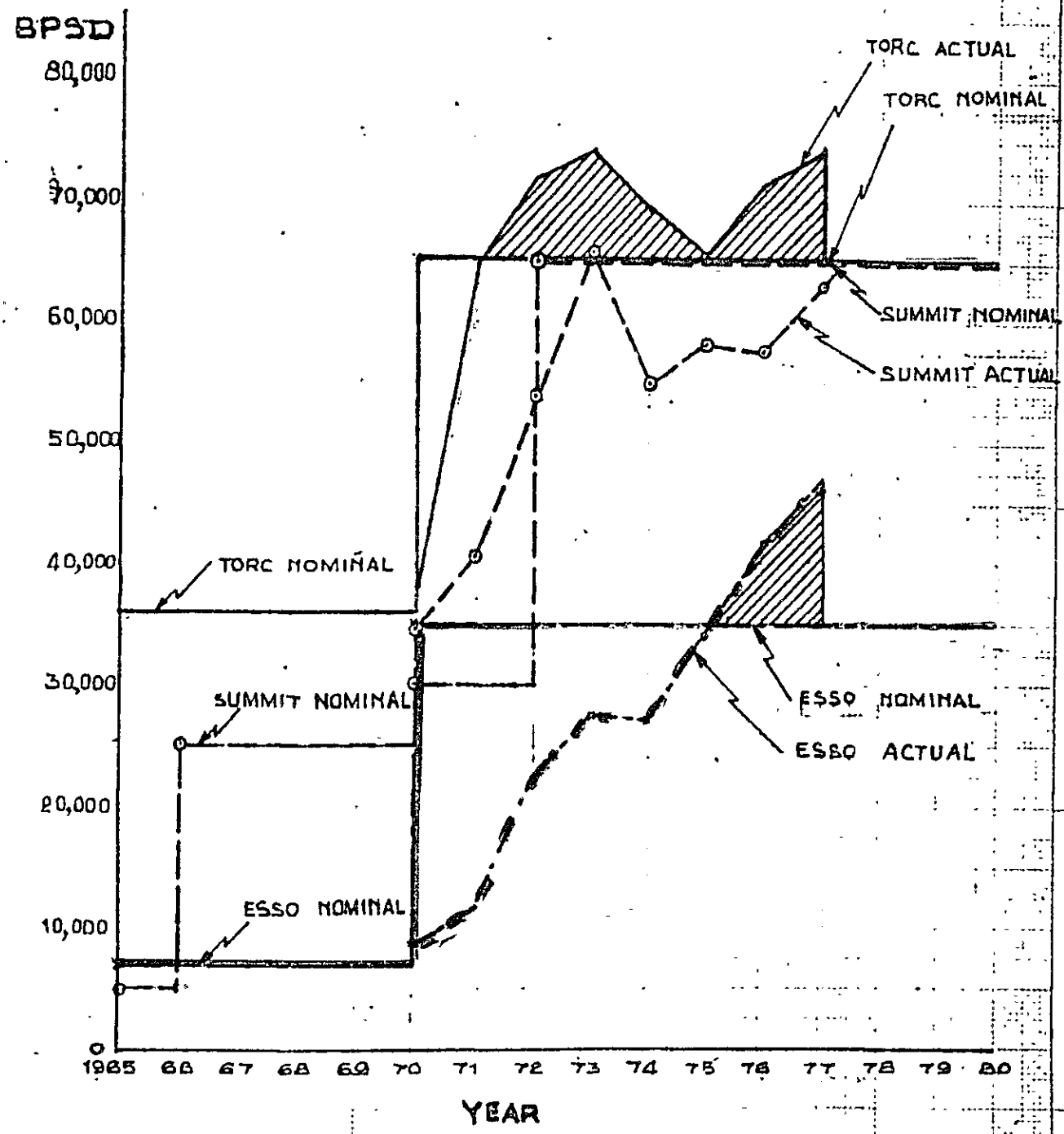
FIG. 1 NOMINAL CAPACITY AND ACTUAL THRUPUT OF 3 REFINERIES



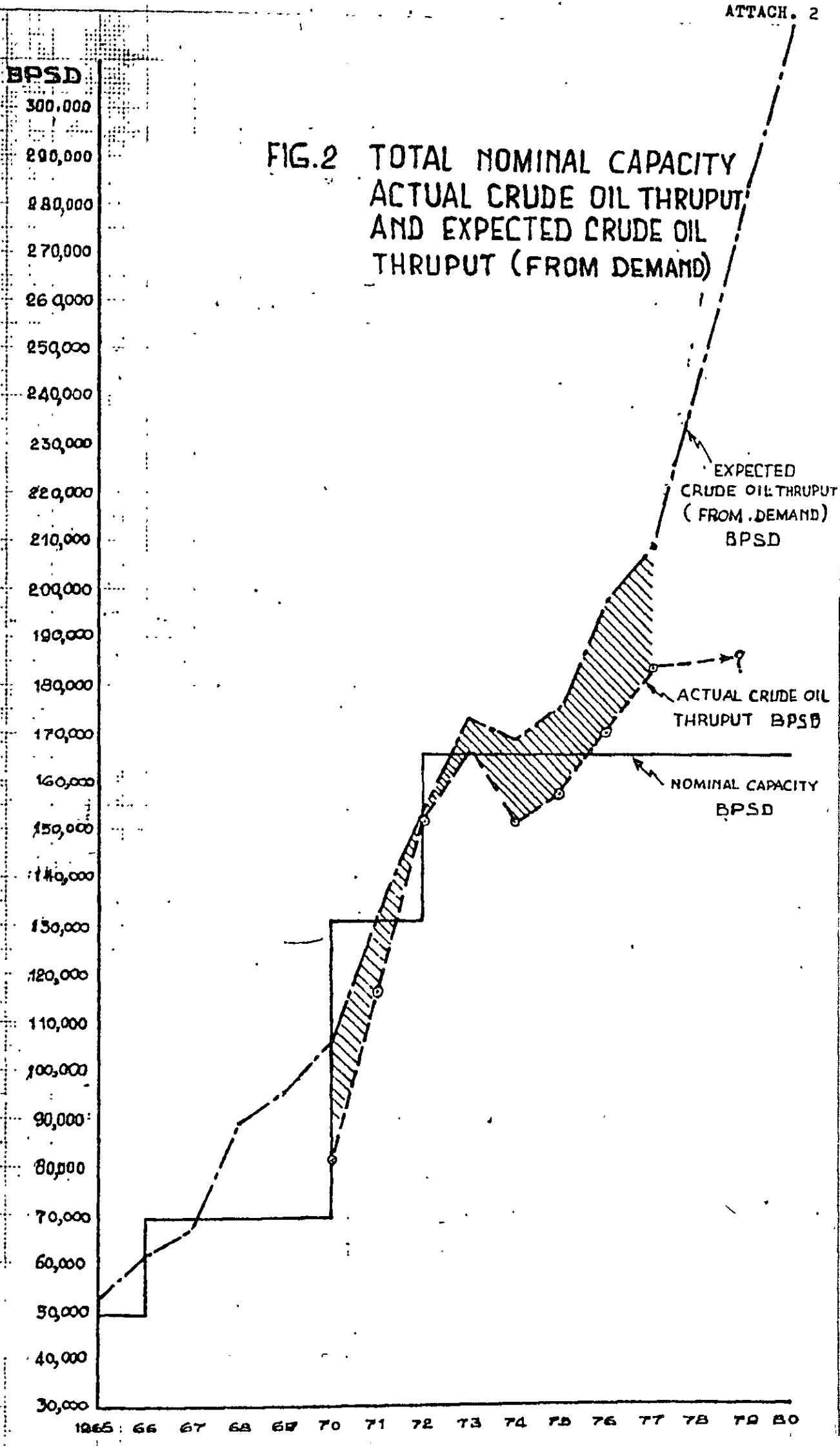
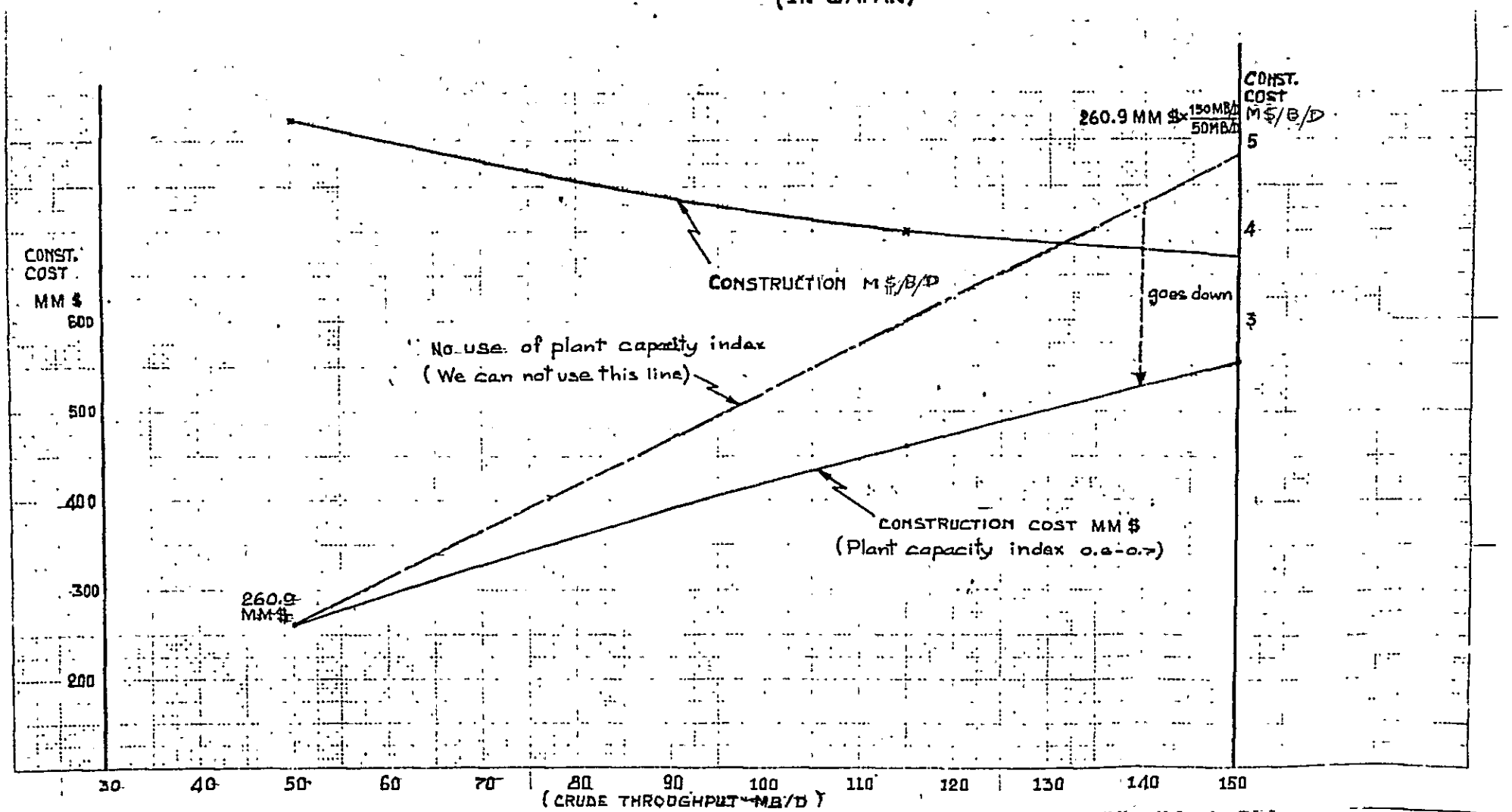


FIG.2 TOTAL NOMINAL CAPACITY ACTUAL CRUDE OIL THRUPUT AND EXPECTED CRUDE OIL THRUPUT (FROM DEMAND)

FIG. 3 GRASS ROOTS REFINERY COST IN 1976
(IN JAPAN)



OVERALL MATERIAL BALANCE
DESIGN CASE

STREAM NO.	1	2	3	4	5	6
DESCRIPTION	Gas From Pipeline (Lb-Moles/Hr)	Gas Plant Feed (Lb-Moles/Hr)	Dew Point Unit Feed (Lb-Moles/Hr)	Acid Gas Vent (Lb-Moles/Hr)	Dew Point Unit Liquids (Lb-Moles/Hr)	Dew Point Unit Gas (Lb-Moles/Hr)
NITROGEN	274.9	111.8	163.1	0.0	0.0	163.1
METHANE	34,554.2	14,055.7	20,498.5	0.0	12.7	20,485.8
CARBON DIOXIDE	12,684.1	5,159.5	7,524.6	4989.4	9.5	7,515.1
ETHANE	3,958.0	1,610.0	2,348.0	0.0	6.3	2,341.7
PROPANE	1,655.7	673.5	982.2	0.0	7.7	974.5
ISOBUTANE	352.8	143.5	209.3	0.0	3.4	205.9
N-BUTANE	322.0	131.0	191.0	0.0	4.3	186.7
ISOPENTANE	103.3	42.0	61.3	0.0	2.9	58.4
N-PENTANE	63.9	26.0	37.9	0.0	2.3	35.6
HEXANES	83.9	34.1	49.8	0.0	7.3	42.5
HEPTANES	35.2	14.3	20.9	0.0	6.6	14.3
OCTANES	12.5	5.1	7.4	0.0	4.1	3.3
WATER	8.1	3.3	4.8	857.6	0.0	4.8
TOTAL	54,108.6	22,009.8	32,098.0	5847.0	67.1	32,031.7
LBS/HR	1,375,942	559,693	816,249	235,033	3,725	812,524
M.W.	25.4	25.4	25.4	40.2	55.5	25.4
MMSCFD(1)	491.68	200.00	291.68	53.13	-	291.07
GPM @ 60°F	-	-	-	-	12.3	-
HHV(BTU/SCF)(1)	918.7	918.7	918.7	0	-	914.8

NOTE (1) - SCF measured at 14.73 psia & 60°F

OVERALL MATERIAL BALANCE

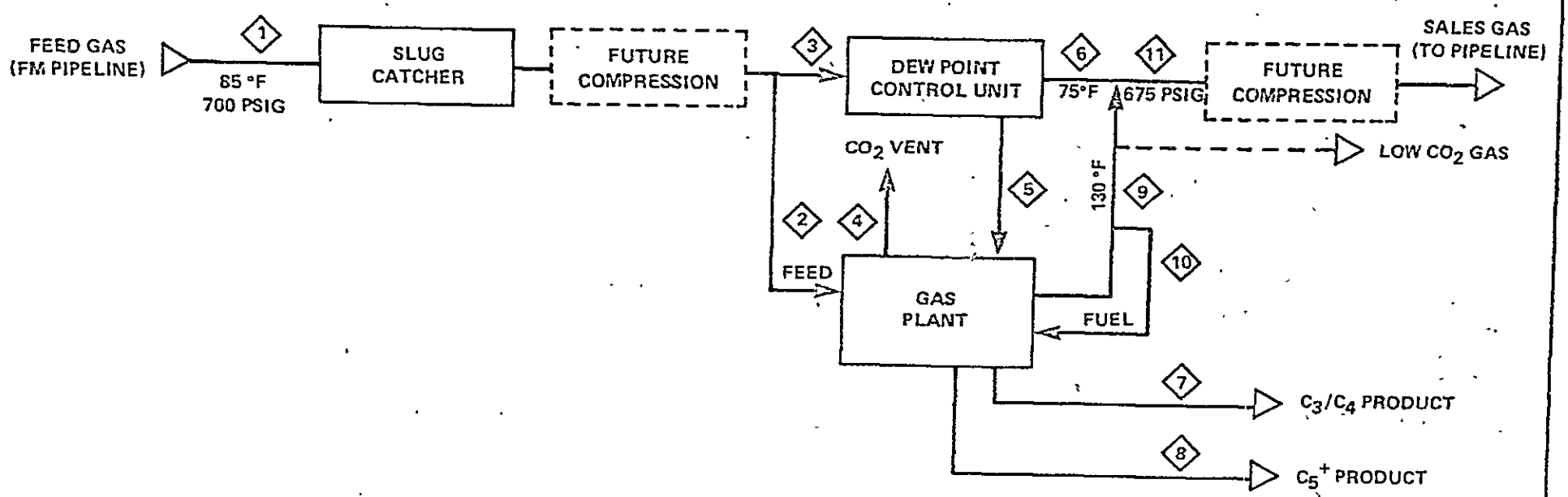
DESIGN CASE

STREAM NO.	7	8	9	10	11
DESCRIPTION	LPG Product	C_5+ Liquids	Gas Plant Sales Gas	Gas Plant Fuel Gas	Net Gas To Pipeline
	(Lb-Moles/Hr)	(Lb-Moles/Hr)	(Lb-Moles/Hr)	(Lb-Moles/Hr)	(Lb-Moles/Hr)
NITROGEN	0.0	0.0	105.1	6.8	268.2
METHANE	0.0	0.0	13,214.5	853.8	33,700.3
CARBON DIOXIDE	0.0	0.0	168.7	10.9	7,683.8
ETHANE	30.0	0.0	1,490.1	96.3	3,831.8
PROPANE	630.8	0.0	47.4	3.1	1,021.9
ISOBUTANE	144.8	0.9	1.1	0.1	207.0
N-BUTANE	129.1	5.6	0.5	0.0	187.2
ISOPENTANE	9.0	35.9	0.0	0.0	58.4
N-PENTANE	2.9	25.3	0.0	0.0	35.6
HEXANES	0.1	41.3	0.0	0.0	42.5
HEPTANES	0.0	20.9	0.0	0.0	14.3
OCTANES	0.0	9.1	0.0	0.0	3.3
WATER	0.0	0.0	0.0	0.0	4.8
TOTAL	946.7	139.0	15,027.4	971.0	47,059.1
LBS/HR	45,508	11,490	269,363	17,405	1,081,887
M.W.	48.1	82.6	17.9	17.9	23.0
MMSCFD(1)	-	-	136.55	8.82	427.62
GPM @ 60°F	171.7	34.9	-	-	-
HHV(BTU/SCF)(1)	-	-	1074.2	1074.2	965.7

NOTE (1) - SCF measured at 14.73 psia & 60°F

NATURAL GAS ORGANIZATION OF THAILAND
NATURAL GAS DEVELOPMENT PROJECT

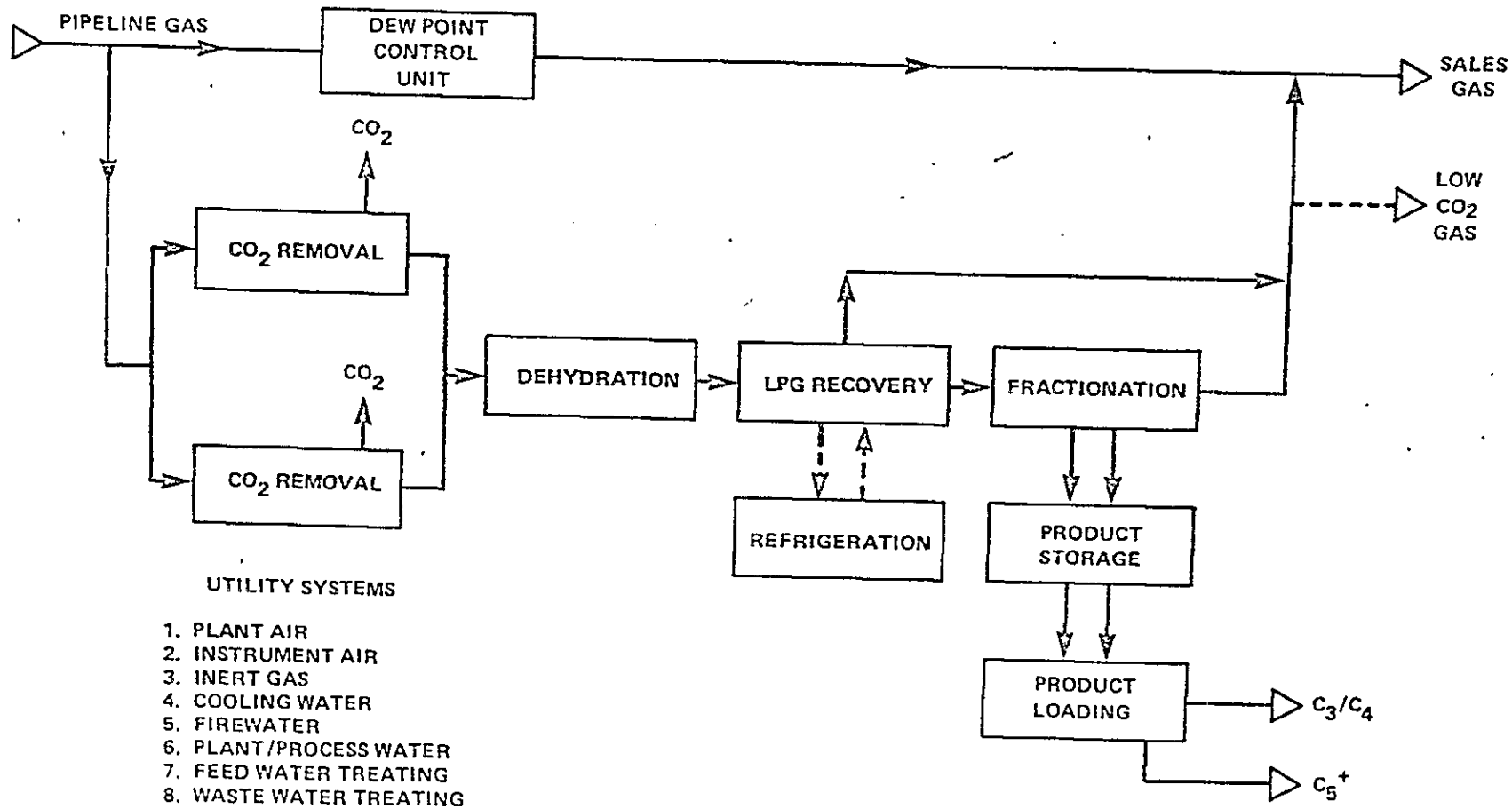
FLUOR OCEAN SERVICES, INC.



BLOCK FLOW DIAGRAM
(OVERALL MATERIAL BALANCE KEY)

NATURAL GAS ORGANIZATION OF THAILAND
NATURAL GAS DEVELOPMENT PROJECT

FLUOR OCEAN SERVICES, INC.



UTILITY SYSTEMS

1. PLANT AIR
2. INSTRUMENT AIR
3. INERT GAS
4. COOLING WATER
5. FIREWATER
6. PLANT/PROCESS WATER
7. FEED WATER TREATING
8. WASTE WATER TREATING
9. STEAM
10. EMERGENCY POWER
11. FLARE & RELIEF
12. METHANOL INJECTION

PROCESS PLANT BLOCK FLOW DIAGRAM

4

NGOT FEED GAS COMPOSITION & HHV

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
GAS PRODUCTION (MMSCFD) (1)										
Union	150	150	200	250	250	250	250	250	250	250
Texas Pacific	-	150	150	250	250	350	350	450	450	450
		300	350	500	500	600	600	700	700	700
GAS COMPOSITION (MOLE %)										
N_2	0.226	0.508	0.468	0.508	0.508	0.555	0.555	0.588	0.588	0.588
C_1	69.339	63.861	64.637	63.861	63.861	62.948	62.948	62.295	62.295	62.295
CO_2	14.888	23.442	22.227	23.442	23.442	24.867	24.867	25.886	25.886	25.886
C_2	9.652	7.315	7.647	7.315	7.315	6.926	6.926	6.648	6.648	6.648
C_3	3.670	3.060	3.146	3.060	3.060	2.958	2.958	2.886	2.886	2.886
i-C_4	0.804	0.652	0.674	0.652	0.652	0.627	0.627	0.609	0.609	0.609
n-C_4	0.670	0.595	0.606	0.595	0.595	0.582	0.582	0.573	0.573	0.573
i-C_5	0.213	0.191	0.195	0.191	0.191	0.188	0.188	0.185	0.185	0.185
n-C_5	0.127	0.118	0.120	0.118	0.118	0.117	0.117	0.116	0.116	0.116
C_6	0.230	0.155	0.166	0.155	0.155	0.142	0.142	0.134	0.134	0.134
C_7	0.120	0.065	0.073	0.065	0.065	0.056	0.056	0.049	0.049	0.049
C_8	0.046	0.023	0.026	0.023	0.023	0.019	0.019	0.016	0.016	0.016
H_2O	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015
Total	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000
HHV(BTU/SCF) (2)	1047.7	918.7	937.1	918.7	918.7	897.2	897.2	881.9	881.9	881.9

(1) 14.73 psia, 60°F, water saturated. (2) Based on composition shown, 14.73 psia, 60°F.

OVERALL MATERIAL BALANCE
DESIGN CASE

STREAM NO.	1	2	3	4	5	6
DESCRIPTION	Gas From Pipeline	Gas Plant Feed	Dew Point Unit Feed	Acid Gas Vent	Dew Point Unit Liquids	Dew Point Unit Gas
	(Lb-Moles/Hr)	(Lb-Moles/Hr)	(Lb-Moles/Hr)	(Lb-Moles/Hr)	(Lb-Moles/Hr)	(Lb-Moles/Hr)
NITROGEN	274.9	111.8	163.1	0.0	0.0	163.1
METHANE	34,554.2	14,055.7	20,498.5	0.0	12.7	20,485.8
CARBON DIOXIDE	12,684.1	5,159.5	7,524.6	4989.4	9.5	7,515.1
ETHANE	3,958.0	1,610.0	2,348.0	0.0	6.3	2,341.7
PROPANE	1,655.7	673.5	982.2	0.0	7.7	974.5
ISOBUTANE	352.8	143.5	209.3	0.0	3.4	205.9
N-BUTANE	322.0	131.0	191.0	0.0	4.3	186.7
ISOPENTANE	103.3	42.0	61.3	0.0	2.9	58.4
N-PENTANE	63.9	26.0	37.9	0.0	2.3	35.6
HEXANES	83.9	34.1	49.8	0.0	7.3	42.5
HEPTANES	35.2	14.3	20.9	0.0	6.6	14.3
OCTANES	12.5	5.1	7.4	0.0	4.1	3.3
WATER	8.1	3.3	4.8	857.6	0.0	4.8
TOTAL	54,108.6	22,009.8	32,098.8	5847.0	67.1	32,031.7
LBS/HR	1,375,942	559,693	816,249	235,033	3,725	812,524
M.W.	25.4	25.4	25.4	40.2	55.5	25.4
MMSCFD(1)	491.68	200.00	291.68	53.13	-	291.07
GPM @ 60°F	-	-	-	-	12.3	-
HHV(BTU/SCF)(1)	918.7	918.7	918.7	0	-	914.8

NOTE (1) - SCF measured at 14.73 psia & 60°F

OVERALL MATERIAL BALANCE

DESIGN CASE

STREAM NO.	7	8	9	10	11
DESCRIPTION	LPG Product	C_5+ Liquids	Gas Plant Sales Gas	Gas Plant Fuel Gas	Net Gas To Pipeline
	(Lb-Moles/Hr)	(Lb-Moles/Hr)	(Lb-Moles/Hr)	(Lb-Moles/Hr)	(Lb-Moles/Hr)
NITROGEN	0.0	0.0	105.1	6.8	268.2
METHANE	0.0	0.0	13,214.5	853.8	33,700.3
CARBON DIOXIDE	0.0	0.0	168.7	10.9	7,683.8
ETHANE	30.0	0.0	1,490.1	96.3	3,831.8
PROPANE	630.8	0.0	47.4	3.1	1,021.9
ISOBUTANE	144.8	0.9	1.1	0.1	207.0
N-BUTANE	129.1	5.6	0.5	0.0	187.2
ISOPENTANE	9.0	35.9	0.0	0.0	58.4
N-PENTANE	2.9	25.3	0.0	0.0	35.6
HEXANES	0.1	41.3	0.0	0.0	42.5
HEPTANES	0.0	20.9	0.0	0.0	14.3
OCTANES	0.0	9.1	0.0	0.0	3.3
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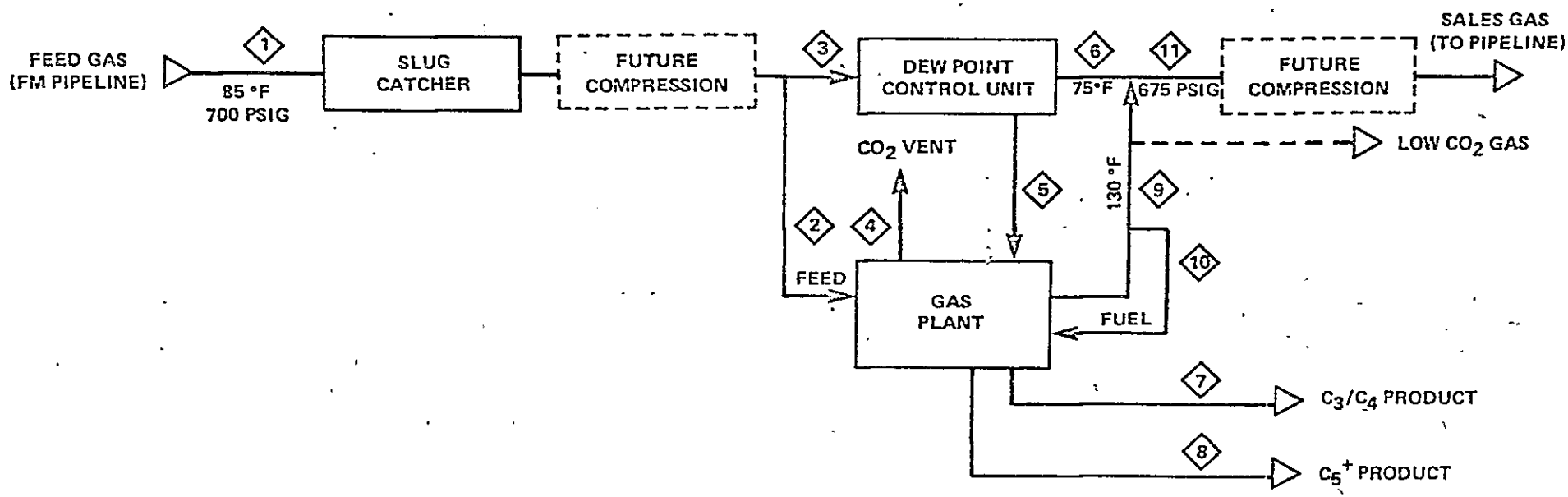

BLOCK FLOW DIAGRAM
(OVERALL MATERIAL BALANCE KEY)

NATURAL GAS ORGANIZATION OF THAILAND
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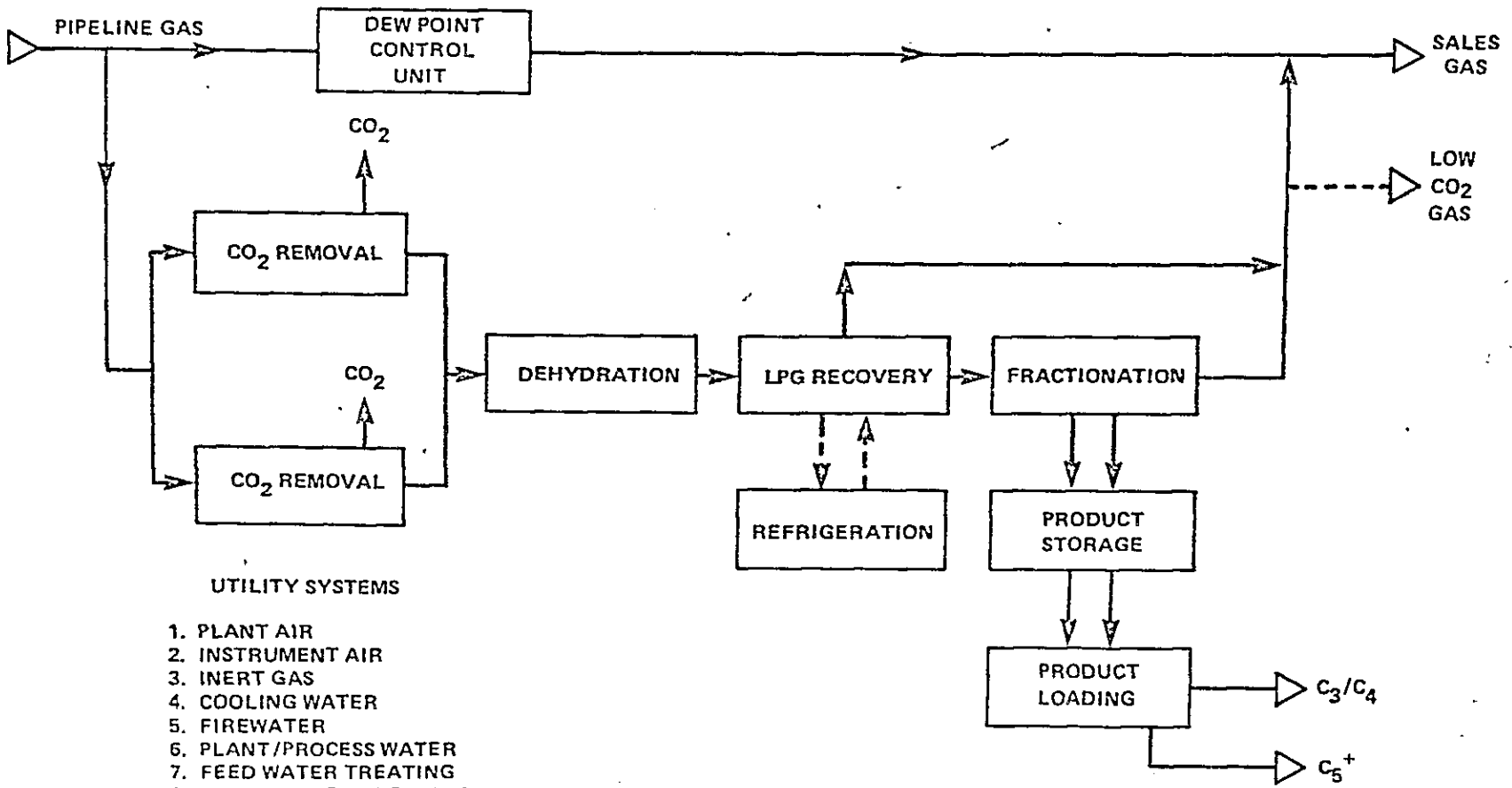

UTILITY SYSTEMS

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PROCESS PLANT BLOCK FLOW DIAGRAM

4

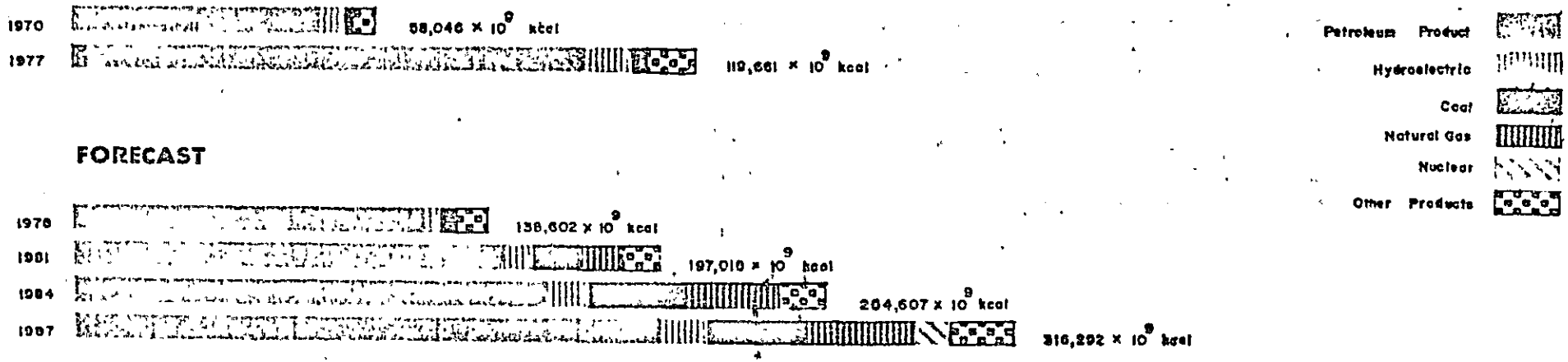
NGOT FEED GAS COMPOSITION & HHV

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
GAS PRODUCTION (MMSCFD) (1)										
Union	150	150	200	250	250	250	250	250	250	250
Texas Pacific	-	150	150	250	250	350	350	450	450	450
		300	350	500	500	600	600	700	700	700
GAS COMPOSITION (MOLE %)										
N_2	0.226	0.508	0.468	0.508	0.508	0.555	0.555	0.588	0.588	0.588
C_1	69.339	63.861	64.637	63.861	63.861	62.948	62.948	62.295	62.295	62.295
CO_2	14.888	23.442	22.227	23.442	23.442	24.867	24.867	25.886	25.886	25.886
C_2	9.652	7.315	7.647	7.315	7.315	6.926	6.926	6.648	6.648	6.648
C_3	3.670	3.060	3.146	3.060	3.060	2.958	2.958	2.886	2.886	2.886
i-C_4	0.804	0.652	0.674	0.652	0.652	0.627	0.627	0.609	0.609	0.609
n-C_4	0.670	0.595	0.606	0.595	0.595	0.582	0.582	0.573	0.573	0.573
i-C_5	0.213	0.191	0.195	0.191	0.191	0.188	0.188	0.185	0.185	0.185
n-C_5	0.127	0.118	0.120	0.118	0.118	0.117	0.117	0.116	0.116	0.116
C_6	0.230	0.155	0.166	0.155	0.155	0.142	0.142	0.134	0.134	0.134
C_7	0.120	0.065	0.073	0.065	0.065	0.056	0.056	0.049	0.049	0.049
C_8	0.046	0.023	0.026	0.023	0.023	0.019	0.019	0.016	0.016	0.016
H_2O	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015
Total	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000
HHV(BTU/SCF) (2)	1047.7	918.7	937.1	918.7	918.7	897.2	897.2	881.9	881.9	881.9

(1) 14.73 psia, 60°F, water saturated. (2) Based on composition shown, 14.73 psia, 60°F.

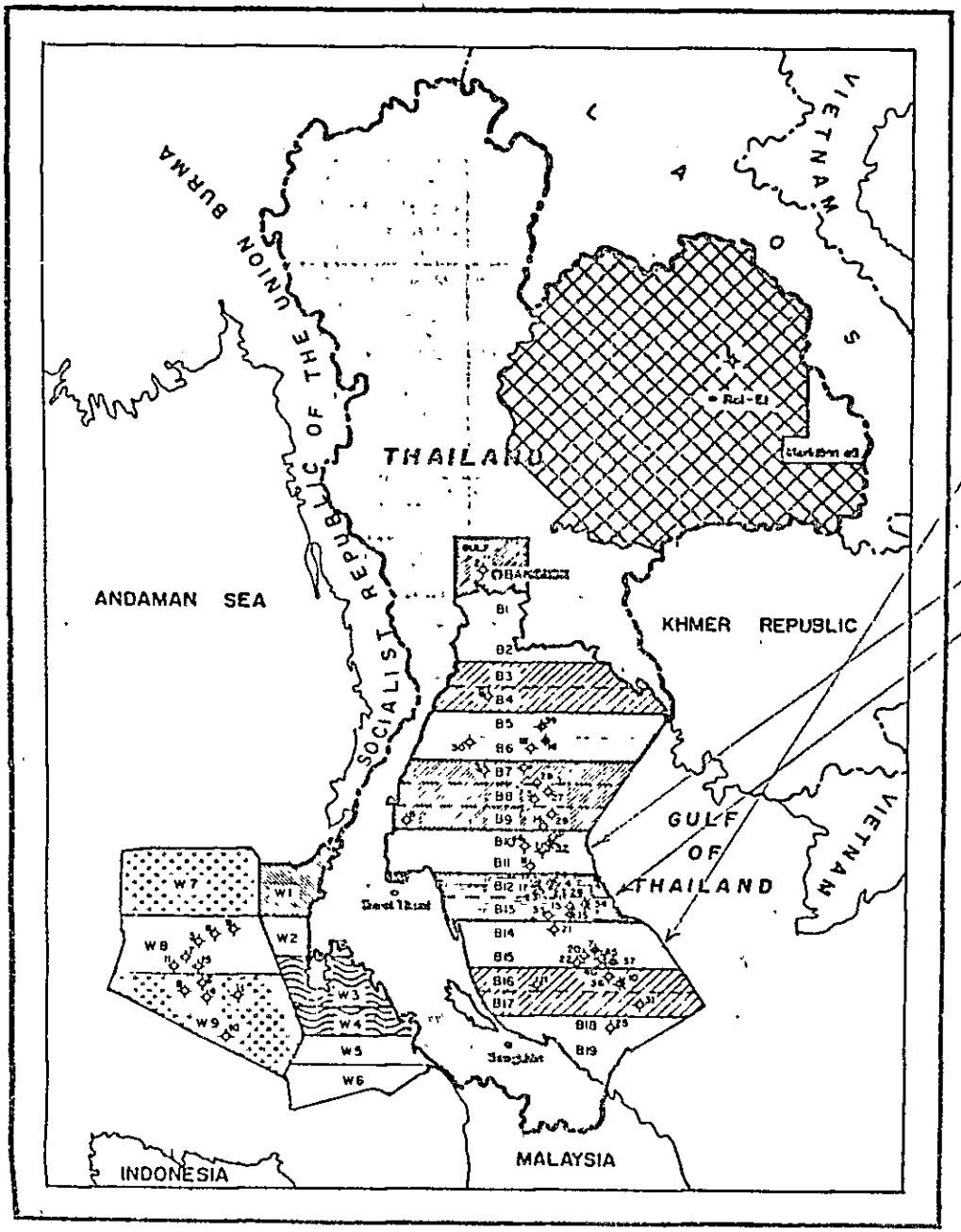
THAILAND ENERGY CONSUMPTION (1974-1977) WITH 23-YEAR FORECAST

ACTUAL



ITEM	YEAR	Petroleum Products		Hydroelectric		Coal and Lignite		Bagasse		Fuel Wood		Charcoal		Paddy Husk		Natural Gas		Nuclear		Total	
		10^9 Kcal	% of Total	10^9 Kcal	% of Total	10^9 Kcal	% of Total	10^9 Kcal	% of Total	10^9 Kcal	% of Total	10^9 Kcal	% of Total	10^9 Kcal	% of Total	10^9 Kcal	% of Total	10^9 Kcal	% of Total	10^9 Kcal	% of Total
Actual	1974	75 459 776	82 09	7,754 542	8 44	2,159,376	2.35	5,565 000	6 05	413 000	0 45	215 000	0 23	360 000	0 39	–	–	–	–	91,926 694	100 00
	1975	77,994 753	79 94	10,571 625	10 83	2,168 574	2 22	5,879 715	6.03	388 413	0 40	130 100	0 13	437.154	0 45	–	–	–	–	97,570 334	100 00
	1976	88,072 765	79 14	11,281 515	10 14	2,542 075	2 29	8,371 981	7 52	389 623	0 35	245 599	0 22	379 348	0 34	–	–	–	–	111,282 906	100 00
	1977	97,842 787	81 77	10 235 239	8 55	2,274 450	1 90	8,302 784	6 94	429 017	0 36	191 000	0 16	386 000	0.32	–	–	–	–	119,661 277	100 00
Forecast	1978	117 625 516	84 87	5,755 428	4 15	5,201 885	3 75	8,967 007	6 47	436,310	0.32	199 194	0 14	416 880	0.30	–	–	–	–	138,602 220	100 00
	1979	127,402 851	81 79	6,241 005	4 01	11,344,637	7.28	9 684,367	6 22	443 727	0 28	207 739	0 13	450 230	0 29	–	–	–	–	155,774 556	100 00
	1980	143 396 330	81 90	7,864 560	4 49	12,216 603	6.98	10 459 117	5,97	451 270	0 26	216 651	0 12	486 949	0 28	–	–	–	–	175,090 710	100 00
	1981	155 051 515	79 90	9,759 204	4 95	15,286 825	7 76	11,295 846	5.73	458 942	0 23	225 945	0 12	525 149	0 27	4,415 040	2.24	–	–	197,018 466	100 00
	1982	161 873 997	73 77	10 143,495	4 62	17,311 623	7 89	12,086 555	5 51	466 744	0 21	235 638	0 11	561 909	0 26	16,740,360	7 63	–	–	219 420 321	100 00
	1983	152,807 219	64 66	11,484 045	4 86	24,013 488	10 16	12,932 614	5 47	474 679	0 20	245 747	0 11	601 234	0 25	33,756 660	14 29	–	–	236,315 686	100 00
	1984	142,968,118	56 15	14,463 045	5 68	32,386 871	12 72	13,837 897	5 44	482 749	0 19	256 290	0 10	634 330	0 25	49,577 220	19 47	–	–	254,606 520	100 00
	1985	160,684 171	58 58	15,386 535	5 61	32,411 984	11 81	14 806 550	5 40	490 956	0 18	267 285	0 10	688 363	0 25	49,577,220	18 07	–	–	274,313 064	100 00
	1986	180,356 918	61 03	15,833 385	5.36	32,438 856	10 98	15,843 008	5.36	482 266	0 16	276 673	0 09	736 549	0 25	49,577 220	16 77	–	–	295 544 895	100 00
	1987	199,904 808	63 20	16,012 125	5 06	32,463 501	10 26	16,793 589	5.31	473 730	0 15	286 433	0 09	780 741	0 25	49,577 220	15 68	–	–	316,292 147	100 00
	1988	217,576 554	64 28	19,461 807	5 75	32,489 625	9 60	17,801 204	5 26	465 345	0 14	296 515	0 09	827 586	0 24	49,577 220	14 64	–	–	338,495 856	100 00
	1989	234 483 135	64 73	20,593 827	5 69	32,517,316	8 98	18 869 276	5 21	457 108	0 13	306 952	0 08	877 241	0 24	49,577 220	13 69	4,542,340	1 25	362,224 415	100 00
	1990	251,714 524	64 94	21,684 141	5 59	32,546 669	8 40	20,001 433	5 16	449 017	0 12	317 757	0 08	929 876	0 24	49,577 220	12 79	10,395 710	2 68	387,616 347	100 00
	1991	275 642 321	66 47	22,804 245	5 50	32 577,783	7 85	21,201 519	5 11	441 069	0 11	328 942	0 08	985 669	0 24	49,577 220	11 96	11,113 200	2 68	414,671 968	100 00
	1992	299,899 403	68 04	23,489 415	5.33	32 605 267	7 40	22,261 593	5 05	443 262	0 10	340 521	0 08	1 034 952	0 23	49,577 220	11 25	11,113 200	2 52	440,754 833	100 00
	1993	325,674 202	69 52	24,240 123	5.17	32,634,125	6 97	23,384 674	4 99	425,593	0 09	352 507	0 08	1,086 670	0 23	49,577 220	10 58	11,113 200	2.37	468,478 314	100 00
	1994	353 636 365	71 06	24,240 123	4 87	32,664 426	6 56	24,543 408	4 93	418 060	0 09	364 915	0 07	1,141 035	0 23	49,577 220	9 96	11,113 200	2 23	497,898 752	100 00
	1995	383 832 715	72 53	24,240 123	4 58	32,696 242	6 18	25,770 578	4 87	410 660	0 08	377 760	0 07	1,198 086	0 22	49 577 220	9 37	11,113 200	2 10	529,216 584	100 00
	1996	415 679 647	73 90	24 240 123	4 31	32,729 649	5 82	27,059 107	4 81	403 391	0.07	391 057	0 07	1,257 991	0 22	49,577 220	8 82	11,113 200	1 98	562 451 385	100 00
	1997	446,065 800	75 09	24,240 123	4 08	32,757 711	5 51	28,141 471	4 74	396,251	0 07	404 822	0 07	1,308 310	0 22	49,577 220	8.35	11,113 200	1 87	594 004 908	100 00
	1998	478 056 263	76 22	24 240 123	3,86	32,786 895	5 23	29,267 130	4 67	389 257	0 06	419 072	0 07	1,360 642	0 22	49,577 220	7 90	11,113 200	1.77	627,209 782	100 00
	1999	511 853 964	77 29	24,240 123	3 66	32,817 247	4 95	30 437 816	4 60	382,348	0 06	433 823	0 07	1,415 068	0 21	49,577 220	7 48	11,113 200	1,68	662,270 809	100 00
	2000	547,262 037	78.30	24,240 123	3 47	32,848 813	4 70	31,655 328	4 53	375 583	0 05	449 094	0 06	1,471 671	0 21	49,577 220	7 09	11,113 200	1 59	699,093 066	100 00

map of thailand, showing exploration blocks and test wells



Thailand Sun Oil, Gulf Oil, Pty Ltd, Petroleum Resources (7, 8, 9)

Tenneco, Texas Pacific, Canadian Superior, Home Oil, Highland, Agip (1, 2, 14, 15)

BP, Deutsche BP, Texas Pacific, Canadian Superior, Home Oil, Highland (3, 4, 16, 17)

Amoco, Idemitsu (5, 6)

Union Oil, Mitsui, Conoco (10, 11)

Union Oil, Seapec Southeast—Asia (12, 13)

Triton Oil, Anschutz, Inlet (18, 19)

Weeks Petroleum, Norse Petroleum (W1)

Amoco (W2)

Pan Ocean (W3, 4)

Oceanic, Suwanamas (W7)

Union, Amoco, BP, Hamilton, Secem Resources (W8)

ESSO (W9)

Dry Hole

Oil Discovery

Gas & Condensate

Oil & Condensate & Gas Discovery

JICA