2.7.3.3 Organization and duty for planning, construction and operation stage.

2.7.3.4 Maintenance including preventing and turnaround, communication, guard and firefighting system.

2.7.3.5 Economic justification at various interest rates.

2.7.3.5.1 B/C

2.7.3.5.2 Rates of return.

2.7.3.5.3 Cash flow.

2.7.3.5.4 Refining operation cost per barrel per stream day of crude oil charge and exrefinery cost of each refining product.

2.7.4 Technical studies for next 20 years.

2.7.4.1 Determine the best capacity expansion schedule for oil refining industries for the next 20 years showing additional installation as required to meet the needs into stages of development.

2.7.4.1.1 Recommend the suitable types of crude oil charged.

2.7.4.1.2 Recommend the size of process units and auxiliaries.

2.7.4.2 Considerations concerning the conservation of energy.

2.7.4.2.1 Better control of operation with the aid of special equipments.

2.7.4.2.2 Better recovery of waste heat such as integrated or semi integrated and waste heat boiler.

2.7.4.3 Considerations of refining capacity.

2.7.4.3.1 Recommend the optimum configuration of the facility, i.e. single train, multiple trains, several small refineries, with cracking units.

2.7.4.3.2 Recommend the economic optimum combination of refining procession steps for the new facilities taking into account.

a. the fuel oil processing.

b. the handling of multiple crude oil.

c. the utilization of special process units such as coker, catalytic crackers and so on to produce more diesel oil.

d. the commutor program for maximizing profit.

e. the refinery yield patterns that are suitable for the demand.

f. the reliability of refining and safty.

g. pollution and environmental requirements for products specification and effluents.

2.7.4.3.3 Increase efficiency and flexibility.

2.7.4.3.4 The combination use of steam and power.

2.7.5 Economic justification for General.

Based upon the information obtained from (2.7.2) and (2.7.4), determine the cost estimates and comparison for the additional refining capacity of 100,000, 150,000 and 200,000 bpsd. The report shall justify.

2.7.5.1 B/C at various interest rates.

2.7.5.2 Rates of return.

2.7.5.3 Refining operation cost per barrel of crude oil charged and exrefinery cost of each refined product.

3. Operating agency

National Energy Administration

4. Assistance requested

4.1 Expert

Field of operation/activity	Total		1979		1980	
	No.	m-m	No.	m-m	No.	m-m
(1) Petroleum Management	1	18	1	6	1	12
(2) Petroleum Economic	2	18	1	6	2	12
(3) Petroleum Engineering	1	12	1	6	1	6
(4) Petroleum Environment	1	5	1	2	1	3
(5) Petroleum Refining and Processing	1	6	1	3	1	3
(6) Petroleum Marketing	1	9	1	3	1	6

4.1.1 Justification for requesting experts :

The method of setting up oil refinery policies and the guide for justifying on additional refinery capacities are the tasks involving highly technical and economics knowledge and experience in which the government does not have people of this qualifying available at the present time.

4.1.2 Job description of experts

The work of experts should consist principally as follows :

4.1.2.1 Refinery process units which are capable of refining 100,000 - 200,000 barrels of crude oil per stream day with 50% possible expansion capacity. Final capacity of new refinery is not exceed 300,000 barrels of crude oil per stream day.

4.1.2.2 Refinery offsites which include utility facilities and pollution abatement of suitable size.

4.1.2.3 Crude oil storage which is including running stock and reserve.

4.1.2.4 Storage tanks for suitable size and number of unfinished and finished products.

4.1.2.5 Storage of spare parts and other equipments.

4.1.2.6 Marine facilities for the unloading of crude oil and petroleum products to the refinery, and water and land shipping facilities for petroleum products from the refinery.

4.1.2.7 Appurtenant facilities which include machine shops, laboratories, administration building, etc.

4.1.2.8 Necessity of petroleum product terminals and gasoline service stations.

4.1.2.9 Infrastructure such as road and railroad.

4.2 Fellowship

Field of study/training	Total		1979		1980	
	No.	m-m	No.	m-m	No.	m-m
(1) Petroleum Management	4	24*	2	12	2	12
(2) Petroleum Economic	3	18	2	12	1	6
(3) Petroleum Engineering	3	18	2	12	1	6
(4) Computer Sciences (optimization Model)	2	12	1	6	1	6

Note: * We should train our staff before the project begin.

4.2.1 Justification for requesting fellowships

The decision on additional refinery capacities and setting up petroleum policies should be reviewed or revised frequently, at present, we are really in need of well qualified personnels to run this project.

4.3 Equipment

4.4 Other

5. Thai Government counterpart contribution to the project

Description of Government counterpart contribution	Total contribution already available	Total contribution To be requested	1979 (Baht)	1980 (Baht)	1981
I. Project Personnel					
(1) Project manager (level 6 or higher)	1	-	30,000	60,000	-
(2) Engineers (level 4-5)	2	-	40,000	96,000	-
(3) Engineers (level 3)	1	4	6,000	120,000	-
(4) Economist (level 4-5)	2	-	40,000	96,000	-
(5) Economist (level 3)	2	6	16,000	192,000	-
(6) Computer (level 4-5)	2	1	16,000	144,000	-
(7) Others (below level 3)	15	10	67,500	450,000	-
II. Equipment					
(1) Premises and building	100 sq.m.	100 sq.m.	60,000	240,000	-
(2) Expendable equipment	as required	-	30,000	50,000	-
(3) Non-expendable equipment	"	-	5,000	20,000	-
III. Other					
(1) Internal travelling expense			50,000	50,000	-

Note: Government officers'salaries : level 6 = 5,000 Baht
level 4-5 = 4,000 Baht
level 3 = 2,000 Baht
level 3 below = 1,500 Baht

6. Related projects/activities

Energy Master Plan Project

7. Future Work Plan

NEA will use the result of this Study and its developed expertises to propose the suitable additional oil refinery-capacity to our Government and will revise its proposal continuously according to the changes in

related situation such as price of crude oil and finish products, inflation, investment cost etc. in cooperate with NEA-Thailand Energy Master Plan Project.

8. Reports

(1) The reports with a separate volume of summary shall be transmitted to the Government of Thailand not later than 60 calendar days after the completion of the studies and the written acceptance thereof by the Thai Government.

(2) The submission of reports shall be in steps as shortly described as follows :-

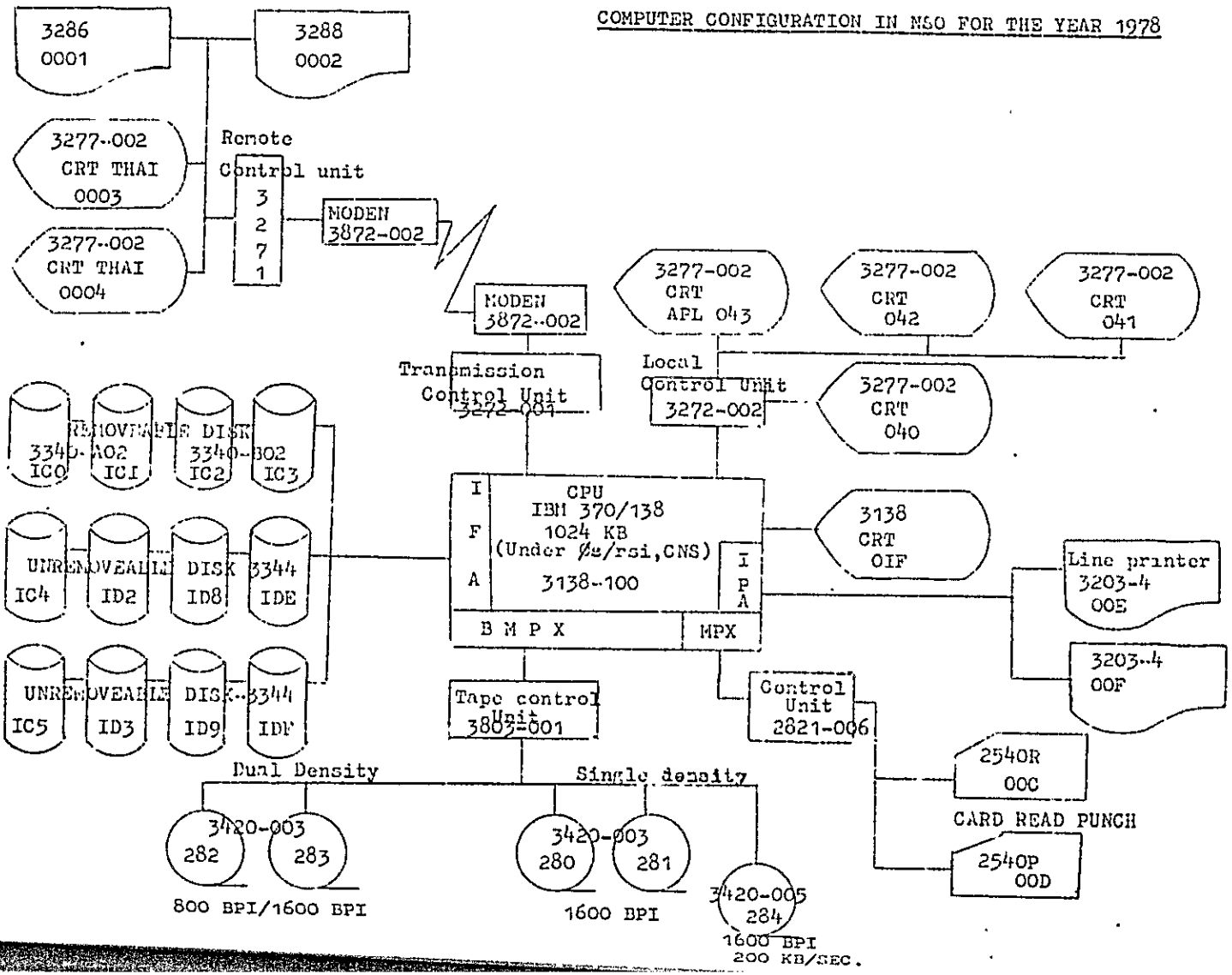
- expert team submits to NEA 10 draft copies
- one month period for NEA's reviews, checking, evaluates and comments
- one month for expert team correction and final prints
- expert team submits to NEA 50 copies
- expert team submits to Embassy and DTEC 10 copies

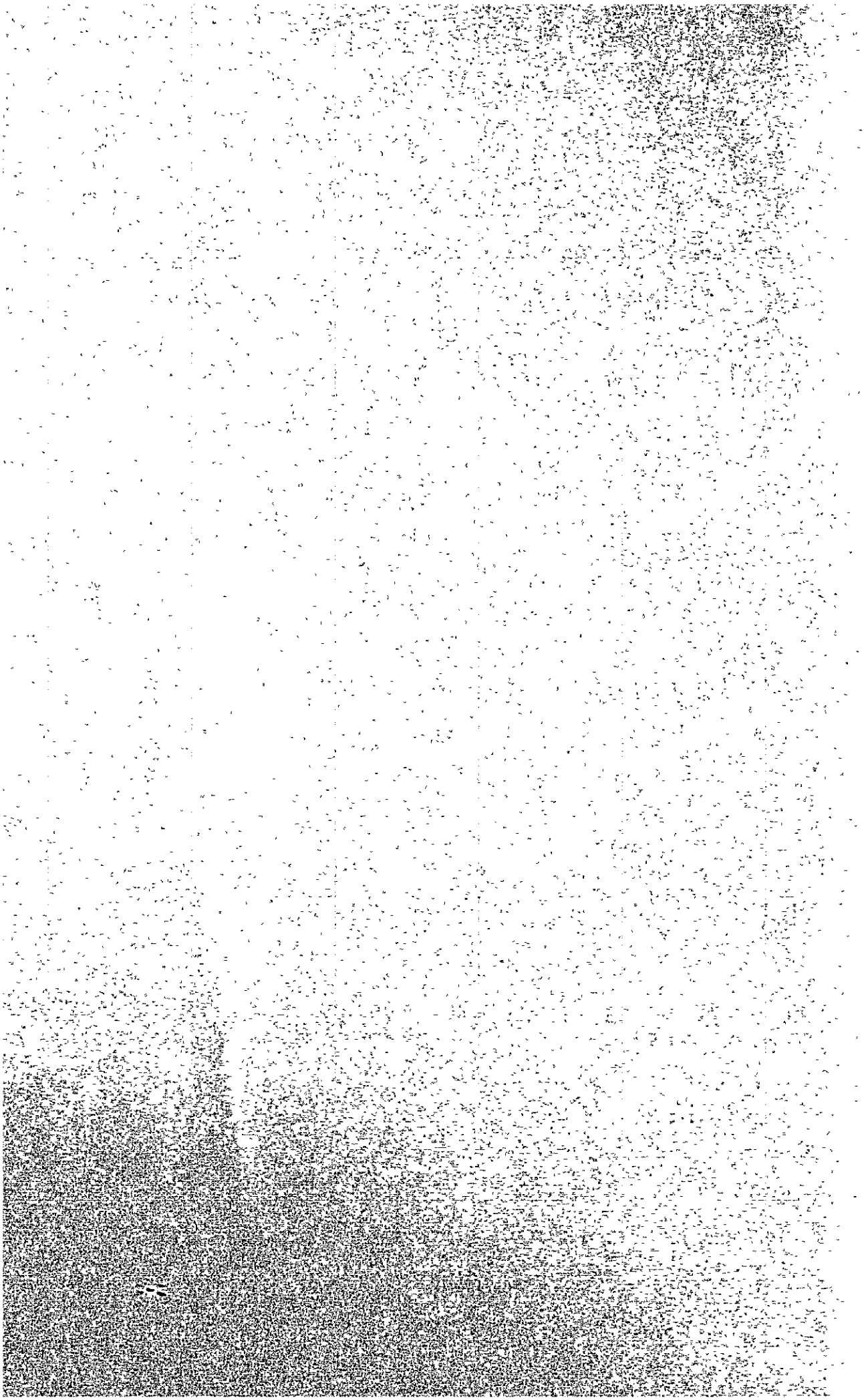
(3) The expert team leader shall submit to the appropriate agency of the Government of Thailand 10 copies of progress report for every month from date of the beginning of this study.

(4) All calculations, design, drawing, specification, estimates, statement, charts, schedules, reports, notice and all other documents and written communication should be carried out in English.

(5) All data, computations, notes studies, reports, designs, drawings, specifications, and other materials and documents relating to this project shall be the property of NEA and the said documents shall be delivered to NEA upon completion or termination of the Plan of Operation provided however, that the expert team may retain copies for his own use.

COMPUTER CONFIGURATION IN NSO FOR THE YEAR 1978





(H)

MEMORANDUM

September 17, 1979

To:

From: Y. Kawase

I. REFINERY

(1) SUMMIT Industrial Corp. (Panama) —— belong to Ministry of Defence
(SUMMIT + CALTEX)

Organization of Fuel Oil (OFO)

Products → Military
Products → EGAT (South Bangkok Power Station)
Products → SUMMIT (Derivery Company)

SUMMIT rents Bangchark Refinery and Fang Refinery from Ministry of Defence, so SUMMIT pays rental fee.

(2) Thai Oil Refinery Co. Ltd. (TORC)
(Shell)

TORC is under the supervision of Ministry of Industry.
TORC pays royalty to Ministry of Industry.
In near future, Thai Government will invest a half of share (Thai Government will buy TORC Refinery then he will invest).

(3) ESSO Standard Thailand Ltd.

ESSO is under the supervision of Ministry of Industry.
ESSO pays royalty to Ministry of Industry.

II. EXPANSION

Bangkok Post and Nation News said expansion of three refineries is as follows.

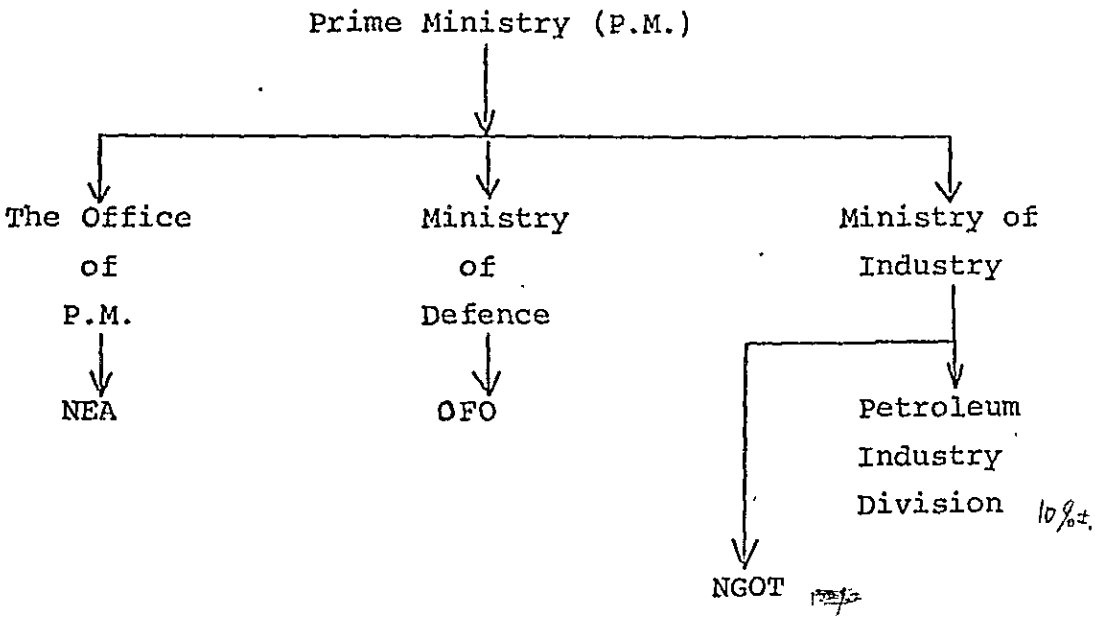
	Existing	Expansion
SUMMIT	65,000 BPSD	45,000 BPSD
TORC	65,000 "	65,000 "
ESSO	35,000 "	35,000 "
Fang	1,000 "	

NEA said to me that expansion of three refineries is not decided, still flexible.

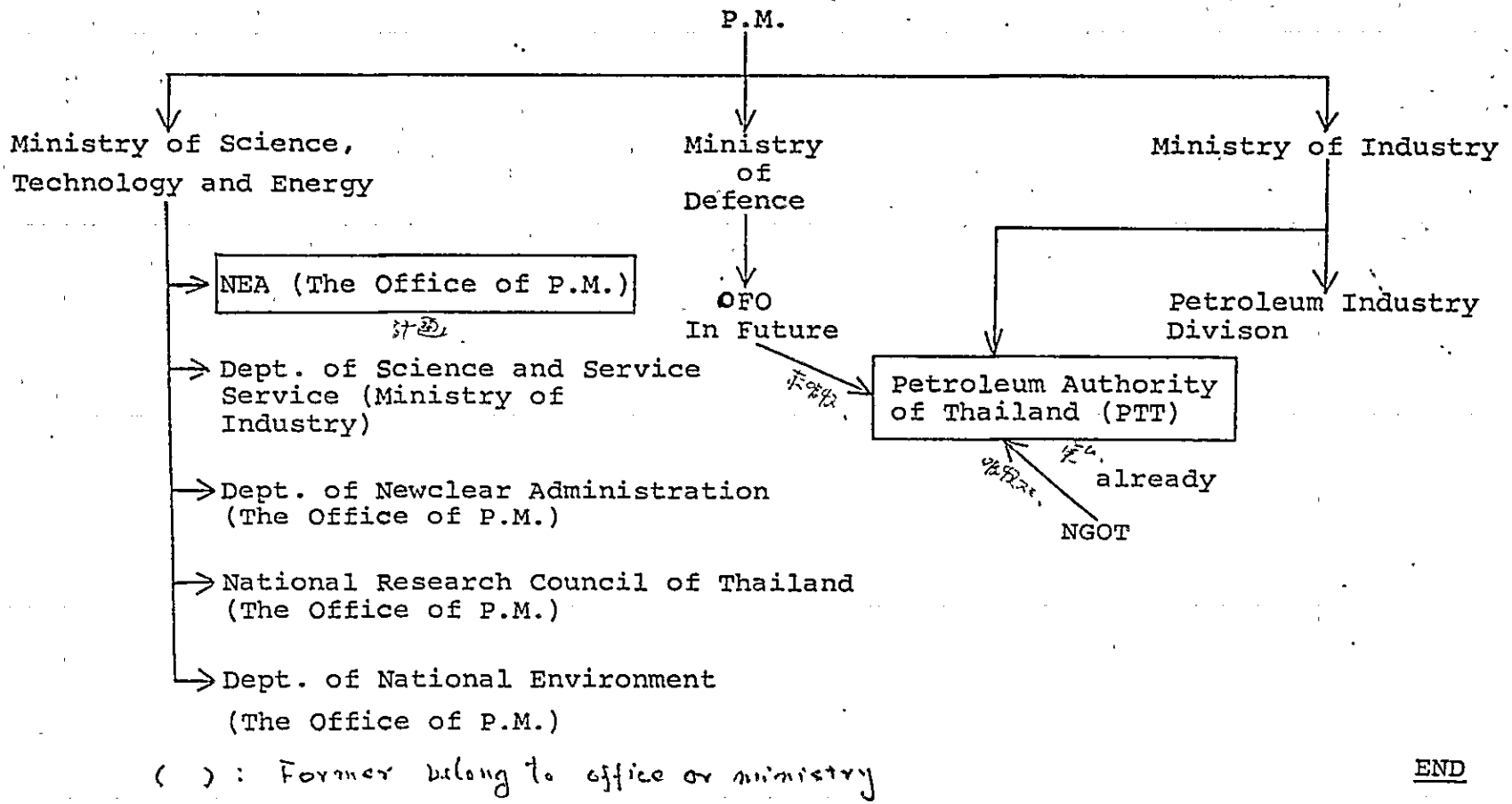
According my estimation, another 90,000 BPSD grass-roots refinery should be needed in 1981.

III. ORGANIZATION

(1) Former

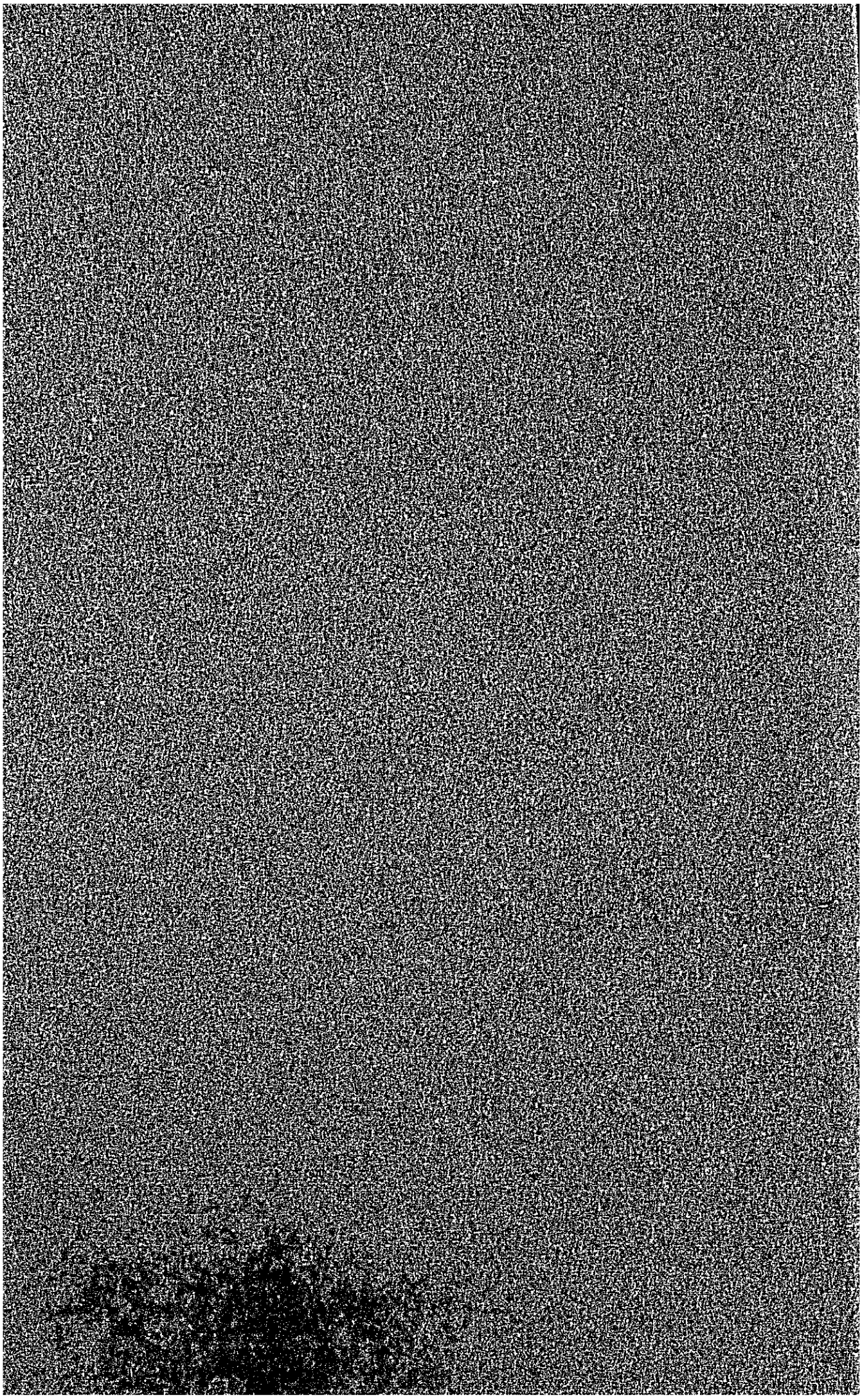


(2) Present + Future



( ) : Former belong to office or ministry

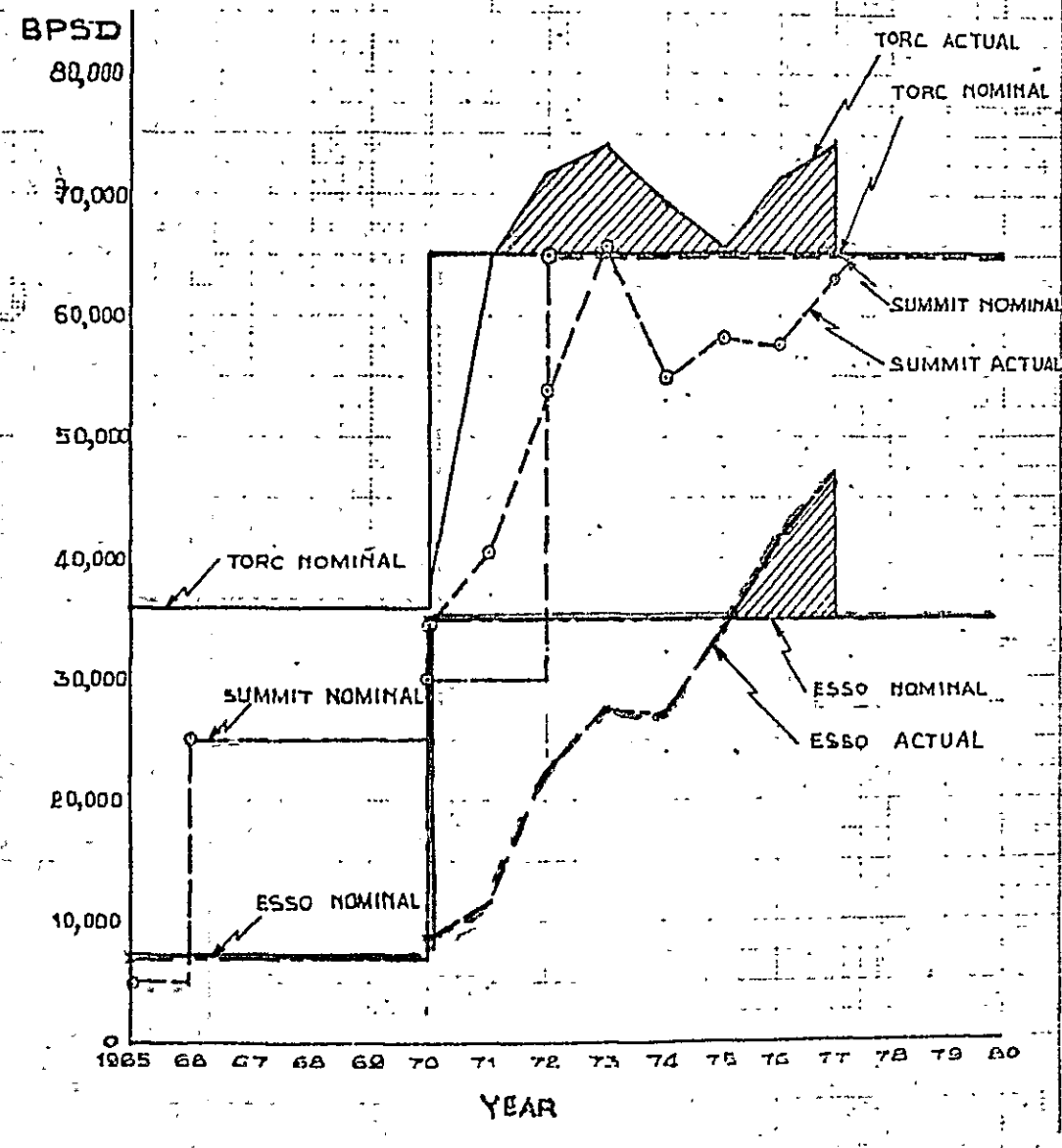
END

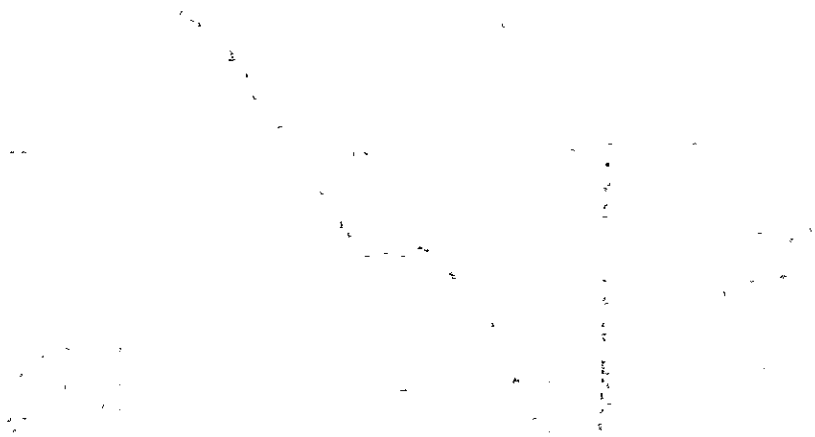


(I)

ATTACH. 1

FIG. 1 NOMINAL CAPACITY AND ACTUAL THRUPUT OF 3 REFINERIES





ATTACH. 2

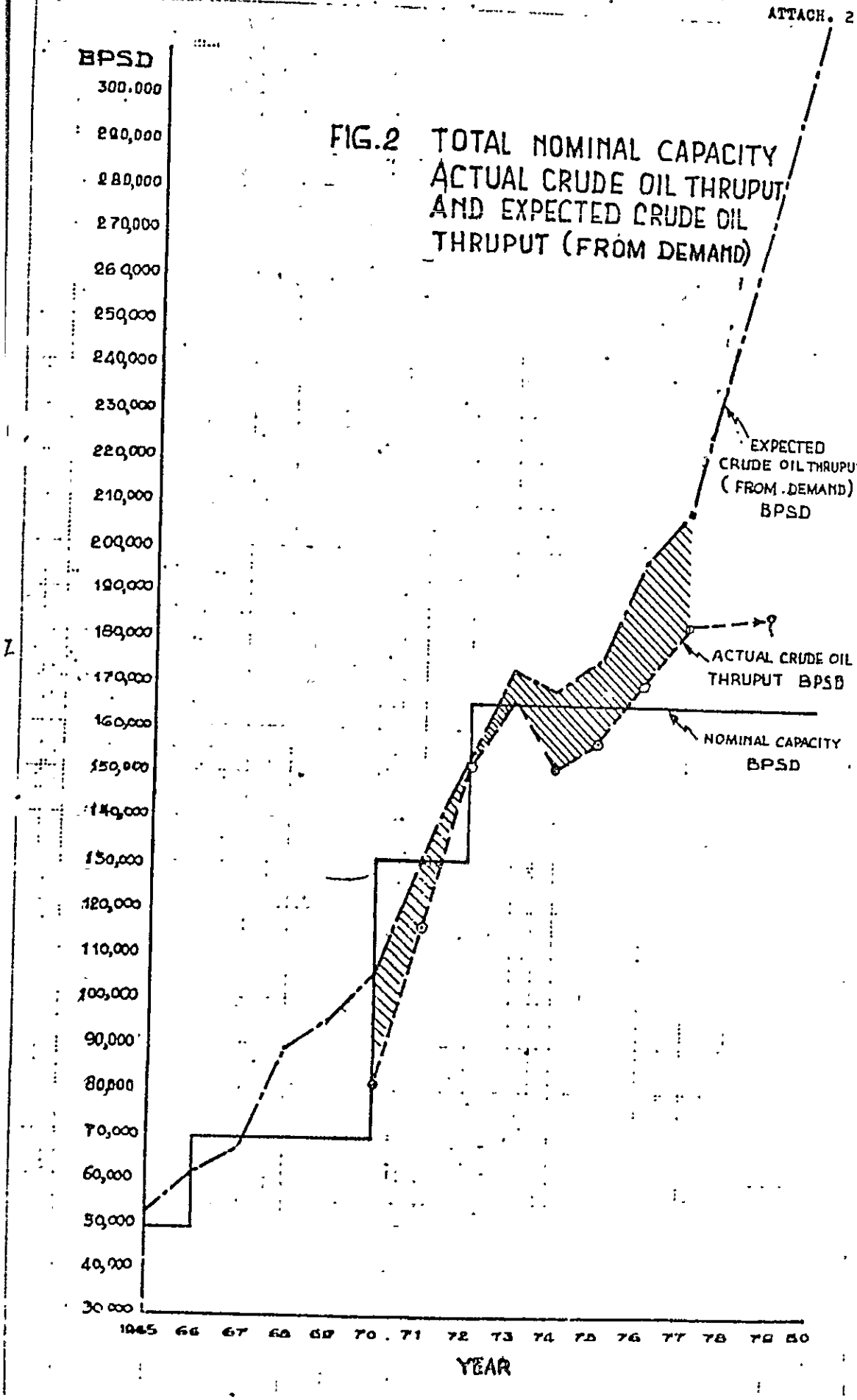
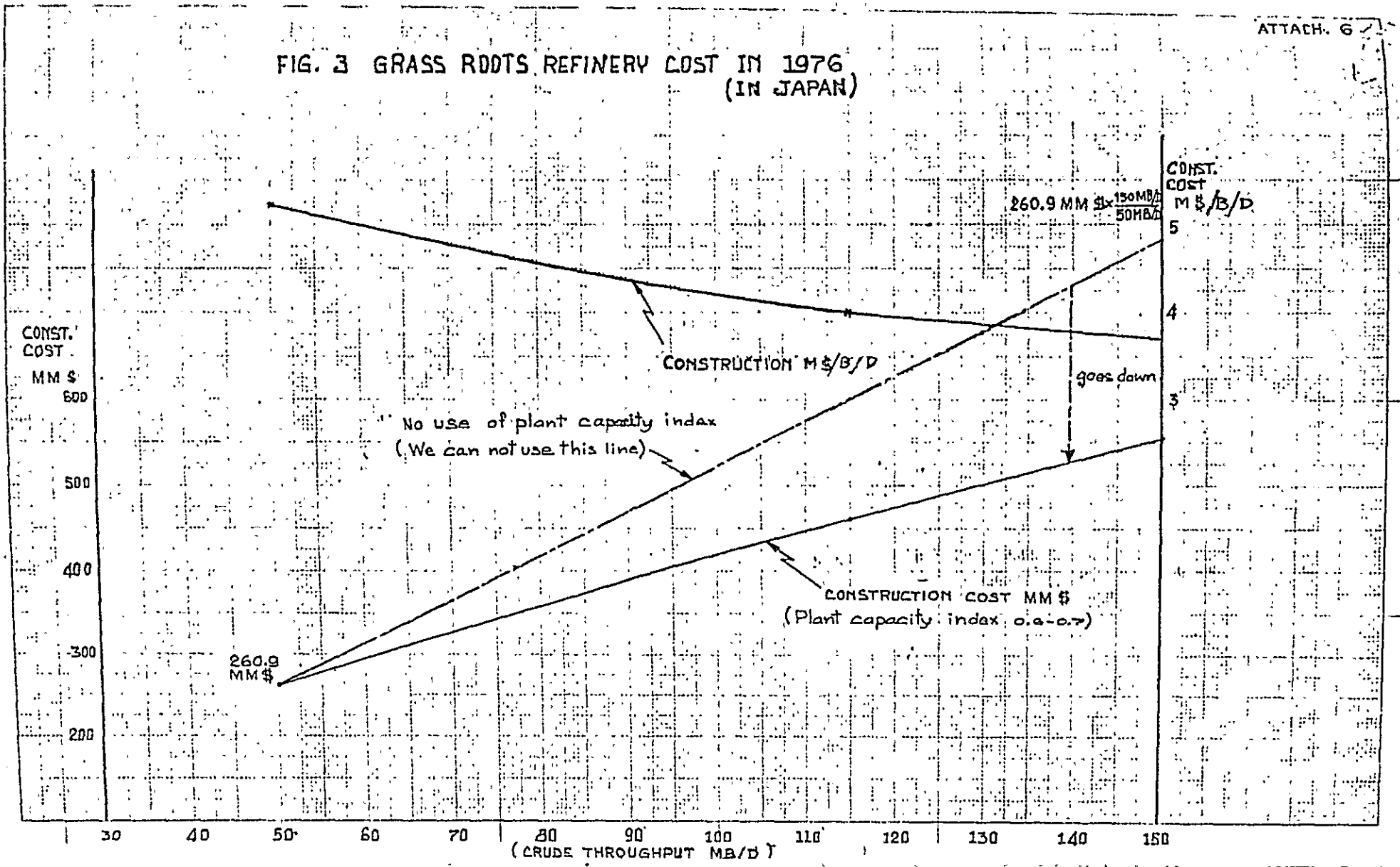


FIG.2 TOTAL NOMINAL CAPACITY ACTUAL CRUDE OIL THRUPUT AND EXPECTED CRUDE OIL THRUPUT (FROM DEMAND)

ATTACH. 6

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	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	32,098.0	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

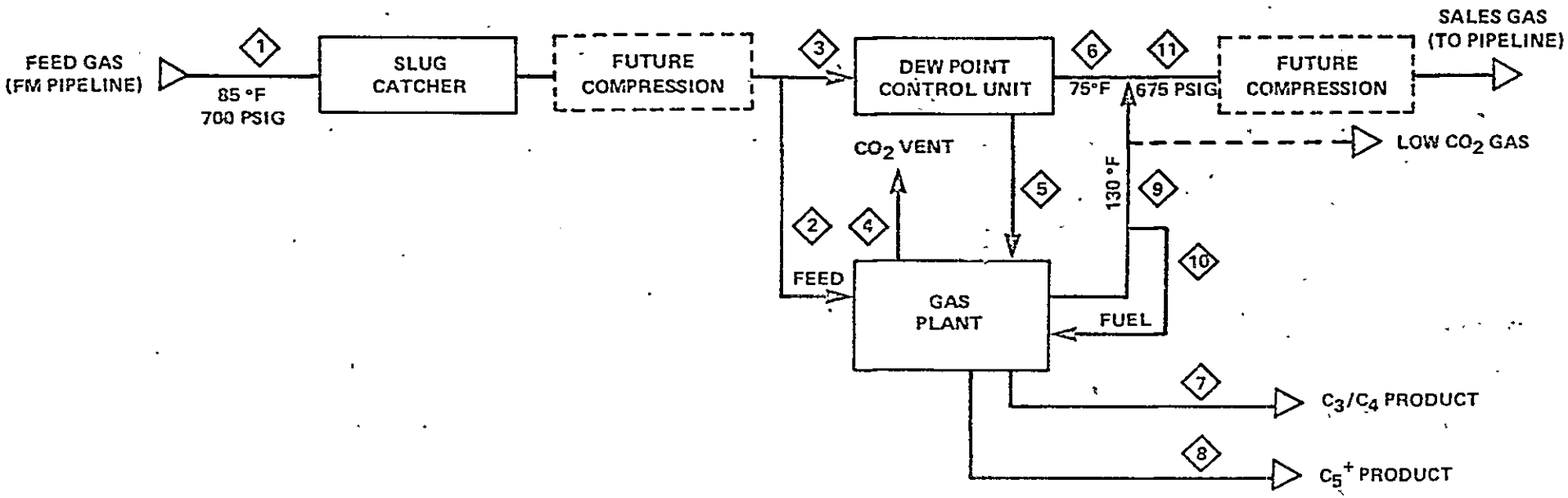
OVERALL MATERIAL BALANCE
DESIGN CASE

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.

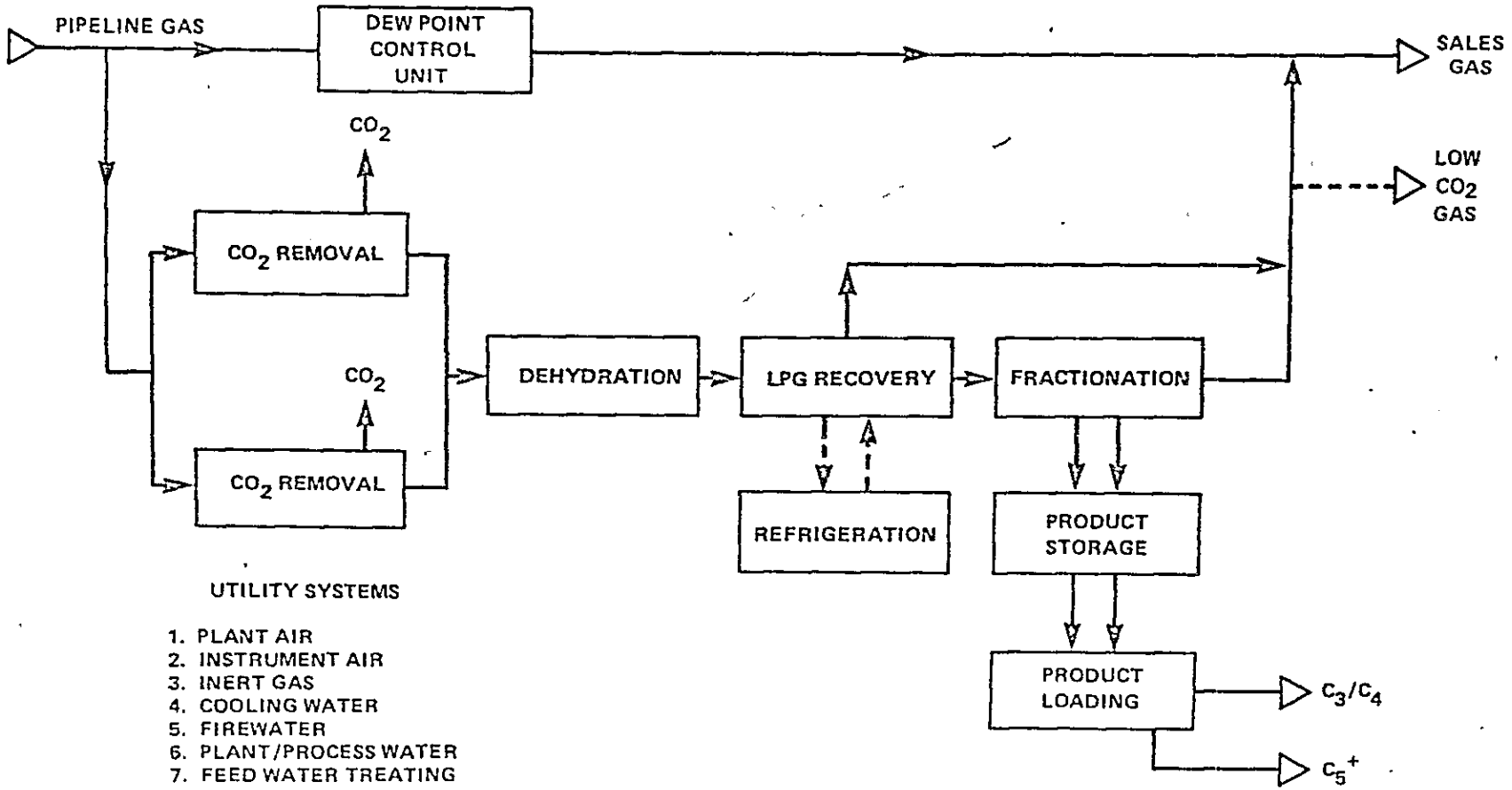


BLOCK FLOW DIAGRAM
(OVERALL MATERIAL BALANCE KEY)

3

NATURAL GAS ORGANIZATION OF THAILAND
NATURAL GAS DEVELOPMENT PROJECT

FLUOR OCEAN SERVICES, INC.



UTILITY SYSTEMS

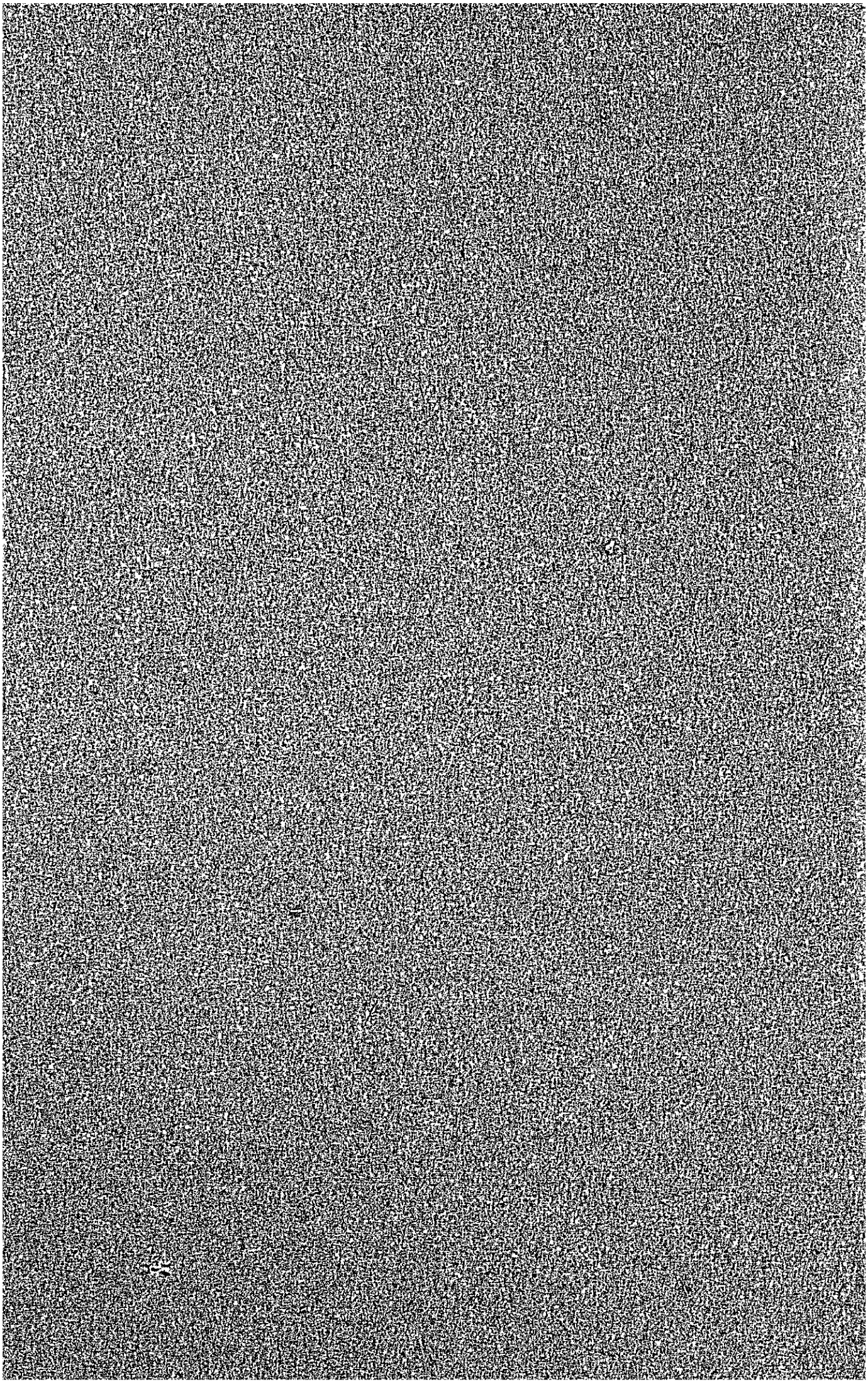
1. PLANT AIR
2. INSTRUMENT AIR
3. INERT GAS
4. COOLING WATER
5. FIREWATER
6. PLANT/PROCESS WATER
7. FEED WATER TREATING
8. WASTE WATER TREATING
9. STEAM
10. EMERGENCY POWER
11. FLARE & RELIEF
12. METHANOL INJECTION

PROCESS PLANT BLOCK FLOW DIAGRAM

NGOT FEED GAS COMPOSITION & HHV

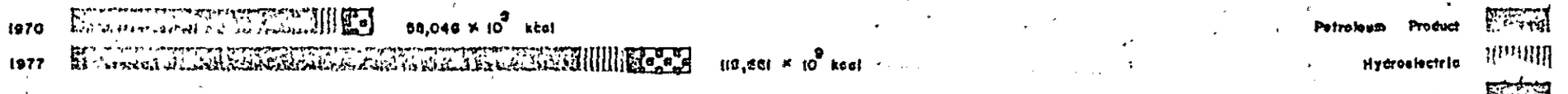
	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
GAS PRODUCTION (MMSCFD) (1)										
Union	150	150	200	250	250	250	250	250	250	250
Texas Pacific	-	150	150	250	250	350	350	450	450	450
		300	350	500	500	600	600	700	700	700
GAS COMPOSITION (MOLE %)										
N_2	0.226	0.508	0.468	0.508	0.508	0.555	0.555	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
$i\text{-}C_4$	0.804	0.652	0.674	0.652	0.652	0.627	0.627	0.609	0.609	0.609
$n\text{-}C_4$	0.670	0.595	0.606	0.595	0.595	0.582	0.582	0.573	0.573	0.573
$i\text{-}C_5$	0.213	0.191	0.195	0.191	0.191	0.188	0.188	0.185	0.185	0.185
$n\text{-}C_5$	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.

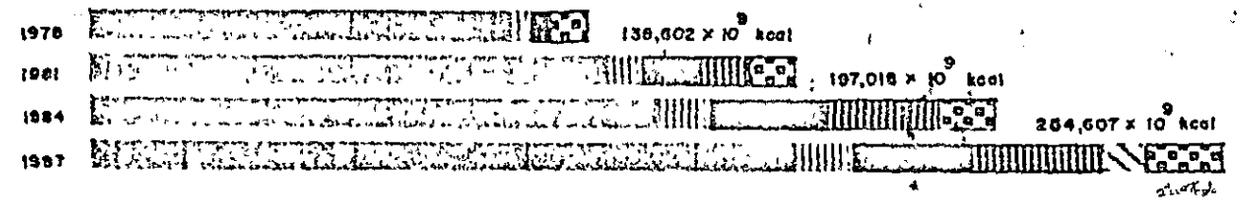


THAILAND ENERGY CONSUMPTION (1974–1977) WITH 23-YEAR FORECAST

ACTUAL

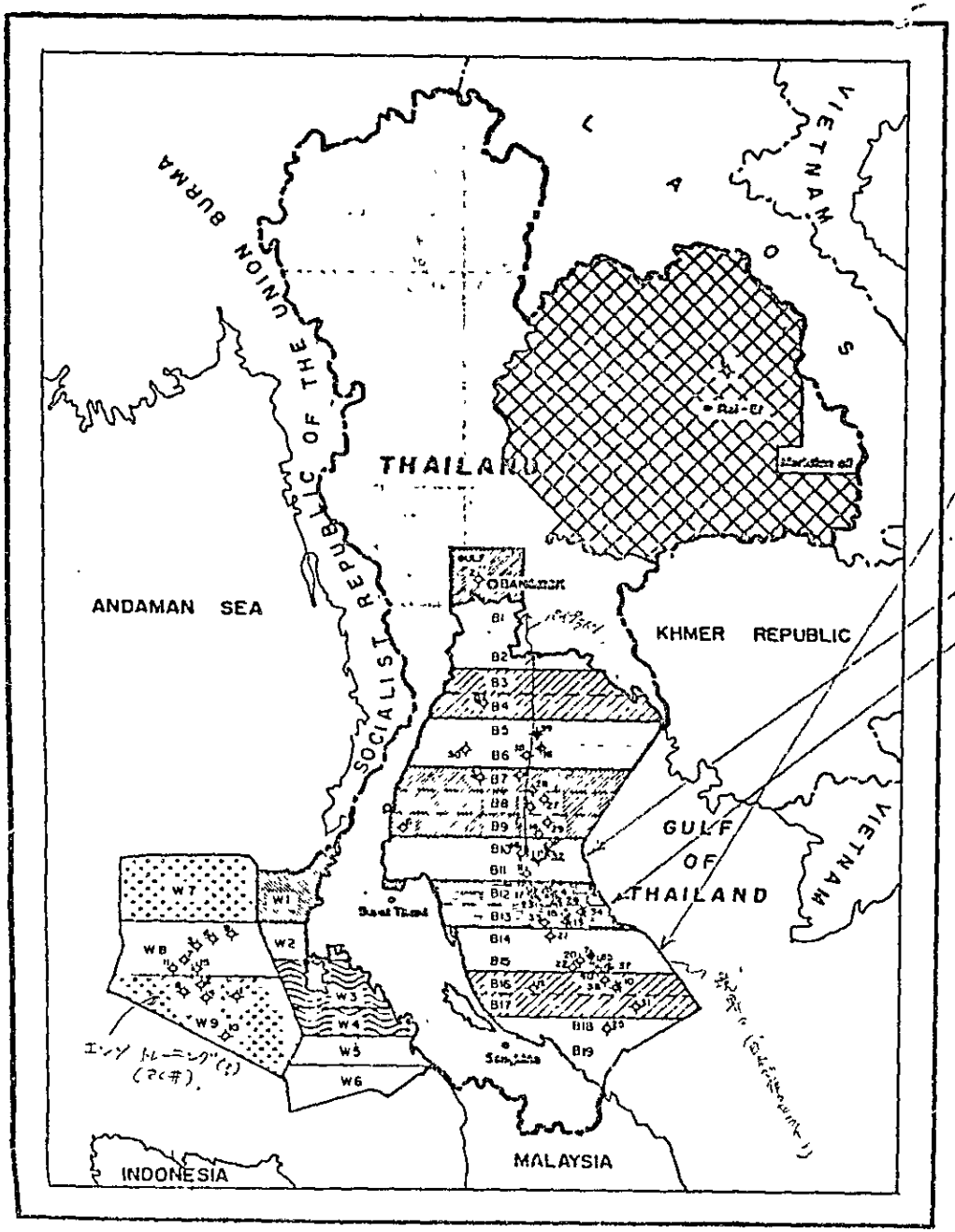


FORECAST



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	92 842 787	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	117,625 536	84 87	5,755 428	4 15	5,201 885	3.75	8,967 007	6 47	416,310	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	486 249	0 28	–	–	–	–	175,090 730	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	17,221 623	7.89	12,086 555	5.53	466 744	0 21	235 638	0 11	561 909	0 26	16,740.360	7 63	–	–	219 420 121	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	738 549	0 25	49,577 220	16 77	–	–	295 544 895	100 00
	1987	199,904 808	63 20	16,017 125	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	32 517 314	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	32 577,781	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	299 899 401	68 04	23 489 415	5.33	32 605 269	7 40	22,263 395	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	440,754 815	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	468,678,814	100 00
	1994	353 836 365	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	415 679 641	73 90	24,240 123	4 31	32,729 649	5 82	27,059 107	4 81	403 391	0 07	393 057	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	32,757 733	5 51	28,143 473	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	478 096 261	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	511 851 964	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	662,230 809	100 00
	2000	547,361 037	78.30	24,210 123	3 47	32 848 813	4 70	31,655,328	4 53	375 580	0 05	449 094	0 06	1,471 671	0 21	49,577 220	7 09	11,113 200	1 59	699 093 966	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) --- Gas
- Seaplee Union Oil, Southeast-Asia (12, 13) --- 1981
- Triton Oil, Anschutz, Inlet (18, 19)
- Weeks Petroleum, Norse Petroleum (W1)
- Amoco (W2)
- Pan Ocean (W3, 4)
- Oceonic, Suwanomas (W7)
- Union, Amoco, BP, Hamilton, Seam Resources (W8)
- ESSO (W9)
- Dry Hole
- Oil Discovery
- Gas & Condensate
- Oil & Condensate & Gas Discovery