEA Regenerator Reflux Drum
Fresh MEA Tank
Reactor Charge Heater
Stripper Charge Heater

(6) MEK Dewaxying Unit

DO Atmos. Flash Tower
DO Press. Flash Tower
DO Stripper
SW Atmos. Flash Tower
SW Press. Flash Tower
SW Stripper
MEK Tower
Filter Feed Drum
Filterate Receiver
Solvent Receiver
SW Mix Surge Drum
DO Mix Surge Drum
Propane Compressor Suction Drum
Propane Receiver
Inert Gas Holder
Solvent Tank
Charge Mix Chiller
Charge Mix Exchanger

Propane Compressor
Vacuum Pump
Rotary Vacuum Filter

(6) Visbreaking Unit

Fractionator
Feed Surge Drum
Fractionator Overhead Receiver
Visbreaker Heater
Decoking Pit

(7) Asphalt Blowing Unit

Oxidizer
Oil Scrubber
Buffer Drum
Spent Gas KO Drum
Air Blower
Charge Heater
Fume Incinerator

(8) Hot Oil System

Hot Oil Expansion Drum
Fuel Gas KO Drum
Hot Oil Heater

(9) Sulfur Recovery Unit

Reactor
Main Burner
Line Burner
Incinerator
Air Blower

ANNEX III-3

CODES AND STANDARDS

A. CRUDE OIL PIPELINE

ANSI B31.4	US Standard Code for Liquid Petroleum Transportation Piping System
ANSI B16.5	Forged Flanges
ANSI B16.9	Welding Fittings
MSS SP44	Large Diameter Flanges
API RP-5L1	Recommended Practice for Railroad Transportation of Line Pipe
API STD 1104	Standard for Welding Pipelines and Related Facilities
API SPEC 6D	Specification of Pipeline Valves
API RP-500C	Recommended Practice for Classification of Areas for Electrical Installation at Petroleum and Gas Pipeline Transportation Facilities
API RP-1102	Recommended Practice for Liquid Petroleum Crossing Railroads and Highways
API RP-1100	Recommended Practice for Pressure Testing of Liquid Petroleum Pipelines
API RP-1109	Recommended Practice for Marking Petroleum Pipeline Facilities
DOT PART 195	Minimum Federal Safety Standards for Liquid Pipelines
API 5L	API Specification for Line Pipe
API 5LX	API Specification for High - Test Line Pipe

B. REFINERY AND MARINE FACILITIES

1 Standards for Tanks and Pressure Vessels

1)	JPI	Japanese Petroleum Institute
2)	API 650	Welded Steel Tanks for Oil Storage
3)	API 620	Design and Construction of Large Welded, Low-Pressure Storage Tanks
4)	ANSI B96.1	Welded Aluminum-Alloy Field-Erected Storage Tanks
5)	ASME	Boiler and Pressure Vessel Code Sect. VIII div. 1 & 2
6)	ASME	Sect. I Power Boilers Sect. II Material Specification Sect. IV Low Pressure Heating Boilers Sect. IX Welding Qualifications
7)	API 2550	Method for Measurement and Calibration of Upright Cylindrical Tank
8)	BS 1515	Pressure Vessels for Chemical Petroleum and Allied Industries
9)	DIN	Deutscher Normenausschus
10)	AD - Merkblatt	
11)	TRD	Technische Regal für Damptkessel
12)	BS 1500	Pressure Vessels

2 Rotating Equipment Standards

1)	API 610	Centrifugal Pumps for General Refinery Services
2)	API 611	General-Purpose Steam Turbines for Refinery Services
3)	API 612	Special-Purpose Steam Turbines for Refinery Services
4)	API 613	High-Speed, Special-Purpose Gear Units for Refinery Services
5)	API 615	Mechanical-Drive Steam Turbines for General Refinery Services
6)	API 616	Combustion Gas Turbines for General Refinery Services
7)	API 617	Centrifugal Compressors for General Refinery Services
8)	API 618	Reciprocating Compressors for General Refinery Services
9)	ASME PTC 7.1	Displacement Pumps
10)	ASME PTC 8.2	Centrifugal Pumps
11)	ASME PTC 9	Displacement Compressor, Vacuum Pumps and Blowers
12)	ASME PTC 10	Centrifugal Compressor

3 Heat Exchanger Standards

Shell and Tube Heat Exchangers

1) TEMA Class R

2) API 660 — Heat Exchanger for General Refinery Services

Air-Cooled Heat Exchangers

1) API 661 — Air-Cooled Heat Exchangers for General Refinery Services

4 Instrumentation Standards

1)	API RP500A	Recommended Practice for Classification of Areas for Electrical Installations in Petroleum Refineries
2)	API RP550	Manual on Installation of Refinery Instruments and Control Systems
3)	API 1101	Measurement of Petroleum Liquid Hydrocarbons by Positive Displacement Meter
4)	API 2000	Venting Atmospheric and Low Pressure Storage Tanks
5)	API 2545	Method of Gauging Petroleum and Petroleum Products
6)	API RP500C	Recommended Practice for Classification of Areas for Electrical Installation at Petroleum and Gas Pipe Line Transportation Facilities
7)	API 2531	Mechanical Displacement Meter Provers
8)	ANSI C1	National Electrical Code (NEC) (NFPA NO. 70)
9)	NEMA	National Electrical Manufacturers Association
10)	NFPA 493	Intrisically Safe Process Control Equipment for Use in Hazardous Location
11)	NFPA 496	Purged Enclosures for Electrical Equipment
12)	IEC	International Electro Technical Commission

5 Electrical Standards

1)	NEC	The National Electrical Code
2)	API RP500A	Recommended Practice for Classification of Areas for Electrical Installations in Petroleum Refineries
3)	API RP540	Recommended Practice for Electrical Installation in Petroleum Refineries
4)	API RP2003	Recommended Practice for Protection Against Ignitions Arising Out of Static, Lighting and Stray Currents
5)	NEMA	National Electrical Manufacturers Association Standares
6)	NFPA 493	Standard for Intrisically Safe Process Control Equipment for Use in Hazardous Location
7)	NFPA 496	Standard for Purged and Ventilated Enclosures for Electrical Equipment in Hazardous Locations
8)	API RP500C	Recommended Practice for Classification of Areas for Electrical Installation at Petroleum and Gas Pipeline Transportation Facilities

6 Structural, Building, and Foundation Standards

1)	ACI	American Concrete Institute
2)	AISC	American Institute of Steel Construction
3)	AIJ	Architectural Institute of Japan
4)	JASS	Japanese Architectural Standard Specification
5)	CEIJ	Civil Engineer Institute of Japan

7 Mechanical Equipment Standard

1) CTI Cooling Tower Institute

8 Fire Fighting Standard

1) NFPA — The National Fire Protection Assn.

9 Piping Standards and Codes

1)	ANSI B31.3	US Standard Code for Petroleum Refinery Piping System
2)	ANSI B31.4	US Standard Code for Liquid Petroleum Transportation Piping System
3)	ANSI B16.5	Forged Flanges
4)	ANSI B16.9	Welding Fittings
5)	MSS SP44	Large Diameter Flanges
6)	API 5L	Specification for Line Pipe
7)	API 5LX	Specification for High-Test Line Pipe
8)	API RP5L1	Recommended Practice for Railroad Transportation of Line Pipe
9)	API SP6D	Spcification of Pipeline Valves
10)	API RP1110	Recommended Practice for Pressure Testing of Liquid Petroleum Pipelines
11)	API RP1102	Recommended Practice for Liquid Petroleum Crossing Railroads and Highways
12)	API RP1109	Recommended Practice for Marking Petroleum Pipeline Facilities
13)	DOT Part 195	Minimum Federal Safety Standards for Liquid Pipelines
14)	PFI	Pipe Fubrication Institute

15)	API 1104	Standard for Welding Pipelines and Related Facilities
16)	ANSI B31.1	Power Piping
17)	ANSI B31.5	Refrigeration Piping
18)	ANSI A21.10	Cast Iron Fittings, 2 inch through 48 inch, for Water Other Liquid
19)	ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings, 25, 125, 250, and 800 lb.
20)	ANSI B16.10	Face-to-Face and End-to-End Dimensions of Ferrous Valves
21)	ANSI B16.11	Forged Steel Fittings, Socket Welding and Threaded
22)	ANSI B16.34	Steel Buttwelding End Valves
23)	API 526	Flanged Steel Safety Relief Valves
24)	API 595	Cast-Iron Gate Valves, Flanged Ends
25)	API 599	Steel Plug Valves
26)	API 600	Steel Gate Valves, Flanged or Buttwelding End
27)	API 601	Metallic Gaskets for Refinery Piping, Double-Jaketed Corrugated and Spiral Work
28)	API 602	Small Carbon Steel Gate Valves, Compact Design
29)	API 604	Ductile Iron Gate Valves, Flanged Ends

30)	API 605	Large Diameter Carbon Steel Flanges (Size; 26 inch to 60 inch inclusive; Nominal Pressure Rating: 75, 150, and 300 lb.)
31)	API 609	Butterfly Valves, to 150 psig and 150 F
32)	MSS SP43	Wrought Stainless Steel Buttwelding Fittings
33)	MSS SP58	Pipe Hangers & Supports-Materials and Design
34)	ANSI B2.1	Pipe Threads (Except Dryseal)
35)	ANSI B16.20	Ring-Joint Gaskets and Grooves for Steel Pipe Flanges
36)	ANSI B16.21	Non-Matallic Gaskets for Pipe Flanges
37)	ANSI B16.25	Buttwelding Ends for Pipe, Valves, Flanges, and Fittings
38)	API 1105	Bulletin on Construction Practices for Oil and Products Pipelines
39)	API 2201	Welding or Hot Tapping on Equipment Containing Flammables
40)	ASME	Boiler and Pressure Vessel Code, Section VIII Pressure Vessels-Division1, Section VIII Alternate Rules for Pressure Vessels-Division2, and Section IX, Welding Qualifications
41)	NACE RP-01-69	Recommended Practice-Control of External Corrosion on Underground or Submerged Metallic Piping Systems
42)	NFPA 30	Flammable and Combustible Liquids Code

43)	JPI-7S-1-65	Steel Butt Welding Fittings for Special Piping Use
44)	JPI-7S-2-65	Steel Butt Welding Fittings for Ordinary Piping Use
45)	JPI-7S-3-65	Steel Socket Welding Fittings for Special Piping Use
46)	JPI-7S-4-71	Asbestos-Sheets for Petroleum Industry
47)	JPI-7S-14-61	Electric-Arc-Welded Carbon Steel Pipes for Petroleum Industry
48)	JPI-7S-15-70	Steel Pipe Flanges for The Petroleum Industry
49)	JPI-7S-16-72	Non-Metallic Gaskets Dimension for Petroleum Industry
50)	JPI-7S-18-62T	Mortar-Lining Steel Pipe for Ordinary Piping
51)	JPI-7S-23-72	Ring-Joint Gaskets and Grooves for Petroleum Industry
52)	JPI-7S-24-74	Standard Marking System for Valves
53)	JPI-7S-31-71	Welder Performance Qualification
54)	JPI-7S-36-75	Cast and Forged Steel Small Valves for the Petroleum Industry (Class 600, Threaded or Socket-Welding Ends)
55)	JPI-7S-37-65	Standard for Flanged Cast-Iron Outside Screw Gate Valves

56)	JPI-7S-39-74	Valve Inspection and Test
57)	JPI-7S-41-70	Spiral Wound Gaskets for Petroleum Industry
58)	JPI-7S-43-72	Large Diameter Carbon Steel Flanges for Petroleum Industry
59)	JPI-7S-46-74	Cast Steel Flanged Valves for the Petroleum Industry (Class 150, 300)
60)	JPI-7S-47-74	Cast Steel Valves for the Petroleum Industry Flanged or Buttwelding Ends (Class 600 to 2500)
61)	JPI-7S-48-74	Flanged Ball Valves for the Petroleum Industry

10 Building Mechanical Facilities Standards

1)	ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
2)	ANSI	American National Standard Institute

11 Safety Standards, Codes and Practices for Plant Design

1)	IP	The Institute of Petroleum
2)	NFPA	National Fire Protection Association
3)	OSHA	Occupational Safety and Health Administration

12 Materials Standards

1)	ASTM	American Society for Testing and Materials
2)	JIS	Japanese Industrial Standards
3)	BS	British Standards Institution
4)	DIN	Deutscher Normenausschus

13 Analytical Methods for Waste Water

1) ASTM Standards Part 31 Water

2) WHO Standards for Drinking Water

14 Fired Heaters Standards

1)	AISC	Design, Fabrication and Erection of Structural Steel for Building
2)	ASME	Pressure Vessel Section VIII Div. 1
3)	ANSI B31.3	Petroleum Refinery Piping
4)	ASTM	American Society for Testing and Materials
5)	API RP 530	Recommended Practice for Calculation of Heater Tube Thickness in Petroleum Refineries
6)	API Std 630	Tube and Header Dimensions for Fired Heaters for Refinery Services

15 Painting & Coating Standards

1)	NAPCA	National Association of Pipe Coating Applicators Specifications
2)	AWWA C203	Coal-tar protective Coatings and Lining for Steel Water Pipelines - Enamel and Tape - Hot - Applied
3)	SIS 05-5900	Pictorial Surface Preparation Standards for Painting Steel Surfaces
4)	SIS 18.51.11	European Scale of Degree of Rusting for Anticorrosive Paints
5)	MUNSELL	Munsell Book of Colour
6)	JIS	Japanese Industrial Standards
7)	SSPC	Steel Structures Painting Council
8)	ASTM	American Society for Testing and Materials
9)	BS	British Standards Institution
10)	NACE	National Association of Corrosion Engineers

16 Insulation Standards

1)	JIS	Japanese Industrial Standards
2)	ASTM	American Society for Testing and Materials
3)	TIMA	Thermal Insulation Manufactures Association
4)	MIL	Military Specification
5)	USAEC	United States Atomic Energy Commission Regulatory Guide 1. 36

17 Civil & Marine Standards

1)	AASHTO	American Association of State Highway and Transportation Officials
2)	ACI	American Concrete Institute
3)	AISC	American Institute of Steel Construction
4)	AWWA	American Water Works Association
5)	AWS	American Welding Society
6)	UBC	Uniform Building Code
7)	ASTM	American Society for Testing and Materials
8)	IMCO	Inter-Governmental Maritime Consultative Organization
9)	API	American Petroleum Institute
10)	AIJ	Architectural Institute of Japan
11)	JASS	Japanese Architectural Standard Specification
12)	CEIF	Civil Engineer Institute of Japan
13)	JPHA	Japan Port and Harbor Association

ANNEX III-4

ALTERNATE PROCESS SCHEME OF CONVENTIONAL ROUTE

ANNEX III-4

ALTERNATE PROCESS SCHEME OF CONVENTIONAL ROUTE

Besides the selected process scheme for the study, the following alternate schemes may be examined in the detail study in future.

(1) Elimination of the hydrofinishing unit

For quality of lube base oils, stability, color and sulfur content are important properties required. Instability and bad color are mainly due to existence of such impurities as sulfur/nitrogen/oxygen compound, etc. as well as aromatic and naphthenic hydrocarbons in base oils.

In the planned scheme of the study, the hydrofinishing unit is added to meet the specification of sulfur content (0.3 or 0.5 wt%) as well as to decolor and improve oxidation/color stability of base oils.

Among the conventional routes, there are two major trends in the world. One is American and Japanese way which provides a hydrofinishing unit aiming at the above mentioned objectives and the other is an European way being adopted mainly by SHELL which has no such unit although in the latter case the sulfur content cannot be reduced as low as 0.3 - 0.5 wt%. In non-existing case of the hydrofinishing unit, they have to cut each distillate in very narrow boiling range, so that the vacuum distillation unit should become more sophisticated as described below, comparing with the conventional route.

- Larger number of trays (two towers)
- Higher vacuum level (lower pressure)
- More side cuts (swing cut is normally drawn off between each distillate)

This is because the narrow cut distillation are required to improve selectivity of removing aromatics and other impurities as extract in the following solvent extraction unit. Nevertheless the operating conditions of the solvent extraction unit should become more severe than the case of providing the hydrofinishing unit.

The choice, whether it adopts hydrofinishing or not, mainly depends upon the policy of process owner or refiner in terms of product quality, especially sulfur content and stability. Regarding stability of the base oil to be used for automotive oil, it can be improved by special additives, while industrial oils such as turbine oil, etc., still require hydrotreatment.

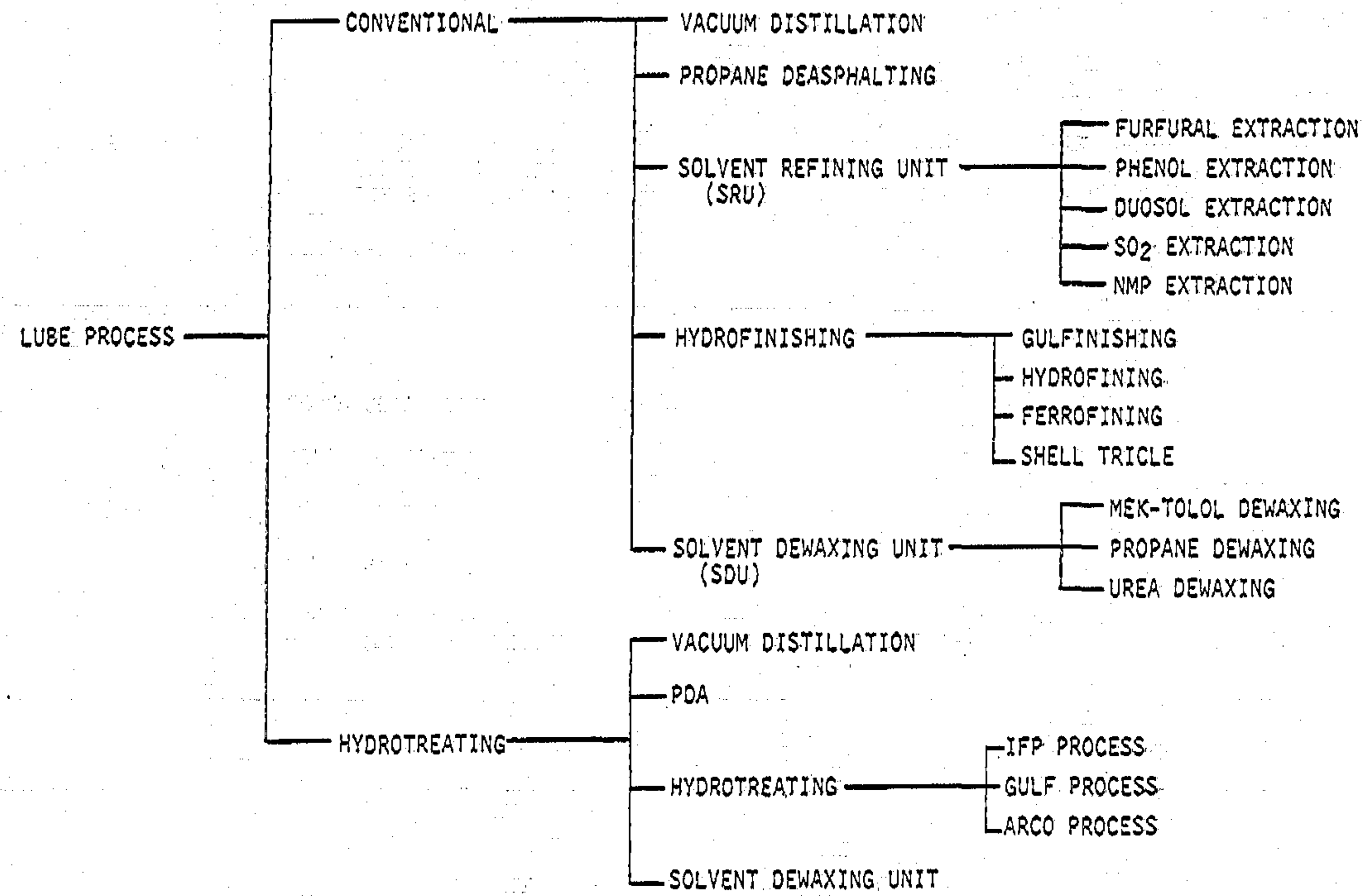
(2) Substitute processes

In the planned scheme, furfural process for the solvent extraction and MEK process for the dewaxing are selected respectively. Instead of these processes, the following processes could be selected as substitutes.

- MMP extraction instead of furfural
- Catalytic dewaxing instead of MEK

Although these substitute processes have merits and demerits against the selected processes, the furfural extraction and MEK dewaxing process are eventually selected for this study as typical process suitable for the Thai lube base oil plant after assesment of various aspects in Thailand in terms of lube oil specification, demand forecast, availability of chemicals etc.

SUMMARY OF LUBE PROCESS



COMPARISON OF SOLVENT REFINING UNIT

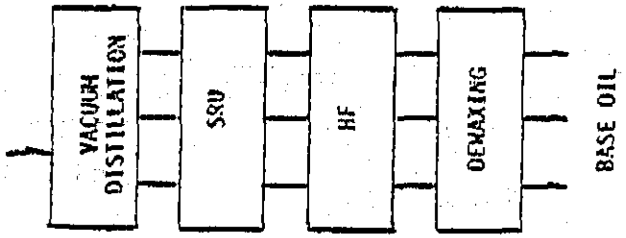
	ADVANTAGE	DISADVANTAGE
FURFURAL	° MUCH COMMERCIAL EXPERIENCES (MORE THAN 100) ° AVAILABILITY ° LOW TOXICITY ° LOWER BOILING POINT (162°C) ° LOWER SOLVENT COST (360 YEN/LITRE)	° HIGHER SOLVENT RATIO THAN NMP (1.5 ~ 3.5)
N M P	° STRONGER SELECTIVITY LOW SOLVENT RATIO AND LOW ENERGY CONSUMPTION (S.R. ~ 2.5)	° SCARCE EXPERIENCE (3 UNITS) ° LIMITED AVAILABILITY ° HIGHER BOILING POINT (202°C) DIFFICULT SEPARATION OF NMP AND LIGHT LUBE ° HIGHER SOLVENT COST (720 YEN/LITRE)

COMPARISON OF DEWAXING UNIT

	ADVANTAGE	DISADVANTAGE
SOLVENT DEWAXING	° MUCH EXPERIENCES ° HIGHER VISCOSITY INDEX	° HIGHER INVESTMENT ° SOPHISTICATED OPERATION REQUIRED
CATALYTIC DEWAXING (MOBIL & BP)	° LOWER COST 1) INVESTMENT 2) OPERATING ° HIGHER 1) YIELD 2) BY-PRODUCT VALUE ° LESS PLOT AREA	° LESS EXPERIENCE ° LOWER VISCOSITY INDEX (5 ~ 11 FOR NEUTRAL OIL AND 2 FOR BRIGHT STOCK)

COMPARISON WITH AND WITHOUT HYDROFINISHING

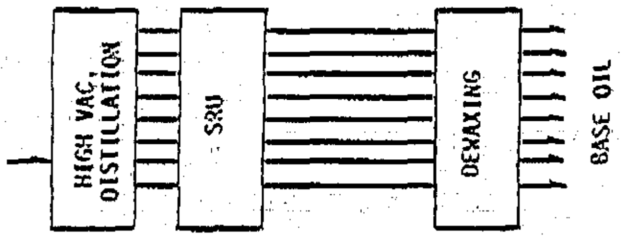
WITH HF



. 20 ~ 30 TRAYS

1) LOW SULFUR (APPLICABLE FOR INDUSTRIAL LUBE TOO)
2) LOWER INVESTMENT (4 BILLION YEN FOR VDU AND HF UNITS)
3) HIGHER FLEXIBILITY AND OPERABILITY
4) MARGINAL RAISE OF VI BY HF

WITHOUT HF



. SOPHISTICATED VDU (2 COLUMNS WITH 100 TRAYS)

1) HIGHER SULFUR (NOT APPLICABLE FOR INDUSTRIAL LUBE)
2) MUCH MOTIVE STEAM FOR VDU IS REQUIRED.
3) HIGHER INVESTMENT FOR VDU (FIVE BILLION YEN FOR TWO COLUMNS PROVIDED WITH 100 TRAYS)
4) MANY INTERMEDIATES TANKS ARE REQUIRED.
5) SOPHISTICATED OPERATION FOR VDU AND SRU

ANNEX IV

ANNEX IV-1

MAXIMIZATION OF THAI LOCAL CONTENTS

ANNEX IV-1

MAXIMIZATION OF THAI LOCAL CONTENTS

As a general philosophy taken in this study, maximization of the local contents for the project is intended to contribute for Thai economy, otherwise to spend considerable amount of foreign currencies as such. As shown in Table IV-2 the percentage of the local currency to the total plant cost excluding import taxes, etc. will be in a range of 25 - 30%.

In order to maximize local currency portion of the cost estimates the following items are taken into consideration as far as it will be practical and economical to the project at the time of 1988.

(1) Equipment and Materials

a) Some equipment and machinery such as carbon steel low pressure vessels and light duty pumps will be purchased in consideration of cost, schedule and import duty when imported.

b) Major bulk materials will be supplied from Thai suppliers.

These items include the following:

- civil materials such as cement, brick, stone, sand, concrete piles, reinforced steel bars, concrete sewer pipes, etc.
- building materials including air conditioning equipment and plumbing
- small steel shapes
- cables and wires
- lighting fixtures

- small capacity transformers
- refractory and castables
- painting and insulation materials, etc.

(2) Field Construction

a) All of construction work will be divided into a number of categories and groups each to be subcontracted to Thai subcontractors.

The subcontracting items include:

- field fabricated storage tanks
- field prefabrication of pipes
- equipment erection
- civil and building work divided into many categories
- piping, electrical, instrument work
- painting, insulation, castable work, etc.

In this regard expatriate skilled labor is minimized in this project, that is all kind of laborers and construction supervisors will be Thai nationals.

(3) Temporary Facilities and Construction Equipment

Materials and laborers for temporary facilities will be mostly supplied by Thai constructors. Only small number of machinery will be imported for the temporary facilities. It is assumed in this study that large construction equipment; e.g. mobile cranes larger than 100 ton will be brought into Thailand and maintained by the prime contractor's construction contingent to supply some small subcontractors.

(4) Chemicals and Others

As much materials and services as possible are considered to be supplied in Thailand, they includes:

- Usual chemicals for the initial fills except such special chemicals as furfural and MEK.

- Indirect laborers necessary for construction such as for operation of field office, warehousing, camp keeping, etc.

- Inland transportation, etc.