TABLE 11 LPG PRODUCTION IN 1981

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
			(1)x(2)	(3)÷2.20462	(4)x24÷10^3	(5)x365÷10^3		(6)÷(7)
	LPG Product lb-Mols/Hr	Molecular Weight lb	LPG Weight lb/Hr	LPG Weight Kg/Hr	LPG Weight t/D	LPG Weight 10^3t/Y	Specific Quantity $60^oF/60^oF$	LPG Volume 10^3Kl/Y
ETHANE	8.3	30.068	249.6	113.2	2.72	0.99	0.374	2.65
PROPANE	165.9	44.094	7,315.2	3,318.1	79.63	29.06	0.508	57.20
BUTANE (ISO+N)	77.0	58.120	4,475.2	2,029.9	48.72	17.78	0.584	30.45
PENTANE (ISO+N)	3.7	72.146	266.9	121.1	2.91	1.06	0.631	1.68
HEXANE	0.1	86.172	8.6	3.9	0.09	0.03	0.664	0.05
TOTAL	255.0		12,315.5	5,586.2	134.07	48.94		92.03

TABLE 12 · LPG PRODUCTION IN 1982

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
			(1)x(2)	(3)÷2.20462	(4)x24÷10^3	(5)x365÷10^3	[illegible]	(6)÷(7)
	LPG Product lb-Mols/Hr	Molecular Weight lb	LPG Weight lb/Hr	LPG Weight Kg/Hr	LPG Weight t/D	LPG Weight 10^3t/Y	Specific Quantity $60^oF/60^oF$	LPG Volume 10^3Kl/Y
ETHANE	12.3	30.068	369.8	167.7	4.02	1.47	0.374	3.93
PROPANE	258.9	44.094	11,415.9	5,178.2	124.28	45.36	0.508	89.29
BUTANE (ISO+N)	113.6	58.120	6,602.4	2,994.8	71.88	26.24	0.584	44.93
PENTANE (ISO+N)	5.1	72.146	367.9	166.9	4.01	1.46	0.631	2.31
HEXANE	0.1	86.172	8.6	3.9	0.09	0.03	0.664	0.05
TOTAL	390.0		18,764.6	8,511.5	204.28	74.56	2.761	140.51

TABLE 13 LPG PRODUCTION IN 1983

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
			(1)x(2)	(3)÷2.20462	(4)x24÷10^3	(5)x365÷10^3		(6)÷(7)
	LPG Product lb-Mols/Hr	Molecular Weight lb	LPG Weight lb/Hr	LPG Weight Kg/Hr	LPG Weight t/D	LPG Weight 10^3t/Y	Specific Quantity $60^oF/60^oF$	LPG Volume 10^3Kl/Y
ETHANE	17.0	30.068	511.2	231.9	5.57	2.03	0.374	5.43
PROPANE	354.8	44.094	15,644.6	7,096.3	170.31	62.16	0.508	122.36
BUTANE (ISO+N)	156.1	58.120	9,072.5	4,115.2	98.76	36.05	0.584	61.73
PENTANE (ISO+N)	7.0	72.146	505.0	229.1	5.50	2.01	0.631	3.19
HEXANE	0.1	86.172	8.6	3.9	0.09	0.03	0.664	0.05
TOTAL	535.0		25,741,9	11,676.4	280.23	102.28		192.76

TABLE 14 LPG PRODUCTION IN 1984

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
			(1)x(2)	(3)÷2.20462	(4)x24÷10^3	(5)x365÷10^3		(6)÷(7)
	LPG Product lb-Mols/Hr	Molecular Weight lb	LPG Weight lb/Hr	LPG Weight Kg/Hr	LPG Weight t/D	LPG Weight 10^3t/Y	Specific Quantity $60^oF/60^oF$	LPG Volume 10^3Kl/Y
ETHANE	21.6	30.068	649.5	294.6	7.07	2.58	0.374	6.90
PROPANE	455.1	44.094	20,067.2	9,102.3	218.46	79.74	0.508	156.97
BUTANE (ISO+N)	199.4	58.120	11,589.1	5,256.7	126.16	46.05	0.584	78.85
PENTANE (ISO+N)	8.9	72.146	642.1	291.3	6.99	2.55	0.631	4.04
HEXANE	0.1	86.172	8.6	3.9	0.09	0.03	0.664	0.05
TOTAL	685.1		32,956.5	14,948.8	358.77	130.95		246.81

ATTACH.15

TABLE15 LPG PRODUCTION IN 1985

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
			(1)x(2)	(3)÷2.20462	(4)x24÷10^3	(5)x365÷10^3		(6)÷(7)
	LPG Product lb-Mols/Hr	Molecular Weight lb	LPG Weight lb/Hr	LPG Weight Kg/Hr	LPG Weight t/D	LPG Weight 10^3t/Y	Specific Quantity $60^oF/60^oF$	LPG Volume 10^3Kl/Y
ETHANE	26.9	30.068	808.8	366.9	8.81	3.22	0.374	8.61
PROPANE	566.0	44.094	24,957.2	11,320.4	271.69	99.17	0.508	195.22
BUTANE (ISO+N)	246.2	58.120	14,309.1	6,490.5	155.77	56.86	0.584	97.36
PENTANE (ISO+N)	10.7	72.146	772.0	350.2	8.40	3.07	0.631	4.87
HEXANE	0.1	86.172	8.6	3.9	0.09	0.03	0.664	0.05
TOTAL	849.9		40,855.7	18,531.9	444.76	162.35		306.11

TABLE 16 LPG PRODUCTION IN 1986

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
			(1)x(2)	(3)-2.20462	(4)x24÷10^3	(5)x365÷10^3		(6)÷(7)
	LPG Product lb-Mols/Hr	Molecular Weight lb	LPG Weight lb/Hr	LPG Weight Kg/Hr	LPG Weight t/D	LPG Weight 10^3t/Y	Specific Quantity $60^oF/60^oF$	LPG Volume 10^3Kl/y
ETHANE	32.0	30.068	962.2	436.4	10.47	3.82	0.374	10.21
PROPANE	684.3	44.094	30,173.5	13,686.5	328.48	119.90	0.508	236.02
BUTANE (ISO+N)	295.8	58.120	17,191.9	7,798.1	187.15	68.31	0.584	116.97
PENTANE (ISO+N)	12.8	72.146	923.5	418.9	10.05	3.67	0.631	5.82
HEXANE	0.1	86.172	8.6	3.9	0.09	0.03	0.664	0.05
TOTAL	1,025.0		49,259.7	22,343.8	536.24	195.73		369.07

TABLE 17 LPG PRODUCTION IN 1987

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
			(1)x(2)	(3)÷2.20462	(4)x24÷10^3	(5)x365÷10^3		(6)÷(7)
	LPG Product lb-Mols/Hr	Molecular Weight lb	LPG Weight lb/Hr	LPG Weight Kg/Hr	LPG Weight t/D	LPG Weight 10^3t/Y	Specific Quantity $60^oF/60^oF$	LPG Volume 10^3Kl/Y
ETHANE	38.0	30.068	1,142.6	518.3	12.44	4.54	0.374	12.14
PROPANE	811.9	44.094	35,799.9	16,238.6	389.73	142.25	0.508	280.02
BUTANE (ISO+N)	350.0	58.120	20,342.0	9,227.0	221.45	80.83	0.584	138.41
PENTANE (ISO+N)	15.2	72.146	1,096.6	497.4	11.94	4.36	0.631	6.91
HEXANE	0.1	86.172	8.6	3.9	0.09	0.03	0.664	0.05
TOTAL	1,215.2		58,389.7	26,485.2	635.65	232.01		437.53

TABLE 18 LPG PRODUCTION IN 1988

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
			(1)x(2)	(3)÷2.20462	(4)x24÷10^3	(5)x365÷10^3		(6)÷(7)
	LPG Product lb-Mols/Hr	Molecular Weight lb	LPG Weight lb/Hr	LPG Weight Kg/Hr	LPG Weight t/D	LPG Weight 10^3t/Y	Specific Quantity $60^oF/60^oF$	LPG Volume 10^3Kl/Y
ETHANE	43.7	30.068	1,314.0	596.0	14.30	5.22	0.374	13.96
PROPANE	946.6	44.094	41,739.4	18,932.7	454.38	165.85	0.508	326.48
BUTANE (ISO+N)	407.0	58.120	23,654.8	10,729.6	257.51	93.99	0.584	160.94
PENTANE (ISO+N)	17.6	72.146	1,269.8	576.0	13.82	5.04	0.631	7.99
HEXANE	0.1	86.172	8.6	3.9	0.09	0.03	0.664	0.05
TOTAL	1,415.0		67,986.6	30,838.2	740.10	270.13		509.42

TABLE 19 LPG PRODUCTION IN 1989

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
			(1)x(2)	(3)÷2.20462	(4)x24÷10^3	(5)x365÷10^3		(6)÷(7)
	LPG Product lb-Mols/Hr	Molecular Weight lb	LPG Weight lb/Hr	LPG Weight Kg/Hr	LPG Weight t/D	LPG Weight 10^3t/Y	Specific Quantity $60^oF/60^oF$	LPG Volume 10^3Kl/Y
ETHANE	50.2	30.068	1,509.4	684.7	16.43	6.00	0.374	16.04
PROPANE	1,087.4	44.094	47,947.8	21,748.8	521.97	190.52	0.508	375.04
BUTANE (ISO+N)	467.2	58.120	27,153.7	12,316.7	295.60	107.89	0.584	184.74
PENTANE (ISO+N)	20.1	72.146	1,450.1	657.8	15.79	5.76	0.631	9.13
HEXANE	0.1	86.172	8.6	3.9	0.09	0.03	0.664	0.05
TOTAL	1,625.0		78,069.6	35,411.9	849.88	310.20		585.00

TABLE 20 LPG PRODUCTION IN 1990

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
			(1)x(2)	(3)÷2.20462	(4)x24÷10^3	(5)x365÷10^3		(6)÷(7)
	LPG Product lb-Mols/Hr	Molecular Weight lb	LPG Weight lb/Hr	LPG Weight Kg/Hr	LPG Weight t/D	LPG Weight 10^3t/Y	Specific Quantity $60^oF/60^oF$	LPG Volume 10^3Kl/Y
ETHANE	57.0	30.068	1,713.9	777.4	18.66	6.81	0.374	18.21
PROPANE	1,234.9	44.094	54,451.7	24,698.9	592.56	216.28	0.508	425.75
BUTANE (ISO+N)	530.2	58.120	30,815.2	13,977.6	335.46	122.44	0.584	209.66
PENTANE (ISO+N)	22.7	72.146	1,637.7	742.8	17.83	6.51	0.631	10.32
HEXANE	0.1	86.172	8.6	3.9	0.09	0.03	0.664	0.05
TOTAL	1,844.9		88,627.1	40,200.6	964.60	352.07		663.99

TABLE 21 REQUIREMENT OF EACH PRODUCT AND TOTAL CRUDE OIL THRU-PUT (EXISTING, EXPANSIO

YEAR	(1) LPG 10^3Kl/y	(2) % of (1) on Crude (23)	(3) Benzine 10^3Kl/y	(4) % of (3) on Crude (23)	(5) Jet Fuel 10^3Kl/y	(6) % of (5) on Crude (23)	(7) Kerosene 10^3Kl/y	(8) % of (7) on Crude (23)	(9) Diesel Oil 10^3Kl/y	(10) % of (9) on Crude (23)	(11) Fuel Oil (Incl. N.G.) 10^3Kl/y	(12) N.G. Equi. Fuel Oil 10^3Kl/y	(13) (11)-(12) Fuel Oil(Excl. N.G.) 10^3Kl/y	% on
1977	Production 240		2,117		752		280		2,797		2,828			
	Demand													
78	292	2.1	2,625	19.1	916	6.6	342	2.5	4,392	31.9	4,223			
79	317	2.1	2,843	19.0	992	6.6	371	2.5	4,757	31.8	4,574			
1980	356	2.1	3,200	19.0	1,116	6.6	417	2.5	5,354	31.7	5,149			
81	396	2.2	3,559	20.3	1,241	7.1	464	2.6	5,954	33.9	5,726	Prod. 4.6	Thru 1,189 6,3	4,537
82	444	2.4	3,986	21.2	1,390	7.4	520	2.8	6,669	35.5	6,413	10.7	2,141 9.8	4,272
83	464	2.4	4,163	21.5	1,452	7.5	543	2.8	6,966	36.1	6,699	12.0	2,529 11.6	4,170
84	479	2.5	4,297	22.6	1,499	7.9	560	3.0	7,189	37.9 396	6,913	16.8	3,578 15.4	3,335
[illegible]	[illegible]	[illegible]	4,692	22.1	1,637	7.7	612	2.9	7,851	37.1	7,549	14.8	3,527 14.3	4,022
86	571	2.5	5,131	22.4	1,790	7.8	669	2.9	8,585	37.5	8,256	15.8	4,106 15.2	4,150
87	620	2.5	5,567	22.0	1,942	7.7	726	2.9	9,315	36.9	8,958	14.2	4,038 13.8	4,920
88	664	2.5	5,961	22.3	2,079	7.8	777	2.9	9,975	37.3	9,592	15.3	4,634 17.8	4,958
89	706	2.5	6,339	22.0	2,211	7.7	826	2.9	10,606	36.9	10,199	14.2	4,577 15.9	5,622
1990	749	2.4	6,723	21.8	2,345	7.6	877	2.9	11,250	36.4	10,818	13.2	4,506 12.5	6,312
91	808	2.4	7,257	21.5	2,531	7.5	946	2.8	12,143	36.0	11,677	12.3	4,506 11.9	7,171
92	868	2.4	7,799	21.3	2,720	7.4	1,017	2.8	13,049	35.6	12,548	11.4	4,506 10.	8,042
93	933	2.4	8,374	21.1	2,921	7.4	1,092	2.7	14,011	35.3	13,473	10.6	4,506 10.4	8,967
94	1,003	2.4	9,002	21.0	3,140	7.3	1,174	2.7	15,063	35.1	14,484	9.9	4,506 9.1	9,978
95	1,077	2.3	9,671	20.8	3,373	7.3	1,261	2.7	16,183	34.8	15,561	9.2	4,506 8.8	11,055
96	1,156	2.3	10,382	20.6	3,621	7.2	1,354	2.7	17,372	34.6	16,705	8.6	4,506 8.4	12,199
97	1,232	2.3	11,060	20.5	3,858	7.2	1,442	2.7	18,507	34.3	17,796	8.0	4,506 8.1	13,290
98	1,311	2.3	11,774	20.4	4,107	7.1	1,535	2.7	19,701	34.2	18,945	7.6	4,506 7.3	14,439
99	1,395	2.3	12,528	20.3	4,370	7.1	1,633	2.6	20,963	34.0	20,158	7.1	4,506 6.8	15,652
2000	1,483	2.2	13,321	20.2	4,646	7.1	1,737	2.6	22,289	33.9	21,433	6.7	4,506 6.1	16,927

Note: *1 Unfinished products is only including in 1977.

*2 The crude oil thru-put of 3 existing refineries, this is conceivabled the maximum capacity of existing 3 refineries.

*3 (25) minus *2 (1,840 B/SD), it is the capacity of the new refinery.

RU-PUT (EXISTING, EXPANSION AND/OR NEW REFINERY) AND EXPANSION AND/OR NEW REFINERY CRUDE OIL THRU-PUT

ATTACH. 21

(12) Equi. Oil 10^3Kl/y	(13) (11)-(12) Fuel Oil(Excl. N.G.) 10^3Kl/y	(14) % of (13) on Crude (23)	(15) Lube Oil 10^3Kl/y	(16) % of (15) on Crude (23)	(17) Bitumen 10^3Kl/y	(18) % of (17) on Crude (23)	(19) Petroleum Product Total 10^3Kl/y	(20)*1 Loss and Own Fuel % on Products	(21) Loss and Own Fuel 10^3Kl/y	(22) % of (21) on Crude (23)	(23) Total Crude Oil Thru-put 10^3Kl/y	(24) Total %	(25) (23)-330x6.3 Crude Oil Thru-put B/SD	(26) Expan.and/or New Ref. Crude Oil Thru-put B/SD
					156	1.6	9,170	9.5	488	5.1	9,658			184,000*2
		32,230.6	128	0.9	205	1.5	13,123	5.0	656	4.8	13,779	100	263,000	
		32,130.6	152	1.0	236	1.6	14,242	5.0	712	4.8	14,954	100	285,000	
		32,130.5	187	1.1	281	1.7	16,060	5.0	803	4.8	16,863	100	322,000	
89 6,3	4,537	27,125.8	225	1.3	347	2.0	16,723	5.0	836	4.8	17,559	100	335,000	151,000*3
41 9,8	4,272	22.8	291	1.5	388	2.1	17,960	4.5	808	4.3	18,768	100	358,000	174,000
29 11,6	4,170	22,621.6	325	1.7	406	2.1	18,489	4.5	832	4.3	19,321	100	369,000	185,000
78 15,9	3,335	16,417.6	377	2.0	419	2.2	18,155	4.5	817	4.3	18,972	100	362,000	178,000
27 14,3	4,022	19,919.0	457	2.2	457	2.2	20,251	4.5	911	4.3	21,162	100	404,000	220,000
06 15,2	4,150	18.1	500	2.2	500	2.2	21,896	4.5	985	4.4	22,881	100	437,000	253,000
38 13,8	4,920	19.5	543	2.1	543	2.1	24,174	4.5	1,088	4.3	25,262	100	482,000	298,000
34 14,8	4,958	18.5	581	2.2	581	2.2	25,576	4.5	1,151	4.3	26,727	100	510,000	326,000
77 13,0	5,622	19.5	618	2.1	618	2.1	27,546	4.5	1,240	4.3	28,786	100	550,000	366,000
06 12,9	6,312	20.4	655	2.1	655	2.1	29,566	4.5	1,330	4.3	30,896	100	590,000	406,000
06 11,9	7,171	21.3	707	2.1	707	2.1	32,270	4.5	1,452	4.3	33,722	100	644,000	460,000
06 10,7	8,042	22.0	760	2.1	760	2.1	35,015	4.5	1,576	4.3	36,591	100	699,000	515,000
06 10,1	8,967	22.6	816	2.1	816	2.1	37,930	4.5	1,707	4.3	39,637	100	757,000	573,000
06 9,5	9,978	23.2	877	2.0	877	2.0	41,114	4.5	1,850	4.3	42,964	100	820,000	636,000
06 8,8	11,055	23.8	943	2.0	943	2.0	44,506	4.5	2,003	4.3	46,509	100	888,000	704,000
06 8,4	12,199	24.3	1,011	2.0	1,011	2.0	48,106	4.5	2,165	4.3	50,271	100	960,000	776,000
06 7,9	13,290	24.7	1,078	2.0	1,078	2.0	51,545	4.5	2,320	4.3	53,865	100	1,028,000	844,000
06 7,3	14,439	25.0	1,147	2.0	1,147	2.0	55,161	4.5	2,482	4.3	57,643	100	1,100,000	916,000
06 6,8	15,652	25.4	1,221	2.0	1,221	2.0	58,983	4.5	2,654	4.3	61,637	100	1,177,000	993,000
06 6,4	16,927	26.1 25.7	1,298	2.0	1,298	2.0	62,999	4.5	2,835	4.3	65,834	100	1,257,000	1,073,000

TABLE 22 REQUIREMENT OF EACH PRODUCT AND TOTAL CRUDE OIL THRU-PUT FOR EXPANSION A

YEAR	(1) LPG Demand -1977's Capacity 10^3Kl/y	(2) % of (1) on Crude (22)	(3) Benzine Demand-1977's Capacity 10^3Kl/y	(4) % of (3) on Crude (22)	(5) Jet Fuel Demand-1977's Capacity 10^3Kl/y	(6) % of (5) on Crude (22)	(7) Kerosene Demand-1977's Capacity 10^3Kl/y	(8) % of (7) on Crude (22)	(9) Diesel Oil Demand-1977's Demand 10^3Kl/y	(10) % of (9) on Crude (22)	(11) Fuel Oil (Incl.N.G.Dem. -1977's Dem. 10^3Kl/y	(12) Natural Gas (Equivalent) 10^3Kl/y	(13) (11)-(12) Fuel Oil (Incl. N.G.) 10^3Kl/y	(14) % of (13) on Crude (22)	Lu
1977															
78	52		508		164		62		1,595		1,395				
79	77		726		240		91		1,960		1,746				
1980	116		1,083		364		137		2,557		2,321				
81	156	2.0	1,442	18.4	439	5.2	184	2.3	3,157	40.2	2,898	1,189	1,709	21.8	
82	204	2.2	1,869	20.5	638	7.0	240	2.6	3,872	42.4	3,585	2,141	1,444	15.8	
83	224	2.3	2,046	21.1	700	7.2	263	2.7	4,169	43.0	3,871	2,529	1,342	13.9	
84	239	2.6	2,180	23.4	747	8.0	280	3.0	4,392	47.0	4,085	3,578	507	5.4	
85	283	2.4	2,575	22.3	885	7.7	332	2.9	5,054	43.9	4,721	3,527	1,194	10.4	
86	331	2.5	3,014	22.8	1,038	7.8	389	2.9	5,788	43.8	5,428	4,106	1,322	10.0	
87	380	2.4	3,450	22.1	1,190	7.6	446	2.9	6,518	41.8	6,130	4,038	2,092	13.4	
88	424	2.5	3,844	22.5	1,327	7.8	497	2.9	7,178	42.1	6,764	4,634	2,130	12.5	
89	466	2.5	4,222	22.1	1,459	7.6	546	2.9	7,809	40.9	7,371	4,577	2,794	14.6	
1990	509	2.4	4,606	21.7	1,593	7.5	597	2.8	8,453	39.9	7,990	4,506	3,484	16.4	
91	568	2.4	5,140	21.4	1,779	7.4	666	2.8	9,346	38.9	8,849	4,506	4,343	18.1	
92	628	2.3	5,682	21.1	1,968	7.3	737	2.8	10,252	38.2	9,720	4,506	5,214	19.4	
93	693	2.3	6,257	20.9	2,169	7.3	812	2.7	11,214	37.5	10,645	4,506	6,139	20.6	
94	763	2.3	6,885	20.7	2,388	7.2	894	2.7	12,266	36.9	11,656	4,506	7,150	21.5	
95	837	2.3	7,554	20.6	2,621	7.1	981	2.7	13,386	36.4	12,733	4,506	8,227	22.4	
96	916	2.3	8,265	20.4	2,869	7.1	1,074	2.7	14,575	36.0	13,877	4,506	9,371	23.1	
97	992	2.3	8,943	20.3	3,106	7.1	1,162	2.6	15,710	35.7	14,968	4,506	10,462	23.7	
98	1,071	2.2	9,657	20.2	3,355	7.0	1,255	2.6	16,904	35.4	16,117	4,506	11,611	24.3	
99	1,155	2.2	10,411	20.1	3,618	7.0	1,353	2.6	18,166	35.1	17,330	4,506	12,824	24.8	
2000	1,243	2.2	11,204	20.0	3,894	7.0	1,457	2.6	19,492	34.8	18,605	4,506	14,099	25.2	

CT AND TOTAL CRUDE OIL THRU-PUT FOR EXPANSION AND/OR NEW REFINERY

.Dem. Dem. /y	(12) Natural Gas (Equivalent) 10^3Kl/y	(13) (11)-(12) Fuel Oil (Incl. N.G.) 10^3Kl/y	(14) % of (13) on Crude (22)	(15) Lube Oil 10^3Kl/y	(16) % of (15) on Crude (22)	(17) Bitumen Demand-1977's Production 10^3Kl/y	(18) % of (17) on Crude (22)	(19) Petroleum Product Total 10^3Kl/y	(20) Loss and Own Fuel 10^3Kl/y	(21) % of (20) on Crude (22) 10^3Kl/y	(22) Crude Oil Thru-put 10^3Kl/y	(23) % of (22) on Crude (22)	(24) Crude Oil Thru-put (22)-330x6.3 B/SD
395				128		49			158				
746				152		80			203				
521				187		125			276				
998	1,189	1,709	21.8	225	2.9	191	2.4	7,553	298	3.8	7,851	100	150,000
585	2,141	1,444	15.8	291	3.2	232	2.5	8,790	347	3.8	9,137	100	174,000
871	2,529	1,342	13.9	325	3.4	250	2.6	9,319	368	3.8	9,687	100	185,000
085	3,578	507	5.4	377	4.0	263	2.8	8,985	355	3.8	9,340	100	178,000
721	3,527	1,194	10.4	457	4.0	301	2.6	11,081	438	3.8	11,519	100	220,000
428	4,106	1,322	10.0	500	3.8	344	2.6	12,726	503	3.8	13,229	100	253,000
130	4,038	2,092	13.4	543	3.5	387	2.5	15,006	593	3.8	15,599	100	298,000
764	4,634	2,130	12.5	581	3.4	425	2.5	16,406	648	3.8	17,054	100	326,000
371	4,577	2,794	14.6	618	3.2	462	2.4	18,376	726	3.8	19,102	100	365,000
990	4,506	3,484	16.4	655	3.1	499	2.4	20,396	806	3.8	21,202	100	405,000
849	4,506	4,343	18.1	707	2.9	551	2.3	23,100	912	3.8	24,012	100	458,000
720	4,506	5,214	19.4	760	2.8	604	2.3	25,845	1,021	3.8	26,866	100	513,000
645	4,506	6,139	20.6	816	2.7	660	2.2	28,760	1,136	3.8	29,896	100	571,000
656	4,506	7,150	21.5	877	2.7	721	2.2	31,944	1,262	3.8	33,206	100	634,000
733	4,506	8,227	22.4	943	2.6	787	2.1	35,336	1,396	3.8	36,732	100	701,000
877	4,506	9,371	23.1	1,011	2.5	855	2.1	38,936	1,538	3.8	40,474	100	773,000
968	4,506	10,462	23.7	1,078	2.4	922	2.1	42,375	1,674	3.8	44,049	100	841,000
117	4,506	11,611	24.3	1,147	2.4	991	2.1	45,991	1,817	3.8	47,808	100	913,000
330	4,506	12,824	24.8	1,221	2.3	1,065	2.1	49,813	1,968	3.8	51,781	100	989,000
605	4,506	14,099	25.2	1,298	2.3	1,142	2.1	53,829	2,126	3.8	55,955	100	1,068,000

TABLE 23 EXAMPLE OF CONSTRUCTION SCHEDULE FOR EACH REFINERY (UNIT : BPSD)

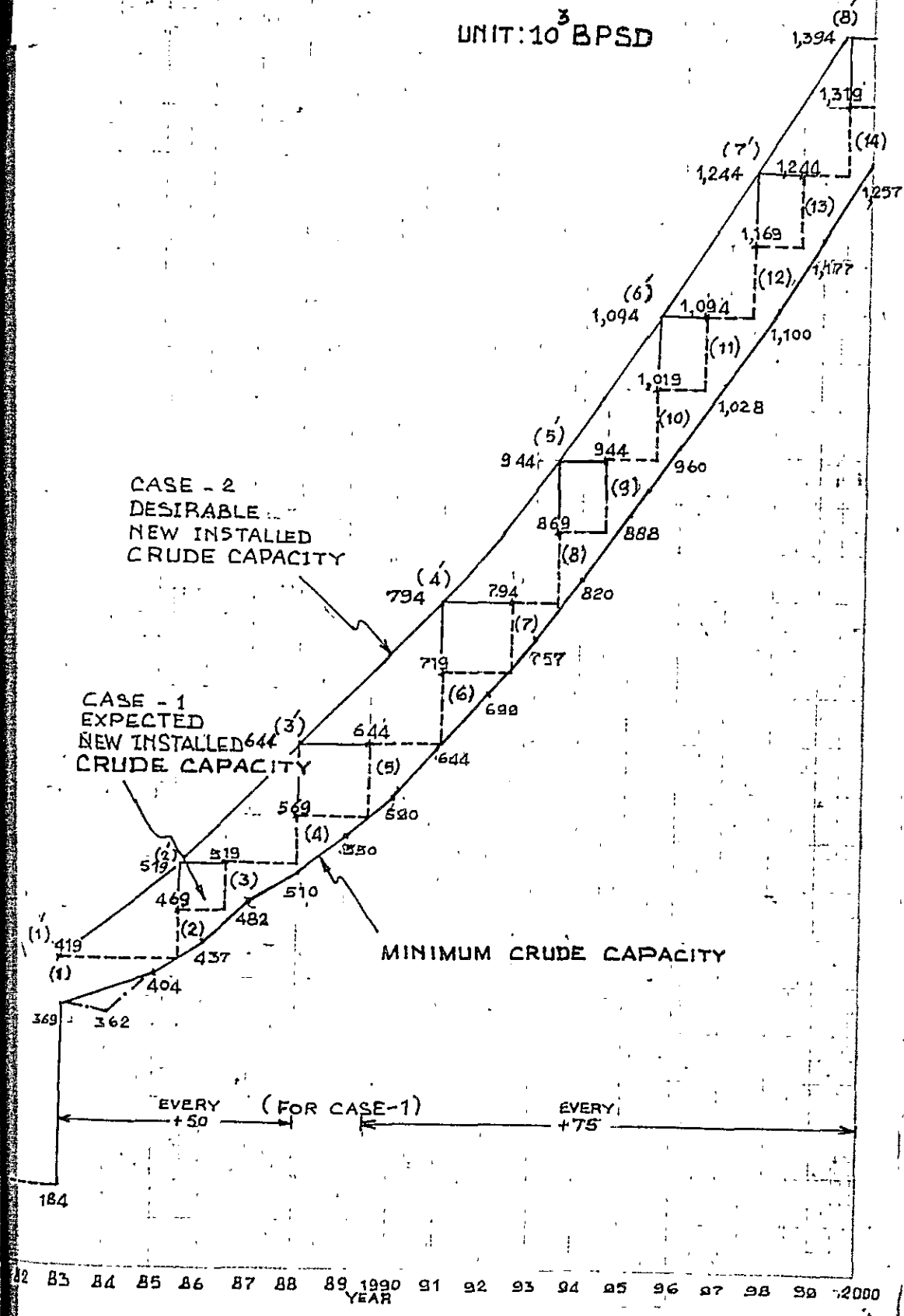
ATTACH. 23

	CASE-1							CASE-2							
	A Exist. (63,000)	B Exist. (74,500)	C Exist. (46,500)	NO.1 New (-)	No.2 New (-)	No.3 New (-)	Total (184,000)		A Exist. (63,000)	B Exist. (74,500)	C Exist. (46,500)	No.1 New (-)	No.2 New (-)	No.3 New (-)	Total (184,000)
1983	45,000 (108,000)	65,000 (139,500)	35,000 (81,500)	90,000 (90,000)	0	0	235,000 (419,000)	1983	45,000 (108,000)	65,000 (139,500)	35,000 (81,500)	90,000 (90,000)	0	0	235,000 (419,000)
84								84							
85				(2)			50,000 (469,000)	85				(2')			100,000 (519,000)
86				50,000 (140,000)				86				100,000 (190,000)			
87				(3) 50,000 (190,000)			50,000 (519,000)	87							
88				(4) 50,000 (240,000)			50,000 (569,000)	88				(3') 125,000 (315,000)			125,000 (644,000)
89					(5) 75,000 (75,000)			89							
1990							75,000 (644,000)	1990					(4')		
91					(6) 75,000 (150,000)		75,000 (719,000)	91					150,000 (150,000)		150,000 (794,000)
92					(7)			92							
93					75,000 (225,000)		75,000 (794,000)	93					(5')		
94					(8) 75,000 (300,000)		75,000 (869,000)	94					150,000 (300,000)		150,000 (944,000)
95						(9) 75,000 (75,000)	75,000 (944,000)	95						(6')	
96						(10) 95,000 (150,000)	75,000 (1,019,000)	96						150,000 (300,000)	150,000 (1,094,000)
97						(11) 75,000 (225,000)	75,000 (1,094,000)	97						(7')	
98						(12) 75,000 (300,000)	75,000 (1,169,000)	98						150,000 (300,000)	150,000 (1,244,000)
99			(13) 75,000 (214,500)				75,000 (1,244,000)	99							
2000			(14) 75,000 (156,500)				75,000 (1,319,000)	2000			(8') 150,000 (289,500)				150,000 (1,394,000)

ATTACH. 24

FIG. 1 TOTAL THROUGH-PUT, EXPANSION AND/OR NEW REFINERY CONSTRUCTION SCHEDULE 1983~2000

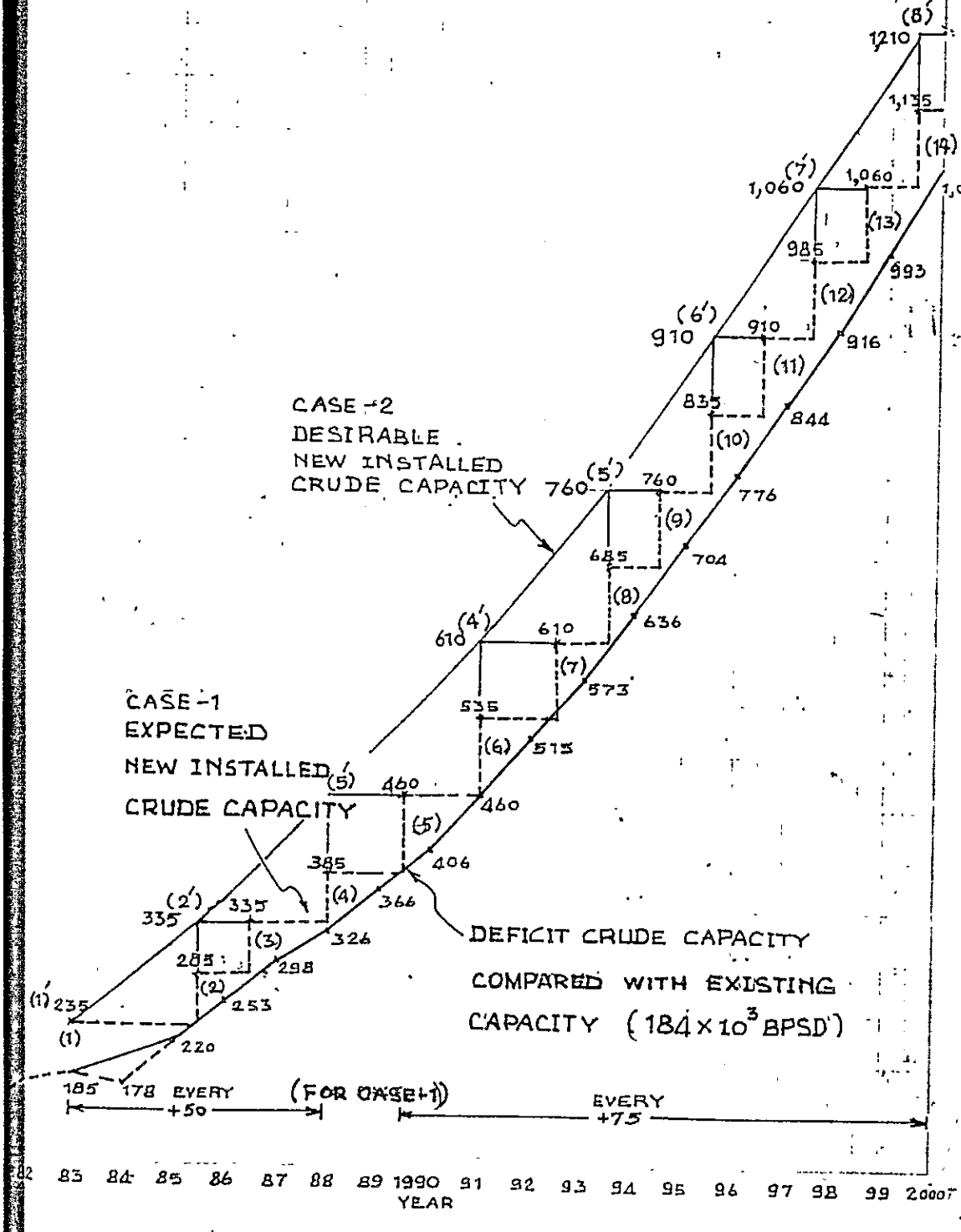
UNIT: 10^3 BPSD



ATTACH: 25

FIG.2 NEW INSTALLATION FROM 1983, EXPANSION AND/OR NEW REFINERY CONSTRUCTION SCHEDULE 1983~2000

UNIT : 10^3 BPSD



(C)

July 16, 1979.

Mr. Tammachart Sirivadhanakul,
Director of Regulatory Division,
National Energy Administration.

Dear Mr. Tammachart,

Re: NATURAL GAS DEMAND FORECAST

I present you the report of"NATURAL GAS DEMAND FORECAST" by your request.

This report is revision of "NATURAL GAS DEMAND FORECAST OF THE INDUSTRY (FUEL AND RAW MATERIAL) on July 20, 1978.

About 1 year past, the natural gas production schedule, natural gas characterization, natural gas requirement, new project have been clear, so I reviced the former report.

But there are still many unknown factors, so natural gas forecast should be reviced every a half year or several months. I recommend you as follows :-

I NATURAL GAS BALANCE AND USAGE

(1) For EGAT

The potential natural gas consumption of South Bangkok and Bang Pakong Power Station is 720 MMscf/D. Sales natural gas will be 546 MMscf/D in 1990.

Initial stage of natural gas production, wholesales natural gas should be consumed by NGOT.

(2) New Project

At present, Thai Government takes up soda ash and integrated flat steel project. The project will consume natural gas not only fuel but raw material or reductant, so these are valuable usage of natural gas.

Soda ash project will be scheduled to commerce the production in 1982 or 1983, but may be in 1984, and integrated flat steel project will be commenced in 1985.

Sales natural gas for projects is 17 - 20% on total sales natural gas (for new project 104 MMscf/D and sales natural gas 546 MMscf/D in 1991).

(3) Existing Industry

Fuel oil firing boiler of the existing industry must be modified to natural gas firing boiler or newly natural gas firing boiler must be replaced.

The cost of modification is 50% of new fuel oil boiler and the price of new fuel oil firing boiler is 15 - 20% higher than fuel oil boiler. So, natural gas price must be reduced for depreciation, interest, insurance and others of high price or modification cost (reduction price of natural gas is very small, such as 0.0354 - 0.108 $/1,000 scf), and bounty and dangerous allowance must be consider by NGOT. Total reduction of sales natural gas price might be 3 - 5%. Its sales natural gas price is 1.98 $/1,000 scf, reduction is 0.06 $ - 0.10 $/1,000 scf (natural gas price for existing industry is 1.92 - 1.88 $/1,000 scf).

Other hand, natural gas firing of existing industry is very small.

Anyhow, modification of existing industry boil might be wait till natural gas production will be going up.

(4) LPG Production

LPG production from the refineries is enough for domestic requirement. So, LPG from natural gas could be export and LPG utilization must be developed such as motor fuel.

LPG production from natural gas should be studied.

(5) Petrochemicals

More profitable usage must be developed, such as industry which uses natural gas raw material. The industry is so-called

petrochemical industry, therefore methane derivative industry and ethylene industry should be developed.

Ethane in Siam Gulf natural gas enough quantity to produce ethylene.

Ethylene production will be 242,000 T/Y in 1985 and 301,800 T/Y in 1990.

Ethylene production of one ethylene center is 300,000 T/Y.

Ethylene price from ethane is very cheaper than ethylene from naphtha or heavier fractions. So, in near future,,Thailand might install ethylene plant and ethylene chemicals plants. When ethylene plant is installed, aromatics (benzene, toluene and xylenes) plant must be installed.

(6) LPG

Natural gas production is not enough for LNG production to export.

II NGOT must guarantee term of natural gas supply

NGOT must guarantee the term of natural gas supply to every natural gas user.

III Bang Pakong Power Station

Nobody can imagine the energy situation for 20 years hence, but if the electric power station still use fuel oil, Bang Pakong Power Station is far from the refineries, or if coal is used for thermal plant, Bang Pakong Power Station must have coal storage and ash dumping area,. and coal import facilities.

IV Natural gas production is increased from 150 to 200 MMscf/D

NGOT is concerning that natural gas production in 1981 will be changed from 150 to 200 MMscf/D and in 1982 from 300 to 350 MMscf/D. My 5 cases study, there is no problem for 50 MMscf/D production increase. Natural gas production increase is preferable for crude oil shortage.

I recommend you that natural gas will be used for EGAT and the new project, not used for the existing industry till natural gas reserves will be confirmed more than 30 years production, and natural gas production will be more than 700 MMscf/D.

I apprcciated if it would be useful for you

Sincerely yours,

y. Kawase

CONTENTS

LIST OF TABLE AND FIGURE

I FOREWORD

I reported "NATURAL GAS DEMAND FORECAST OF THE INDUSTRY (FUEL AND RAW MATERIAL) on July 20, 1978.

But recently, the natural gas production is changed from 500 MMscf/D to 700 MMscf/D, the composition of sales natural gas is cleared, the pipeline route is decided that NGOT has no schedule to lay the pipeline to Saraburi of cement industrial area.

So, I recalculate the natural gas demand forecast more accuracy than the old report.

The main recalculation is the natural gas consumption for EGAT.

Natural gas will be utilized for EGAT, new project and existing industry.

EGAT is the main natural gas user, new project is used natural gas as raw material or reduction agent, so there are no problems at all. The problem is for existing industry, it must modified from fuel oil to natural gas. The modification has very small merit, and natural gas price for existing industry should be cheaper than fuel oil on calorific value. And the point is natural gas life, if it is less than 25 years, Thai Government could not recommend to use natural gas to existing industry.

I present the report, but there is still much unknown factor, so natural gas utilization schedule shall be reviced many times.

II NATURAL GAS HEATING BALUE

In old report, natural gas heating value was 1,000 BTU/scf as net heating value.

In this report, I calculate the sales natural gas heating value from Fluor Ocean Services International Inc.'s report. Average net heating value is 864 BTU/scf which is shown in TABLE-1 (ATTACH.1).

And EGAT assumed two heating value, one is 1,000 BTU/scf and other is 900 BTU/scf.

III NATURAL GAS FOR EXISTING INDUSTRY

NGOT has no schedule to lay a pipeline to Saraburi of cement industrial area.

Natural gas consumption of existing industry except cement industry is shown in TABLE-2 (ATTACH.2).

IV INTEGRATED FLAT STEEL PROJECT

Production flow is shown in FIG.1 (ATTACH.3), and natural gas consumption is shown in TABLE-3 (ATTACH.4).

In the planning, electricity will be bought from EGAT.

Natural Gas Consumption will be as follows :-

	1985	1990	
MMscf/D	50	75	(1,000 BTU/scf)
"	57.87	86.81	(864 BTU/scf)

V SODA ASH PROJECT

Soda ash production would be commenced in 1982 or 1983, and production and natural gas consumption schedule is shown in TABLE-4 (ATTACH.4).

Natural gas consumption for soda ash project is 17.63 x 10^6scf/D (946 BTU/scf) including ammonia production and electric generation.

In this calculation, soda ash manufacturing will be commenced from 1984, and expansion is not concerned.

VI TOTAL NATURAL GAS BALANCE OF EXISTING INDUSTRY, NEW PROJECT AND EGAT

TABLE-6 (ATTACH.6) is shown total natural gas balance of existing

industry, new project and EGAT.

Sales Natural Gas (Production)	:	Fluor's report (TABLE-5).
Consumption Existing Industry	:	My report on July 20, 1978 (TABLE-2) (Origin is SOFREGAZ INTERIM REPORT).
New Project	:	TABLE-3 and 4.

4 cases are made in TABLE-6 (ATTACH.6).

(1) CASE-1 sales natural gas 100% for EGAT

Sales natural gas is not supplied to the existing industry and the new project, in other words, the wholesales natural gas is utilized for electricity generation.

(2) CASE-2 C - 70% (70% max.) of potential existing industry natural gas is supplied. After the year of 1988, natural gas of each year is 70% on potential existing industry natural gas consumption.

And the new project is 100% on potential of its natural gas consumption. The rest of natural gas is for EGAT.

(3) CASE-3 0 - 50% (50 max.) of potential existing industry natural gas is supplied. After the year of 1986, natural gas consumption of each year is 50% on potential existing industry natural gas consumption.

And the new project is 100% on potential of its natural gas consumption. The rest of natural gas is for EGAT.

(4) CASE-4 No natural gas for existing industry.

And the new project is 100% on potential of its natural gas consumption. The rest of natural gas is for EGAT.

The reason of 10% increase every year for conversion to natural firing boiler of the existing industry is that old boiler can not modified to natural gas firing boiler, a life of boiler is

already passed over several years, so it lost money to the investment of modification.

If the existing industry is modified much fuel oil firing boilers to natural gas boilers, natural gas firing electric power plants of Bang Pakong Power Station should be changed from natural gas to diesel and fuel oil within 10 years.

VII NGOT NATURAL GAS PRODUCTION AND DEMAND FORECAST (MADE BY NGOT)

NGOT made schedule of LPG and natural gas production and the demand forecast of natural gas for EGAT, the existing industry and the new industry (new project). NGOT disclosed these data which are shown in TABLE-7 (ATTACH.7).

Comparison of TABLE-6 (ATTACH.6) TOTAL NATURAL GAS BALANCE which is based on SOFREGAZ INTERIM REPORT and Fluor's report, and TABLE-7 (ATTACH.7) QUANTITY OF NATURAL GAS PRODUCTION OF NGOT COMPARING WITH THE DEMAND FORECAST, and TABLE-10 (ATTACH.9) is shown in TABLE-8 (ATTACH.8).

EGAT investigated his own natural gas demand forecast, and NGOT was reported natural gas, LPG and remain of natural gas (sales natural gas) production and natural gas demand forecast of the existing industry and the new project. But I could not know how NGOT and EGAT calculate natural gas volume, so I will calculate it which based on Fluor's report.

VIII EGAT NATURAL GAS CONSUMPTION SCHEDULE (MADE BY EGAT)

TABLE-9 (ATTACH.9) is shown the capacity of each plant of EGAT and the modification schedule of South Bangkok thermal plant and new installation of Bang Pakong.

TABLE-10 (ATTACH.9) is shown the forecast demand of natural gas on electricity generation of EGAT during 1981 - 1985. In this table, natural gas heating value is assumed as 900 BTU/scf and 1,000 BTU/scf.

In TABLE-7 (ATTACH.7), natural gas demand forecast of EGAT

is shown, but demand forecast in 1981 is 181.8 scf/D and TABLE-10 (ATTACH.9) in 1981 is 162.9 scf/D, another demand forecast is same.

Both natural gas demands of EGAT are over the remain of natural gas (the sales natural gas), these may be only a requirement of EGAT.

IX HEAT EFFICIENCY OF ELECTRIC GENERATOR USING NATURAL GAS

According to TABLE-10 (ATTACH.9) which is estimated by EGAT, I calculated heat efficiency of South Bangkok dual plant, Bang Pakong combined cycle plant and thermal plant.

Power Station		Heat Efficiency
South Bangkok		
Dual	No.1 - No.5	36.426 % TABLE-11 (ATTACH.10)
Bang Pakong		
Combined Cycle	No.1 - No.2	41.237 % TABLE-12 (ATTACH.11)
Thermal	No.1 - No.2	38.234 % TABLE-13 (ATTACH.12)

Heat efficiency of combined cycle plant is 41.237%, it seems too low, but I suppose that EGAT is concerned time factor.

X SALES CONTRACT BETWEEN NGOT AND UNION

The sales contract between NGOT and Union is as follows :-

1. Natural gas heating value

Natural gas heating balue is 950 - 1,150 BTU/scf in gross heating value.

2. Natural gas price

Natural gas price is 1.04$/MM BTU at date of negotiation.

3. Exploration period

Exploration period is 8 years and can be extended for 4 years.

Union, Texas-Pacific and Union-MOECO were already extended for 4 years.

4. Termination of production period

Termination period is 30 years production and can be extended for 10 years but the extension is NGOT's option. Production period is commenced from next day of the end of exploration period.

Union extended for 4 years on April, 1977, so Union's production period will be commenced from April, 1982.

5. Yearly contract quantity

Yearly contract quantity is that daily contract quantity multiples for 365 days.

NGOT can reduce to 50% and increase to 125% of yearly contract quantity. Union has duty to supply for 125% but not whole year, only several months per year.

When NGOT does not receive yearly contract quantity, NGOT must pay yearly contract quantity, but NGOT can receive natural gas of shortage in the next year or several years later without fee.

6. Daily contract quantity

Daily contract quantity of next week is made on every Friday.

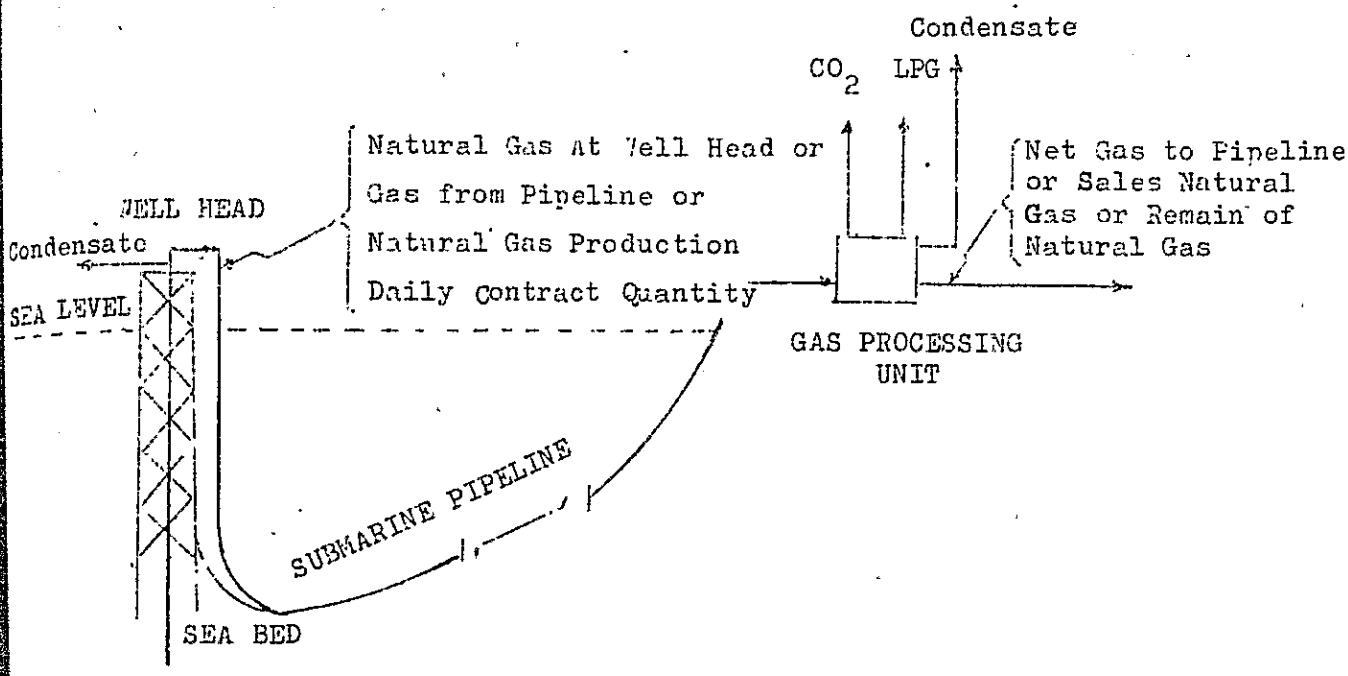
NGOT can change daily contract quantity as follows :-

within ± 10%	before	6 hours, NGOT must notice to Union.
within ± 25%	before	12 hours, NGOT must notice to Union.
more than ± 25%	before	24 hours, NGOT must notice to Union.

But NGOT can not make less than 50% of daily contract quantity.

7. Release from responsibility of NGOT

When NGOT can not receive 50% of daily contract quantity according to irresitive force, NGOT is exempted from the responsibility.



XI NATURAL GAS BALANCE FOR EGAT

XI.1 Wholesales natural gas to EGAT (Made by NGOT) (CASE-1)

NGOT natural gas demand forecast of TABLE-7 (ATTACH.7) and TABLE-10 (ATTACH.9) are almost over the remain of natural gas (the sales natural gas). So, I calculate as following conditions :-

No allocation to the existing industry.

No allocation to the new industry (new project).

This means that the whole remain of natural gas (sales natural gas) is allocated to EGAT.

Sales natural gas (net gas to pipeline) is come from TABLE-5 (ATTACH.5). Natural gas consumption of each unit at Bang Pakong and South Bangkok is come from TABLE-10 (ATTACH.9), but the natural gas consumption was calculated by 900 BTU/scf of heating value, so I correct to 864 BTU/scf of heating value (net heating value of low heating value).

The result is shown in TABLE-14 (ATTACH.13).

(1) Wholesales natural gas can be consumed by electric generation.

(2) Natural gas demand of South Bangkok Power Station is very big

except the year of 1981 and 1982. So number of boiler which is converted from fuel oil firing to natural gas firing must be reduced after the year of 1983.

(3) EGAT can be consumed natural gas (382 MMscf/D) for Bang Pakong electric power station as long as natural gas production.

(4) Natural gas reserves of Union is 1.5 trillion and Texas-Pacific is 3.5 trillion (it is said that reserves of Texas-Pacific is 0 - 4.5 trillion), if so, natural gas life is about 20 years consuming as 700 MMscf/D. Depreciation year of the set of electric generator is 20 years, but life of electric generator set is 25 years.

(5) Nobody can imagine the energy situation for 20 years hence, but if the electric power station still uses fuel oil, Bang Pakong Power Station is far from the refinery.

(6) EGAT has the budget for modification of No.4 and No.5 plant but not for No.1 - No.3 plant.

XI.2 Wholesales natural gas to EGAT (Made by me) (CASE-2)

Natural gas consumption of No.1, No.2 combined cycle and No.1, No.2 thermal unit at Bang Pakong Power Station are come from TABLE-12 (ATTACH.11) and TABLE-13 (ATTACH.13).

These consumptions are as same as EGAT's calculation in TABLE-10 (ATTACH.9) but corrected heating value.

Natural gas consumption of No.1 - No.5 thermal units of South Bangkok Power Station are calculated individually, and its natural gas demand was shown in TABLE-11 (ATTACH.10).

The result is shown in TABLE-15 (ATTACH.14)

(1) Wholesales natural gas will be consumed by electric generator at South Bangkok and Bang Pakong, and no natural gas for new project and existing industry.

(2) Maximum consumption of EGAT in 1988 and in 1982 (in case of 250 MMscf/D natural gas production in 1981) are a little bit smaller than wholesales natural gas.

Conversion from fuel oil firing to natural gas firing is expensive, so it is not economical for only 1 or 2 years using natural gas, conversion of South Bangkok No.4 and No.5 (each 300 MW) is lost much money. Thus in 1988, daily contract quantity of natural gas should be less than Fluor's report.

In case of 200 MMscf/D natural gas production, the year of 1982 is same situation of the year of 1988 in case of 150 MMscf/D natural gas production.

(3) If wholesales natural gas is supplied only to EGAT, Bang Pakong natural gas firing untis could be used as long as natural gas production.

XI.3 Supply to EGAT and 100% new project (CASE-3)

In CASE-3, sales natural gas is supplied to EGAT and the new project, but it is not supplied to the existing industry.

100% of the new projects means :-

Natural gas demand of the new projects (integrated flat steel and soda ash project) supplied 100% on potential of its natural gas demand by NGOT.

The result is shown in TABLE-16 (ATTACH.15).

(1) In case of 200 MMscf/D production in 1981, maximum consumption in 1982 is a little bit smaller than natural gas for EGAT. So, in 1982, the daily contract quantity should be less than Fluor's schedule.

(2) CASE-3 is the best case, because Bang Pakong total capacity is 382 MMscf/D from the year of 1984, and natural gas for EGAT is 442 MMscf/D after 1990. So, if the new project is not expanded, Bang Pakong units could be used natural gas as long as its production.

XI.4 Supply to EGAT, 0 - 50% existing industry and 100% new project (CASE-4)

0 - 50% on potential existing industry natural gas demand means :-

in 1981 modification and testing of natural gas firing boiler of existing industry, so natural gas demand is zero.

in 1982 10%

(going up 10% on potential existing industry natural gas demand every year.

in 1986 50%

(↓

in 1991 50%

Natural gas demand of existing industry in not 100% on potential of its natural demand. The reason was described in VI (page 3).

The result is shown in TABLE-17 (ATTACH.16).

(1) In CASE-4, from the year of 1990, NGOT could not supply enough natural gas to EGAT. Demand of Bang Pakong plants will be 382 MMscf/D of sales natural gas, but natural gas for EGAT will be 377 -375 MMscf/D after 1990.

CASE-4 is big problem, Bang Pakong plants must be changed to fuel oil firing or coal firing after 1990.

(2) If NGOT supplies a lot of natural gas to existing industry, Bang Pakong plants must be changed to fuel oil firing within 10 years.

(3) If NGOT supplies natural gas enough for Bang Pakong plants, he must supply less than 45% on potential existing industry natural gas demand. But another problem is occured.

For instance, some company will replace fuel oil firing to natural gas firing in 1990, and few years later, he wants to expand his factory, he should use fuel oil for expanaion, thus the company uses natural gas and fuel oil.

XI.5 Supply to EGAT, 0 - 70% existing industry and 100% new project (CASE-5)

0 - 70% on potential existing industry natural gas demand means:-

in 1981 modification and testing of natural gas firing boiler of existing industry, so natural gas demand is zero.

in 1982 10%

going up 10% on potential existing industry natural gas demand every year.

in 1988 70%

in 1991 70%

Others are same as XI.4.

The result is shown in TABLE-18 (ATTACH.17).

1. In CASE-5, in 1987 and from the year of 1990, NGOT could not supply enough natural gas to EGAT.

So, Bang Pakong Power Plant can not run 100%, it is about 92%.

These status is same as XI.4.

XII NATURAL GAS RESERVES AND PRODUCTION AND LIFE

Expected natural gas recoverable reserves and production is very important to planning for natural gas delivery otherwise natural gas utilization.

Natural gas production will be commenced in Autumn of 1981. Natural gas is estimated that Union 1.5 trillion scf and Texas-Pacific 0 - 4.5 trillion (it is said 3.5 trillion scf). So, total reserves is 5.0 trillion scf.

1.5 trillion scf ÷ 250 MMscf/D ÷ 365 days = 16.4 years

Union said that he will produce natural gas for 20 years.

3.5 trillion scf ÷ 450 MMscf/D ÷ 365 days = 21.3 years

or 4.5 trillion scf ÷ 450 MMscf/D ÷ 365 days = 27.4 years

But, Union - MOECO (No.10 and No.11 Concession) is now carring exporatory drilling, and Bangkok Post newspaper said

"Mitsui and Union oil estimate the well would bring daily commercial production of 2.125 million cubic meters, it is about 80 MMscf/D.

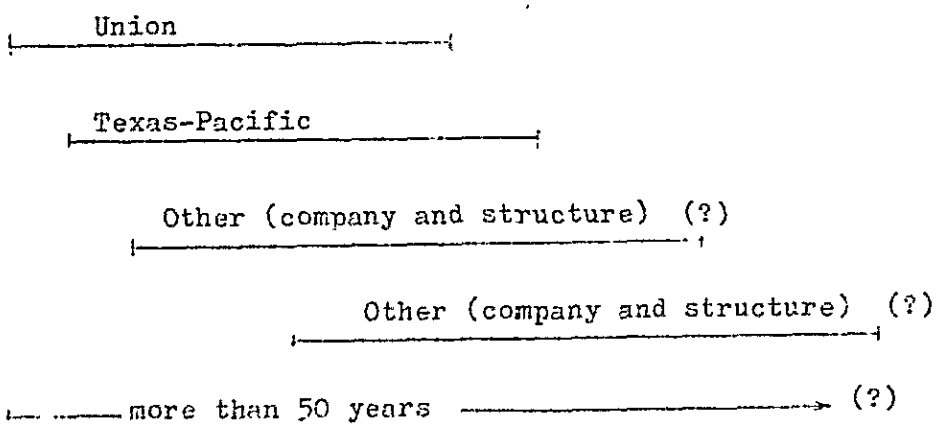
Union, Texas-Pacific and Union-MOECO have another structures which are not yet carried exploratory drilling in their concession. So, in future more natural gas reserves would be discovered, and natural gas life might be assumed more than 50 years.

Mining license (concession) shall be terminated 30 years after finished the exploration period.

TABLE-19 (ATTACH.18) shows natural gas reserves and production (daily contract quantity). When reserves are estimated as 5 trillion scf. 700 MMscf/D production (daily contract quantity) can be continued for 20 years. When reserves are estimated as 10 trillion scf, 1,400 MMscf/D production (daily contract quantity) can be continued for 20 years, and 900 MMscf/D production (daily contract quantity) can be continued for 30 years.

But, each company who has the concession and each structure will not start commercial production at the same time.

	Start	
Union	autumn	1981
Texas-Pacific		1982
Other (company and structure)	later than	1983 (?)
⋮	"	
	"	



So, natural gas production from Siam Gulf is not only 20 years but more than 50 years, and natural gas production will be bigger than natural gas production schedule of TABLE-5 (ATTACH.5).

Natural gas requirement should be larger than natural gas production, if the production is over the requirement, natural gas should be flared. So that, when sales agreement is signed, it must be carefully to avoid over agreement.

(1) The most safty and economical way is that natural gas is supplied to EGAT and new project, natural gas consumption should be larger than its production.

Natural gas expected demand for EGAT is as follows :-

			MMscf/D
Bang Pakong	Combined Cycle	No.1	55
	"	No.2	55
	Thermal	No.1	136
	"	No.2	136
	Sub Total		382
South Bangkok	Thermal	No.1	52
	"	No.2	52
	"	No.3	78
	Dual	No.4	78
		No.5	78
	Sub Total		338
	Grand Total		720

Minimum Demand

Bang Pakong 382 MMscf/D

Maximum Demand

Bang Pakong + South Bangkok 720 MMscf/D

Sales natural gas volume is about 91.0% of natural gas at well head (daily contract quantity) in 1981, and 79.3% in 1999, because CO_2 is elimated and LPG is produced. Maximum natural gas for EGAT is as follows :-

720 MMscf/D ÷ 91.0% = 791 MMscf/D

720 MMscf/D ÷ 79.3% = 908 MMscf/D

(sales natural gas) (natural gas at well head)

When sales natural gas consumption of the new project is same as TABLE-6 (ATTACH.6), total natural gas consumption is as follows :-

	FOR NEW PROJECT MMscf/D		FOR EGAT MMscf/D		TOTAL MMscf/D		Production* Sales Natural Gas MMscf/D
in 1981	0	+	720	=	720	(1)	134
in 1984	17.63	+	720	=	737.63	(2)	445
in 1985	75.50	+	720	=	795.50	(3)	434
in 1990	104.44	+	720	=	824.44	(5)	546

Note: * at present schedule (TABLE-5, ATTACH.5).

720 MMscf/D ÷ 91.0% = 791 MMscf/D

737.63 " ÷ 90.5% = 815 "

795.50 " ÷ 88.3% = 901 "

824.44 " ÷ 79.3% =1,040 "

So, note (A) of TABLE-19 (ATTACH.18) is a limit for sales natural gas (900 MMscf/D natural gas production at well head).

The above mentitoned calculation is EGAT maximum and 100% new project TABLE-6 (ATTACH.6), this is similar to CASE-3 (TABLE-16, ATTACH.15). At present schedule natural gas production at well head is 700 MMscf/D, but the above expected natural gas production at well head is 1,040 MMscf/D.

XIII. FUEL OIL FIRING BOILER IS RENEWED OR MODIFIED TO NATURAL GAS FIRING BOILER

In America, many boils of electric generator are using natural gas, and also it is using as raw material of petrochemicals

and household usage.

In Japan, natural gas production is very small.

Boiler operating number in Japan, in 1979 is as follows :-

Oil Firing Boiler	114,456
Gas Firing Boiler*	4,434
Coal Firing Boiler	944
Others	3,177
Total	123,011

Note: * Most of them are town gas firing small boiler.

Merit and demerit of fuel oil firing and natural gas firing.

	Fuel Oil Firing Boiler	Natural Gas Firing Boiler New or Modification
Cost		New: 15 - 20% up of fuel oil boiler. Modification: 50% of new fuel oil boiler.
Heat Efficiency		Same as fuel oil boiler.
Smoke Tube	Every two months	Need not. So, operation ratio is big.
Air Pollution	SO_x and NO_x are much.	Very small
Others	Almost same	

The above mentioned table, natural gas firing boiler has merits of smoke tube cleaning and air pollution, but price of new boiler or modification cost of old boiler is very high.

So, natural gas price must be lower than fuel oil by colorific value. The depreciation of high price or modification cost, and

insurance and interest must be minus from fuel oil price on calorific value. And also a bounty and dangerous allowance for using natural gas must be paid by NGOT.

XIII.1 Natural gas price for new boiler of existing industry

The price of new natural gas firing boiler was estimated by Mr. M. Heya, Ishikawajima-Harima Heavy Industries Co., Ltd. He estimated the price of natural gas firing boiler as 15 - 20% up to the price of fuel oil firing boiler. I calculate 20% which is including interest and insurance for price up and others

TABLE-20 DEPRECIATION FOR 20% PRICE UP OF NEW NATURAL GAS FIRING BOILER

Boiler Capacity T/H	1	3	5	10
Fuel Oil Firing Boiler $	21,250	31,500	45,000	65,000
Natural Gas Firing Boiler (up 20%) $	25,500	37,800	54,000	78,000
Different $	4,250	6,300	9,000	13,000
Depreciation, interest, insurance and others				
20 years* $/D	0.58	0.86	1.23	1.78
10 years* $/D	1.16	1.73	2.47	3.56
5 years* $/D	2.33	3.45	4.93	7.12

Note: * Depreciation years

Natural gas consumption of small natural gas firing boiler is as follows :-

Conditions of steam (These are assumed because they are different for each)

Steam Pressure	17 Kg/cm^2 - G
	18 Kg/cm^2 - A (256 psia)
Super Heated	500 ^oF (steam temperature)
Boiler Feed Water	30^oC (86^oF)

From Steam Table

Psia	500 ^oF
240	1,264.6 BTU/lb
256	1,262.84 BTU/lb
260	1,262.4 BTU/lb

1,262.84 BTU/lb ÷ 0.4563 Kg/lb = 2,767.57 BTU/Kg

= 2,767.57 x 10^3 BTU/T

2,767.57 x 10^3 BTU/T ÷ 905 BTU/scf* = 3.06 x 10^3 scf/T

Note: * 1,000 BTU/scf gross = 905 BTU/scf net

3.06 x 10^3 scf/T ÷ 85% (dfficiency) = 3.6 x 10^3 scf/T

TABLE-21 NATURAL GAS CONSUMPTION OF NEW NATURAL GAS FIRING BOILER

Boiler Capacity T/H	Mscf/T/H	Mscf/T/D	$/D*1	$/D*2
1 T/H	3.6	86.4	138.24	171
3 T/H	10.8	259.2	414.72	513
5 T/H	18.0	432.0	691.20	855
10 T/H	36.0	864.0	1,382.40	1,711

Note: *1 Sales natural gas cost (NGOT COST)
1.6 $/MM BTU = 1.6 $/1,000 scf (assume)

*2 Sales natural gas price equivalent 600" Fuel Oil
1.98 $/MM BTU = 1.98 $/1,000 scf (assume)
(see TABLE-22 Note: *3)

Natural gas price for the new natural gas boiler is as follows:-

TABLE-22 DISCOUNT OF SALES NATURAL GAS PRICE FOR DEPRECIATION OF PRICE UP OF NEW NATURAL GAS FIRING BOILER

Boiler Capacity T/H		1	3	5	10
Natural Gas Consumption*1	Mscf/T/D	86.4	259.2	432.0	864.0
Depreciation					
20 years	$*2/D	0.58	0.86	1.23	1.78
	$/1,000 scf	0.0067 (0.34%)*3	0.0033 (0.17%)	0.0028 (0.14%)	0.0021 (0.11%)
10 years	฿/D	1.16	1.73	2.47	3.56
	฿/1,000scf	0.0134 (0.68%)	0.0068 (0.35%)	0.0057 (0.29%)	0.0041 (0.21%)
5 years	$/D	2.33	3.45	4.93	7.12
	$/1,000 scf	0.0270 (1.36%)	0.0133 (0.68%)	0.0114 (0.58%)	0.0082 (0.41%)

Note: *1 from TABLE-21

*2 from TABLE-20

*3 600" Fuel oil

Retail Price as March 10, 1978

1.66 B/lit = 1,660 ฿/Kl

= 81.37 ฿/Kl 20.40 ฿/$

L.F.O. = 9,371 Kcal/lit ÷ 0.252 Kcal/BTU = 37,186.5 BTU/lit

∵ 1 BTU = 0.2520 Kcal = 37.2 MBTU/lit

= 37.2 MMBTU/Kl

37.2 MM BTU/Kl = 81.37 ฿/Kl

$$\frac{81.37\ \text{฿/Kl}}{37.2\ \text{MMBTU/Kl}} \times 905\ \text{BTU/scf} = 1.98\ \text{฿/1,000 scf}$$

∵ 905 BTU/scf —— sales natural gas

$$\frac{0.0067\ \text{฿/1,000 scf}}{1.98\ \text{฿/1,000 scf}} \times 100 = 0.34\%$$

Discount of sales natural gas price for depreciation, interest, insurance and others must be calculated every boiler, But, in case of new natural gas firing boiler, discount rate might be applied for 20 years depreciation.

XIII.2 Natural gas price for modified boiler of existing industry

Mr. M, Heya estimated the modification cost is about 50% of new fuel oil firing boiler. I calculate 52.2%, 2.5% is interest, insurance and others for 50% modification cost.

TABLE-23 DEPRECIATION FOR MODIFICATION COST

Boiler Capacity T/H	1	3	5	10
Fuel Oil Firing Boiler $	21,250	31,500	45,000	65,000
Modification Cost 52.5% $	11,156	16,538	23,625	34,125
Depreciation				
20 years $/D	1.53	2.27	3.24	4.67
10 years $/D	3.06	4.53	6.47	9.35
5 years $/D	6.11	9.06	12.95	18.70

TABLE-24 DISCOUNT OF SALES NATURAL GAS PRICE FOR DEPRECIATION OF MODIFICATION COST

Boiler Capacity T/H				
Natural Gas Consumption Mscf/D*1	86.4	259.2	432.0	864.0
Depreciation, interest insurance and others				
20 years $/D*2	1.53	2.27	3.24	4.67
$/1,000 scf	0.0177 (0.89%)	0.088 (0.44%)	0.0075 (0.38%)	0.0054 (0.27%)
10 years $/D	3.06	4.53	6.47	9.35
$/1,000 scf	0.0354 (1.79%)	0.0175 (0.88%)	0.0150 (0.76%)	0.0108 (0.55%)
5 years $/D	6.11	9.06	12.95	18.70
$/1,000 scf	0.0707 (3.57%)	0.0350 (1.77%)	0.0300 (1.52%)	0.0216 (1.09%)

Note: *1 from TABLE-21

*2 from TABLE-23

*3 see TABLE-22 *3

Discount of sales natural gas price for depreciation, interest, insurance and others must be calculated every boiler. But, in case of modification of fuel oil firing boiler, modified natural gas firing boil must be used more than 10 years.

XIII.3 NGOT guarantees supply sales natural gas to existing industry

When natural gas is used for boiler of existing industry, natural price must be estimated every boiler.

For new natural gas firing boiler, NGOT must guatantee more than 20 years natural gas supply. And for modified gas firing boiler, NGOT must guarantee to supply natural gas for certain period which is requested by user. The certain period must be 10 - 20 years.

XIV.4 Insitive usage system

NGOT must encourage the existing industry to use natural gas for boiler, and NGOT might pay dangerous allowance.

Sales Natural Gas Price $/1,000 scf	Bounty	
	%	$/1,000 scf
1.98	20	0.396
	15	0.297
	10	0.198
	5	0.099
	3	0.059
	2	0.040
	1	0.020

Note: bounty 20% - sales natural gas price is 1.584 $/1,000 scf - less than 1.6 $/1,000 scf.

So, NGOT can discount 19%. If bounty and dangerous allowance is 3% and discount for depreciation and others of modification cost is 1.79% (see TABLE-24, 10 years depreciation, 1 ton/hr boiler), total is 4.79% on sales natural gas 1.98 $/1,000 scf, it is 1.89 $/1,000 scf. And if bounty and dangerous allowance is same as the above and discount for depreciation and others of new natural gas firing boiler cost up is 0.11% (see TABLE-22, 20 years depreciation, 10 ton/hr boiler), total is 3.11% on sales natural gas price 1.98 $/1,000 scf, it is 1.92 $/1,000 scf, So, mininum discount price of sales natural gas is 1.89 $/1,000 scf and maximum of it is 1.92 $/1,000 scf.

Bounty and allowance can not decided theoretically. NGOT must determine by his consideration, but it is needed to persuade the existing industry to agree upon pricing.

I suppose, bounty and allowance has to be minimum 3% and maximum 5%, because if less than 3%, there is no merit for existing

industry and if more than 5%, existing industry who can not use natural gas make a complaint. Too high bounty is not fare for whole existing industry.

XV VALUABLE USAGE OF NATURAL GAS

Natural gas production from Siam Gulf will make big contribution to Thai economy.

EGAT and existing industry

Natural gas production will be commenced in autumn 1981, and it could be saved crude oil 10% - 15% (7% in the year of 2000) on crude oil throughput as natural gas 700 MMscf/D production at well head.

As far as the natural gas is used by EGAT (electricity) and the existing industry (steam), it is only saving crude oil not valuable usage.

New project

Thai Government is planning new project to use natural gas as raw material or reduction agent, it is more valuable usage. The new projects are integrated flat steel project and soda ash project, and these projects are carried the feasibility study by JICA and not through JICA fertilizer project is concerned.

LPG production

LPG is manufacture in maximum rate and LPG can be export to Japan.

Ethylene production (Petrochemical)

In natural gas, ethane (C_2H_6) fraction is very much contained.

TABLE-25 ETHYLENE PRODUCTION FROM ETHANE IN NATURAL GAS

		in 1985	in 1990
C_2H_6	10^3 lb/D	2,773.3	3.458.4
	(%)*1	(10.4)	(11.0)
	T/D	1,260.6	1,572
C_2H_4	T/D*2	807	1,006
	T/Y	242,000	301,800

Note: *1 % on net gas to pipeline

*2 Ethane recovery from natural gas is 80% on natural gas, and ethylene yield from ethane is 8% on ethane.

Ethylene production of 242,000 T/Y and 301,800 T/Y are economical size, and the ethylene cost is very cheaper than ethylene cost from naphtha or heavier fractions. So, in near future, Thailand might install ethylene plant, and manufactur polyethylene, polyvynilchloride, polystylene and other many ethylene petrochemicals. When ethylene plant is installed, aromatics (benzene, toluene and xylene) plant must be installed.

LNG production

Natural gas production is not enough for LNG production to export.

XV CONCLUSION

XV .1 Natural gas production (life)

At present natural gas production schedule is 700 MMscf/D, and it is said that the life will be 25 years.

But, (1) recently Union-MOECO confirmed natural gas reserves and expected natural gas production is about 80 MMscf/D (2) Union, Texas-Pacific and Union:MOECO have several structures which are not yet carried exploratory drilling in their concession. So, the life of natural gas production is expected more than 50 years, optimistic

people said life of Thai natural gas production life may be about 100 years.

XV .2 Natural gas utilization

Natural gas utilizations are (1) electric generation (for EGAT) (2) new project (integrated flat steel and soda ash project) in future, fertilizer project (3) existing industry (4) LPG production (5) petrochemicals.

(1) Electric generation (for EGAT)

Minimum natural gas consumption

Bang Pakong Power Station will be install for natural gas utilization, so it can not use fuel oil.

Bang Pakong power plant

o Combined Cycle Power	240 MW x 2	= 480 MW
Natural Gas Consumption	55 MMscf/ x 2	= 110 MMscf/D
o Thermal plants Power	550 MW x 2	= 1,100 MW
Natural Gas Consumption	136 MMscf/D x 2	= 272 MMscf/D

Total

Power	2,080 MW
Natural Gas Consumption	382 MMscf/D

Maximum natural gas consumption

Natural gas consumption of South Bangkok and Pang Pakong power plants.

South Bangkok

	MW	MMscf/D
No.1	200	52
No.2	200	52
No.3	300	78
No.4	300	78
No.5	300	78
Total	1,300	338

Bang Pakong and South Bangkok total

MW	MMscf/D
3,380	720

Sales natural gas production is 134.16 MMscf/D in 1981 and 546.35 MMscf/D after 1990.

(2) New project

Soda ash project is ASEAN Project, and JICA is carring feasibility study. It will be commenced the production in 1982 or 1983, actually may be in 1984.

Integrated flat steel project which JICA is carring feasibility study will be commenced the production in 1985.

Fertilizer project is studying by some Japanese group. It will be commenced the production several years later.

(3) Existing industry

When existing industry uses natural gas instead of fuel oil, he must rebuild from fuel oil firing boiler to natural gas firing boiler or modify from fuel oil firing boiler to natural gas firing boiler

New natural gas boiler price is 15 - 20% higher than new fuel oil firing boiler, and modification cost is 50% of new fuel oil firing boiler. So, NGOT must reduce the natural gas price for compensation, interest, insurance and others of price up of new boiler or modification cost, moreover pay bounty and dangerous allowance.

If natural gas firing boiler has big merit for instance, heat efficiency is high, natural gas price reduction is not necessary, but some demerit.

(4) LPG

LPG production from the refineries will be enough for domestic requirement. So, LPG from natural gas could be export.

In the other hand, LPG utilization must be developed such as motor car fuel.

(5) Ethylene petrochemicals

Ethane in Siam Gulf natural gas is enough quantity to produce ethylene economically. In near future, ethylene plant and associated plants will be installed.

XVI COMMENTS

(1) At the present time, natural gas might be used for EGAT and new project. Natural gas firing boiler is not attractive for existing industry.

(2) When natural gas production is increased, and natural gas production life is long, then natural gas might be used for existing industry.

(3) More profitable usage must be developed, such as industry which uses natural gas as raw material. The industry is so-called petrochemical industry, therefore, methane derivative industry and ethylene industry should be developed.

end.

TABLE-1 EACH YEAR AND AVERAGE HEATING VALUE OF SALES NATURAL GAS (CALCULATED FROM FLUOR'S REPORT)

Unit:BTU/scf

	H.V. Net	H.V. Gross		H.V. Net	H.V. Gross
1981	946*	1,044*	1986	854	944
1982	856	945	1987	863	955
1983	876	964	1988	855	947
1984	858	947	1989	868	959
1985	867	959	1990	880	977

Average H.V. Net 864 BTU/scf
H.V. Gross 955 BTU/scf

Note: * In 1981, only Union will produce natural gas, so it is not included in average.

TABLE-2 NATURAL GAS CONSUMPTION OF EXISTING INDUSTRY EXCEPT CEMENT INDUSTRY

Unit: MMscf/D

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991		Source*
Construction Material (except cement)	7.43	7.68	7.95	8.27	8.59	8.86	9.13	9.39	9.68	9.97		page 8
Iron and Steel Mill	5.48	5.48	5.48	5.48	5.48	5.48	5.48	5.48	5.48	5.48		page 10
Chemical and Fertilizer	8.82	9.34	9.84	10.60	11.29	11.97	11.72	13.51	14.35	15.15		page 13
Sythetic Fiber	4.82	5.07	5.32	5.59	5.67	5.73	5.78	5.84	5.88	5.95		page 14
Yarn and Fabric	2.47	2.60	2.74	2.85	2.96	3.10	3.21	3.34	3.48	3.62		page 14
Pulp and Paper	13.15	14.79	19.73	20.55	21.10	21.92	22.74	23.29	24.11	24.93		page 16
Glass	14.11	14.65	15.32	15.81	16.25	18.25	18.74	19.10	19.64	20.16		page 18
Tire	2.47	2.74	3.01	3.28	3.56	3.84	4.11	4.38	4.93	5.21		page 19
Food & Beverage	16.98	17.80	18.64	19.72	20.54	21.36	22.20	23.02	23.84	24.96		
Total (Potential) 1,000 BTU/scf**	75.73	80.15	88.03	92.15	95.44	100.51	103.11	107.35	111.40	115.43		
864 BTU/scf***	87.65	92.77	101.89	106.66	110.46	116.33	119.34	124.25	128.94	133.60		

Note: * Source—NATURAL GAS DEMAND FORECAST OF THE INDUSTRY (FUEL RAW MATERIAL), July 20, 1978. (My report)

** Net Heating Value of my report on July 20, 1978.

*** Net heating value of the sales natural gas in this report.

FIG.1 PRODUCTION FLOW OF INTEGRATED FLAT STEEL PLANT

Unit : 1,000 ton/year

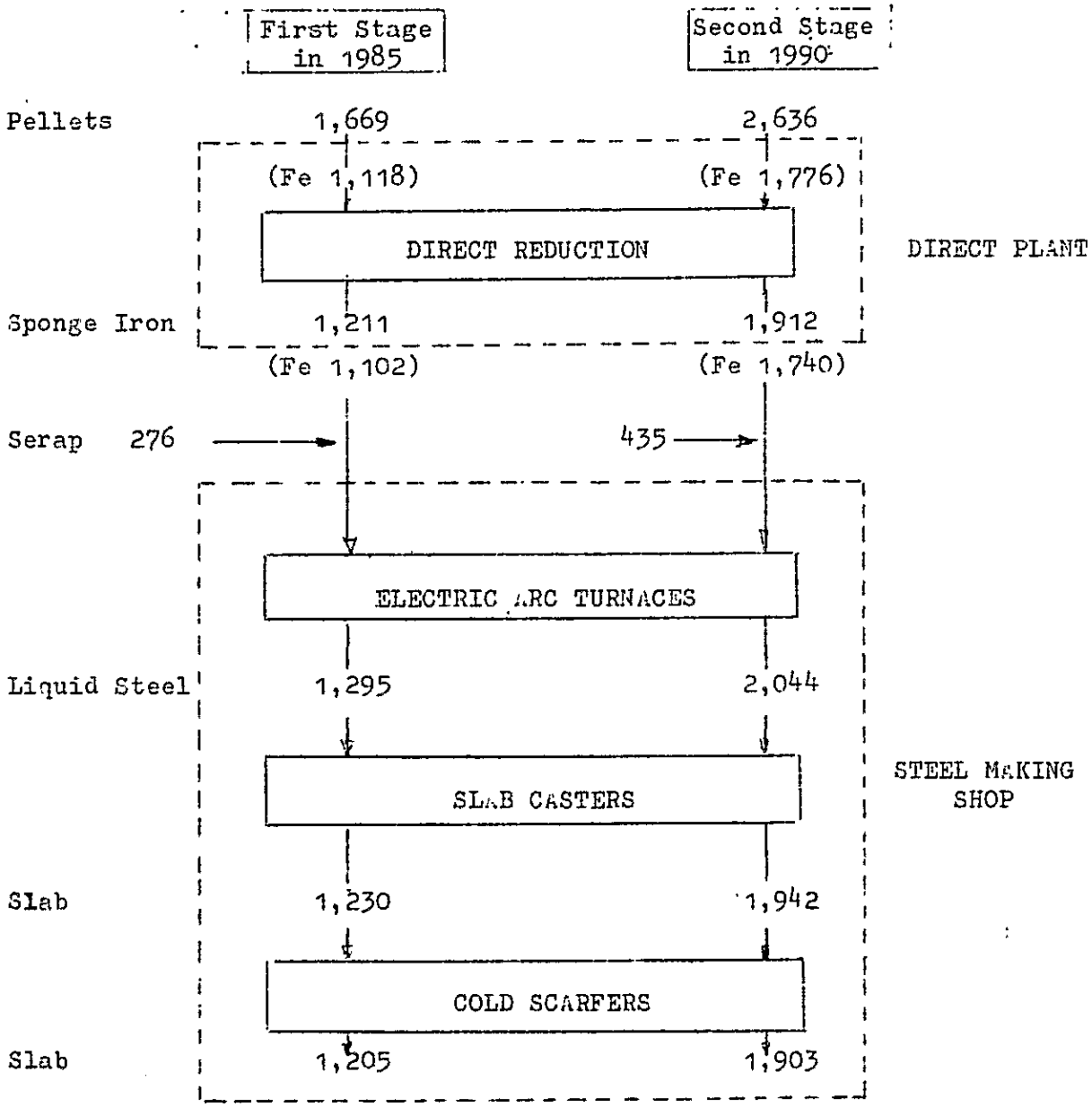


TABLE-3 NATURAL GAS AND ELECTRICITY CONSUMPTION OF INTEGRATED FLAT STEEL PLANT

		1st Stage (1985)	2nd Stage (1990)	
Natural Gas MMscf/D		50 (57.87)*	75 (86.81)*	Approx. 80% is used in DR plant as reductant.
Electric Power Max. demand	KW	230,000	340,000	Approx. 65% is consumed in electric furnace.
Annual Consumption	KWH	$1,500 \times 10^6$	$2,400 \times 10^6$	

Note: Based at 67% Fe in iron oxides.

* 50 MMscf/D and 75 MMscf/D may be calculated 1,000 BTU/scf, so convert to 864 BTU/scf.

TABLE-4 SODA ASH PROJECT

Production

Soda Ash	400,000 ton/y	1,200 ton/D
Ammonium Chloride	200,000 ton/y	600 ton/D

Natural Gas Consumption (including electric generation) 17,000 NM^3/Hr

$$17{,}000\ NM^3/Hr \times \frac{35.315\ scf}{1\ NM^3} \times \frac{(273 + 15.55)^\circ F}{273^\circ F} = 634.6 \times 10^3\ scf/Hr$$

$$634.6 \times 10^6\ scf/Hr \times 24\ Hr = 15.23 \times 10^6\ scf/D$$

$$15.23 \times 10^6\ scf/D \times \frac{1{,}000\ BTU/scf}{864\ BTU/scf} = 17.63 \times 10^6\ scf/D$$

TABLE-5 NATURAL GAS PRODUCTION SCHEDULE
(FLUOR'S REPORT)

Unit:MMscf/D

	Nominal Production			(1)	(2)
	Union	+ Texas	= Total	Gas from Pipeline	Net Gas to pipeline
1981	150		150	147.50	134.16
1982	150	150	300	295.01	267.01
1983	200	150	350	344.17	309.05
1984	250	250	500	491.68	444.94
1985	250	250	500	491.68	434.17
1986	250	350	600	590.01	512.88
1987	250	350	600	590.01	499.57
1988	250	450	700	688.35	578.43
1989	250	450	700	688.35	562.32
1990	250	450	700	688.35	546.35
⋮	⋮	⋮	⋮	⋮	⋮

Note : (1) Natural gas from well head

(2) Natural gas to end user

TABLE-6 TOTAL NATURAL GAS BALANCE

(EXISTING INDUSTRY, NEW PROJECT AND EGAT)

ATTACH.6

Unit : MMscf/D

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
150 MMscf/D in 1981											
(1) Production											
Sales Natural Gas	134.16	267.01	309.05	444.94	434.17	512.88	499.57	578.43	562.32	546.35	546.35
Consumption											
Existing Industry											
100%	0	87.65	92.77	101.89	106.66	110.46	116.33	119.34	124.25	128.94	133.60
0 - 70%	0%	10%	20%	30%	40%	50%	60%	70%	70%	70%	70%
	0	8.77	18.55	30.57	42.66	55.23	69.80	83.54	86.98	90.26	93.12
0 - 50%	0%	10%	20%	30%	40%	50%	50%	50%	50%	50%	50%
	0	8.77	18.55	30.57	42.66	55.23	58.17	59.67	62.13	64.47	66.80
New Project											
Integrated Flat Steel	0	0	0	0	57.87	57.87	57.87	57.87	57.87	86.81	86.81
Soda Ash	0	0	0	17.63	17.63	17.63	17.63	17.63	17.63	17.63	17.63
Sub Total	0	0	0	17.63	75.5	75.5	75.5	75.5	75.5	104.44	104.44
Consumption Total											
Exist. Ind. 0 - 70%, New Project 100%	0	8.77	18.55	48.2	118.16	130.73	145.30	159.04	162.48	194.70	197.96
" 0 - 50%, "	0	8.77	18.55	48.2	118.16	130.73	133.67	135.17	137.63	168.91	171.24
" 0% , "	0	0	0	17.63	75.5	75.5	75.5	75.5	75.5	104.44	104.44
Remain For EGAT 100%	Same as (1)										
(2) Exist. Ind. 0 - 70%, New Project 100%	134.16	258.24	290.50	396.74	316.01	382.15	354.27	419.39	399.84	351.65	348.39
(3) " 0 - 50%, "	134.16	258.24	290.50	396.74	316.01	382.15	365.9	443.26	424.69	377.44	375.11
(4) " 0% , "	134.16	267.01	309.05	427.31	358.67	437.38	424.07	502.93	486.82	441.91	441.91
200 MMscf/D in 1981											
Production											
Sales Natural Gas	178.88	311.73									
Consumption											
Existing Industry											
0 - 70%	0	8.77									
Remain For EGAT											
0 - 70%	178.88	302.96									

TABLE-7 QUANTITY OF NATURAL GAS PRODUCTION OF NGOT COMPARING WITH THE DEMAND FORECAST

ATTACH.7

YEAR	Natural Gas Production		Demand Forecast of Natural Gas on Heat Value 1,000 BTU/scf			TOTAL	LPG	LPG *4	LPG *5	Project of Pipeling	
	Natural Gas At Well Head MM scf/D	Heat Value 1,000 BTU/scf MM scf/D	EGAT *1 MM scf/D	Existing *2 Industry MM scf/D	New *3 Industry MM scf/D	MM scf/D	Demand Forecast MM Lit.	Production from Existing Refinery MM Lit.	Shortage MM Lit.	LPG from Gas Plant MM Lit.	Remain of Natural Gas MM scf/D
1978	-	-	-	-	-	-	292.3	240.35	51.95	-	-
1979	-	-	-	-	-	-	316.6	240.35	76.25	-	-
1980	-	-	-	-	-	-	356.4	240.35	116.05	-	-
1981	150	157	181.8	29.3	-	211.1	396.3	240.35	155.95	155.95	133.14
1982	300	275	229.5	32.2	-	261.7	443.9	240.35	203.55	203.55	245.65
1983	350	327	414.0	35.4	-	449.4	463.6	240.35	223.25	223.25	295.29
1984	500	459	414.0	38.9	41.61	494.51	478.5	240.35	238.15	238.15	423.50
1985	500	459	531.9	42.9	41.61	616.41	522.5	240.35	282.15	282.15	419.46
1986	600	538	531.9	45.9	41.61	619.41	571.4	240.35	331.05	331.05	489.23
1987	600	538	531.9	49.2	51.61	632.71	620.0	240.35	379.65	379.65	484.97
1988	700	616	531.9	52.6	53.36	637.86	688.2	240.35	447.85	447.85	555.82
1989	700	616	531.9	56.2	53.52	641.62	763.9	240.35	523.55	523.55	547.70
1990	700	616	531.9	60.2	53.52	645.62	847.9	240.35	607.55	607.55	485.45
1991	700	616	531.9	64.4	53.52	649.82	941.2	240.35	700.85	635.94	463.94
1992	700	616	531.9	68.8	53.52	654.22	1,044.7	240.35	804.35	635.94	463.94
1993	700	616	531.9	73.7	53.52	659.12	1,159.7	240.35	919.35	635.94	463.94
1994	700	616	531.9	78.8	53.52	664.22	1,287.2	240.35	1,046.85	635.94	463.94
1995	700	616	531.9	84.4	53.52	669.82	1,428.8	240.35	1,188.45	635.94	463.94

*1 Demand forecast of South Bangkok power plant and Bang Pakong power station (not including the demand forecast of new construction of power station at Surat-Songkhla. (Forecast data from EGAT, January 1979).

*2 Existing industry

*3 New industry - ammonia, soda ash and sponge iron.

*4 LPG capacity in country (Production at present, not expansion).

*5 LPG produced from refinery.

TABLE-8 COMPARISON OF NGOT AND FLUOR FOR NATURAL GAS PRODUCTION AND DEMAND FORECAST

Unit : MMscf/D

	NGOT*1	EGAT*7	NGOT*1	TABLE-6*4	NGOT*1	TABLE-6		NGOT*1		NGOT*1	TABLE-6*4
	(1) For EGAT	(2) For EGAT	(3) For Existing Industry	(4) For Existing Industry*2	(5) For New Industry*5	(6) For New Industry*3		(7) (1)+(3)+(5)		(8) Remain of Natural Gas	(9) Sales Natural Gas*6
1981	181.8	162.9	29.3	0	-	-		211.1		133.14	134.16
1982	229.5	229.5	32.2	8.8	-	-		261.7		245.65	267.01
1983	414.0	414.0	35.4	18.6	-	-		449.4		295.29	309.05
1984	"	531.9	38.9	30.6	41.61	17.63		494.51		423.50	444.94
1985	531.9	"	42.9	42.7	"	75.5		616.41		419.46	434.17
1986	"	"	45.9	55.2	"	"		619.41		489.23	512.88
1987	"	"	49.2	58.0	51.61	"		632.71		484.97	499.57
1988	"	"	52.6	59.7	53.36	"		637.86		555.82	578.43
1989	"	"	56.2	62.1	53.52	"		641.62		547.70	562.32
1990	"	"	60.2	64.5	"	104.44		645.62		485.45	546.35
1991	"	"	64.4	66.8	"	"		649.82		463.94	"
1992	"	"	68.8		"			654.22		"	"
1993	"	"	73.7		"			659.12		"	
1994	"	"	78.7		"			664.22		"	
1995	"	"	84.8		"			669.82		"	

Note: *1 TABLE-7 (ATTACH.7), 1,000 BTU/scf

*2 Potential natural-gas demand of existing industry 0 - 50%, from TABLE-6 (ATTACH.6).

*3 (864 BTU/scf) New projects are integrated flat steel and soda ash project, and they are studying by JICA, but not yet decided, from TABLE-6 (ATTACH.6).

*4 TABLE-6 (ATTACH.6)

*5 New industry - ammonia, soda ash and sponge iron, from TABLE-7 (ATTACH.7).

*6 Heating value is 864 BTU/scf, from TABLE-5 (ATTACH.5).

*7 TABLE-10 (ATTACH.9).(1,000 BTU/scf)

TABLE-9 NATURAL GAS FIRING POWER PLANT

Location		Capacity MW	Completion	
South Bangkok				
Thermal	No.1	200	Existing	From 1981*
	No.2	200	"	
	No.3	300	"	
	No.4	300	"	
	No.5	300	"	
Bang Pakong	No.1	240	Oct. 1980	
Combined Cycle	No.2	240	April 1981	
Bang Pakong	No.1	550	July 1983	
Thermal	No.2	550	April 1984	

Note: Modification No.1 and No.2 in 1981, No.3 in 1982, No.4 and No.5 in No.4 and No.5 in 1983.

TABLE-10 FORECAST DEMAND OF NATURAL GAS ON ELECTRICITY GENERATING OF EGAT DURING 1981 - 1995 (MADE BY EGAT)

Unit : MMscf/D

	Bang Pakong				South Bangkok	Grand Total	
	Combined Cycle		Thermal		Thermal	N.G. H.V.	N.G. H.V.
	No.1	No.2	No.1	No.2	No.1-No.5	900 BTU/scf	1,000 BTU/scf
1981	53	53	-	-	75	181	162.9
82	"	"	-	-	149	255	229.5
83	"	"	131	-	223	460	414.0
84	"	"	"	131	"	591	531.9
85	"	"	"	"	"	"	"
86	"	"	"	"	"	"	"
87	"	"	"	"	"	"	"
88	"	"	"	"	"	"	"
89	"	"	"	"	"	"	"
90	"	"	"	"	"	"	"
91	"	"	"	"	"	"	"
92	"	"	"	"	"	"	"
93	"	"	"	"	"	"	"
94	"	"	"	"	"	"	"
95	"	"	"	"	"	"	"

TABLE-11 SOUTH BANGKOK THERMAL PLANT

Thermal	Capacity	Potential N.G. Cons.		Factor	N.G. Cons.
	MW	F' (Mscf/H)	F" (MMscf/D)	%	MMscf/D
No.1	200	2,170	52	100	52
No.2	200	2,170	52	"	52
No.3	300	3,255*	78	"	78
No.4	300	3,255	78	"	78
No.5	300	3,255	78	"	78

Note: * $3{,}415 \text{ BTU/KWH} \times \frac{300 \text{ KW}}{0.36426} \div 864 \text{ BTU/scf} = 3{,}255 \text{ Mscf/H}$

Some of five thermal plants will be modificated to dual thermal plant.

Efficiency — $3{,}415 \text{ BTU/KWH} \times \frac{300 \text{ MW}}{x} \div 900 \text{ BTU/scf} \times 24 \text{ H} = 75 \text{ MMscf/D}$

(Note: 75 MMscf/D was calculated by EGAT)

$x = 36.426\ \%$

ATTACH.10

TABLE-12 COMBINED CYCLE PLANT AT BANG PAKONG

Combined Cycle	Capacity	Potential N.G. Cons.		Factor	N.G. Cons.	Completion Date
	MW	F' (Mscf/H)	F'' (MMscf/D)	%	MMscf/D	
No.1 (Comp. Oct. 1980)	240	2,300*	55	100	55	1980
No.2 (Comp. April 1981)	240	2,300	55	100	55	1981

Note: * $3{,}415 \text{ BTU/KWH} \times \frac{240 \text{ MW}}{41.237} \div 864 \text{ BTU/scf} = 2{,}300 \text{ Mscf/H}$

Efficiency — $3{,}415 \text{ BTU/KWH} \times \frac{240 \text{ MW}}{x} \div 900 \text{ BTU/scf} \times 24 \text{ H} = 53 \text{ scf/D}$

(Note: 53 scf/D was calculated by EGAT)

$x = 41.237\ \%$

ATTACH. 11

TABLE-13 THERMAL PLANT AT BANG PAKONG

Thermal	Capacity MW	Potential N.G. Cons. F' (Mscf/H)	Potential N.G. Cons. F" (MMscf/D)	Factor %	N.G. Cons. MMscf/D
No.1 (Comp. July 1983)	550	5,686*	136	100	136
No.2 (Comp. Aug. 1984)	550	5,686	136	100	136

Note: * 3,415 BTU/KWH x $\frac{550\ MW}{0.38234}$ ÷ 864 BTU/scf = 5,686 Mscf/H

Efficiency — 3,415 BTU/KWH x $\frac{550\ MW}{x}$ ÷ 900 BTU/scf x 24 H = 131 scf/D

(Note: 131 scf/D was calculated by EGAT)

x = 38.234 %

ATTACH. 12

TABLE-14

CASE-1 FORECAST DEMAND OF NATURAL GAS ON ELECTRICITY GENERATING OF EGAT DURING 1981 - 1995

Unit : MMscf/D

	Bang Pakong				South Bangkok					Natural Gas Balance				
	(1) C.C. No.1	(2) C.C. No.2	(3) T. No.1	(4) T. No.2	(5) ~ (9) T. No.1	T. No.2	T. No.3	T. No.4	T. No.5	(10)*1 Max. Cons.	(11)*2 Min. Cons.	(12)*3 Shut-Down	(13)*4 For EGAT	(14)*5 For EGAT Min.
1981	55	55	0	0			78			188	133	(2)	134	101
1982	"	"	0	0			155			265	210	(7)	267	200
1983	"	"	136	0			232			478	342	(3)	309	232
1984	"	"	"	136			"			614	478	(4)	445	334
1985	"	"	"	"			"			"	"	(3)	434	326
1986	"	"	"	"			"			"	"	(4)	513	385
1987	"	"	"	"			"			"	"	(3)	500	375
1988	"	"	"	"			"			"	"	(4)	578	434
1989	"	"	"	"			"			"	"	(3)	562	422
1990	"	"	"	"			"			"	"	(4)	546	410
1991	"	"	"	"			"			"	"	(3)	"	"
1992	"	"	"	"			"			"	"	(4)	"	"
1993	"	"	"	"			"			"	"	(3)	"	"
1994	"	"	"	"			"			"	"	(4)	"	"
1995	"	"	"	"			"			"	"	(3)	"	"

Note: C.C. Combined Cycle plant

T. Thermal plant

(10)*1 Potential Natural gas consumption (1) + (2) .....+ (5) ~ (9)

(11)*2 (10) minus natural gas consumption of the biggest plant which is shut-down for maintenance. No. is shown in (12).

(12)*3 No. of plant which is shut-down for maintenance (the biggest plant).

(13)*4 Wholesales natural gas which is come from (1) of TABLE-6 (ATTACH.6).

(14)*5 (13) x 75% This is minimum natural gas consumption per day which is limited by contract.

TABLE-15 CASE-2 NATURAL GAS BALANCE OF EGAT (WHOLESALES NATURAL GAS IS SUPPLIED TO EGAT)
(NATURAL GAS PRODUCTION 150 OR 200 MMSCF/D IN 1981)

		Bang Pakong				South Bangkok					NATURAL GAS BALANCE FOR EGAT				
		(1) C.C. No.1	(2) C.C. No.2	(3) T. No.1	(4) T. No.2	(5) T. No.1	(6) T. No.2	(7) T. No.3	(8) T. No.4	(9) T. No.5	(10)*1 Max.Cons.	(11)*2 Min.Cons,	(12)*3 Shut-Down	(13)*4 for EGAT	(14)*5 For EGAT Min.
150 MMscf/D	1981	55	55	-	-	52					162	107	(2)	134	101
	1982	55	55	-	-	52	52	78			292	214	(7)	267	200
	1983	55	55	136	-	52	-	78			376	240	(3)	309	232
	1984	55	55	136	136	-	-	78			460	324	(4)	445	334
	1985	55	55	136	136	-	-	78			460	324	(3)	434	326
	1986	55	55	136	136	52	-	78			512	376	(4)	513	385
	1987	55	55	136	136	52	-	78			512	376	(3)	500	375
	1988	55	55	136	136	52	52	78			564**	428	(4)	578***	434
	1989	55	55	136	136	52	52	78			564	428	(3)	562	422
	1990	55	55	136	136	52	52	78			564	428	(4)	546	410
	1991	55	55	136	136	52	52	78			564	428	(3)	546	410
200 MMscf/D	1981	55	55			52	52				214	159	(2)	178	134
	1982	55	55			52	52	78			292**	214	(7)	312***	234

Note: C.C. Combined cycle plant

T. Thermal plant

(10)*1 Potential natural gas consumption (1) + (2) + ...

(11)*2 (10) minus natural gas consumption of the biggest plant which is shut-down for maintenance. No. is shown in (12).

(12)*3 No. of plant which is shut-down for maintenance (the biggest plant).

(13)*4 Wholesales natural gas which is come from (1) of TABLE-6 (ATTACH.6).

(14)*5 (13) x 75% This is minimum natural gas consumption per day, limited by contract.

** (10) is less than *** (13), so when contract is made, daily contract quantity must be less than Fluor's report.

TABLE-16 CASE-3 NATURAL GAS BALANCE FOR EGAT (ONLY SUPPLY TO NEW PROJECT)

(NATURAL GAS PRODUCTION 150 OR 200 MMSCF/D IN 1981)

Unit : MMscf/D

	Bang Pakong				South Bangkok					NATURAL GAS BALANCE FOR EGAT				
	(1) C.C.No.1	(2) C.C. No.2	(3) T. No.1	(4) T. No.2	(5) T. No.1	(6) T. No.2	(7) T. No.3	(8) T. No.4	(9) T. No.5	(10)*1 Max. Con	(11)*2 Min. Con	(12)*3 Shut-Down	(13)*4 For EGAT	(14)*5 For EGAT Min.
150 MMscf/D														
1981	55	55	-	-	52	-	78			162	107	(2)	134	94
1982	55	55	-	-	52	52	78			292	214	(7)	267	187
1983	55	55	136	-	52	-	78			376	240	(3)	309	216
1984	55	55	136	136	-	-	78			460	324	(4)	427	299
1985	55	55	136	136	-	-	78			460	324	(3)	359	251
1986	55	55	136	136	-	-	78			460	324	(4)	437	306
1987	55	55	136	136	-	-	78			460	324	(3)	424	297
1988	55	55	136	136	52	-	78			512	376	(4)	503	312
1989	55	55	136	136	52	-	78			512	376	(3)	487	341
1990	55	55	136	136	-	-	78			460	324	(4)	442	309
1991	55	55	136	136	-	-	78			460	324	(3)	442	309
200 MMscf/D														
1981	55	55			52	52	-			214	159		179	125
1982	55	55			52	52	78			292*	214		312**	218

Note: C.C. Combined cycle plant

T. Thermal plant

(10)*1 Potential natural gas consumption (1) + (2) + ...

(11)*2 (10) minus natural gas consumption of the biggest plant which is shut-down. No. is shown in (12).

(12)*3 No. of plant which is shut-down for maintenance (the biggest plant).

(13)*4 Wholesales natural gas which is come from (4) of TABLE-6 (ATTACH.6).

(15)*5 (13) x 75% This is minimum natural gas consumption per day which is limited by contract.

* (10) is less than ** (13), so when contract is made, daily contract quantity must be less than Fluor's report.

TABLE-17 CASE-4 NATURAL GAS BALANCE FOR EGAT (SUPPLY 50% MAX. OF EXISTING INDUSTRY AND 100% OF NEW PROJECT)
(NATURAL GAS PRODUCTION 150 OR 200 MMSCF/D IN 1981)

Unit : MMscf/D

	Bang Pakong				South Bangkok					NATURAL GAS BALANCE FOR EGAT				
	(1) C.C. No.1	(2) C.C. No.2	(3) T. No.1	(4) T. No.2	(5) T. No.1	(6) T. No.2	(7) T. No.3	(8) T. No.4	(9) T. No.5	(10)*1 Max. Con.	(11)*2 Min. Con.	(12)*3 Shut-Down	(13)*4 For EGAT	(14)*5 For EGAT Min.
150 MMscf/D														
1981	55	55	-	-	52					162	107	(2)	134	101
1982	55	55	-	-	52	52	78			292	214	(7)	258	194
1983	55	55	136	-	52	-	78			376	240	(3)	291	218
1984	55	55	136	136	-	-	78			460	324	(4)	397	298
1985	55	55	136	136	-	-	78			460	324	(3)	316	237
1986	55	55	136	136	-	-	78			460	324	(4)	382	187
1987	55	55	136	136	-	-	78			460	324	(3)	366	275
1988	55	55	136	136	-	-	78			460	324	(4)	443	332
1989	55	55	136	136	-	-	78			460	324	(3)	425	319
1990	55	55	136	136	-	-	78			382* (460)*	← can not →		377**	283
1991	55	55	136	136	-	-	78			382* (460)*	← can not →		375**	281
200 MMscf/D														
1981	55	55	-	-	52	52				214	159	(2)	179	134
1982	55	55	-	-	52	52	78	78		370	292	(7)	312	234

Note : .C.C. Combined cycle plant

T. Thermal plant

(10)*1 Potential natural gas consumption (1) + (2) + ...

(11)*2 (10) minus natural gas consumption of the biggest plant which is shut-down for maintenance. No. is shown in (12).

(12)*3 No. of plant which is shut-down for maintenance (the biggest plant).

(13)*4 Wholesales natural gas which is come from (1) of TABLE-6 (ATTACH.6).

* ' (10) is bigger than ** (13) , so Bang Pakong Power Plant must use fuel oil.

TABLE-18 CASE-5 NATURAL GAS BALANCE FOR EGAT (SUPPLY 70% MAX. EXISTING INDUSTRY AND 100% NEW PROJECT)
(NATURAL GAS PRODUCTION 150 OR 200 MMSCF/D in 1981)

Unit : MMscf/D

	Bang Pakong				South Bangkok					NATURAL GAS BALANCE FOR EGAT				
	(1) C.C. No.1	(2) C.C. No.2	(3) T. No.1	(4) T. No.2	(5) T. No.1	(6) T. No.2	(7) T. No.3	(8) T. No.4	(9) T. No.5	(10)*1 Max. Con.	(11)*2 Min. Con.	(12)*3 Shut-Down	(13)*4 For EGAT	(14)*5 For EGAT Min.
150 MMscf/D														
1981	55	55	-	-	52					162	107	(2)	134	101
1982	55	55	-	-	52	52	78			292	214	(7)	258	194
1983	55	55	136	-	52	-	78			376	240	(3)	291	218
1984	55	55	136	136	-	-	78			460	324	(4)	397	298
1985	55	55	136	136	-	-	-			382	246	(3)	316	237
1986	55	55	136	136			78			460	324	(4)	382	287
1987	55	55	136	136			-			382* (460)	← can not →		354**	266
1988	55	55	136	136			78			460	324	(4)	419	314
1989	55	55	136	136			78			460	324	(3)	400	300
1990	55	55	136	136			-			382* (460)	← can not →		352**	264
1991	55	55	136	136			-			382* (460)	← can not →		348**	261
200 MMscf/D														
1981	55	55			52	52				214	159	(2)	179	134
1982	55	55			52	52	78			292*	214	(7)	303**	227

Note : C.C. Combined cycle plant

T. Thermal plant

(10)*1 Potential natural gas consumption (1) + (2) +.....

(11)*2 (10) minus natural gas consumption of the biggest plant which is shut-down for maintenance. No. is shown in (12).

(12)*3 No. of plant which is shut-down for maintenance (the biggest plant).

(13)*4 Wholesales natural gas which is come from (1) of TABLE-6 (ATTACH.6).

* (10) is bigger than ** (13), so Bang Pakong Power Plant must use fuel oil.

TABLE-19 NATURAL GAS RESERVES AND PRODUCTION

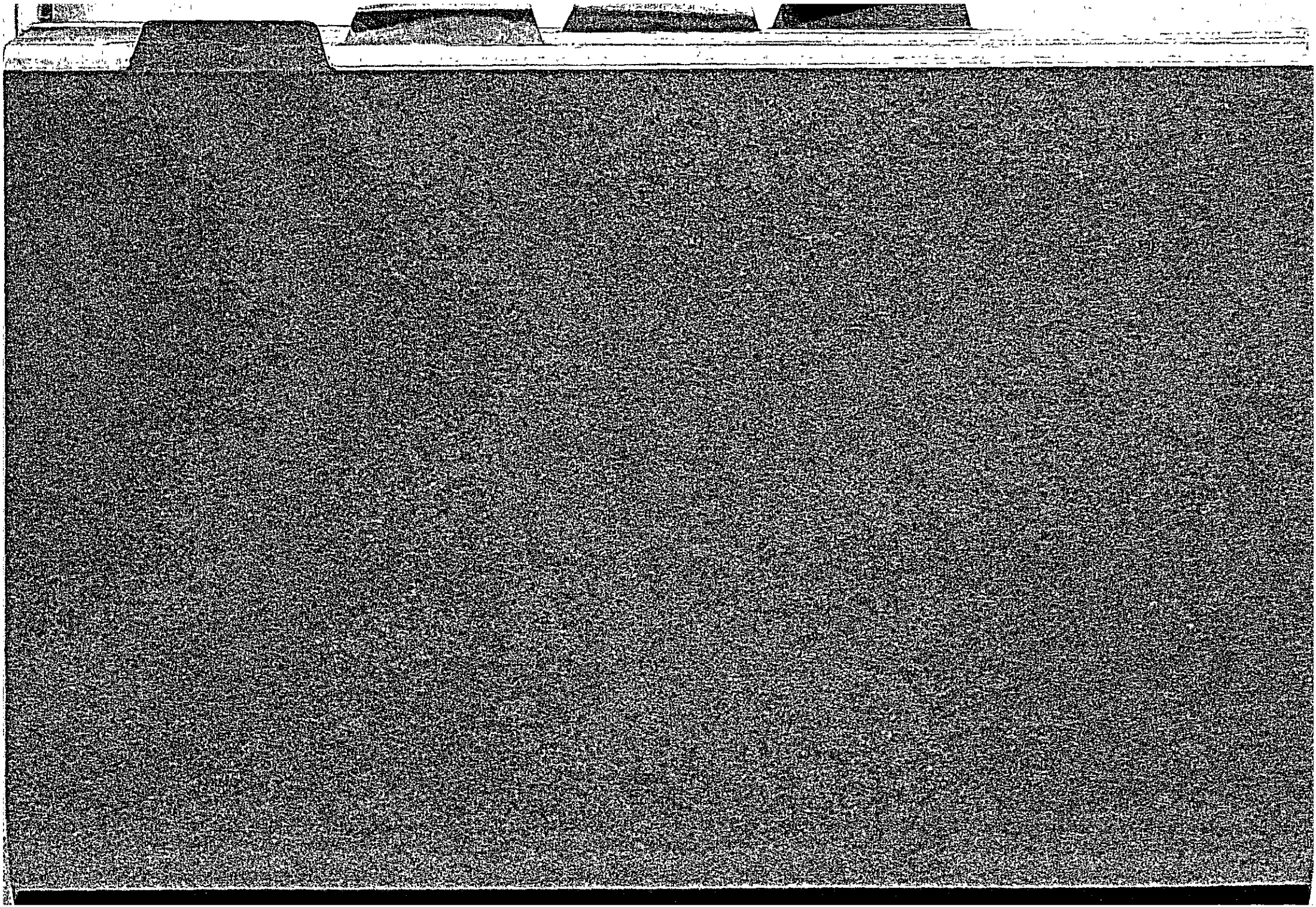
10^6 scf/D \ scf x 10^{12}	3	4	5	6	7	8	9	10	11	12	13	14	15
500	16.4	[21.9]	27.4	32.9	38.4	43.8	49.3	54.8	60.3	65.8	71.2	76.7	83.2
600	13.7	[18.6]	22.8	27.4	32.0	36.5	41.1	45.7	50.2	54.8	59.4	63.9	68.5
700	11.7	15.6	[19.6]	23.5	27.4	31.3	35.2	39.1	43.1	47.0	50.9	54.8	58.7
800	10.3	13.7	17.1	[20.5]	24.0	27.4	30.8	34.2	37.7	41.1	44.5	49.7	51.4
900 (A)	9.1	12.2	15.2	18.3	[21.3]	24.4	27.4	30.4	33.5	36.5	39.6	42.6	45.7
1,000 (B)	8.2	11.0	13.7	16.4	[19.2]	21.9	14.7	27.4	30.1	32.9	35.6	38.4	41.1
1,200	6.8	9.1	11.4	13.7	16.0	18.3	[20.5]	22.8	25.1	27.4	29.7	32.0	34.2
1,400	5.9	7.8	9.8	11.7	13.7	15.7	17.6	[19.6]	21.5	23.5	25.4	27.4	29.4

Note: [ ] 20 years reserves

____ 30 years reserves

ATTACH.18

A



(D)

August 9, 1979.

Mr. Tammachart Sirivadhanakul,
Director of Regulatory Division,
National Energy Administration.

Dear Mr. Tammachart,

Re: LPG PRODUCTION FROM NATURAL GAS

I study LPG production from 100% of natural gas (from well head), and whether Thailand can export LPG to Japan or not.

I do not use computor, but the calculation is based on Fluor's report and Chiyoda's estimation, so the result is not so much different.

When LPG is manufactured from 100% of natural gas (from well head), the dew point control unit is unnecessary. Therefore, the cost of dew point control operation must be minused from the cost of LPG unit. I suppose that the cost of dew point control unit is 15 -30% on the cost of LPG unit. In my report, I apply for 15% of that.

I LPG PRODUCTION QUANTITY IN THAILAND

Natural Gas Production		LPG Production T/Y		
		C_3 LPG	C_4 LPG	Total
350 MMscf/D (in 1983)		196.2	107.8	304.0
500 MMscf/D (after 1984)	In 1984	272.5	150.0	422.5
700 MMscf/D (after 1988)	In 1988	360.0	199.1	559.1
LPG From Refinery	In 1979			181.0

I suppose that LPG production from the refinery after the expansion and new refinery completion, LPG from these refineries is excess for domestic requirement, because these refineries will

have a lot of cracking units. Thai LPG demand in 1982 will be 244 MT, so Thailand could not export before the completion of the expansion and new refinery.

Accordingly, the most of LPG from natural gas should be exported to Japan (Japan is the best LPG market for Thailand), to obtain foreign currency, but after the completion of the expansion and new refinery.

After 1983, Thailand will be available to export for 300 x 10^3T/Y and after 1988 for 560 x 10^3T/Y.

II LPG USAGE

Every countries are saving crude oil, therefore, they are going to substitute petroleum products (from crude oil) to natural gas and LPG.

New usage of LPG for Thailand

1. Motor car
2. Gas turbine fuel for electric generators of EGAT in province.
3. Others (such as refrigerator)

III MARKETING RESEARCH IN JAPAN

Thai LPG Production from Natural Gas

in 1983	304 x 10^3 T
after 1988	559 x 10^3 T

Japanese LPG Domestic Production and Import

Domestic in 1983	5,917 x 10^3T	33.8 %
Import in 1983	11,589 x 10^3T	66.2 %
Total	17,506 x 10^3T	100.0 %

Japan is very good LPG market for Thailand.

IV FEASIBILITY STUDY

FOB Price of C_3 LPG and C_4 LPG

	C_3 LPG $/T	C_4 LPG $/T
1979 Jan.	133	111
1989 Jan.	125.5	115.50
1989 April	126.50	127.50
1989 July	160.00	180.00
Price on Spot		
1989 July	200.00	300.00

Latest FOB price of C_3 LPG is 160 $/T and C_4 LPG is 180 $/T (before the 2nd oil crisis), the price up is according to tight of all over the world LPG market.

The FOB price of them will be going up very rapidly.

THAI LPG COST VS LPG FOB PRICE Unit: ฿

Natural Gas Price (from pipeline) $/MMBTU	C_3 LPG $/T 160	168	177	187	192
	C_3 LPG $/T 180	189	199	210	216
1.50	+12.26	+20.16	+30.16	+40.16	+45.16
1.70*1	+ 1.96	+ 9.86	+19.86	+29.86	+84.86
1.78	- 9.11	- 1.21	+ 8.79	+18.79	+23.79
2.06*2	-30.70	-22.80	-10.80	- 0.8	+ 4.2

Note: *1 1.70 $/MMBTU may be current natural gas price including transportation fee.

*2 Fuel oil 1,200" equivalent price on calorific value.

Natural gas production is 500 MMscf/D.

From the above mentioned table, at present status, if C_3 LPG FOB price is 192 $/T and C_4 LPG FOB price is 216 $/T, the profit is nearly zero. In other word, FOB LPG price should be higher than equivalent price of fuel oil 1,200". Anyhow, C_3 and C_4 FOB price will be immediately going up.

So, NGOT should watch a movement of LPG FOB price.

V SALES NATURAL GAS IS DECREASED ACCORDING TO LPG PRODUCTION INCREASE

When LPG production is 100% from natural gas (from well head), the sales natural gas is decreased. Fluor LPG production is not from 100% of natural gas (from well head).

Unit : MMSCF/D

	1981	1982	1983	1984	1985
Decreased Sales Natural Gas	18.20	31.91	36.00	52.02	46.42
Sales Natural Gas For Existing Industry (50%)	8.77	18.55	30.57	42.66	55.23
	1986	1987	1988	1989	1990
Decreased Sales Natural Gas	52.64	46.16	51.61	44.45	36.97
Sales Natural Gas For Existing Industry (50%)	58.17	59.17	62.13	64.47	66.80

VI LOCATION OF NATURAL GAS PROCESSING UNIT

Thailand has many water ways. LPG transportation cost by water is very cheap. And Thailand has possibility to export LPG to Japan. Therefore, the location of natural gas processing unit should not be far from sea-shore.

If LPG is increased production, NGOT can not supply sales natural gas to the existing industry even if 50% on total consumption,