

YEAR	2012	2013	2014	2015	2016	2017	2018
PROJECT YEAR	24	25	26	27	28	29	30
<b>CURRENT ASSET</b>							
CASH ON HAND	48625	45594	42635	39748	36933	34190	31519
ACCOUNT RECEIVABLE	0	0	0	0	0	0	0
PRODUCT INVENTORY	0	0	0	0	0	0	0
OTHERS	0	0	0	0	0	0	0
<b>TTL. CURRENT ASSET</b>	<b>48625</b>	<b>45594</b>	<b>42635</b>	<b>39748</b>	<b>36933</b>	<b>34190</b>	<b>31519</b>
<b>FIXED ASSET</b>							
*EQUIPMENT & MACHINERY	50872	50872	50872	50872	50872	50872	50872
CUM. DEPRECIATION	50872	50872	50872	50872	50872	50872	50872
BOOK VALUE	0	0	0	0	0	0	0
*CIVIL & BUILDING	7326	7326	7326	7326	7326	7326	7326
CUM. DEPRECIATION	7326	7326	7326	7326	7326	7326	7326
BOOK VALUE	0	0	0	0	0	0	0
*INTANGIBLE ASSET	1847	1847	1847	1847	1847	1847	1847
CUM. AMORTIZATION	1847	1847	1847	1847	1847	1847	1847
BOOK VALUE	0	0	0	0	0	0	0
OTHERS	0	0	0	0	0	0	0
<b>TTL. FIXED ASSET</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
<b>TTL. ASSET</b>	<b>48625</b>	<b>45594</b>	<b>42635</b>	<b>39748</b>	<b>36933</b>	<b>34190</b>	<b>31519</b>
<b>CURRENT LIABILITY</b>							
ACCOUNT PAYABLE	0	0	0	0	0	0	0
S-T LOAN	0	0	0	0	0	0	0
OTHERS	0	0	0	0	0	0	0
<b>TTL. CURRENT LIABILITY</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
<b>L-T LIABILITY</b>							
L-T LOAN	15703	13086	10469	7852	5234	2617	0
<b>TTL. LIABILITY &amp; EQUITY</b>	<b>48625</b>	<b>45594</b>	<b>42635</b>	<b>39748</b>	<b>36933</b>	<b>34190</b>	<b>31519</b>
<b>STOCKHOLDERS EQUITY</b>							
CAPITAL	7733	7733	7733	7733	7733	7733	7733
RETAINED EARNING	25190	24776	24434	24164	23966	23840	23786
<b>TTL. EQUITY</b>	<b>32923</b>	<b>32509</b>	<b>32167</b>	<b>31897</b>	<b>31699</b>	<b>31573</b>	<b>31519</b>

\*\*\* CAPITAL INVESTMENT COST \*\*\*\*\*

PROJECT YEAR	-2	-1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	TOTAL
TERM	1	2	1	2	--																					--
CAPITAL INVESTMENT	14183	14358	15675	15858	6.0E+04																					
PLANT INVESTMENT	14183	14183	14916	14916	5.8E+04																					
EQUIP. & MACHINERY	12718	12718	12718	12718	5.1E+04																					
CIVIL & BUILDING	1465	1465	2198	2198	7326.00																					
PRE-OPERATION COST	0	0	393	393	785.00																					
INITIAL W/C	0	0	15	15	29.00																					
IOC	0	175	352	352	1061.68																					

\*\*\* INCREASING W/C \*\*\*\*\*

PROJECT YEAR	-2	-1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	TOTAL	
ON-STREAM FACTOR (%)	0.00	0.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	---	
INCREASING W/C	--	--	1301	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
INCREASING W/C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1301.00	
INCREASING W/C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1301.00	

\*\*\* DEPRECIATION/AMORTIZATION \*\*\*\*\*

PROJECT YEAR	-2	-1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	TOTAL	
DPR./AMT.	0	0	2740	2740	2740	2740	2740	2740	2740	2740	2740	2740	2740	2740	2740	2740	2740	2740	2740	2740	2740	2740	2740	2740	2740	2740	4.9E+04
DEPRECIATION	0	0	2570	2570	2570	2570	2570	2570	2570	2570	2570	2570	2570	2570	2570	2570	2570	2570	2570	2570	2570	2570	2570	2570	2570	2570	4.7E+04
EQUIP. & MACHINERY	0	0	2238	2238	2238	2238	2238	2238	2238	2238	2238	2238	2238	2238	2238	2238	2238	2238	2238	2238	2238	2238	2238	2238	2238	2238	4.5E+04
CIVIL & BUILDING	0	0	132	132	132	132	132	132	132	132	132	132	132	132	132	132	132	132	132	132	132	132	132	132	132	132	2657.36
AMORTIZATION	0	0	369	369	369	369	369	369	369	369	369	369	369	369	369	369	369	369	369	369	369	369	369	369	369	369	1846.68
PRE-OPERATION COST	0	0	157	157	157	157	157	157	157	157	157	157	157	157	157	157	157	157	157	157	157	157	157	157	157	157	785.00
IOC	0	0	212	212	212	212	212	212	212	212	212	212	212	212	212	212	212	212	212	212	212	212	212	212	212	212	1061.68

\*\*\* ANNUAL REVENUE \*\*\*\*\*

PROJECT YEAR	-2	-1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	
ON-STREAM FACTOR (%)	0.00	0.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	
ANNUAL REVENUE	--	--	11564	11564	11564	11564	11564	11564	11564	11564	11564	11564	11564	11564	11564	11564	11564	11564	11564	11564	11564	11564	11564	11564	11564	11564
LPG	--	--	8540	8540	8540	8540	8540	8540	8540	8540	8540	8540	8540	8540	8540	8540	8540	8540	8540	8540	8540	8540	8540	8540	8540	8540
CAPA. (TON/YEAR)	--	--	61000	61000	61000	61000	61000	61000	61000	61000	61000	61000	61000	61000	61000	61000	61000	61000	61000	61000	61000	61000	61000	61000	61000	61000
UNIT PRICE (US\$/TON)	140.00	140.00	140.00	140.00	140.00	140.00	140.00	140.00	140.00	140.00	140.00	140.00	140.00	140.00	140.00	140.00	140.00	140.00	140.00	140.00	140.00	140.00	140.00	140.00	140.00	140.00
NAPHTA	--	--	720	720	720	720	720	720	720	720	720	720	720	720	720	720	720	720	720	720	720	720	720	720	720	720
CAPA. (TON/YEAR)	--	--	3200	3200	3200	3200	3200	3200	3200	3200	3200	3200	3200	3200	3200	3200	3200	3200	3200	3200	3200	3200	3200	3200	3200	3200
UNIT PRICE (US\$/TON)	225.00	225.00	225.00	225.00	225.00	225.00	225.00	225.00	225.00	225.00	225.00	225.00	225.00	225.00	225.00	225.00	225.00	225.00	225.00	225.00	225.00	225.00	225.00	225.00	225.00	225.00
LEAN GAS	--	--	2304	2304	2304	2304	2304	2304	2304	2304	2304	2304	2304	2304	2304	2304	2304	2304	2304	2304	2304	2304	2304	2304	2304	2304
CAPA. (MSCF/YEAR)	--	--	1.1E+07	1.1E+07	1.1E+07	1.1E+07	1.1E+07	1.1E+07	1.1E+07	1.1E+07	1.1E+07	1.1E+07	1.1E+07	1.1E+07	1.1E+07	1.1E+07	1.1E+07	1.1E+07	1.1E+07	1.1E+07	1.1E+07	1.1E+07	1.1E+07	1.1E+07	1.1E+07	1.1E+07
UNIT PRICE (US\$/MSCF)	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21
PROJECT YEAR	24	25	26	27	28	29	30	TOTAL																		
ON-STREAM FACTOR (%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	

\*\*\* RAW MATERIAL COST \*\*\*\*\*

PROJECT YEAR	-2	-1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	
ON-STREAM FACTOR (%)	0.00	0.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	
RAW MATERIAL COST	--	--	2625	2625	2625	2625	2625	2625	2625	2625	2625	2625	2625	2625	2625	2625	2625	2625	2625	2625	2625	2625	2625	2625	2625	2625
RICH GAS	--	--	2625	2625	2625	2625	2625	2625	2625	2625	2625	2625	2625	2625	2625	2625	2625	2625	2625	2625	2625	2625	2625	2625	2625	2625
UNIT CONS. (MSCF/TON)	205.57	205.57	205.57	205.57	205.57	205.57	205.57	205.57	205.57	205.57	205.57	205.57	205.57	205.57	205.57	205.57	205.57	205.57	205.57	205.57	205.57	205.57	205.57	205.57	205.57	
UNIT PRICE (US\$/MSCF)	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	
PROJECT YEAR	24	25	26	27	28	29	30	TOTAL																		
ON-STREAM FACTOR (%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	

\*\*\* RAW MATERIAL COST \*\*\*\*\*

PROJECT YEAR	-2	-1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
ON-STREAM FACTOR (%)	0.00	0.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
RAW MATERIAL COST	--	--	5.2E+04	5.2E+04	5.2E+04	5.2E+04	5.2E+04	5.2E+04	5.2E+04	5.2E+04	5.2E+04	5.2E+04	5.2E+04	5.2E+04	5.2E+04	5.2E+04	5.2E+04	5.2E+04	5.2E+04	5.2E+04	5.2E+04	5.2E+04	5.2E+04	5.2E+04	5.2E+04
RICH GAS	--	--	5.2E+04	5.2E+04	5.2E+04	5.2E+04	5.2E+04	5.2E+04	5.2E+04	5.2E+04	5.2E+04	5.2E+04	5.2E+04	5.2E+04	5.2E+04	5.2E+04	5.2E+04	5.2E+04	5.2E+04	5.2E+04	5.2E+04	5.2E+04	5.2E+04	5.2E+04	5.2E+04
UNIT CONS. (MSCF/TON)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
UNIT PRICE (US\$/MSCF)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PROJECT YEAR	24	25	26	27	28	29	30	TOTAL																	
ON-STREAM FACTOR (%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

\*\*\* VARIABLE OPE-COST \*\*\*\*\*

PROJECT YEAR	-2	-1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	
ON-STREAM FACTOR (%)	0.00	0.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	
VARIABLE OPE-COST	--	--	957	957	957	957	957	957	957	957	957	957	957	957	957	957	957	957	957	957	957	957	957	957	957	957
ELECTRICITY	--	--	346	346	346	346	346	346	346	346	346	346	346	346	346	346	346	346	346	346	346	346	346	346	346	346
UNIT CONS. (KWH/TON)	406.70	406.70	406.70	406.70	406.70	406.70	406.70	406.70	406.70	406.70	406.70	406.70	406.70	406.70	406.70	406.70	406.70	406.70	406.70	406.70	406.70	406.70	406.70	406.70	406.70	406.70
UNIT PRICE (US\$/KWH)	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
WATER	--	--	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
UNIT CONS. (M3/TON)	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
UNIT PRICE (US\$/M3)	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
CHEMICALS	--	--	176	176	176	176	176	176	176	176	176	176	176	176	176	176	176	176	176	176	176	176	176	176	176	176
UNIT CONS. (US\$/TON)	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89
RIVER TRANSPORTATION	--	--	435	435	435	435	435	435	435	435	435	435	435	435	435	435	435	435	435	435	435	435	435	435	435	435
UNIT CONS. (US\$/TON)	7.13	7.13	7.13	7.13	7.13	7.13	7.13	7.13	7.13	7.13	7.13	7.13	7.13	7.13	7.13	7.13	7.13	7.13	7.13	7.13	7.13	7.13	7.13	7.13	7.13	7.13
PROJECT YEAR	24	25	26	27	28	29	30	TOTAL																		
ON-STREAM FACTOR (%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	--																	

\*\*\* FIXED OPE-COST \*\*\*\*\*

PROJECT YEAR	-2	-1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	
FIXED OPE-COST	--	--	1933	1933	1933	1933	1933	1933	1933	1933	1933	1933	1933	1933	1933	1933	1933	1933	1933	1933	1933	1933	1933	1933	1933	1933
LABOR COST	--	--	348	348	348	348	348	348	348	348	348	348	348	348	348	348	348	348	348	348	348	348	348	348	348	348
MAINTENANCE	--	--	1231	1231	1231	1231	1231	1231	1231	1231	1231	1231	1231	1231	1231	1231	1231	1231	1231	1231	1231	1231	1231	1231	1231	1231
INSURANCE	--	--	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180
PLANT OVERHEAD	--	--	174	174	174	174	174	174	174	174	174	174	174	174	174	174	174	174	174	174	174	174	174	174	174	174
PROJECT YEAR	24	25	26	27	28	29	30	TOTAL																		
FIXED OPE-COST	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LABOR COST	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MAINTENANCE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
INSURANCE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PLANT OVERHEAD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

\*\*\* INCOME TAX \*\*\*\*\*

PROJECT YEAR	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	25
NET INCOME B/TAX	1870	1870	1870	1870	1870	2240	2240	2240	2240	2240	2258	2350	2402	2474	2546	2618	2690	2761	2833	2905	-702	-650	-558	
IMPORT DUTY	0	1397	1397	1397	1397	1397	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
TAXABLE INCOME	1870	473	473	473	473	843	2240	2240	2240	2240	2258	2350	2402	2474	2546	2618	2690	2761	2833	2905	-702	-650	-558	
INCOME TAX RATE (%)	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	
INCOME TAX	561	142	142	142	142	253	672	672	672	672	677	699	720	742	764	785	807	828	850	872	0	0	0	
NET INCOME A/TAX	1309	531	531	531	531	590	1568	1568	1568	1568	1580	1651	1681	1732	1782	1832	1865	1935	1983	2034	-702	-650	-558	

PROJECT YEAR	24	25	26	27	28	29	30	TOTAL
NET INCOME B/TAX	-486	-414	-342	-270	-198	-126	-54	4.3E+04
IMPORT DUTY	0	0	0	0	0	0	0	0 6985.00
TAXABLE INCOME	-486	-414	-342	-270	-198	-126	-54	3.6E+04
INCOME TAX RATE (%)	0	0	0	0	0	0	0	--
INCOME TAX	0	0	0	0	0	0	0	0 1.2E+04
NET INCOME A/TAX	-486	-414	-342	-270	-198	-126	-54	2.4E+04

\*\*\* DEBT SERVICE PAYMENT ( ) \*\*\*\*\*

PROJECT YEAR	-2	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
TERM	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
BORROWING	12718	12893	13274	13436	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
REMAINING	12718	25611	38885	52341	52341	52341	52341	52341	52341	52341	52341	52341	52341	52341	52341	52341	52341	52341	52341	52341	52341	52341	52341	52341
REPAYMENT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
INTEREST	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PROJECT YEAR	11	12	13	14	15	16	17	18	19	20	21	22	23											
TERM	1	2	1	2	1	2	1	2	1	2	1	2	1	2										
BORROWING	0	0	0	0	0	0	0	0	0	0	0	0	0											
REMAINING	51032	49724	48415	47107	45798	44490	43181	41873	40564	39256	37947	36639	35330	34022	32713	31404	30096	28787	27479	26170	24862	23553	22245	20936
REPAYMENT	1309	1309	1309	1309	1309	1309	1309	1309	1309	1309	1309	1309	1309	1309	1309	1309	1309	1309	1309	1309	1309	1309	1309	1309
INTEREST	720	702	684	666	648	630	612	594	576	558	540	522	504	486	468	450	432	414	396	378	360	342	324	306
PROJECT YEAR	23	24	25	26	27	28	29	30	TOTAL															
TERM	1	2	1	2	1	2	1	2	--															
BORROWING	0	0	0	0	0	0	0	0	5.2E+04															
REMAINING	19628	18319	17011	15702	14394	13085	11777	10468	9160	7851	6543	5234	3926	2617	1309	0	0	0	0	0	0	0	0	0
REPAYMENT	1309	1309	1309	1309	1309	1309	1309	1309	1309	1309	1309	1309	1309	1309	1309	1309	1309	1309	1309	1309	1309	1309	1309	1309
INTEREST	288	270	252	234	216	198	180	162	144	126	108	90	72	54	36	18	0	0	0	0	0	0	0	0



# 第 13 章

## 經濟 評 價





## 第13章 経済評価

### 13.1. 緒言

ビルマの鉱業（特に石油・ガスの生産）は、国内の加工・製造業部門に原・燃料を供給し、又、農業、林業と共に主要な外貨獲得源であることから、ビルマ経済にとってきわめて重要な部門である。本プロジェクトは、現在原料あるいは燃料として利用されている石油随伴ガスからLPGを抽出、生産し、その製品を輸出するというエネルギー輸出プロジェクトであり、本プロジェクトがビルマの経済に及ぼす影響は大きいものがある。

ビルマ国LPG総合開発計画は、Phase I - Part 1, Phase I - Part 2, Phase IIが既の実施中であり、本プロジェクトはこうした一連のLPG回収計画のPhase IIIとして計画されているものである。本経済分析では、このLPG回収プロジェクトPhase IIIの実施により期待できる経済効果を評価するものである。

### 13.2 本プロジェクトの経済的便益

本プロジェクトの経済的便益を直接便益と間接便益に区別して評価する。

#### 13.2.1 直接便益

本プロジェクトの直接便益としては、生産されるLPG、副生ナフサ及びリーンガスの経済価値が挙げられる。

本プロジェクトの実施により生産されるLPGは、その全量が近隣諸国へ輸出され、貴重な外貨の獲得手段となる。又、副生するナフサもその全量が輸出される。さらに、将来LPGの国内需要が増加した場合、これを充たすことができる。

本経済分析では、LPG及び副生ナフサの輸出による外貨収入と経済価格によるリーンガス販売収入を直接便益と見做して、次の13.3節に詳述する如く経済効果を評価する。

#### 13.2.2 間接便益

本プロジェクトでは、下記の便益が間接便益として考えられる。

- 1) 雇用機会の増大
- 2) 地域社会への経済効果
- 3) 民生向上への波及効果
- 4) 技術移転効果
- 5) LPG総合開発計画の一環としての便益

これらの間接便益の各項目については13.5節で述べる。

### 13.3 経済的内部収益率

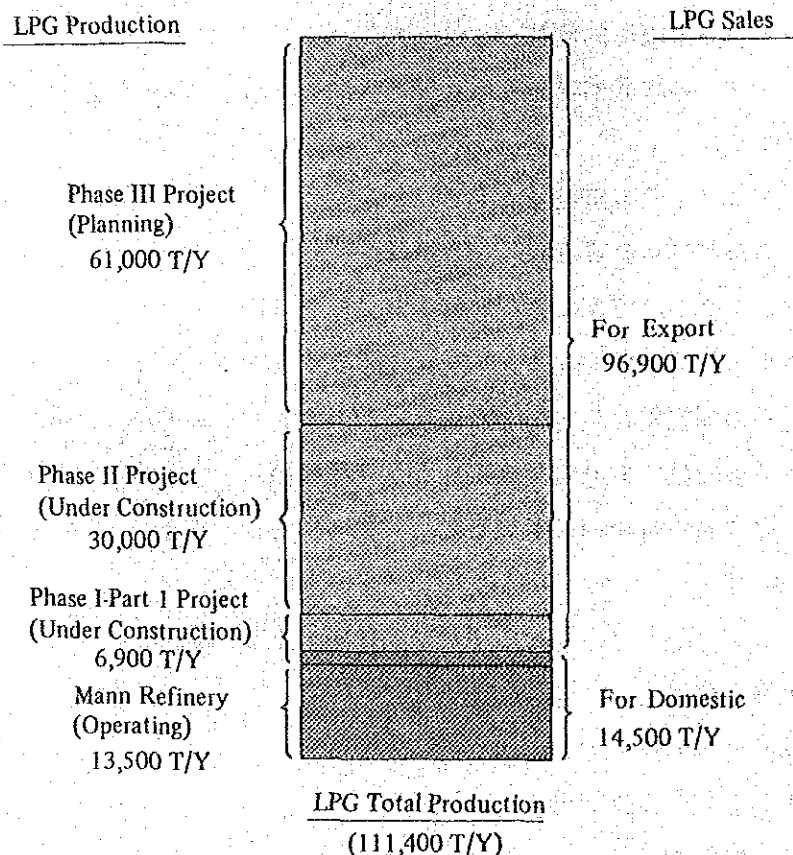
本節で経済的便益及び費用を算出のうえ、経済的内部収益率（EIRR: Economic Internal Rate of Return）を求める。

#### 13.3.1 LPG及び副生ナフサの需給予測

本プロジェクトの実施による経済効果を正しく把握する為に、プロジェクトが実施される場合と実施されない場合の1989年以降に予想されるビルマのLPG及びナフサの需要・供給状態を検討する必要がある。

ビルマのLPGの生産状況及び生産計画は、第13-1図に示される通り、既存製油所におけるLPG回収と、Phase I、Phase II、Phase IIIから成るLPG総合開発計画によるLPG生産に依る。

Fig. 13-1 LPG Production and Sales Plan



上図に示される通り、ビルマのLPGの国内消費量は低水準であり、Phase IIIプロジェクトで生産されるLPGは、全量が輸出されることになっている。すなわち、本Phase IIIプロジェクトが実施されない場合、本プロジェクトで生産されるLPG相当量だけ

ビルマのLPG輸出量が減少することになる。

本プロジェクトで副生されるナフサも全量輸出される予定であり、かつ、ビルマはナフサあるいはガソリン材の輸入を行っていないので、結局、本プロジェクトが実施されない場合、LPGの場合と同様に本プロジェクトで副生されるナフサ相当量だけビルマのナフサ輸出量が減少することになるものと考えられる。

### 13.3.2 直接便益

本プロジェクトが実施された場合の直接便益は、前項で述べられたごとく、LPG及び副生ナフサの輸出による外貨収入であり、副生リーングスの販売収入である。

第12章に述べられているように、プラントの操業開始時のLPG及び副生ナフサの輸出価格は各々US\$140/T、US\$225/Tと設定されている。これは第5章で述べられているように、その国際市場価格動向に基づいて設定されたものである。従って、本経済分析ではLPG及び副生ナフサの価格は財務分析で用いた輸出価格をその経済価格と見做すものとする。

しかしながら、副生リーングスは原料リッチガスと容量等価で引き取られるが、その熱量は低下しており、本プロジェクトが実施された場合これを熱源として利用するリーングスのユーザー（チャンギンセメント工場及びミヤノウ発電所）は熱量の低下分を補うため使用量を増加させるなどの対策が必要となってくる。従って、本経済分析ではリーングスの経済価格として財務分析で用いた販売価格に対し熱量の低下分だけ割引かれた価格を採用する。

なお、便益と費用の評価にあたっては、外国為替のシャドー・レートを用いず、財務分析で用いた実務為替レートによる米ドル評価を採用し、本プロジェクトの経済的便益と費用を算出する。

以上から、本プロジェクトの直接便益は第13-1表の通りとなる。

Table 13-1. Economic Benefit

Item	Unit Price	Annual Amount (US\$1,000)
LPG	US\$140/T	8,540
Naphtha	US\$225/T	720
Lean Gas	US\$0.183/10 <sup>3</sup> SCF	2,010
Total	-	11,270

### 13.3.3 経済的費用

#### (1) 本プロジェクトの実施に伴う初期費用

本プロジェクト実施のための初期費用としては、プラントの建設費用、コミッションング費用、操業前費用、初期運転資金が必要とされる。その金額は、第13-2表に示されるように、財務分析での内部収益率（IRROI）を試算した際に用いた投資額と同じとする。

#### (2) 原料の消費費用

本プロジェクトの生産活動に際して使用する原料は、MOCより供給される随伴ガスである。この随伴ガスは現在既にプラント建設予定地周辺にあるセメント工場及び発電所で燃料として使用されている。従って、本プロジェクトの原料の経済費用は、財務分析で用いたMOCによる原料ガス供給価格と同等とする。

#### (3) 労働資源の消費費用

本プラントで雇用される労働資源は、事業の内容からしてビルマの中でもかなり高いレベルにあり、財務分析においても相応の賃金レベルが用いられている。故に、ここではこの労働資源を財務分析で用いたのと同じ賃金レベルで評価する。

#### (4) その他の生産費用

上記以外の生産費用としては、用役・薬品費用、製品の国内輸送費用、さらに設備の補修費、管理費を計上する。土地は国有地であり無償で提供されるが、本プロジェクトが実施されない場合、他に利用計画がないのでその経済費用はゼロとする。

ビルマの税法に基づき賦課される税金（輸入税、所得税）と固定資産に対する保険料は、ビルマ国の立場からは譲渡費用と見做され、本経済分析では移転項目として処理する。

従って、本プロジェクトの経済的費用は第13-2表の通りとなる。

Table 13-2. Economic Cost

(US\$1,000)

Item		Year		Annual Operating Cost
		Capital Cost		
		-2	-1	1 - 20
Capital Cost	Plant Construction Cost	28,366	29,831	--
	Commissioning Fee	--	407	--
	Pre-operation Cost	--	378	--
	Initial Working Capital	--	29	--
Operating Cost	Variable Operating Cost (Raw Material: Rich Gas)	--	--	3,582 (2,625)
	Fixed Operating Cost	--	--	1,753
Total		59,011		5,335

## 13.3.4 経済的内部収益率の算定

上述の経済的便益及び費用を基盤に、本プロジェクトの操業期間（20年）における経済的内部収益率（EIRR）を算定すると、その結果は第13-3表の通りである。

Table 13-3. Economic Internal Rate of Return

(US\$1,000)

Year	Economic cost			Economic Benefit	Economic Cash Flow
	Capital Cost	Operating Cost	Total		
-2 ('87)	28,366	--	28,366	--	-28,366
-1 ('88)	30,645	--	30,645	--	-30,645
1 ('89)	1,301	5,335	6,636	11,270	4,634
2 - 19	--	5,335	5,335	11,270	5,935
20 (2008)	-1,330	5,335	4,005	11,270	7,265
Total	58,982	106,700	165,682	225,400	59,718
				EIRR	7.20%

上表の通り、EIRRは7.20%となり、財務収益率の税引後IRROIの5.11%を上回り、税引前IRROI 7.90%をやや下回ることが示された。そして、第13.4節に示されるように、本プロジェクトの実施により総額US\$90,532,000の外貨の獲得が可能となり、本プロジェクトの実施はビルマの経済に大きく貢献するものである。

さらに、第13.5節で検討されるように本プロジェクトの実施はビルマに種々の間接便益をもたらすこととなるので、本プロジェクトの経済的効果は高いものと判断され、その実施の妥当性が示唆されるものである。

#### 13.4 Phase III プロジェクトの外貨収支効果

本プロジェクトを実施した場合に予測されるビルマ国の外貨収支に及ぼす影響を調査する。

##### 13.4.1 前提条件及び分析方法

###### (1) 所要資金の調達

財務分析にて前述された所要資金は第13-4表に示されるように調達され、導入される。なお、長期借入金の借入条件は財務分析における基本ケースと同じとする。

Table 13-4. Financing Schedule

(US\$1,000)

Year	-1 (1987/88)	-2 (1988/89)	Total
Self Financing	2,930	4,802	7,732
Long-Term Loan	25,611	26,730	52,341
Total	28,541	31,532	60,073

###### (2) 外貨の流出

操業開始後において、外貨にて支払われる費用は

- ・長期借入金の返済金及び支払い金利
- ・補修費の内、外貨にて調達される費用（予備品等の輸入費用）

である。

###### (3) 外貨の獲得

本プロジェクトの実施により期待される外貨の獲得はLPG及び副生ナフサの輸出による売上によってもたらされる。

上記の外貨獲得額から外貨流出額を差引いたものを本プロジェクトの実施により得られる外貨収入とする。

##### 13.4.2 外貨収支

上述の前提に基づき、本プロジェクトを実施した際に予測される外貨収支を第13-5表に示す。

Table 13-5. Net Foreign Exchange Earnings

(US\$1,000)

Year	Foreign Exchange Inflow			Foreign Exchange Outflow				Net Foreign Exchange Flow (1) - (2)
	LPG Export	Naphtha Export	Sub-Total (1)	Maintenance Cost	Interest on Long-Term Loan	Repayment of Long-Term Loan	Sub-Total (2)	
-2	0	0	0	0	0	0	0	0
-1	0	0	0	0	0	0	0	0
1	8,540	720	9,260	659	1,439	0	2,098	7,162
2	8,540	720	9,260	659	1,439	0	2,098	7,162
3	8,540	720	9,260	659	1,439	0	2,098	7,162
4	8,540	720	9,260	659	1,439	0	2,098	7,162
5	8,540	720	9,260	659	1,439	0	2,098	7,162
6	8,540	720	9,260	659	1,439	0	2,098	7,162
7	8,540	720	9,260	659	1,439	0	2,098	7,162
8	8,540	720	9,260	659	1,439	0	2,098	7,162
9	8,540	720	9,260	659	1,439	0	2,098	7,162
10	8,540	720	9,260	659	1,439	0	2,098	7,162
11	8,540	720	9,260	659	1,421	2,617	4,697	4,563
12	8,540	720	9,260	659	1,349	2,617	4,625	4,635
13	8,540	720	9,260	659	1,277	2,617	4,553	4,707
14	8,540	720	9,260	659	1,205	2,617	4,481	4,779
15	8,540	720	9,260	659	1,134	2,617	4,410	4,850
16	8,540	720	9,260	659	1,062	2,617	4,338	4,922
17	8,540	720	9,260	659	990	2,617	4,266	4,994
18	8,540	720	9,260	659	918	2,617	4,194	5,066
19	8,540	720	9,260	659	846	2,617	4,122	5,138
20	8,540	720	9,260	659	774	2,617	4,050	5,210
21	0	0	0	0	702	2,617	3,319	-3,319
22	0	0	0	0	630	2,617	3,247	-3,247
23	0	0	0	0	558	2,617	3,175	-3,175
24	0	0	0	0	486	2,617	3,103	-3,103
25	0	0	0	0	414	2,617	3,031	-3,031
26	0	0	0	0	342	2,617	2,959	-2,959
27	0	0	0	0	270	2,617	2,887	-2,887
28	0	0	0	0	198	2,617	2,815	-2,815
29	0	0	0	0	126	2,617	2,743	-2,743
30	0	0	0	0	54	2,617	2,671	-2,671
Total	170,800	144,000	185,200	13,180	29,147	52,341	94,668	90,532

試算された外貨収支によると、本プロジェクトはそのプロジェクトライフを通じて、US\$185,200,000の外貨を獲得し、外貨の流出はUS\$94,668,000である。従って、本プロジェクトの実施により差引きUS\$90,532,000の外貨の蓄積が可能となり、ビルマ国経済に大きく貢献することが期待される。

### 13.5. Phase III プロジェクトの間接便益

#### 13.5.1 雇用機会の増大

本LPG回収プラントの建設にあたっては、各種の地元労働者が雇用される。また、建設完了に伴ない、約450人以上の従業員が雇用され長期にわたり生産活動に従事することになり、その家族も含めると約1,800人にも及ぶ人口に対し安定的な収入が期待されるものである。

プラントの建設予定地であるチャンギン地域では、現在稼動中のセメント工場以外には目ぼしい工業はなく、雇用機会の増大は本プロジェクトの重要な間接便益の一つである。

#### 13.5.2 地域社会への経済効果

本プロジェクトの実施により、建設期間、操業期間を通じて、資機材、製品、生活物資の流通が活発化する。本プロジェクトにおいては、プラントの建設と共に従業員とその家族の為に広大な居住地域が開発され、チャンギン地域のインフラストラクチャーが著しく強化される。また、本プラントの存在により各種の商業活動が促進化されるなど、地域開発が図られる。

#### 13.5.3 民生向上への波及効果

本プロジェクトは製品輸出プロジェクトであり、直接的にその製品を国内で販売する訳ではない。しかしながら、本プロジェクトの実施により間接的に他の設備で生産される国内向けLPGの供給を保証することになると考えることができる。この為、現在一般家庭で主燃料として使われている木材・木炭等をLPGに転換し民生向上をうながし、さらには貴重な木材資源の保護並びに有効利用への発展へつながるなど、間接的な民生向上への波及効果が期待できる。

#### 13.5.4 技術移転効果

第5章で述べられているように、現在のところビルマにおけるLPGの需要は、板ガラス工場等一部重工業に限られている。

このようにLPGの国内需要が小さいのは、その価格面もさることながら、LPGが高圧下で液化された危険物であるためその取扱いに十分慣れておらず、技術面・法規面の整備が不備であることなどによるものと考えられる。



従って、本プロジェクトが実施されるならば、特に、

- 1) 高圧LPG製造技術の修得
- 2) 高圧LPG取扱い技術の修得

による技能レベルの向上が期待され、その結果LPGの国内需要の開発につながるものと予想される。

#### 13.5.5 LPG総合開発計画の一環としての便益

本プロジェクトは、ビルマLPG総合開発計画のPhase IIIとして実施されるものである。そのため、Phase IIプロジェクトではPhase IIIの実施を念頭においてシリアム・ターミナルの規模を大きく設定しているので、Phase IIIプロジェクトにおいては、棧橋建設が不要となる。

また、工事の種類がPhase IIと類似のため、Phase IIプロジェクトの建設工事に投入された建設機械の多くを本Phase IIIプロジェクトの建設工事に転用することが可能となり、建設費の低減につながっている。

このように、本Phase IIIプロジェクトはLPG総合開発計画の一環として実施されることにより、過去の投資を生かすことができるものである。



第 14 章  
提 言



## 第14章 提 言

本プロジェクトが予定の時期に建設を完了し、順調な操業を行ない、製品・副製品を安定的に供給して計画通りの利益を確保するために、調査団として、次の事項の提言を行う。

### 14.1 建設計画

- (1) 建設工程の遅延を防ぐために、次の事を厳守すること。
  - (a) プラントサイト、ターミナルサイト、栈橋建設地のリバーベッド、パイプライン・ルート及び送電線・ルートの詳細調査は本プロジェクトの契約前に完了しておくこと。
  - (b) ターミナルサイトの土盛り・埋め立て工事はビルマ側で実施されるが、比較的難工事が予測されるので、先行実施し、本プロジェクトの契約発効前に完了しておくこと。
  - (c) 建設機械はP I Cが現在所有しているものを、かなりの台数使用する計画になっているが、補修ヶ所の実体把握を確実にしない、部品の調達は、本プロジェクトの調印後直ちに入手できるようにあらかじめ配慮し、整備を完全に行なうこと。
  - (d) 本プロジェクトで建設を計画している、Zクラフト及びFRP-Boatを建設工事に有効に活用するため、できるだけ早く入手できるようにあらかじめ配慮すること。  
又、建設時の機器・資材類はイラワジ河による運送のため、専用船の確保を行なうこと。
- (2) 建設費用の低減を図る為に、次の点を詳細設計段階で検討することが好ましい。
  - (a) 球型タンクのタンク間距離を見直す。日本における高圧ガス取締法では、周囲に保安施設等が無い場合のL P G球型タンク間距離は、互いに隣り合うタンク径の和1/4以上となっている。これに基づく配置計画を第14-1図・第14-2図に示す。サイト用地の大巾な縮小が期待できる。チャンギン・ターミナルを例にとると埋め立て用の土量が約88,000M<sup>3</sup>から60,000M<sup>3</sup>と30%減少する(土盛高さ4m)。
  - (b) Phase Iで建設中のシリアム・ターミナルの工事で本プロジェクトの工事を円滑に行なうためL P G配管・ユーティリティ配管には適当な位置にノズル出し・バルブ止め等を行ない、容易に連結できるように配慮すること。
- (3) 工程の遅延による建設費の上昇は、採算性への影響が大きいことから、本プロジェクトは建設工程表通りに実行されることが必要である。
- (4) 建設工程及び建設費の変更を避けるために、本プロジェクトに必要な機器・資材のうち、ビルマ側で調達を予定されているものは工事進歩上支障なきよう確保しておくこと。

## 14.2 運営管理

- (1) 基地の運営に際しては、輸出用外航船の配船繰り、各LPGターミナル間のLPG移送用リバーバージの運営及び基地のLPG在庫管理を充分調整して行なう必要がある。マネージメント技術の習熟が必要である。

シリアム・ターミナルのLPG用栈橋に余裕がないので運用面の配慮は不可欠である。

- (2) 高圧ガスの取扱いにかかわる災害を防止するために、LPGの取扱いに熟達した技術者を大量に養成し、又国内法規・取扱いマニュアルを整備しておくこと。

## 14.3 輸出・内需販売

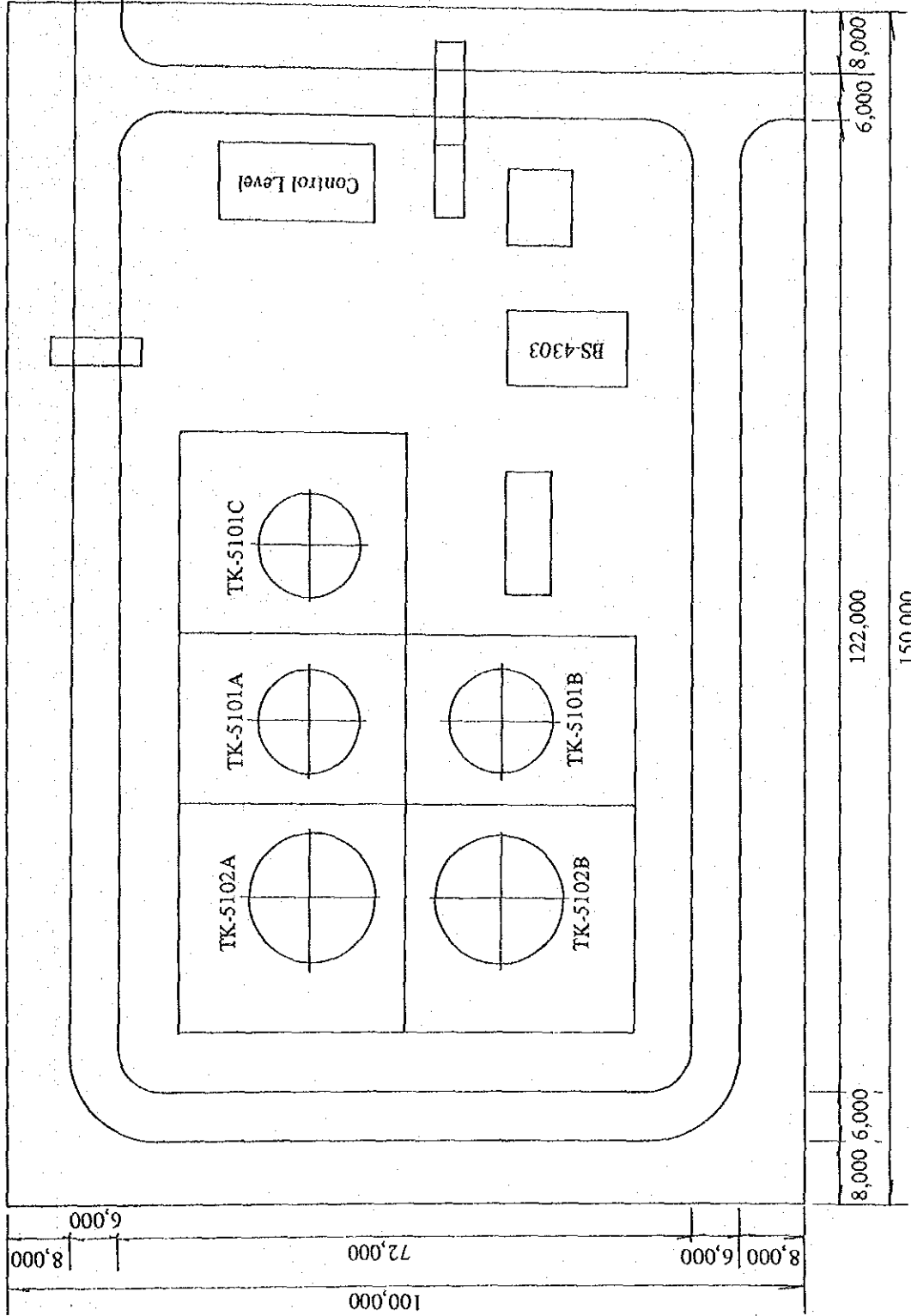
- (1) 製品LPGを安定的に高価格で販売することは、このプロジェクトの採算上特に重要である。第5.3節で述べた提言を実行すること。

- (2) 内需は段階的に増加する。したがってPhase Iのマン・ターミナル及びシリアム・ターミナル完成後はマンおよびシリアム製油所で生産されたLPGのうち内需用以外は輸出に向けられる。この場合Phase IIIの基本計画値を上回る輸出量となる可能性があるので調整が必要となる。マン製油所で生産されるLPGはオレフィン型なので、タンクの仕分け・Bargeぐり輸出価格面の調整等運用上の配慮が必要である。

しかし本LPG総合開発計画の成果をあげるためには、建設した設備を最大限に有効利用し、輸出規模を大きくする努力をすべきである。

国内市場の開発については、第5.5節で述べた提言を実行すること。

Fig. 14-1 Alternated Plot Plan for Kyangin Terminal Site









**APPENDIX – I**

**PROGRESS REPORT**



THE SUMMARY OF DISCUSSION  
BETWEEN  
THE JAPANESE FEASIBILITY STUDY TEAM AND  
THE PETROCHEMICAL INDUSTRIES CORPORATION  
ON THE INTEGRATED LIQUEFIED PETROLEUM GAS PROJECT  
(PHASE III)

The Japan Study Team (hereinafter referred to as "the Team") led by TETSUHIKO TSUNODA organized by the Japan International Cooperation Agency (hereinafter referred to as "JICA") visited the Socialist Republic of the Union of Burma from 27<sup>th</sup>: April to 16<sup>th</sup>: May 1985 in order to work out the Feasibility Study for the Integrated Liquefied Petroleum Gas Project (Phase III) (hereinafter referred to as "the Project") based on the Scope of Work for the Feasibility Study of the Project which was signed on 9<sup>th</sup>: April 1985 in Rangoon by Burmese side and on 22<sup>nd</sup>: April 1985 in Tokyo by Japanese side.

During its stay in the Socialist Republic of the Union of Burma, the Team exchanged views, conducted site surveys and also had a series of discussions with the Burmese authorities concerned for the feasibility study for the Project.

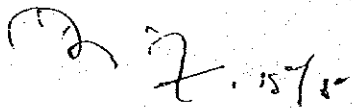
As a result of the site surveys and discussions the Team prepared the Progress Report and submitted 10 copies of it to Petrochemical Industries Corporation (hereinafter referred to as "PIC").

PIC expressed sincere appreciations for the effort of the Team and satisfaction for the content of the Progress Report.

The Team promised to make their best efforts to prepare the Final Report after their return to Japan and expressed that the draft final report will be submitted by the middle of August 1985 to Burmese side.

The Team would like to put on record their sincere appreciation for the warm hearted welcome and cooperation extended to them by the Burmese side during their stay in Burma, and were able to collect enough data to enable them to carry out the study on an effective and efficient manner.

Rangoon, Dated: 15<sup>th</sup> May, 1985.



( U Tin Maung Aye )  
Managing Director  
Petrochemical Industries  
Corporation.



( T. Tsunoda )  
Team Leader  
The Feasibility Study Team  
Japan International Cooperation  
Agency (JICA).

PROGRESS REPORT  
OF  
FEASIBILITY STUDY TEAM  
FOR  
THE INTEGRATED LIQUEFIED PETROLEUM GAS PROJECT (PHASE III)

MAY 1985

JAPAN INTERNATIONAL COOPERATION AGENCY  
(JICA)

## Progress Report

### 1. BACKGROUND

In accordance with the "Summary of Discussion between the Japanese Preliminary Survey Team and the Petrochemical Industries Corporation on the Scope of Work for the Feasibility Study on the Integrated Liquefied Petroleum Gas Project (Phase III)", August 1st., 1984, the Japan International Cooperation Agency (JICA) sent a seven member survey team (team) led by Mr. Tetsuhiko Tsunoda to Burma to study the feasibility of the Proposed Integrated LPG Project (Phase III) (this Project) from 27<sup>th</sup>: April to 16<sup>th</sup>: May, 1985.

### 2. THE PURPOSE OF TEAM

The purposes of the team's activity in Burma are to collect supplementary information and data in order to examine the feasibility of this Project from economic and technical points of view.

### 3. PROGRESS REPORT

Although the conclusion of the study can only be brought through study in Japan, the team would like to state the tentative views on some points of this Project.

It should be clearly noted that the team's views mentioned here might be changeable in the course of further study.

### 3.1 The proposed Sites of this Project

The following proposed sites may be suitable for this Project.

- (a) Kyangin North (near Kyangin Cement Mill) for new LPG Plant.
- (b) Kyangin South (near Malakagon) for new LPG loading terminal.
- (c) Existing Syriam LPG Terminal for expansion of LPG Storage Tanks.

### 3.2 Loading and Unloading Jetties

Jetties of each site may be considered as follows:

- (a) A new jetty may be provided at Malakagon for loading of products of the new LPG Plant.
- (b) The LPG Jetty at Syriam may afford to unload LPG from the new plant together with LPG from the other plants to load for export.

### 3.3 Electric Power Supply System

New power transmission line from Myanaung Power Station to new LPG Recovery Plant shall be constructed.

The following conditions may be suitable for this project.

- (a) Capacity                      7000KVA
- (b) Voltage                        66KV
- (c) Frequency                      50HZ



4. SUBJECTS OF STUDY

- (a) Associated Gas reserves, production capability and properties of the proposed Gas & Oil Fields
- (b) Plans of terminals and LPG Recovery Plant
- (c) Marketing of LPG
- (d) Plan of River Barges
- (e) Economic evaluation
- (f) Construction
- (g) Plan of Electric Power Supply System
- (h) Others

5. ACTIVITIES OF THE TEAM IN BURMA

The team collected information and data on various aspects of this Project regarding the above mentioned subjects of study through discussion with the Burmese officials and investigation in site.

Details of activities of the team in Burma are shown in Annexure 2, "Notes of Discussion and Visit".

6. The following items will be studied by the team after its return to Japan.

A. Associated Gas reserves and production capability of the proposed Gas & Oil Fields.

- (1) Evaluation of Associated Gas reserves and production capability for this Project.

### 3.4 The Existing Piping Lines

The following existing piping lines may be available for this Project.

Line Size (inch)	Use	Existing		Use for this Project	Note
		Direction			
		From	To		
10	Feed Gas	SHWEPYITHA Gas Field	EPC Control Station	None	
8	Feed Gas	EPC Control	HTANTABIN Control Station	Part of Lean Gas line to MYANAUNG Gas Turbine	
8	Feed Gas	EPC Control	MYANAUNG Gas Turbine	Part of Lean Gas line to MYANAUNG Gas Turbine	
10	Feed Gas	HTANTABIN Oil Field	HTANTABIN Control Station	Part of Feed Gas line to LPG Plant	
10	Feed Gas	HTANTABIN Control Station	KYANGIN Cement Mill	Part of Lean Gas line to KYANGIN Cement Mill	
10	Feed Gas	HTANTABIN Control Station	SEIKTHA Methanol Plant	Part of Lean Gas line to SEIKTHA Methanol Plant	Under Planning

3.5 Basic conditions related to Feasibility Study are agreed with PIC and Study Team in "Annexure 1".

B. Plan of LPG Recovery Plant, Terminals and Jetty.

(1) Making conceptual design:

- (a) Capacity
- (b) Site
- (c) Layout
- (d) Facilities
- (e) Processing

(2) Investigation as to the following items:

- (a) Utilities plan
- (b) Pipe lines
- (c) Management for LPG Recovery Plant and Terminals

C. Marketing of LPG

- (1) Analysis of LPG demand in Burma.
- (2) LPG demand forecast in Burma by using Burmese informations.
- (3) International LPG demand forecast by worldwide information about LPG.
- (4) Estimation of LPG export price at Rangoon port.
- (5) Recommendations to increment of LPG demand.

D. Plan of LPG Barges

- (1) Evaluation of the actual transport condition in Irrawaddy River, and of the usability of existing pusher tug boats.
- (2) Provision of conceptual design of Special River Barges for LPG transportation between new LPG Terminal and Syriam Terminal.
  - (a) Type (Self propelling)
  - (b) Capacity payload - 600 Ton or more
  - (c) Classification - NK
  - (d) The number required - Three
  - (e) Management

E. Economic Evaluation

Economic and financial evaluation will be done in the following manners, and some alternative evaluation, if necessary, will be also done.

(1) Financial analysis

Project revenue and cost incurred from this Project will be used for the financial calculation.

(2) Economic analysis

The analysis will be made from the viewpoint of contribution of this Project to Burmese economy.

F. Investment cost and implementation schedule

(1) The investment cost shall be estimated in foreign currency portion and the local currency portion, respectively.

(2) Preparation of the detailed implementation schedule of this Project.

G. Plants of Electric Power Supply System

(1) Making conceptual design of transmission line from Myanaung Power Station to Plant Site.

(a) Route

(b) Length

Annexure 1

BASIC CONDITIONS RELATED TO THE FEASIBILITY STUDY

Basic Condition Related to the Feasibility Study

No.	Items	Basic Conditions
1.	Sites	(1) KYANGIN North (near KYANGIN Cement Mill) for new LPG Plant (2) KYANGIN South (near MALAKAGON) for NEW LPG loading Terminal (3) The existing Syriam LPG Terminal for Expansion of LPG Storage Tanks.
2.	Jetties	(1) Loading jetty of New LPG Terminal will be provided at Malakagon. (2) The LPG Jetty at Syriam Terminal will be both used as loading & unloading.
3.	Electric Power Supply System	(1) Capacity 7000KVA (2) Voltage 66KV (3) Frequency 50HZ
4.	Existing Piping lines	(1) Five of six existing piping lines stated in para 3.4 of this PROGRESS REPORT will be available for this PROJECT.
5.	Production Rate	LPG from New LPG Recovery Plant ..... 61,000 MT/Year
6.	Expected amount of LPG for Export	(1) LPG from NEW Recovery Plant ..... 61,000 MT/Year (2) LPG from Mann Extraction Plant ..... 30,000 MT/Year (3) LPG from Syriam Refinery ..... 5,900 MT/Year Total ..... 96,900 MT/Year
7.	Products Prices	(1) Export LPG - 140 \$/t (2) Associated Gas from Gas Fields to New LPG Recovery Plant - 1.80K/1,000 SCF (3) Lean Gas from New LPG Recovery Plant to Existing Plants - 1.80K/1,000 SCF (4) Motor Spirit from New LPG Recovery Plant to domestic Use - 3.50K/Gal (IP) (5) Motor Spirit from New LPG Recovery Plant for export - 225 \$/T





Annexure 2

NOTES OF DISCUSSION AND VISIT

NOTES OF DISCUSSION AND VISIT

- 1<sup>st</sup>: Apr. 26 Fri. : Leave Tokyo at 17:20 pm by TG 741  
: Arrive at Bangkok at 21:30 pm
- 2<sup>nd</sup>: Apr. 27 Sat. : Leave Bangkok at 14:50 pm by TG 305  
: Arrive at Rangoon at 15:30
- 3<sup>rd</sup>: Apr. 28 Sun. : Discussion within the Team
- 4<sup>th</sup>: Apr. 29 Mon. : (PM) Meeting at PIC
- 5<sup>th</sup>: Apr. 30 Tue. : (AM) Visit the Japanese Embassy and  
Japan International Cooperation Agency.  
: (PM) Discussion at PIC
- 6<sup>th</sup>: May 1 Wed. : Discussion within the Team
- 7<sup>th</sup>: May 2 Thu. : (AM) Discussion at MOC  
: (PM) Joint Discussion with TSC/PIC
- 8<sup>th</sup>: May 3 Fri. : (AM) Discussion at PIC  
: (PM) Joint Discussion with PIC/EPC
- 9<sup>th</sup>: May 4 Sat. : (AM) Visit Syriam Refinery, Syriam  
LPG Terminal and Jetties
- 10<sup>th</sup>: May 5 Sun. : Go to Seiktha from Rangoon
- 11<sup>th</sup>: May 6 Mon. : Survey Kyangin the North Site and the  
South Site.  
: Survey Kyangin LPG Jetty site
- 12<sup>th</sup>: May 7 Tue. : Survey Myanaung Power Station  
: Survey Myanaung Gas Field  
: Survey Myanaung Gas Control Station  
: Survey Transmission-line route from  
Myanaung Power Station to Plant site.

- 13<sup>th</sup>: May 8 Wed. : Survey Kyangin Cement Mill  
: Survey Kyangin Cement Jetty  
: Survey Seiktha Methanol Plant  
: Survey Seiktha Methanol Jetty
- 14<sup>th</sup>: May 9 Thu. : Survey Shwepyitha Oil Field  
: Survey Htantabin Oil Field  
: Survey Methanol Temporary Jetty
- 15<sup>th</sup>: May 10 Fri. : Return to Rangoon from Seiktha
- 16<sup>th</sup>: May 11 Sat. : (AM) Discussion within the Team  
: (PM) Discussion of questionnaire content  
at PIC
- 17<sup>th</sup>: May 12 Sun. : Discussion within the Team
- 18<sup>th</sup>: May 13 Mon. : (AM) Joint Discussion with PIC/TSC/EPC  
: (PM) Joint Discussion with PIC/TSC/EPC
- 19<sup>th</sup>: May 14 Tue. : Joint Discussion with PIC/TSC/EPC
- 20<sup>th</sup>: May 15 Wed. : (AM) SUBMIT THE PROGRESS REPORT to the  
Burmese Side.  
: (PM) RECEIVE BURMESE REPLY for the  
questionnaire prepared by the Team  
: Joint final Discussion with PIC/TSC/EPC
- 21<sup>st</sup>: May 16 Thu. : (AM) Visit the Japanese Embassy and Japan  
International Cooperation Agency  
: Leave Rangoon at 16:30 pm by TG 306  
: Arrive at Bangkok at 18:10 pm
- 22<sup>nd</sup>: May 17 Fri. : Leave Bangkok at 10:30 am by TG 740  
: Arrive at Tokyo at 18:25 pm

Answers to JICA Questionnaire Connected With  
Integrated Liquefied Petroleum Gas Project, Phase III

1. In response to the Inception Report submitted by JICA for the Feasibility Study on the Integrated Liquefied Petroleum Gas Project (Phase III), the Petrochemical Industries Corporation (PIC), the Executing Agency for the Project, has submitted herewith answers to questionnaires as well as explanations to the salient points with a view to assisting the Study Mission to calculate the feasibility of the Project.
2. In addition to the series of discussions held between the Mission and the various Corporations of the Burmese Government, namely the Myanma Oil Corporation (MOC), the Electric Power Corporation (EPC), and the Technical Services Corporation (TSC), the Mission was given the opportunity of visiting the Syriam Refinery and Syriam Terminal, the Cement Mill and Cement Jetty at Kyangin, the Gas Turbine Power Plant at Myanaung, the Gas and oil fields at Myanaung, Shwepyitha and Htantabin, and the construction sites of the Methanol Plant and Methanol Jetty at Seiktha.
3. To enable the Mission to obtain understanding of the Burmese Industrial Development Plan and Energy Usage, the Mission was provided with a copy of "Report to the Phithu Hluttaw, 1985/86.

4. The Mission and the Burmese Side had agreed in principle to the following points:-
- 4.1 The capacity of the Phase III LPG Plant shall be 50 Million Standard Cubic Feet per day.
  - 4.2 The available Associated Gas will be from Myanaung, Shwepyitha and Htantabin Fields.
  - 4.3 Lean Gas from the Extraction Plant shall be fed by pipeline to Kyangin Cement Mill, Myanaung Gas Turbine Power Station and Seiktha Methanol Plant.
  - 4.4 A new gas line spanning through Shwepyitha, Myanaung and Htantabin shall be laid for feed associated gas to the Phase III Plant.
  - 4.5 A new Electric Power Transmission line shall be installed between the Myanaung Power Station and the LPG Plant, as well as the branch lines to the LPG Terminal and LPG Jetty.
  - 4.6 The net storage capacity of the LPG Terminal shall be on the basis of production volume for 15 days as regards LPG Terminal Site and 20 days as regards Syriam Terminal.
  - 4.7 According to the results of actual site surveys, the provisional site for LPG Plant is to be on Kyangin North and provisional site for Terminal and Jetty sites are to be on Kyangin South. Confirmation shall be concluded after detailed study.

- 4.8 Infrastructure facilities such as electric power supply and water supply for a housing complex of 300 families shall be included in the scope of the Project.
- 4.9 The method of transportation of LPG from the Phase III Plant to Syrian Terminal is to be by self-powered LPG Barges, capable of carrying 600 tons or more of LPG per load. The total number of such barges is to be 3 (three).
- 4.10 The method of transportation of Naphtha from the LPG Plant to LPG Terminal is to be by pipeline. From the LPG Terminal Naphtha will be transported by oil barges either to Syrian or elsewhere. The barges for such transportation is outside the scope of the Project.
- 4.11 The prices of LPG and Naphtha per metric ton basis is to be as follows for purposes of economic evaluation:-

	<u>FOB Export</u> <u>Price</u>	<u>Domestic</u> <u>Price</u>
1. Propane	US\$ 140	Ks. 2,000
2. Butane	US\$ 140	Ks. 1,550
3. Naphtha	US\$ 225	Ks. 1,120

- 4.12 Some of the construction machinery required for Phase III construction could be obtained from the presently useable fleet belonging to PIC. However, spare parts will be required to enable those machines to operate efficiently.

4.13 PIC requested the Mission to include suitable river craft, landing craft type (Z-craft) of 100 ton capacity so that materials could be transported by Irrawaddy River from Rangoon to Kyangin Area and also suitable river launch to ferry light materials and personnel between the East bank and West bank of the Irrawaddy river as there are no bridges crossing the river at Kyangin Area. This would have favourable impact on implementation schedule of the Project.

4.14 The communication network between the LPG Plant, Terminal, Jetty, Feed Gas Producer and Lean Gas End User will have to be established either by utilizing the existing public telephone network and/or by installing wireless-telephone systems and carrier-telephone. Provision of such a network shall be in the scope of the Project.

4.15 PIC and JICA discussed financial and economic matters on the Phase III study, and PIC gave answers to questionnaires. PIC and JICA agreed that the study basis on financial and economic analysis on the Phase III Project shall be according to the study premises.

4.16 PIC and JICA agreed to have the Project implementation sites named as follows:-

(a) Kyangin LPG Extraction Plant

(b) Kyangin LPG Terminal

(c) Kyangin LPG Jetty

4.17 It agreed feed gas specification for design base shall be as per PIC's reply to questionnaires.

Annexure 3

LIST OF MEMBERS



## LIST OF MEMBERS

### JAPANESE SIDE:

Mr. Tetsuhiko TSUNODA : Study Team Leader  
Project Management

Mr. Muneteru YOSHIKAWA : Process and  
Transportation

Mr. Akira NAGUMO : Civil and Infrastructure

Mr. Masatoshi HARADA : Construction Cost and  
Operating Plan

Mr. Shinji IZUME : Marketing

Mr. Saburo MIZUNO : Electric  
Transmission-line

Mr. Masaaki AWAMOTO : Project Economist

(Mr. Yuusuke KITAMURA : Advisor JICA H/Q)

BURMESE SIDE:

P.I.C. (Head Office)

U TIN MAUNG AYE : Managing Director  
U THAN WIN : Director (Planning)  
U HTUN AUNG : Director (Production)  
U TIN HLA : Director (Finance)  
U HLAING MYINT SAN : Deputy Director (Planning)  
U MYA PE : Asst. Director (Finance)  
U KYAW WIN MAUNG : Head of Dept. (Planning)  
U AUNG HTUT : Head of Dept. (Planning)

P.I.C. (Syriam Refinery)

U MYINT AUNG : General Manager  
U KYAW SEIN : Deputy General Manager (Production)  
U NGWE : Deputy General Manager (Planning)  
U SAN TIN : Engineer

T.S.C. (Head Office)

U HLA MYINT : Director  
U THEIN WIN : Deputy Director (Works Planning)  
U MYINT THEIN : Deputy Project Engineer  
U THAN NGWE : Assistant Engineer (Civil)

M.O.C. (Head Office)

U TIN NYUNT : General Manager (Exploration)  
U SAW AUNG HLAING : Production Superintendent  
U SEIN HLAING : Development Geologist  
U MIN ZAW : Deputy Production Superintendent

M.O.C. (Kyangin Field Site)

U AUNG MYINT : Manager  
U MIN ZAW : Deputy Production Superintendent  
U BO : Senior Production Engineer  
U KHIN MAUNG OHN : Senior Production Engineer

E.P.C. (Myanaung Power Station)

U WIN KYAING : Acting General Manager  
U AYE THEIN : Mechanical/Maintenance Engineer  
U MYINT THEIN : Electrical Maintenance Engineer

KYANGIN CEMENT FACTORY

U TIN AUNG : Deputy General Manager  
U KYI MAUNG : Project Manager  
U THEIN LWIN : Project Engineer (Electrical Engineer)

M.O.C. (Shwepyitha Oil Field)

U YE GAUNG : Drillers-in-Charge  
U TINT NAING : Engineer -in-Charge

M.O.C. (Htantabin Oil Field)

U KYAW KHIN : Engineer -in-Charge

M.O.C. (Prome Oil Field)

U KYI WIN : Manager  
U MYINT SWE : Senior Production Engineer  
U KHIN MAUNG PUN : Production Engineer  
U WIN SHWE : Production Engineer

P.I.C. (Seiktha Methanol Plant Site)

U TIN MOE : Project Engineer  
(Methanol Factory Project)

**APPENDIX – II**

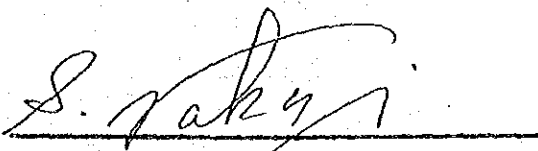
**SCOPE OF WORK**



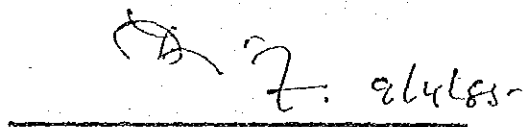
SCOPE OF WORK  
FOR  
THE FEASIBILITY STUDY  
ON  
THE INTEGRATED LIQUEFIED PETROLEUM GAS PROJECT (PHASE III)  
IN  
THE SOCIALIST REPUBLIC OF THE UNION OF BURMA  
AGREED UPON BETWEEN  
THE JAPAN INTERNATIONAL COOPERATION AGENCY  
AND  
THE PETROCHEMICAL INDUSTRIES CORPORATION

Tokyo: 22<sup>nd</sup>: April, 1985

Rangoon: 9<sup>th</sup>: April, 1985



Shinya NAKAI  
Leader, Japanese Preliminary  
Survey Team



U Tin Maung Aye  
Managing Director  
Petrochemical Industries  
Corporation

## I. Introduction

In response to the request of the Government of the Socialist Republic of the Union of Burma (hereinafter referred to as "GSRUB"), the Government of Japan has decided to conduct a feasibility study on the Integrated Liquefied Petroleum Gas Project (Phase III) (hereinafter referred to as "the Study") in accordance with the laws and regulations in Japan.

The Japan International Cooperation Agency (hereinafter referred to as "JICA") the official agency responsible for the implementation of the technical cooperation programs of the Government of Japan will undertake the Study in close cooperation with the authorities of the Socialist Republic of the Union of Burma.

The present Document sets forth the Scope of Work with regard to the Study.

## II. Basic Project Concept Proposed by GSRUB

1. The Integrated Liquefied Petroleum Gas Project (hereinafter referred to as "the Project") is composed of the 3 phases as follows:

Phase I: part one

Installation of one coking plant with capacity of 5,200 B.P.S.D. using topped crude as feedstock at the Syriam Refinery equipped with facilities to produce approximately 8,000 metric tons of internationally acceptable quality liquefied petroleum gas (L.P.G.) in addition to premium motor-spirit, regular motor-spirit, diesel-oil and petroleum coke.

Phase I: part two

- (1) Installation of terminals for L.P.G. at Syriam Refinery Complex and Mann Refinery Complex. The terminal at Syriam is to be adequately sized to accommodate 114,000 metric tons on final annual basis as follows.
  - (i) L.P.G. production from Syriam Refinery (8,000 metric tons)
  - (ii) Mann Refinery (15,000 metric tons)
  - (iii) Mann oil-field (30,000 metric tons)
  - (iv) Htantabin oil field (61,000 metric tons)
- (2) The terminal at Syriam is to be equipped to receive L.P.G. from special river crafts (barges) and to load L.P.G. into export tankers.
- (3) Procurement of 4 Nos. special river crafts (barges) to enable transport of L.P.G. from terminal at Mann Refinery complex to Syriam terminal.



Phase II:

- (1) Installation of one L.P.G. extraction plant with capacity of 24,000,000 standard cubic feet per day (S.C.F.P.D.) using associated gas as feedstock at Mann oil-field.
- (2) Installation of L.P.G. pipe line from the Extraction Plant to terminal at Mann Refinery Complex.

Phase III:

- (1) Installation of one unit of L.P.G. extraction plant with capacity of 50,000,000 S.C.F.P.D. using associated gas as feedstock at Htantabin, Myanaung and Shwepyitha oil fields.
- (2) Auxiliary facilities to receive, store and load L.P.G. production into special river crafts (barges).
- (3) Procurement of special river crafts (barges) to enable transport L.P.G. from Htantabin oil field to Syriam terminal.

2. Expected Production of L.P.G. per annum

8,000 metric tons from Syriam Refinery (Phase I: part one)  
15,000 metric tons from the Mann Refinery (Phase I: part two)  
30,000 metric tons from Mann oil-field (Phase II)  
61,000 metric tons from Htantabin oil-field (Phase III)  
(total production of L.P.G. per annum is 114,000 metric tons)

III. Objective of the Study

The objective of the study is to examine the feasibility of Phase III from economic and technical points of view.

#### IV. Scope of Work

In order to achieve the above objectives, the Study will cover the following aspects:

##### 1. Areas

- (1) Syrian (Receiving Main Terminal)
- (2) Kyangin North, Kyangin South (Loading Terminal and Jetty Sites)
- (3) Kyangin North and Kyangin South (L.P.G. Plant Sites)
- (4) Htantabin Oil Field, Myanaung Oil Field, Shwepyitha Oil Field (Feedstock Sources)
- (5) Seiktha Methanol Plant, Kyangin Cement Mill, Myanaung E.P.C. Power Station (Lean Gas Users)

##### 2. Data Collection

- (1) Natural Condition
  - 1) Location
  - 2) Topography
  - 3) Geography
- (2) Feed Stock
  - 1) Quantity
  - 2) Quality
  - 3) Composition
  - 4) Price
- (3) L.P.G. Production
  - 1) Quantity
  - 2) Quality
  - 3) Composition
  - 4) Price

(4) Storages, Loading Facilities and Transportation

- 1) Road
- 2) River
- 3) Terminals
- 4) Port

(5) Infrastructure and Utilities

- 1) Electricity
- 2) Water
- 3) Air
- 4) Others

(6) Present Situation of Phase I and Phase II

3. Conceptual Design

(1) The L.P.G. extraction plant at Kyangin North or Kyangin South

- 1) Capacity
- 2) Site
- 3) Lay-out
- 4) Facilities including feedstock and lean gas pipelines.
- 5) Processing

(2) Special river crafts (barges) for transportation of L.P.G.

- 1) Capacity
- 2) Quantity
- 3) Type

*del*

(3) The terminals and Jetties at Kyangin North or  
Kyangin South and Syriam for L.F.G.

- 1) Capacity
- 2) Site
- 3) Lay-out
- 4) Facilities

4. Management

5. Marketing

6. Investment and Operating Costs

7. Implementation Schedule

8. Economic and Financial Analysis

9. Overall Evaluation and Recommendations

V. Steps and Schedule of the Study

1. Steps

Step 1: Preparatory Office Work

Step 2: Field Work in Burma

Step 3: Home Office Work in Japan

Step 4: Presentation of and Discussion on the Draft  
Final Report

2. Schedule

As shown in Annexure I.

## VI. Reports

JICA shall prepare and submit the following reports written in English to GSRUB.

1. Inception Report at the beginning of Step 2: 5 copies
2. Progress Report at the end of the Step 2 : 10 copies
3. Draft Final Report and its summary within 2 ½ (two and one half) months after commencement of the step 3 : 20 copies
4. Final Report and its summary within 1 ½ (one and one half) months after the receipt of comments on the Draft Final Report by P.I.C. : 50 copies

## VII. Undertaking of GSRUB

1. To facilitate smooth conduct of the Study, GSRUB shall take necessary measures:
  - (1) to secure the safety of the Japanese study team
  - (2) to permit the members of the Japanese study team to enter, leave and sojourn in Burma for the duration of their assignment therein, and exempt from alien registration requirements and consular fees
  - (3) to exempt the members of the Japanese study team from taxes, duties, fees and other charges on equipment, machinery and other materials brought into Burma for the conduct of the Study

*th*

- (4) to exempt the members of the Japanese study team from income tax and charges of any kind imposed on or in connection with any emoluments or allowances paid to the members of the Japanese study team for their services in connection with the implementation of the Study
  - (5) to provide necessary facilities to the Japanese study team for the remittances as well as utilization of funds introduced into Burma from Japan in connection with the implementation of the Study
  - (6) to provide the medical services as needed and its expenses will be chargeable on the members of the Japanese study team
  - (7) to secure permission to take all data and all documents related to the Study out of Burma to Japan by the Japanese study team.
2. GSRUB shall bear claims, if any arises, against the members of the Japanese study team resulting from, occurring in the course of, or otherwise connected with the discharge of their duties in the implementation of the Study, except when such claims arise from gross negligence or wilful misconduct on the part of the members of the Japanese study team.

3. PIC shall act as counterpart agency to the Japanese study team and also as coordinating body in relation with other governmental and non-governmental organizations concerned for the smooth implementation of the Study.
4. PIC shall, at its own expense, provide the Japanese study team with the following, in cooperation with other agencies concerned, if necessary:-
  - (1) available data and information related to the Study
  - (2) counterpart personnel
  - (3) suitable office with necessary equipment in PIC
  - (4) credentials of identification cards
  - (5) chauffeured vehicles

#### VIII. Undertaking of the Government of Japan






For the implementation of the Study, the Government of Japan shall take necessary measures through JICA:


1. to dispatch, at its own expense, study team to the Socialist Republic of the Union of Burma
2. to pursue technology transfer to the Burmese counterpart personnel in the course of the Study


#### IX. Mutual Consultation

JICA and PIC will consult with each other in respect of any matter that is not agreed upon in this document and may arise from or in connection with the Study.

Tentative Schedule of the Study

Item	1					9			8		5	
	April	May	June	July	August	September	October	November	December	January	February	
Preparatory Office Work (Step 1)												
Field Work (Step 2)												
Home Office Work (Step 3)												
Presentation of Draft Final Report (Step 4)												
Submission of Final Report												

 in Japan

 in Burma

*Handwritten signature*





## APPENDIX - III

LPG 回収計画 Phase III における  
EXPANDER PROCESS の評価について



## APPENDIX-III

### LPG回収計画 PHASE III における EXPANDER PROCESS の評価について

#### 1. LPG回収 PROCESS

LPG の回収 PROCESS として、現在世界中で使用されているものは、次の通りである。

- (1) Absorption
- (2) Refrigerated Absorption
- (3) Refrigeration
- (4) Compression
- (5) Adsorption
- (6) Cryogenic Joule Thomson
- (7) Cryogenic Expander
- (8) 上記 Process (1)~(7) の複合型

#### 2. Phase III の LPG回収 Process の検討

##### 2.1 検討対象 Process

現在使用されている LPG 回収 Process のうち、最も進歩した高度の技術を含み、ビルマ側から要望のあった、次の Process を検討の対象とする。

- (1) Refrigerated Absorption Process ..... Base Case
- (2) Cryogenic Expander and Refrigerated Absorption Complex ..... Case 1
- (3) Cryogenic Expander Process ..... Case 2

##### 2.2 前提条件

###### (1) 装置能力

原料ガス処理量       $50 \times 10^6$  SCFD

###### (2) 原料ガスの性状

(LPG 総合開発計画事前調査報告書 1984 年 8 月に基づく。タンタピン 80%、シェピタ 20%)

O <sub>2</sub>	0.02	MOL%
CO <sub>2</sub>	0.80	"
C <sub>1</sub>	86.14	"
C <sub>2</sub>	5.36	"
C <sub>3</sub>	4.26	"
C <sub>4</sub>	2.76	"
C <sub>5</sub>	0.53	"
C <sub>6</sub>	0.13	"
	100.00	

(3) 原料ガスの受入れ条件

圧力 2.8 kg/cm<sup>2</sup> g  
温度 38 °C

(4) リーンガスの払出し条件

圧力 3.5 kg/cm<sup>2</sup> g

### 2.3 Process Flow

検討対象の3方式のBlock Flow Diagramを第A-1図、第A-2図、第A-3図に示す。

Case 1・Case 2の各ProcessにおけるExpanderの使用位置は、Dehydration Sectionを出た原料ガスが、熱交換により冷熱を回収して冷却され、次にプロパン冷凍システムで冷却され、凝縮した液体を分離された段階のガス側である（冷却の最終段階の位置）。

Expanderの動力の回収方法はリーンガスの昇圧用のCompressorのDriverである。

原料ガスの最終の冷却段階の温度は次の通りである。

- ① Base Case - 3.5 °C
- ② Case 1 - 5.5 °C
- ③ Case 2 - 7.7 °C

各工程におけるMaterial Flowの主要点をBlock Flow Diagramに示す。

### 2.4 製品の収率とLPG回収率

Type of Process	Ref. Absorber (Base case)	Expander + Absorber (Case -1)	Expander (Case -2)
Lean Gas	49,150 Nm <sup>3</sup> /H [0]	48,617 Nm <sup>3</sup> /H [▼ 533 Nm <sup>3</sup> /H]	48,350 Nm <sup>3</sup> /H [▼ 800 Nm <sup>3</sup> /H]
C <sub>3</sub> LPG	32,670 T/Y [0]	34,155 T/Y [△ 1,485 T/Y]	32,733 T/Y [△ 63 T/Y]
C <sub>4</sub> LPG	31,767 T/Y [0]	31,894 T/Y [△ 127 T/Y]	31,577 T/Y [▼ 190 T/Y]
LPG Total	64,437 T/Y [0]	66,049 T/Y [△ 1,612 T/Y]	64,310 T/Y [▼ 127 T/Y]
C <sub>3</sub> Yield	88%	92%	88%
C <sub>4</sub> Yield	98%	98%	97%

## 2.5 Utility Consumption

Utility の主要な部分の電気の使用量は次の通りである。その他は金額的に各ケース間で大差がないので省略する。

原料ガス及びリーンガスの昇圧用 Compressor の Driver の Gas Turbine の燃料は Process 内で生産されるリーンガスの一部である。

	R.A (Base Case)	Expander (Case-1)	Expander (Case-2)
Electric Power Consumption	3,300 kWh/H	2,600 kWh/H	2,000 kWh/H
	[Base]	▼ 700 kWh/W	▼ 1,300 kWh/H

## 2.6 Process 構成のシステム・主要機器の能力

	R.A System (Base Case)	Expander (Case-1)	Expander (Case-2)
Process Unit			
i) Charge Gas Comp.	1,310 kW	→	2,032 kW
ii) Lean Gas Comp. (Gas Turbine)	933 kW (2,243 kW) 2,500	1,746 kW (3,056 kW) 3,500	2,485 kW (4,517 kW) 4,850
iii) Expander Comp. (Expander)	—	522 kW (529)	730 kW (752)
iv) Absorber	Exists	Exists	None
Hot Oil System	9.3 MMkcal/h	9.7 MMkcal/h	7.4 MMkcal/h
C <sub>3</sub> Ref. System	2.5 MMkcal/h	1.7 MMkcal/h *	1.1 MMkcal/h
Cooling Water System	2,500 T/H	2,200 T/H	1,800 T/H
Power Receiving	5,000 kVA	4,000 kVA	4,000 kVA

## 2.7 建設費の比較

(Unit: ¥100 million)

	R.A System (Base case)	Expander (Case-1)	Expander (Case-2)
Rotary Machinery	Base	+ 2.9	+ 3.7
Compressor			
Gas Turbine			
Expander			
Absorber System	Base	0	- 0.6
Hot Oil System	Base	0	- 0.2
C <sub>3</sub> Ref. System	Base	- 0.5	- 0.8
Cooling Water System	Base	- 0.1	- 0.2
Power Receiving	Base	- 0.1	- 0.1
Others	Base	+ 1.7	+ 0.8
Total	Base	+ 3.9	+ 2.6

## 2.8 経済性の評価

### (1) 経済性評価の前提

#### A. 単価

- ・電気 0.12 KYAT/kWh
- ・リーングラス 1.8 KYAT/1,000SCF
- ・LPG 140 US\$/T
- ・輸送費 60 KYAT/T チャンギン〜ラングーン

#### B. Exchange Rate

- KYAT/US\$ 8.6
- KYAT/100Yen 3.5

C. 維持費について各方式を比較する場合、回転機の建設費の10%を年間の費用として計上する。他の設備は大差なしとみる。

	Base Case	Case 1	Case 2
維持費(億円/年)	Base	+0.29	+0.37

D. 金利は2.75%年とする。

E. 償却費用は20年の金額均等償却で初年度からとする。

F. リーンガスのカロリー評価を行なう。

G. その他費用は各方式の間で金額的に大差なしとみる。

(2) 各方式の経済的比較

簡便法の荒利益比較を行なう。

(Unit: 1,000 kyat/yr.)

	RA system (Base case)	Expander (Case 1)	Expander (Case 2)
Lean gas	Base	- 215	- 323
LPG	Base	+ 1,941	- 153
Transportation	Base	- 97	- 8
Electricity	Base	+ 665	+ 1,236
Facility interest	Base	- 375	- 250
Maintenance cost	Base	- 508	- 648
Depreciation expense	Base	- 682	- 455
Total		+ 729	- 601

2.9 考 察

Expander を冷熱発生的手段として利用する技術は、Joule Thomson 法のごとく、昔から存在していたが、近年 Expander の動力回収を組み込み省エネルギーをねらう Expander Process が一般化している。O.G.J. の Report (July 16, 1984) によれば、全世界で Gas Processing 装置 1,367 基中 Cryogenic Expander Process は 326 基である。比較的装置規模の大きな場合又は  $C_2$  分の分離のため冷温が要求される場合には特徴が生かされて Expander が使用される。

$C_3$  LPG の回収率を 90% 以上要求されるような場合には Cryogenic Expander に Absorber System を組み合わせる Complex Process が有効となる。

今回の Phase III Project の場合は、各 Process の比較検討のごとく Base Case の Refrigeration Absorption 法と Case 2 の Cryogenic Expander 法を対比すると  $C_3$  回収率 88% レベルでは Base Case が有利である。

Case 1 の Expander Absorber の組み合わせ Process では  $C_3$  回収率の向上が期待できる

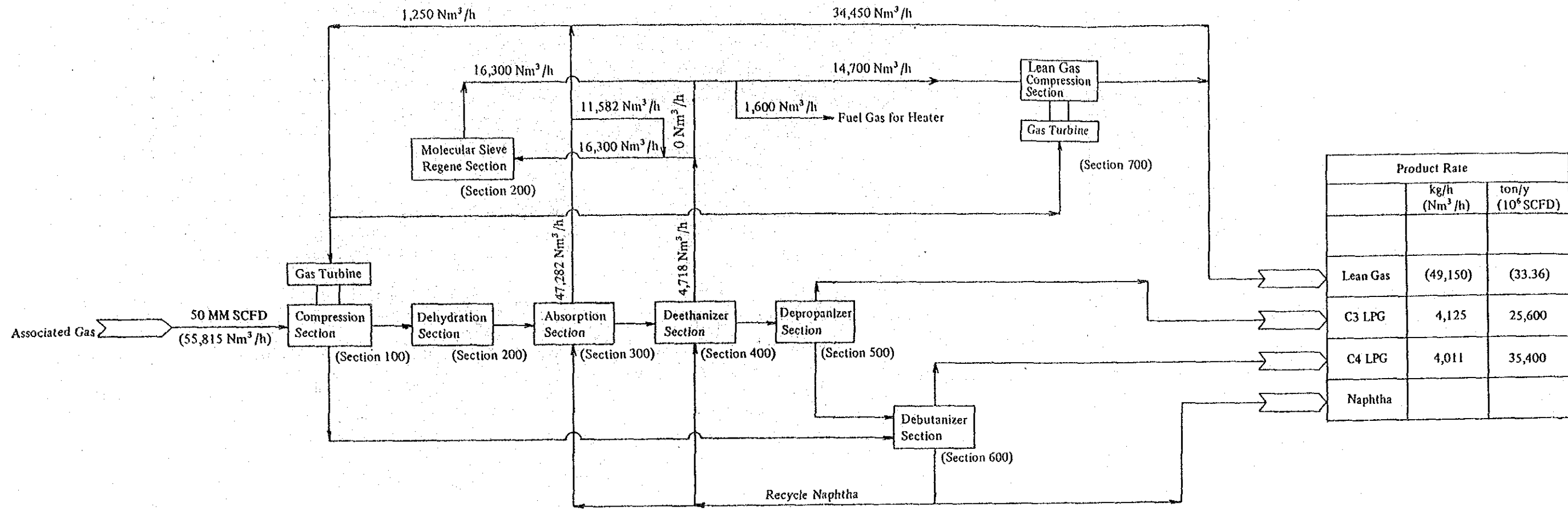


が Process 中に工程が増え複雑化し、回転機器が増加するので、運転管理及び維持管理は高度の技術が要求される。経済的評価は今回の Project の前提では Base Case より Case 1 が、若干有利となっているが、装置の年間の稼働日数の差による利益差等を考慮すると、(数日間の不稼働による期待利益の損失に見合う) 逆転も予測される。

今回のプロジェクトの概念設計における C<sub>3</sub> 回収率は 90% であり、世界的な Gas Processing の装置と比較し、遜色がないレベルであり、副生リーングスのユーザーに対する品質面・数量バランス面から見て妥当である。

以上の考察から、LPG 回収計画 Phase II のプロセスは、運転管理・維持管理の比較的容易な Refrigerated Absorption Process が適当であるとリコメンドする。

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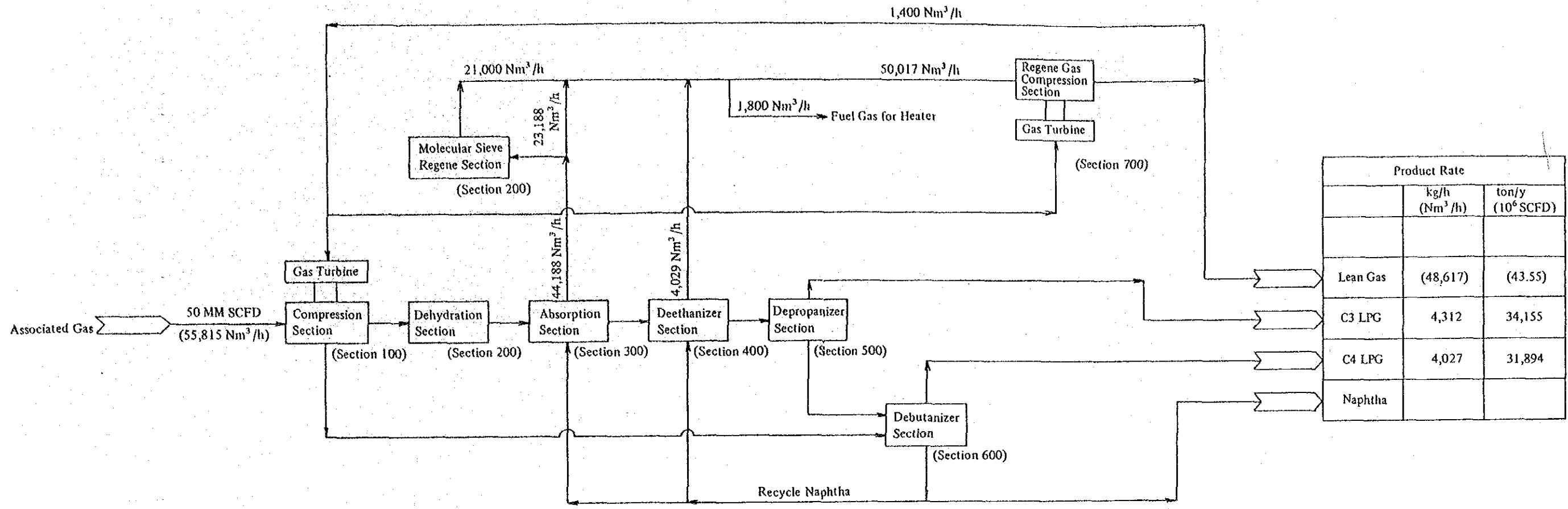


Remarks

1. Operation service factor : 330 days/year
2. Gas flow rate is shown at regenerating operation of molecular sieve.
3. Feed gas flow rate is dry base.
4. AG composition
  - N<sub>2</sub> : 0.00 mol %
  - O<sub>2</sub> : 0.02 mol %
  - CO<sub>2</sub> : 0.88 mol %
  - C<sub>1</sub> : 86.14 mol %
  - C<sub>2</sub> : 5.36 mol %
  - C<sub>3</sub> : 4.26 mol %
  - C<sub>4</sub> : 2.76 mol %
  - C<sub>5</sub> : 0.53 mol %
  - C<sub>6</sub><sup>+</sup> : 8.13 mol %

Fig. A-1 RA System (Base Case)

APPENDIX-III



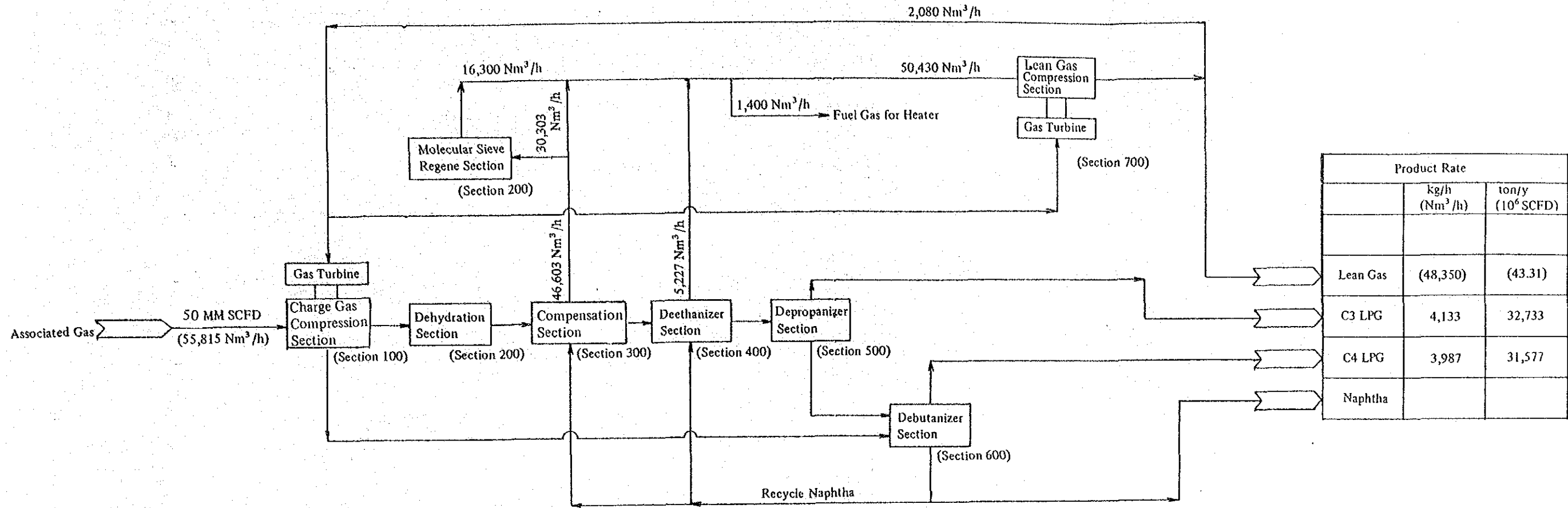
Product Rate		
	kg/h (Nm³/h)	ton/y (10 <sup>6</sup> SCFD)
Lean Gas	(48,617)	(43.55)
C3 LPG	4,312	34,155
C4 LPG	4,027	31,894
Naphtha		

Remarks

1. Operation service factor : 330 days/year
2. Gas flow rate is shown at regenerating operation of molecular sieve.
3. Feed gas flow rate is dry base.
4. AG composition
  - N<sub>2</sub> : 0.00 mol %
  - O<sub>2</sub> : 0.02 mol %
  - CO<sub>2</sub> : 0.88 mol %
  - C<sub>1</sub> : 86.14 mol %
  - C<sub>2</sub> : 5.36 mol %
  - C<sub>3</sub> : 4.26 mol %
  - C<sub>4</sub> : 2.76 mol %
  - C<sub>5</sub> : 0.53 mol %
  - C<sub>6</sub><sup>+</sup> : 8.13 mol %

Fig. A-2 Expander Process (Case-1)

APPENDIX-III



	Product Rate	
	kg/h (Nm <sup>3</sup> /h)	ton/y (10 <sup>6</sup> SCFD)
Lean Gas	(48,350)	(43.31)
C3 LPG	4,133	32,733
C4 LPG	3,987	31,577
Naphtha		

Remarks

1. Operation service factor : 330 days/year
2. Gas flow rate is shown at regenerating operation of molecular sieve.
3. Feed gas flow rate is dry base.
4. AG composition
  - N<sub>2</sub> : 0.00 mol %
  - O<sub>2</sub> : 0.02 mol %
  - CO<sub>2</sub> : 0.88 mol %
  - C<sub>1</sub> : 86.14 mol %
  - C<sub>2</sub> : 5.36 mol %
  - C<sub>3</sub> : 4.26 mol %
  - C<sub>4</sub> : 2.76 mol %
  - C<sub>5</sub> : 0.53 mol %
  - C<sub>6</sub><sup>+</sup> : 8.13 mol %

Fig. A-3 Expander Process (Case-2)



**APPENDIX – IV**

**SUMMARY OF DISCUSSIONS**



SUMMARY OF DISCUSSIONS  
F O R  
THE FEASIBILITY STUDY REPORT (DRAFT)  
ON  
THE INTEGRATED LPG PROJECT (PHASE III)  
IN  
THE SOCIALIST REPUBLIC OF THE UNION OF BURMA

The Japanese Study Team (the Team) led by Mr. TETSUHIKO TSUNODA organized by the Japan International Cooperation Agency (JICA) visited The Socialist Republic of the Union of Burma from 24<sup>th</sup> to 31<sup>st</sup> August 1985 and presented to the Petrochemical Industries Corporation (PIC) six (6) copies of draft final report entitled "THE FEASIBILITY STUDY REPORT ON THE INTEGRATED LPG PROJECT (PHASE III) IN THE SOCIALIST REPUBLIC OF THE UNION OF BURMA".

During its stay in the Socialist Republic of the Union of Burma, the Team explained the above-mentioned report and had a series of discussions with the Burmese authorities concerned for the Project.

The followings are the summary of the meetings and discussions:

1. Participants at the Discussions:

(a) Petrochemical Industries Corporation

- (i) U Tin Maung Aye, Managing Director
- (ii) U Than Win, Director (Planning)
- (iii) U Tin Hla, Director (Finance)
- (iv) U Hlaing Myint San, Deputy Director (Planning)
- (v) U Kyaw Win Maung, Head of Dept. (Planning)



- (b) Myanma Oil Corporation
  - (i) U Tin Nyunt, General Manager (Exploration)
- (c) Technical Services Corporation
  - (i) U Hla Myint, Director (Implementation)
- (d) Electric Power Corporation
  - (i) U Than Tin, Assistant Chief Engineer
  - (ii) U Hla, Superintending Engineer
- (e) J.I.C.A. Team
  - (i) Mr. Tetsuhiko Tsunoda, Team Leader
  - (ii) Mr. Muneteru Yoshizawa, Process and Transportation
  - (iii) Mr. Masaaki Awamoto, Project Economist
  - (iv) Mr. Yoshio Yabe, Advisor J.I.C.A. H/Q

2. Subjects of the Discussions:

2.1 Presentation of the captioned report (draft final) and summarized explanation in general were made by the Team to the Burmese side on 26<sup>th</sup>, 27<sup>th</sup>, 28<sup>th</sup>, and 29<sup>th</sup> August, 1985.

2.2 Discussions were made during those days and confirmed points thereof are recorded in paragraph 3 hereinafter.

3. Confirmation

In the course of discussions for the Draft Final Report, the following points were mutually confirmed by both parties.

3.1 The Feasibility Report has been prepared according to the Scope of Work for the Feasibility Study on the Integrated Liquefied Petroleum Gas Project (Phase III), dated 9<sup>th</sup> April 1985 (Rangoon) and 22<sup>nd</sup> April 1985 (Tokyo).

3.2 The technical analysis regarding the availability of feedstock for the proposed 50 x 10<sup>6</sup> SCFD capacity

LPG Extraction Plant; the analysis of required ancillary facilities thereto (Terminals, Jetty, LPG Transportation Barges, Offsites and Construction Machinery), and the analysis of Electric Power requirement for the Project have been fully covered in the report.

3.3 Analysis of the export trend of LPG from Burma, as well as the operational method of performing such export through the Syriam Terminal and Jetty, have been well covered in the Report, proving that it is physically possible to export 96,900 T/Y of LPG, the total products from Syriam Coker (5,900 T/Y), Mann GOCS (30,000 T/Y) and Kyangin Plant (61,000 T/Y).

3.4 However, analysis of export operation from Syriam Terminal has also shown that 20 days per month are necessary to lift 96,900 T/Y of LPG, leaving 10 days extra per month. During this period, it is possible to accommodate 13,000 T/Y from Mann Refinery for additional export if necessary. Hence the total LPG export possible through Syriam Terminal is around 109,900 T/Y. The detailed analysis is as per Annexure I.

3.5 The analysis of the financial aspects of the Project has taken into consideration the three different methods of financing, viz, Base Case with annual interest rate of 2.75% and terms of repayment as 30 years (including 10 years grace period), Case A with the interest rate of 5.0% per annum and terms of repayment as 10 years, and Case B with the interest rate of 7.8% per annum and terms of repayment as 10 years. It has been clearly

shown that the Base Case is the only alternative for making the Project feasible.

3.6 The draft final report, apart from correction of certain typographical errors and omission of certain extraneous sentences, has been agreed to by both parties and no significant changes are necessary. However, in Chapter 2, Page 12, "Financial Analysis", the following paragraphs shall be added:-

(a) The IRROI after contribution to state of the Project is 5.11%. This indicates that the profitability of the Project itself may not be so high, but not so desperately low. However, the IRROE after contribution is 34.32%, if capital procurement under the soft financing conditions of long term loan presumed in this report is affirmative.

(b) The position of funds and financial situation of the Project are sound and hence the Project is financially viable.

Similarly, in page 13 of the same Chapter and under "Economic Analysis", the following paragraph shall be added:-

The EIRR is 7.20% which is better than 5.11% of the IRROI after contribution to state but is slightly lower than 7.90% of the IRROI before contribution to state in the financial analysis. The implementation of the Project will contribute immensely to the Burmese Economy, by earning foreign exchange amounting to US\$ 90532000 as direct economic benefits

over the entire project life. Furthermore, a number of indirect economic benefits are also conceived. As results of the above benefits, the project will make a high overall economic effect, and therefore the Implementation of the project is suggested itself to proceed positively.

4. Final Report

The Final Report on the Feasibility Study shall be prepared by the Team and presented to the Burmese side in due course covering the points specified in paragraph 3.6 above.

The Draft Final Report including the above-mentioned points was mutually confirmed and agreed between PIC and the Team on August 30<sup>th</sup>, 1985.

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( TETSUHIKO TSUNODA )

Team Leader

The Feasibility Study Team

Japan International

Cooperation Agency.

*T. 20/8/85*

( TIN MAUNG AYE )

Managing Director

Petrochemical Industries

Corporation.

Syriam Terminal LPG Handling Volume

Project Phase	LPG Production Facility	LPG Output	Use		For Export						
			For Export	For Domestic Consumption	C <sub>3</sub> LPG		C <sub>4</sub> LPG		T/SD	T/SD	
					T/Y	T/SD	T/Y	T/SD			
Phase I part 1	Syriam Refinery Cokey LPG Plant	6,900	6,900	-	2,300	7.0	4,600	13.4			
Phase I part 2	Mann Refinery	13,500	12,000	1,500	2,400	7.3	9,600	29.1			
Phase II	Mann GOCS Extraction Plant	30,000	30,000	-	11,200 (13,600)	33.9 (41.2)	18,800 (28,400)	57.0 (86.1)			
Phase III	Kyangin LPG Extraction Plant	61,000	61,000	-	25,600	77.6	35,400	107.3			
Syriam Terminal LPG Handling Volume		111,400	109,900	1,500	41,500		68,400				
		109,900 (T/Y)									

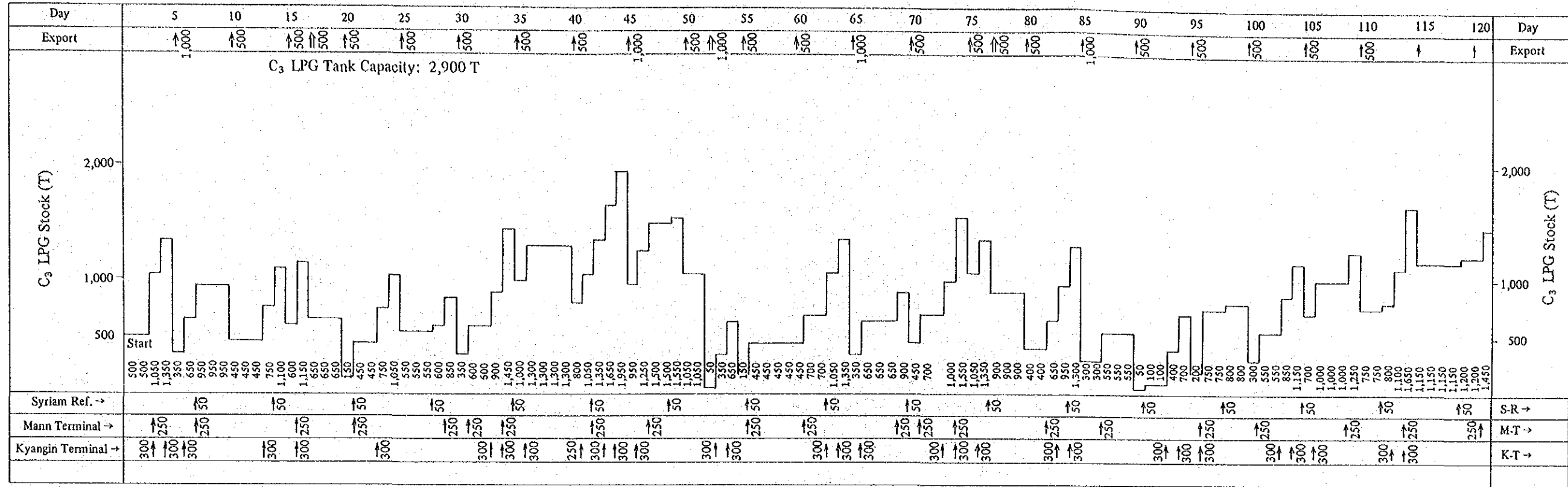
Mean Transportation Frequency

- a) Mann Terminal 7.6 ship/M (@ 500 T Barge)
- b) Kyangin Terminal 9.2 ship/M (@ 600 T Barge)
- c) Export 6.1-6.8 ship/M (@1,500 T Tanker)

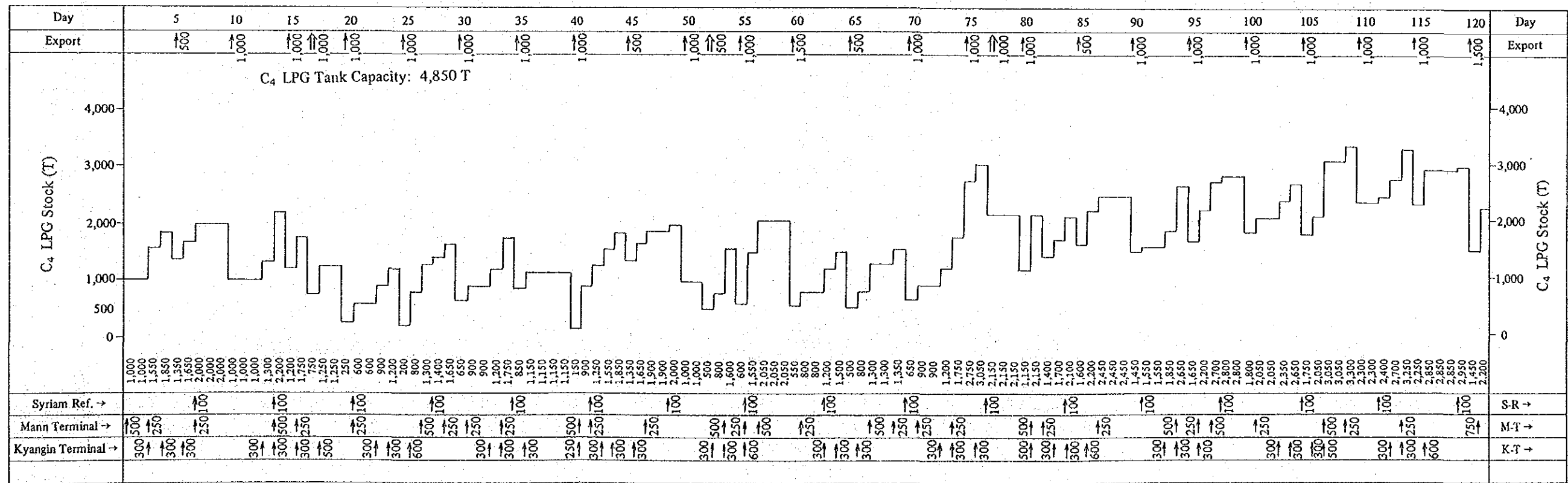
Jetty & Barge Operation Schedule Alternate Case (Export: 109,900 T/Y)

Day	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120	Day
Export	□	□	□ □	□ □	□	□	□	□	□	□ □	□ □	□	□	□	□	□ □	□	□	□	□	□	□	□	□	Export
Kyangin Terminal	B 500-4		◇	◇				◇	◇							◇	◇								K-T
Syriam Terminal	B 600-1		◇	◇				◇	◇							◇	◇								
	B 600-2		◇	◇				◇	◇							◇	◇								M-T
	B 600-3		◇	◇				◇	◇							◇	◇								
Mann Terminal	B 500-1		○	○				○	○							○	○								S-T
Syriam Terminal	B 500-2		○	○				○	○							○	○								
	B 500-3		○	○				○	○							○	○								S-T
	B500-4		○	○				○	○							○	○								
S-T Jetty No Operation																									S-T No. Operation
S-T Jetty 2 Barge Operation	□	□ □	□ □	□ □	□	□	□	□	□	□ □	□ □	□	□	□	□	□ □	□	□	□	□	□	□	□	□	S-T 2 Barge Operation
Jetty	Export	River Barge	Operation																						
□ Syriam	C <sub>3</sub> } Loading	zzz C <sub>4</sub> Only	w: One day waiting																					*1 Allowance one Ship	
◇ Kyangin	C <sub>4</sub> } Loading	□ C <sub>3</sub> , C <sub>4</sub> Loading	ww: Two day waiting																						
○ Mann			Loading: One day																						
			Unloading: One day																						
				Navigation																					
				Syriam → Kyangin 5 (days)																					
				Kyangin → Syriam 3																					
				Syriam → Mann 6																					
				Mann → Syriam 5																					

C<sub>3</sub> LPG Receiving and Shipping Schedule of Syriam Terminal Alternate Case



C<sub>4</sub> LPG Receiving and Shipping Schedule at Syriam Terminal Alternate Case









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