Chapter 9.

CAPITAL REQUIREMENT AND ITS PROCUREMENT

Chapter 9. CAPITAL REQUIREMENT AND ITS PROCUREMENT

9.1 Total Construction Cost

The capital requirement for plant construction was derived as shown in Table 9-1 on the basis of the construction costs calculated in Chapter 7.

Table 9-1. Construction Cost

Item	Phase I – Part 2		Phase II	
	Foreign Currency Portion (1,000 ¥)	Local Currency Portion (1,000 K)	Foreign Currency Portion (1,000 ¥)	Local Currency Portion (1,000 K)
Equipment & Machinery and Erection Work	7,691,250	34,029	6,772,500	30,375
Building, Civil Work	-	4,973	-	2,594
Sub-Total	7,691,250	38,992	6,772,500	32,969
(Sub-Total in US Dollars)	(US$38,440,000)		(US$33,668,000)	
Grand Total	US$72,108,000			

9.2 Other Costs

In addition to the total construciton cost, the following costs emanating during the plant construction will have to be accounted for:

- o Commissioning cost
- o Pre-operation cost
- o Working capital
- o Interest incurred during plant construction

The standards adopted for calculating the cost factors listed above are described hereunder.

1) Commissioning cost

The commissioning cost is the expense that is incurred for conducting plant performance warranty operation after the plant construction has been completed by the contractor, and before the plant is transferred to the plant owner. In this Survey Report, the commissioning cost was calculated on the basis of the following considerations:

(a) Phase I – Part 2

Since Phase I – Part 2 of this project involves the construction of product LPG receiving and shipping facilities, no commissioning cost is required for this phase of the project. However, the labor cost incurred by PIC during this period will be included in the Pre-Operation Cost.

(b) Phase II

The commissioning period is assumed to extend over a period of two months, so a labor cost equivalent to two months, as well as material and utility cost for ten days of performance warranty operation, are included as cost items. The results of calculation are shown in Table 9-2. As pointed out above, the labor cost incurred by PIC during this period will be included in the Pre-Operation Cost.

Table 9-2. Commissioning Cost (Phase II)

Item	Foreign Currency Portion (1,000 ¥)	Local Currency Portion (1,000 K)
Supervisor's Fee	32,000	-
Labor Cost		100
Material and Utility Cost	-	30
Sub-Total	32,000	130
Total (1,000 US$)	156	

2) Pre-operation cost

The cost items included in the Pre-Operation Cost are the labor cost and ancillary costs incurred by PIC during the construction period, as well as external procurement costs such as survey cost and office supplies procurement cost.

- Phase I – Part 2: K1,584,000 (US$209,000)
- Phase II: K1,728,000 (US$228,000)

3) Working capital

The Working Capital is the amount of funds necessary for continuing the operation of a newly constructed industrial plant. In this Survey Report, the Working Capital is defined as the sum obtained by subtracting the Accounts Payable from the total of Cash, Terminal Tank Inventory (Products) and Accounts Receivable. The results of calculation are shown in Table 9-3.

Table 9-3 Working Capital

Item	Phase I – Part 2 (1,000 K)	Phase II (1,000 K)
(a) Cash	820	672
(b) Inventory (Product)	2,951	
(c) Account Receivable	5,691	1,142
(d) Account Repayable	872	693
Working Capital = (a) + (b) + (c) - (d)	8,590	1,121
Sub-Total (1,000 US$)	1,133	148
Total (1,000 US$)	1,281	

(a) Cash

Cash equivalent to two months' labor cost, overhead, material & utilities cost, and LPG (or motor spirit material) transportation cost, as calculated by ordinary methods, will have to be retained on hand.

(b) Terminal tank inventory

The mean inventories of LPG at Mann and Syriam Terminals, as described in Chapter 4, will be as shown below. These products in stock are multiplied by their unit prices to obtain the Terminal Tank Inventory.

Mann Terminal (Phase I – Part 2):	1,570 tons
Syriam Terminal (Phase I – Part 2):	720 tons

(c) Accounts receivable

The period of grace on receipt of sales revenue is assumed to be one month, and the total amount of sales for one month is calculated as Accounts Receivable.

(d) Accounts payable

The period of grace on payments for raw materials and utilities is assumed to be one month, and the total amount of payments for one month is calculated as Accounts Payable.

9.3 Total Capital Requirement (Excluding Interest During Construction)

Table 9-4 shows the Total Capital Requirement as calculated from the results obtained in Sections 9.1 and 9.2.

9.4 Procurement of Required Capital

The procurement of required capital, including local currency portion and foreign currency portion, is described hereunder.

1) Foreign currency portion

The Burmese side desires to obtain long-term loans for the entire foreign currency portion of the required capital, but no definite source of financial aid has been determined at the present stage.

Table 9-4. Total Capital Requirement

Item	Phase I – Part 2		Phase II	
	Foreign Currency Portion (1,000 ¥)	Local Currency Portion (1,000 K)	Foreign Currency Portion (1,000 ¥)	Local Currency Portion (1,000 K)
Construction Cost				
Equipment, Machinery and Erection Work	7,691,250	34,019	6,772,500	30,375
Building and Civil Work	-	4,973	-	2,594
Commissioning Cost	-	-	32,000	130
Pre-Operation Cost	-	1,584	-	1,728
Sub-Total	7,691,250	40,576	6,804,500	34,827
Working Capital	-	8,590	-	1,121
Sub-Total	7,691,250	49,166	6,804,500	35,948
Sub-Total (1,000 US$)	33,295	6,486	29,457	4,742
Total (1,000 US$)	39,781		34,199	
Grand Total (1,000 US$)	73,980			

Note: A description of 'Interest During Construction' is given in Chapter 10.

In this Survey Report, the foreign currency portion of the required capital is assumed to be procured through long-term intergovernmental loans under the following assumed loan conditions:

Interest per annum: 2.25%

Method of repayment:

Uniform semi-annual installment repayment of principal and interest.

Term of repayment:

Repayment during thirty years after acceptance of loan, including a period of grace of ten years.

2) Local currency portion

The local currency portion of the required capital is assumed to be met by the Burmese side's owned capital.

9.5 Capital Investment Plan

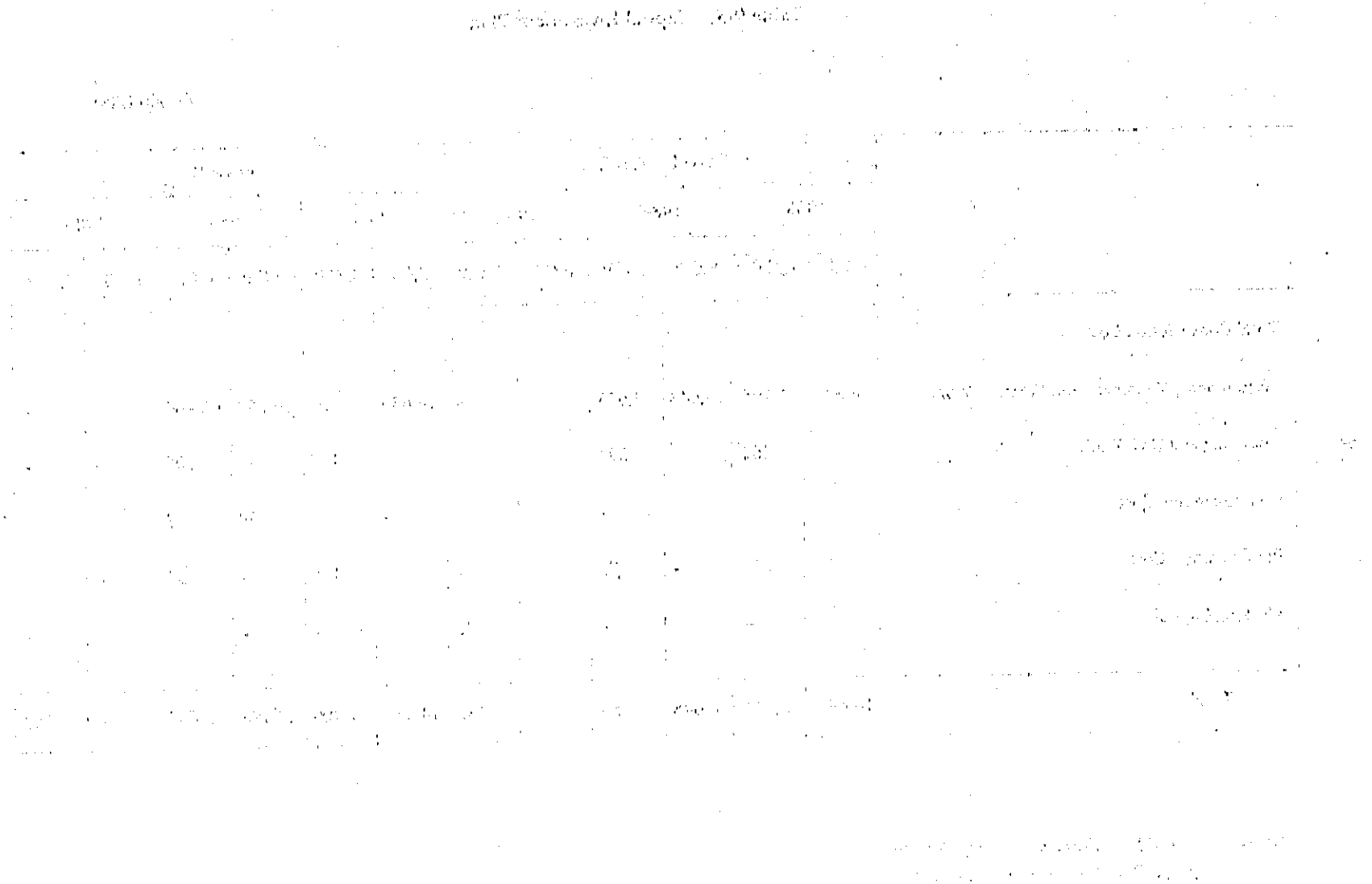
Table 9-5 shows the capital investment plan for each plant construction year, with respect to the total capital requirement shown in Table 9-4 and based on the plant construction plan studied in Chapter 6.

Table 9-5. Capital Investment Plan

(1,000 US$)

	Phase I – Part 2						Phase II					
	1983		1984		1985		1984		1985		1986	
	F.C.P*1	L.C.P*2	F.C.P	L.C.P	F.C.P	L.C.P	F.C.P	L.C.P	F.C.P	L.C.P	F.C.P	L.C.P
Total Construction Cost												
Equipment, Machinery and Erection Work	16,647	1,795	16,648	2,693	-	-	14,659	1,603	14,659	2,404	-	-
Building and Civil Work	-	262	-	394	-	-	-	137	-	205	-	-
Commissioning Cost	-	-	-	-	-	-	-	-	139	17	-	-
Pre-Operation Cost	-	137	-	72	-	-	-	169	-	59	-	-
Working Capital	-	-	-	-	-	1,133	-	-	-	-	-	-
Total	16,647	2,194	16,648	3,159	-	1,133	14,659	1,909	14,798	2,685	-	148

Notes: *1 F.C.P = Foreign Currency Portion
*2 L.C.P = Local Currency Portion



Chapter 10.

FINANCIAL EVALUATION

Chapter 10. FINANCIAL EVALUATION

10.1 Data for Financial Analysis

A description is offered hereunder of the various numerical figures, systems, assumptions and other data used in the financial analysis of the Project in this Survey Report.

10.1.1 Method of Grasping the Project Observed from Financial Evaluation

The range of this Survey Report extends over Phase I – Part 2 and Phase II of the Integrated LPG Recovery Project planned by the Burmese side. As described in Chapter 4, Phase I – Part 2 of the project involves the construction of LPG receiving, shipping and storage facilities for exporting LPG recovered by Mann Refinery, Syriam Refinery and Mann GOCS LPG Extraction Plant, while Phase II of the project involves the construction of Mann GOCS LPG Extraction Plant using associated gas from the Mann oil and gas fields as feedstock gas.

Without implementation of Phase I – Part 2 of the project, export of product LPG in accordance with Phase II of the project will be impossible, and without implementation of Phase II of the project, the scale of the LPG receiving shipping as well as storage facilities will have to be altered. That is, both Phase I – Part 2 and Phase II of the project are mutually most intimately related in aspects of scale of facilities and role played in the overall project, so conducting a financial evaluation of the project as a whole, or comprehensively on both Phase I – Part 2 and Phase II of the project, is judged to be the most appropriate action.

Accordingly, financial evaluation of the project in this Survey Report is conducted with the profitability of the entire project as the basic criterion, although separate evaluation is also made of the profitability of the Phase I – Part 2 and Phase II portions of the project.

In this Survey Report, the project's financial evaluation is made on the basis of prices existing as of the time of conclusion of the project contract.

10.1.2 Project Life (Economic Life Span)

The aim of this project is to export LPG produced from Syriam and Mann Refineries and Mann GOCS LPG Extraction Plant. Incidentally, according to the construction schedule of this project, the Mann GOCS LPG Extraction Plant constructed in Phase II of the project is to be put in operation one yar later than the LPG receiving, shipping and storage facilities constructed in Phase I – Part 2 of the project. Therefore, in order to permit the entire volume of LPG produced during the life expectancy of the LPG Extraction Plant constructed in Phase II, it will be necessary to match the time of completion of Phase I – Part 2 (LPG receiving and shipping facilities) with the time of completion of Phase II (LPG Extraction Plant).

In view of this consideration, and based on the results of deliberations with the Burmese side, the life expectancies of the two portions of the project were determined as follows:

Phase I – Part 2:	21 years
Phase II:	20 years

These life expectancies are judged appropriate from the following considerations:

1) With projects of this type, the life expectancy is generally evaluated as a term of 15–20 years.

2) As described in Chapter 2, feedstock gas can be supplied with stability during the life expectancy of the project.

10.1.3 Foreign Exchange Rate

As a result of deliberations with the Burmese side, it was decided that the mean foreign exchange rate as of September, 1981, would be used for conducting financial calculations. The mean exchange rate existing as of September this year was selected for the following reasons:

1) Since the Burmese government adopts the floating exchange system of determining the exchange rate of the Kyat in accordance with fluctuations in the foreign currencies of various

countries against the SDR rate, it will be necessary to adopt the most recent foreign exchange rate.

2) Since the Burmese economy is relatively stable in recent years, there is no fear of any drastic change in the country's monetary system.

Table 10-1 shows the foreign exchange rates for the period from January to September, 1981.

Table 10-1. Exchange Rate

Period		U.S. Dollar	
		Kyat per Unit *1	Yen per Unit *2
1981	Jan.	6.7175	203.21
	Feb.	6.6988	206.92
	Mar.	6.8955	209.98
	Apr.	6.8000	216.32
	May	7.0158	221.87
	Jun.	7.1772	235.47
	Jul.	7.3598	233.17
	Aug.	7.4880	235.07
	Sept.	7.5794	231.09

Notes: *1 Based on Selected Monthly Economic Indicators published in Burma.
*2 Based on data released by Bank of Tokyo.

10.1.4 Total Capital Requirement

Financial calculations are made by employing the results obtained in Chapter 9. Incidentally, when calculating the project's internal rate of return on equity (IRROE), the interest incurred during construction is included in the total capital requirement.

10.1.5 Capital Investment Plan

Financial calculations are performed in accordance with the capital investment plan

described in Chapter 9. Also, the entire foreign currency portion of the total capital requirement is assumed to be procured through long-term intergovernmental loan under the following loan conditions:

Interest per annum: 2.25%

Method of repayment:
Uniform semi-annual installment repayments of principal and interest.

Term of repayment:
Repayment of semi-annual installment in thirty years after acceptance of loan, including a period of grace of ten years.

Accordingly, when calculating the project's internal rate of return on equity, the loan repayment schedule is drafted on the basis of the above-mentioned loan conditions. Table 10-2 shows the schedule for repayment of foreign currency loan.

10.1.6 Sales Plan

1) Product quantity

The products to be sold through this project in accordance with the operation schedule described in Chapter 9 are the following:

(a) LPG produced by Mann Refinery

A portion of the LPG products produced by Mann Refinery is to be retained for domestic consumption, and the remainder transported to Syriam Terminal by river barges for export from the Terminal.

(b) LPG produced by Syriam Refinery

The entire volume of LPG produced by Syriam Refinery is to be exported.

(c) LPG produced by Mann GOCS LPG Extraction Plant

The entire volume of LPG produced by Mann GOCS LPG Extraction Plant is to

Table 10-2. Schedule for Repayment of Foreign Currency Loan

(1,000 US$)

Year		Phase I – Part 2		Phase II		Total Scheme	
		Loan: 16,647 (1983) 16,648 (1984)		Loan: 14,659 (1984) 14,798 (1985)		Loan: 16,647 (1983) 31,307 (1984) 14,798 (1985)	
		Repayment	Interest	Repayment	Interest	Repayment	Interest
1	(1983)	-	187	-	-	-	187
2	(1984)	-	562	-	165	-	727
3	(1985)	-	750	-	496	-	1,246
4	(1986)	-	750	-	663	-	1,413
5	(1987)	-	750	-	663	-	1,413
6	(1988)	-	750	-	663	-	1,413
7	(1989)	-	750	-	663	-	1,413
8	(1990)	-	750	-	663	-	1,413
9	(1991)	-	750	-	663	-	1,413
10	(1992)	-	750	-	663	-	1,413
11	(1993)	416	750	-	663	416	1,413
12	(1994)	1,248	736	336	663	1,614	1,399
13	(1995)	1,664	703	1,103	650	2,767	1,353
14	(1996)	1,664	665	1,473	621	3,137	1,286
15	(1997)	1,664	627	1,473	588	3,137	1,215
16	(1998)	1,664	591	1,473	555	3,137	1,146
17	(1999)	1,664	553	1,473	522	3,137	1,075
18	(2000)	1,664	515	1,473	489	3,137	1,004
19	(2001)	1,664	477	1,473	456	3,137	933
20	(2002)	1,664	441	1,473	423	3,137	864
21	(2003)	1,664	403	1,473	390	3,137	793
22	(2004)	1,664	365	1,473	356	3,137	721
23	(2005)	1,664	328	1,473	324	3,137	652
24	(2006)	1,664	291	1,473	290	3,137	581
25	(2007)	1,664	253	1,473	257	3,137	510
26	(2008)	1,664	215	1,473	224	3,137	439
27	(2009)	1,664	178	1,473	191	3,137	369
28	(2010)	1,664	141	1,473	157	3,137	298
29	(2011)	1,664	103	1,473	125	3,137	228
30	(2012)	1,664	66	1,473	91	3,137	157
31	(2013)	1,255	29	1,473	58	2,728	87
32	(2014)	424	5	1,106	25	1,530	30
33	(2015)	-	-	368	4	368	4

be transported to Mann Terminal by pipeline, then transported to Syriam Terminal by river barges for export.

(d) By-products produced by Mann GOCS LPG Extraction Plant

Gasoline material produced by this LPG Extraction Plant is to be processed into gasoline material for export, while lean gas is to be sold to MOC.

2) Product selling price and raw material procurement price

Following deliberations with the Burmese side, the product selling prices and raw material procurement prices were determined as described hereunder.

(a) LPG export price (FOB price, Rangoon)

The LPG export price was set at US$170/ton for performing financial calculations. This selling price was determined on the basis of the following preconditions described in Chapter 3:

- o The calculation is based on international market prices
- o The destinations for LPG export are assumed to be Taiwan and the Philippines

The profitability of this project will be largely influenced by the LPG export price. That is, assuming Singapore and Hong Kong of relatively low transportation cost as the export destinations will raise the export price and increase the project's profitability. On the other hand, assuming Japan and the Republic of Korea as the export destination will decrease the project's profitability. In this respect, assuming Taiwan and the Philippines as the export destinations will provide a median case lying midway between cases of overly optimistic and overly pessimistic profitability.

From this observation, the export price set at US$170/ton is conceived to be the most appropriate in that it is not biased to either an optimistic or pessimistic evaluation of project profitability.

(b) By-product selling price

The selling prices of gasoline material (C_5+ distillate) and lean gas which are produced by Mann GOCS LPG Extraction Plant were determined as described hereunder.

- Gasoline material

  As described in Chapter 3, gasoline material is to be exported. Its ex-factory price, Mann Oil Products Terminal, was set at US$295/ton.

- Lean gas

  As described in Chapter 3, the prices shown in Table 10-3 are adopted as lean gas selling prices. Since lean gas can be used as produced in place of associated gas, MOC has agreed to purchase lean gas at the same price of associated gas.

Table 10-3. Local Sales Price of Lean Gas (Associated Gas)

	Sales Price (K/1,000 SCF)	Tax	Ex-Factory Price (K/1,000 SCF)	Ex-Factory Price (US$/1,000 SCF)
Lean Gas (Assoicated Gas)	1.05		1.05	0.139

(Source: MOC)

(c) Associated gas procurement price

The associated gas prices shown in Table 12-3 are used for making financial calculations. MOC, which is in charge of development of oil and gas is assumed to purchase associated gas at these prices.

(d) Prices for procurement of LPG produced by Mann and Syriam Refineries

As described in Chapter 3.2.1, LPG produced by Mann and Syriam Refineries is usable as fuel in place of kerosene. Therefore, financial calculations are made by selling

its price at US$60/ton, which is roughly equivalent to the local sales price of kerosene shown in Table 10-4.

Table 10-4. Local Sales Price of Kerosene

	Sales Price (K/I.G.)	Tax (K/I.G.)	Ex-Factory Price (K/I.G.)	Ex-Factory Price (US$/Ton)
Kerosene	2.10	0.93	1.17	60.0

3) Sales revenues

Table 10-5 shows the annual sales revenues as calculated on the basis of the various preconditions set forth in Items 1) and 2).

10.1.7 Operating Cost

1) Raw material cost

Annual raw material costs were calculated from the raw material prices studied in Section 10.2.8.

2) Labor cost

Annual labor costs were calculated from the required labor force and remuneration system studied in Chapter 8.

3) Maintenance cost

Annual maintenance costs were calculated on the assumption that they would run up to 2.8% of plant machinery and equipment procurement cost (FOB price). The foreign currency portion of this cost item was calculated as 1.5% of plant machinery and equipment procurement cost (FOB price).

Table 10-5. Summary of Sales Revenue

Year	Item	Phase I – Part 2	Phase II		
		LPG	LPG	Lean Gas	Motor Spirits Material
1985	Quantity	21,100 (T)	-	-	-
	Unit Price	170 (US$/T)	-	-	-
	Revenue	3,587 (1,000 US$)	-	-	-
	Total		-		
	Project Total		3,587 (1,000 US$)		
1986	Quantity	22,600 (T)	30,000 (T)	6,850,800 (MSCF)	2,900 (T)
	Unit Price	170 (US$/T)	170 (US$/T)	0.139 (US$/MSCF)	295 (US$/T)
	Revenue	3,842 (1,000 US$)	5,100 (1,000 US$)	952 (1,000 US$)	856 (1,000 US$)
	Total	3,842 (1,000 US$)	6,908 (1,000 US$)		
	Project Total		10,750 (1,000 US$)		
1987–2005	Quantity	23,000 (T)	30,000 (T)	6,850,800 (MSCF)	2,900 (T)
	Unit Price	170 (US$/T)	170 (T)	0.139 (US$/MSCF)	295 (US$/T)
	Revenue	3,910 (1,000 US$)	5,100 (1,000 US$)	952 (1,000 US$)	856 (1,000 US$)
	Total		6,908 (1,000 US$)		
	Project Total		10,818 (1,000 US$)		

4) Insurance cost

Annual insurance costs were calculated on the assumption that they would run up to 1.0% of plant machinery and equipment procurement cost (FOB price).

5) Fixed assets tax

PIC being a public corporation, and its owners and business objectives being public in nature, it is assumed that no fixed assets tax will be imposed.

6) Overhead cost

Annual overhead costs were assumed to run up to 50% of annual labor costs.

7) Utility cost

Annual utility costs were calculated on the basis of the annual rates of consumption of utilities and their unit prices derived in Chapter 8.

Table 10-6 shows annual operating costs, excluding interest and depreciation costs. Interest and depreciation costs will differ according to loan conditions and depreciation conditions, but they were calculated on the basis of the following preconditions when performing financial calculations:

- o Interest conditions: Refer to Item 10.1.5.
- o Depreciation conditions:
  The straight line method of depreciation was adopted, with all machinery and equipment depreciated in twenty years, and salvage value set at 10%. Commissioning cost, pre-operation cost, working capital and interest during construction are to be depreciated in five years, with no salvage value.

10.1.8 Contribution to State (Corporation Tax)

In conformance with Burmese taxation laws, the rate of contribution to state was assumed to be 30% of the taxable income.

Table 10-6. Summary of Operating Cost

(1,000 US$)

Year	Item	Phase I – Part 2	Phase II
1985	Raw Material	1,266	-
	Labor	60	-
	Maintenance	519	-
	Insurance	185	-
	Overhead	30	
	Utility	45	-
	LPG Transportation	130	-
	Motor Spirit Material Transportation	-	-
	Total	2,235	-
	Project Total	2,235	
1986	Raw Material	1,356	1,100
	Labor	60	49
	Maintenance	519	513
	Insurance	185	183
	Overhead	30	25
	Utility	112	454
	LPG Transportation	441	-
	Motor Spirit Material Transportation	-	4
	Total	2,703	2,328
	Project Total	5,031	
1987–2005	Raw Material	1,380	1,100
	Labor	60	49
	Maintenance	519	513
	Insurance	185	183
	Overhead	30	25
	Utility	113	454
	LPG Transportation	445	-
	Motor Spirit Material Transportation*	-	4
	Total	2,732	2,328
	Project Total	5,060	

Notes: Interest and depreciation excluded.

10.2 Financial Analysis

PIC, which is an executing agency of this project, presently manges four refineries located in Syriam, Chauk, malun and Mann. Therefore, in the financial analysis, an attempt was made to elucidate the influence which this project exerts on the financial situation of PIC as a whole.

PIC plans to procure the foreign currency portion of the capital required for this project by long-term foreign loan and to meet the local currency portion with its owned capital. Accordingly, in this Survey Report, the financial analysis is performed by calculating the following internal rates of return (IRR) by employing the Discounted Cash Flow Method (DCF Method):

1) IRR on investment (IRROI)

The term IRROI indicates the internal rate of return on total capital investment, or on the total sum of PIC's capital investment (local currency portion) plus foreign loan (foreign currency portion), and reveals the profitability of the project as a whole. That is, IRROI indicates the profitability of the project itself, excluding influences such as the loan conditions on borrowed capital and the ratio of owned capital to total capital requirement.

2) IRR on equity (IRROE)

On the other hand, the term IRROE indicates the internal rate of return on PIC's capital investment (local currency portion), and reveals the profitability only with respect to equity, excluding the loan portion.

Here, IRROE is calculated on the basis of the loan conditions on borrowed capital and amount of owned capital which were assumed in Chapter 10.

10.2.1 Preconditions for Analysis

This project consists of the Phase I – Part 2 portion of the project for LPG receiving, shipping and storage, and the Phase II portion of the project for LPG extraction from associated gas. Phase I – Part 2 involves handling of LPG produced by the Mann and Syriam Refineries in addition to LPG produced through Phase II of the project, and while the time of its implementation differs from that of Phase II, it serves as the base for handling the entire volume of LPG produced by Phase II (Mann GOCS LPG Extraction Plant) and also plays the

role of infrastructure for implementing Phase II of the project.

Accordingly, evaluating the economy of these two project phases separately would be irrational, and a financial evaluation of the project as a whole, with both phases evaluated in coordination, will be more appropriate. This method of approach is regarded here as the 'Base Case'. Naturally, a study was also made to evaluate the influences exerted by the financial situations of these two project phases on the profitability of the base case. The principal preconditions adopted for making these evaluations are described hereunder.

1) Gross sales

(a) Base case

The sales revenues acquired through the sale of 21,100 tons of LPG in the initial year of operation (1985), 52,600 tons of LPG and by-products (lean gas, gasoline material) in the second year, and 53,000 tons of LPG and by-products in the third and subsequent years for a period of 19 years, are regarded as the gross sales, Table 10-5 shows the gross sales for these years of operation.

(b) Case for study of profitability of Phase I – Part 2 and Phase II

The following preconditions are adopted in order to evaluate the financial situations of these project phases with respect to the base case:

- Phase I – Part 2
  It is assumed that the volume of LPG handled will be 21,100 tons in the initial year of operation (1985), 52,600 tons in the second year, and 53,000 tons in the third and subsequent years for a period of 19 years.

- Phase II
  It is assumed that Phase II (LPG Extraction Plant) will export LPG by paying to Phase I – Part 2 (LPG receiving, shipping and storage facilities) all the costs for the utilization of facilities, or for the use of Terminals (including river barge transportation costs). In this case, Phase II is assumed to pay US$60/ton to Phase I – Part 2, which is the operating cost per ton of LPG (excluding raw material cost and interest).

2) Procurement of funds and repayment of loan

In this financial analysis, IRROI is obtained with respect to the capital requirement indicated in Chapter 9.

Also, when obtaining IRROE, the interest incurred during construction, as well as the amount of repayment of principal and interest each year, are calculated with respect to PIC's investment of owned capital and foreign currency portion on the basis of loan conditions (Refer to Table 10-2) and repayment of borrowed capital beyond the project's life expectancy is taken into consideration.

3) Operating cost

(a) Base case

The operating costs of Phase I – Part 2 and Phase II of the project are assumed as shown in Table 10-6.

(b) Cases for study of profitability of each Phase I – Part 2 and Phase II

- Phase I – Part 2:

  The operating costs of Phase I – Part 2 shown in Table 10-6 and the LPG procurement costs from Phase II of the project are taken into consideration.

- Phase II:

  The operating costs of Phase II shown in Table 10-6 are assumed.

Other preconditions are assumed to be in conformance with Section 10.1.

10.2.2 Results of Analysis

1) Financial projection

(a) Base case

- IRROI: Shown in Table 10-9.
- IRROE: Shown in Table 10-10.

(b) Case for study of profitability of Phase I ⇒ Part 2 and Phase II

- o IRROI (Phase I – Part 2): Shown in Table 10-11.
- o IRROI (Phase II): Shown in Table 10-12.
- o IRROE (Phase I – Part 2): Shown in Table 10-13.
- o IRROE (Phase II): Shown in Table 10-14.

2) Summary of financial analysis

The following table shows the IRROI and IRROE indices as obtained from the financial projection tables:

Table 10-7. IRROI, IRROE

	Base Case	Viability of Each Facility	
		Phase I – Part 2	Phase II
IRROI (%)	3.52	3.26	3.84
IRROE (%)	25.04	21.43	30.81

3) Profitability

(a) Base case

As shown in Table 10-7, the value of IRROI, the profitability index for the base case, is 3.52%. This value is not so high as a project profitability index, but at any rate it shows that the project is feasible.

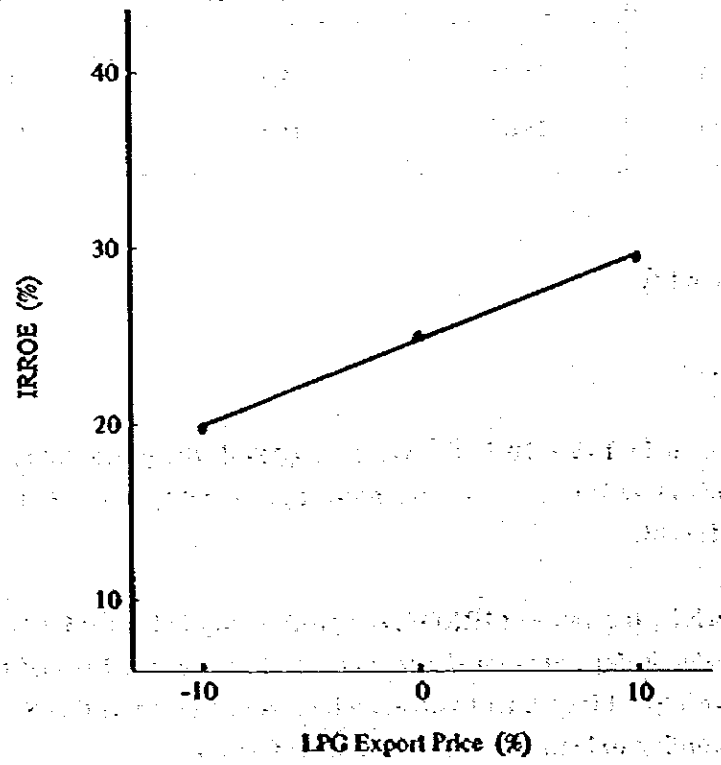
Meanwhile, the value of IRROE, the profitability index for PIC's capital investment, is 25.04%. This value is derived from the results calculated on the basis of foreign loan conditions and PIC's own capital investment volume which are assumed in this Survey Report, and is liable to change according to loan conditions and other factors.

Also, as shown in Table 10-10, the cash flow element of Financial Projection is smaller compared with that shown in Table 10-9 (Financial Projection on IRROI base), indicating that the value of IRROE is liable to fluctuate widely according to increases or decreases caused by product prices.

For example, as shown in Fig. 10-1, a fluctuation of LPG price by 10% results in a corresponding change of roughly 4.9% in IRROE index. On the other hand, the IRROI index is not as sensitive to the LPG price and undergoes a change of only about 1.3%, as indicated by the results of sensitivity analysis conducted in Section 10.2.3.

As judged from the foregoing explanation, the IRROE index may appear highly unstable since it is largely influenced by foreign currency loan conditions and ratio of investment of owned capital, but the project is actually highly feasible as long as the project is implemented under the conditions prescribed by this Survey Report.

Fig. 10-1. IRROE vs. LPG Export Price (Base Case)



(b) Case for study of profitability of Phase I – Part 2 and Phase II

As shown in Table 10-7, the IRROI indices for Phase I – Part 2 and Phase II of the project are 3.26% and 3.84%, respectively. It is to be noted, however, that the profitabilities of these two project phases were calculated separately only for the sake of convenience in the evaluation of profitability of the base case. Naturally, this is only a case of separate calculation, and various other combinations of profitability evaluation are conceivable. For example, since Phase I – Part 2 of the project essentially involves the construction of infrastructures, its profitability may be assumed at a far lower level, resulting in Phase II of higher profitability.

10.2.3 Sensitivity Analysis

The following two items were selected from among the various preconditions set in Section 10.1, and an analysis was made of the influences exerted by their changes on the profitability of the base case:

- o Total construction cost
- o LPG export price (FOB price)
- o LPG procurement price from Mann and Syriam Refineries

1) Influence of capital investment

A change in total construction cost influences the operating cost through changes brought about in depreciation cost, mainteannce cost and insurance. Fig. 10-2 and Table 10-8 indicate the sensitivity of IRROI to changes in the total construction cost within the range of ±15%.

As indicated by the results, the IRROI index is not so sensitive with respect to total construction cost and undergoes a change of only about 1.4% with respect to a change in total construction cost of 15%.

This is because the ratios of depreciation, maintenance and insurance costs to operating cost are not so high, thereby preventing the change in total construction cost from bringing about a conspicuous change in profitability. However, it is to be noted that a change in total construction cost by 15% has the effect of decreasing the IRROI index to 2.34%, making the project barely profitable.

Fig. 10-2. Sensitibity Analysis – Change in Construction Cost

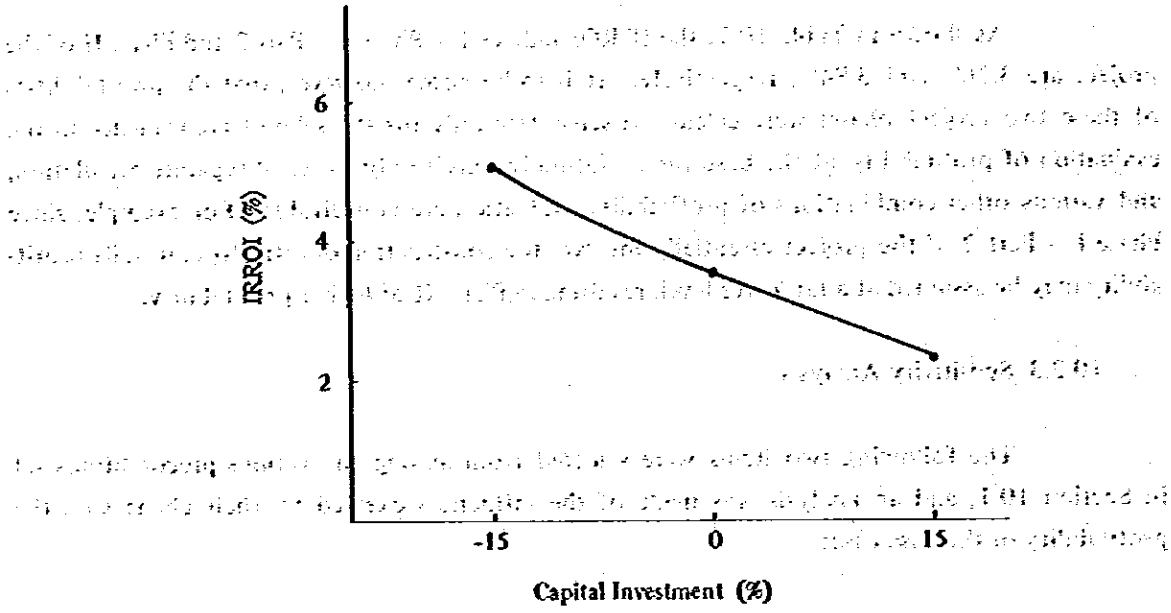


Fig. 10-3. Sensitivity Analysis – Change in LPG Export Price

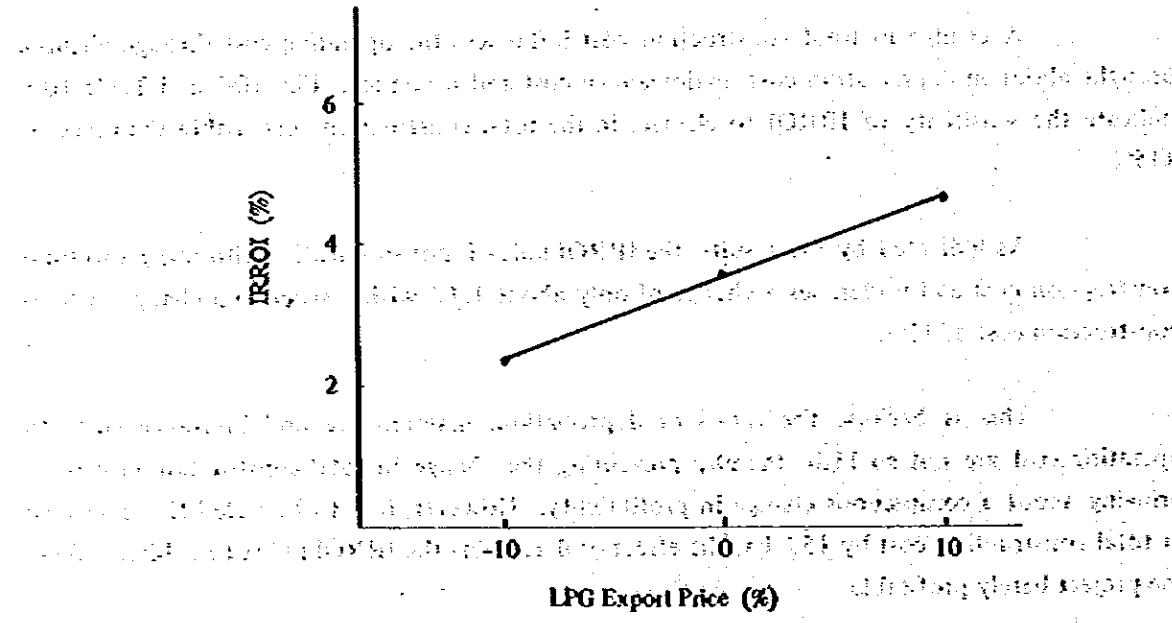
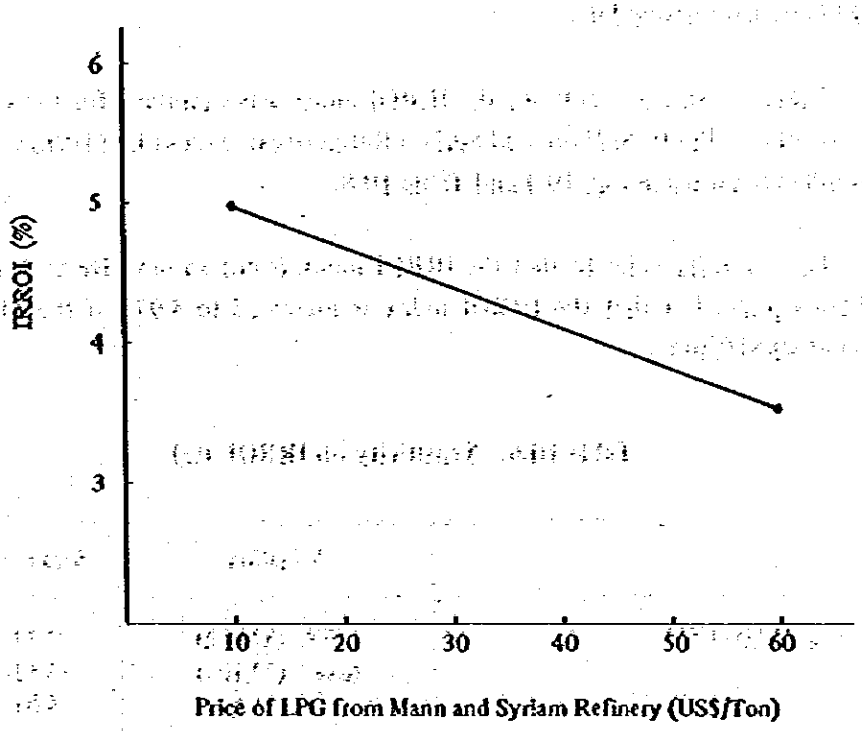


Fig. 10-4. Sensitivity Analysis – Change in Price of LPG from Mann and Syriam Refinery



2) Influence of LPG export price

Fig. 10-3 and Table 10-8 indicate the sensitivity of IRROI to changes in the LPG export price within the range of ±10%. As indicated by the results, the IRROI index is increased from 3.52% to 4.64% with respect to an increase in LPG export price by 10%.

3) Influence of price for purchasing LPG from Mann and Syriam Refineries

The price for purchasing LPG from the Mann and Syriam Refineries was set at US$60/ton following deliberations with the Burmese side, and financial analysis of the project was made on this assumption.

However, if Phase I – Part 2 of this project was not implemented, the LPG produced by Mann and Syriam Refineries will have to be flared off without being utilized effectively as energy resource, excepting for that portion earmarked for domestic consumption (3,000/yr).

As observed from this viewpoint, the aforementioned LPG purchasing price appears to deserve reconsideration. Also, as a practical problem, the LPG purchasing price is simply a matter of LPG transfer within PIC.

Based on this observation, the IRROI index was examined for the cases when the price for purchasing LPG from Mann and Syriam Refineries was set at US$10/ton and at US$30/ton. The results are shown in Fig. 10-4 and Table 10-8.

These results indicate that the IRROI index is not so sensitive with respect to the LPG purchasing price, but that the IRROI index is increased to 4.97% if the LPG purchasing price was set at US$10/ton.

Table 10-8. Sensitivity on IRROI (%)

	Variation	Sensitivity on IRROI (%)
Construction Cost (1,000 US$)	+15% (82,922)	2.34 (-1.18)
	Base (72,108)	3.52 (Base)
	-15% (61,290)	5.04 (+1.52)
LPG Sales Price (US$/T)	+10% (187)	4.64 (+1.12)
	Base (170)	3.52 (Base)
	-10% (153)	2.33 (-1.19)
Price of LPG from Mann and Syriam Refinery (US$/T)	60 (Base)	3.52 (Base)
	30	4.41 (+0.89)
	10	4.97 (+1.45)

10.3 Conclusion

The conclusion reached on the basis of the results of financial analysis and sensitivity analysis conducted in the preceding sections is described hereunder.

1) Justification of project implementation as observed from financial analysis

Phase I -- Part 2 and Phase II, with these two phases of the project most inseparately

related in aspects of both scale of facilities and role in the manufacture and export of LPG products. Accordingly, in order to sound out the project's financial evaluation, it will be necessary to make the profitability of the entire project, inclusive of both phases of the project, the criterion of judgement.

While the propriety of capital investment to a given project may be evaluated by various methods in consideration of the characteristics of the project to be evaluated or from the standardpoint of evaluation of the corporation making the investment, the financial evaluation in this Survey Report was conducted by adopting the DCF Method and calculating the IRROI and IRROE indices.

A financial evaluation of this project simply on the basis of the IRROI and IRROE indices obtained by calculation leads us to the conclusion that investment to this project is appropriate for the following reasons:

(a) The IRROI index of this project is 3.52%. That is, while the profitability of the project itself may not be so high, its profitability is certain.

(b) If the foreign currency portion of the capital requirement can be met by procuring long-term loan of low interest and long term of repayment as assumed in this Survey Report, the IRROE index for this project will be 25.04%, making implementation of this project highly feasible.

2) The point at issue

If the project schedule was delayed owing to some inadvertent situation, inflation will set in to raise the capital requirement. That is, as pointed out in the section on sensitivity analysis, the profitability of the project itself is not so sensitive to slight changes in total construction cost, but when the capital investment is increased by 15%, the IRROI index of the project will be decreased to 2.34% making the project barely profitable.

3) Recommendations

The following recommendations are offered in order to improve the profitability of this project on the basis of the conclusions reached in preceding Items 1) and 2):

(a) While the profitability of the project itself is 3.52% and not so high, the project can

be made amply feasible by procuring the foreign currency portion of the capital requirement through a foreign loan of low interest and long term of repayment as proposed in this Survey Report. Accordingly, the greatest efforts must be made to secure a foreign loan that will be advantageous for the project.

(b) Efforts must also be made to export LPG to adjacent countries in order to decrease the transportation cost and to benefit from LPG export prices of greater profit margin.

(c) This project will become barely profitable if the IRROI index was decreased from 3.52% to 2.34% owing to an increase in total construction cost by 15%. Accordingly, in view of the highly adverse influence which an increase in total construction cost will exert on the project's profitability, it will be imperative to implement this project as originally planned.

Table 10-9. Financial Projection (IRROI – Base Case)

(1,000 US$)

Year	Investment (1)	*1 W.C. (2)	Gross Sales (3)	*2 Op. Costs (4)	Gross Revenue (5)=(3)-(4)	Depreciation (6)	*3 P.B.T. (7)=(5)-(6)	*4 Tax (8)	*5 P.A.T. (9)=(7)-(8)	Cash Flow (10)=(9)+(6)-(1)-(2)
1 (1983)	18,841	-	-	-	-	-	-	-	-	-18,841
2 (1989)	36,375	-	-	-	-	-	-	-	-	-36,375
3 (1985)	17,483	1,133	3,587	2,235	1,352	1,772	-420	-126	-294	-17,138
4 (1986)	-	148	10,750	5,031	5,719	3,364	2,355	707	1,648	4,864
5 (1987) – 7 (1989)	-	-	10,818	5,060	5,758	3,364	2,394	718	1,676	5,040
8 (1990)	-	-	10,818	5,060	5,758	3,322	2,436	731	1,705	5,027
9 (1991) – 22 (2004)	-	-	10,818	5,060	5,758	3,245	2,513	754	1,759	5,004
23 (2005)	-	-8,492	10,818	5,060	5,758	1,515	4,243	1,273	2,970	12,977

IRROI : 3.52%

Notes: *1 W.C.: Working Capital, *2 Op. Costs: Operating Cost excluding Depreciation, *3 P.B.T.: Profit before Tax
*4 Tax = Contribution to State, *5 P.A.T.: Profit after Tax

Table 10-10. Financial Projection (IRROE – Base Case)

(1,000 US$)

Year	Equity (1)	*1 I.D.C. (2)	*2 W.C. (3)	Gross Sales (4)	*3 Op. Costs (5)	Gross Revenue (6)=(4)-(5)	Depreciation (7)	Interest (8)	*4 P.B.T. (9)=(6)-(7)-(8)	*5 Tax (10)	*6 P.A.T. (11)=(9)-(10)	Repayment (12)	Cash Flow (13)=(11)+(7)-(12)-(1)-(2)-(3)
1 (1983)	2,194	187	-	-	-	-	-	-	-	-	-	-	-2,381
2 (1984)	5,068	727	-	-	-	-	-	-	-	-	-	-	-5,795
3 (1985)	2,685	496	1,133	3,587	2,235	1,352	1,921	750	-1,319	-396	-923	-	-3,316
4 (1986)	-	-	148	10,750	5,031	5,719	3,645	1,413	661	198	463	-	3,960
5 (1987)	-	-	-	10,818	5,060	5,758	3,645	1,413	700	210	490	-	4,135
6 (1988)	-	-	-	10,818	5,060	5,758	3,645	1,413	700	210	490	-	4,135
7 (1989)	-	-	-	10,818	5,060	5,758	3,645	1,413	700	210	490	-	4,135
8 (1990)	-	-	-	10,818	5,060	5,758	3,454	1,413	891	267	624	-	4,078
9 (1991)	-	-	-	10,818	5,060	5,758	3,245	1,413	1,100	330	770	-	4,015
10 (1992)	-	-	-	10,818	5,060	5,758	3,245	1,413	1,100	330	770	-	4,015
11 (1993)	-	-	-	10,818	5,060	5,758	3,245	1,413	1,100	330	770	416	3,599
12 (1994)	-	-	-	10,818	5,060	5,758	3,245	1,399	1,114	334	780	1,614	2,411
13 (1995)	-	-	-	10,818	5,060	5,758	3,245	1,353	1,160	348	812	2,767	1,290
14 (1996)	-	-	-	10,818	5,060	5,758	3,245	1,286	1,227	368	859	3,137	967
15 (1997)	-	-	-	10,818	5,060	5,758	3,245	1,215	1,298	389	909	3,137	1,017
16 (1998)	-	-	-	10,818	5,060	5,758	3,245	1,146	1,367	410	957	3,137	1,065
17 (1999)	-	-	-	10,818	5,060	5,758	3,245	1,075	1,438	431	1,007	3,137	1,115
18 (2000)	-	-	-	10,818	5,060	5,758	3,245	1,004	1,509	453	1,056	3,137	1,164
19 (2001)	-	-	-	10,818	5,060	5,758	3,245	933	1,580	478	1,106	3,137	1,214
20 (2002)	-	-	-	10,818	5,060	5,758	3,245	864	1,649	495	1,154	3,137	1,262
21 (2003)	-	-	-	10,818	5,060	5,758	3,245	793	1,720	516	1,204	3,137	1,312
22 (2004)	-	-	-	10,818	5,060	5,758	3,245	721	1,792	538	1,254	3,137	1,362
23 (2005)	-	-	-8,492	10,818	5,060	5,758	1,515	652	3,591	1,077	2,514	3,137	9,384

Cash Flow of Subsequent Years: Yr 24 (2006): -3,544, Yr 25 (2007): -3,494, Yr 26 (2008): -3,444, Yr 27 (2009): -3,395, Yr 28 (2010): -3,346, Yr 29 (2011): -3,297, Yr 30 (2012): -3,247, Yr 31 (2013): -2,789, Yr 32 (2014): -1,551, Yr 33 (2015): -371

IRROE: 25.04%

Notes: *1 I.D.C.: Interest During Construction, *2 W.C.: Working Capital, *3 Op. Costs: Operating Costs excluding Depreciation and Interest, *4 P.B.T.: Profit Before Tax
*5 Tax = Contribution to state, *6 P.A.T.: Profit After Tax

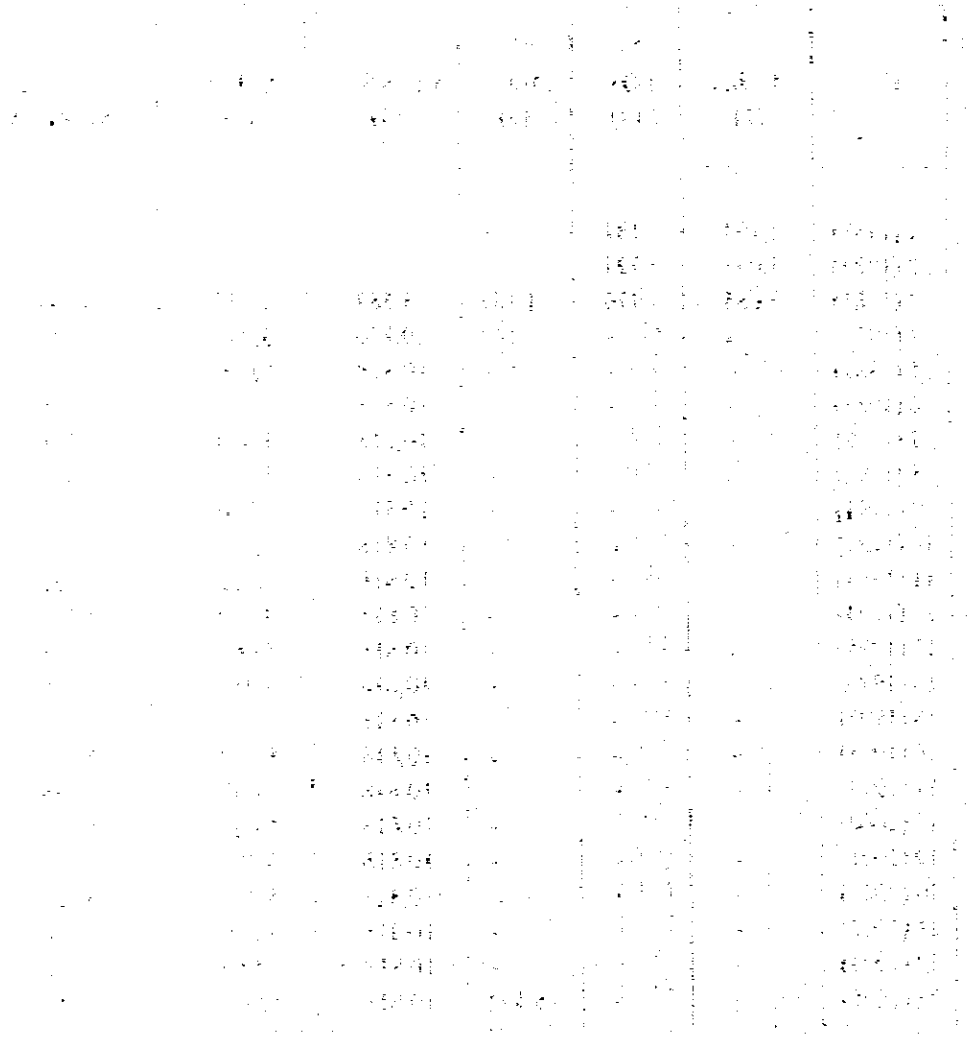


Table 10-11. Financial Projection (IRROI – Phase I – Part 2)

(1,000 US$)

Year	Investment (1)	*1 W.C. (2)	Gross Sales (3)	*2 Op. Costs (4)	Gross Revenue (5)=(3)-(4)	Depreciation (6)	*3 P.B.T. (7)=(5)-(6)	*4 Tax (8)	*5 P.A.T. (9)=(7)-(8)	Cash Flow (10)=(9)+(6)-(1)-(2)
1 (1983)	18,841	-	-	-	-	-	-	-	-	-18,841
2 (1989)	19,807	-	-	-	-	-	-	-	-	-19,807
3 (1985)	-	1,133	3,587	2,235	1,352	1,772	-420	-126	-294	345
4 (1986)	-	-	8,942	6,003	2,939	1,772	1,167	350	817	2,589
5 (1987) – 7 (1989)	-	-	9,010	6,032	2,978	1,772	1,206	362	844	2,616
8 (1990) – 22 (2004)	-	-	9,010	6,032	2,978	1,730	1,248	374	874	2,604
23 (2005)	-	-4,977	9,010	6,032	2,978	-	2,978	893	2,085	7,062

IRROI : 3.26%

Notes: *1 W.C.: Working Capital, *2 Op. Costs: Operation of Cost excluding Depreciation, *3 P.B.T.: Profit Before Tax
*4 Tax = Contribution to state, *5 P.A.T.: Profit After Tax

Table 10-12. Financial Projection (IRROI – Phase II)

(1,000 US$)

Year	Investment (1)	*1 W.C. (2)	Gross Sales (3)	*2 Op. Costs (4)	Gross Revenue (5)=(3)-(4)	Depreciation (6)	*3 P.B.T. (7)=(5)-(6)	*4 Tax (8)	*5 P.A.T. (9)=(7)-(8)	Cash Flow (10)=(9)+(6)-(1)-(2)
1 (1983)	-	-	-	-	-	-	-	-	-	-
2 (1984)	16,568	-	-	-	-	-	-	-	-	-16,568
3 (1985)	17,483	-	-	-	-	-	-	-	-	-17,483
4 (1986)	-	148	5,108	2,328	2,780	1,592	1,188	356	832	2,276
5 (1987) – 8 (1990)	-	-	5,108	2,328	2,780	1,592	1,188	356	832	2,424
9 (1991) – 22 (2004)	-	-	5,108	2,328	2,780	1,515	1,265	380	885	2,400
23 (2005)	-	-3,515	5,108	2,328	2,780	1,515	1,265	380	885	5,915

IRROI : 3.84%

Notes: *1 W.C.: Working Capital, *2 Op. Costs: Operation of Cost excluding Depreciation, *3 P.B.T.: Profit before Tax
*4 Tax = Contribution to state, *5 P.A.T.: Profit after Tax

Table 10-13. Financial Projection (IRROE – Phase I – Part 2)

(1,000 US$)

Year	Equity (1)	*1 I.D.C. (2)	*2 W.C. (3)	Gross Sales (4)	*3 Op. Costs (5)	Gross Revenue (6)=(4)-(5)	Depreciation (7)	Interest (8)	*4 P.B.T. (9)=(6)-(7)-(8)	*5 Tax (10)	*6 P.A.T. (11)=(9)-(10)	Repayment (12)	Cash Flow (13)=(11)+(7)-(12)-(1)-(2)-(3)
1 (1983)	2,194	187	-	-	-	-	-	-	-	-	-	-	-2,381
2 (1984)	3,159	562	-	-	-	-	-	-	-	-	-	-	-3,721
3 (1985)	-	-	1,133	3,587	2,235	1,352	1,921	750	-1,319	-396	-923	-	-135
4 (1986)	-	-	-	8,942	6,003	2,939	1,921	750	268	80	188	-	2,109
5 (1987)	-	-	-	9,010	6,032	2,978	1,921	750	307	92	215	-	2,136
6 (1988)	-	-	-	9,010	6,032	2,978	1,921	750	307	92	215	-	2,136
7 (1989)	-	-	-	9,010	6,032	2,978	1,921	750	307	92	215	-	2,136
8 (1990)	-	-	-	9,010	6,032	2,978	1,730	750	498	149	349	-	2,079
9 (1991)	-	-	-	9,010	6,032	2,978	1,730	750	498	149	349	-	2,079
10 (1992)	-	-	-	9,010	6,032	2,978	1,730	750	498	149	349	-	2,079
11 (1993)	-	-	-	9,010	6,032	2,978	1,730	750	498	149	349	416	1,663
12 (1994)	-	-	-	9,010	6,032	2,978	1,730	736	512	154	358	1,248	840
13 (1995)	-	-	-	9,010	6,032	2,978	1,730	703	545	164	381	1,664	447
14 (1996)	-	-	-	9,010	6,032	2,978	1,730	665	583	175	408	1,664	474
15 (1997)	-	-	-	9,010	6,032	2,978	1,730	627	621	186	435	1,664	501
16 (1998)	-	-	-	9,010	6,032	2,978	1,730	591	657	197	460	1,664	526
17 (1999)	-	-	-	9,010	6,032	2,978	1,730	553	695	209	486	1,664	552
18 (2000)	-	-	-	9,010	6,032	2,978	1,730	515	733	220	513	1,664	579
19 (2001)	-	-	-	9,010	6,032	2,978	1,730	477	771	231	540	1,664	606
20 (2002)	-	-	-	9,010	6,032	2,978	1,730	441	807	242	565	1,664	631
21 (2003)	-	-	-	9,010	6,032	2,978	1,730	403	845	254	591	1,664	657
22 (2004)	-	-	-	9,010	6,032	2,978	1,730	365	883	265	618	1,664	684
23 (2005)	-	-	4,977	9,010	6,032	2,978	-	328	2,650	795	1,855	1,664	5,168

Cash Flow of Subsequent Years: Yr 24 (2006): -1,868, Yr 25 (2007): -1,841, Yr 26 (2008): -1,815, Yr 27 (2009): -1,789, Yr 28 (2010): -1,763, Yr 29 (2011): -1,736, Yr 30 (2012): -1,710, Yr 31 (2013): -1,275, Yr 32 (2019): -428, Yr 33 (2015):

IRROE : 21.43%

Notes: *1 I.D.C.: Interest During Construction, *2 W.C.: Working Capital, *3 Op. Costs: Operating Costs excluding Depreciation and Interest, *4 P.B.T.: Profit Before Tax
*5 Tax = Contribution to state, *6 P.A.T.: Profit After Tax

Table 10-14. Financial Projection (IRROE – Phase II)

(1,000 US$)

Year	Equity (1)	*1 I.D.C. (2)	*2 W.C. (3)	Gross Sales (4)	*3 Op. Costs (5)	Gross Revenue (6)=(4)-(5)	Depreciation (7)	Interest (8)	*4 P.B.T. (9)=(6)-(7)-(8)	*5 Tax (10)	*6 P.A.T. (11)=(9)-(10)	Repayment (12)	Cash Flow (13)=(11)+(7)-(12)-(1)-(2)-(3)
1 (1983)	-	-	-	-	-	-	-	-	-	-	-	-	-
2 (1984)	1,909	165	-	-	-	-	-	-	-	-	-	-	-2,074
3 (1985)	2,685	496	-	-	-	-	-	-	-	-	-	-	-3,181
4 (1986)	-	-	148	5,108	2,328	2,780	1,724	663	393	118	275	-	1,851
5 (1987)	-	-	-	5,108	2,328	2,780	1,724	663	393	118	275	-	1,999
6 (1988)	-	-	-	5,108	2,328	2,780	1,724	663	393	118	275	-	1,999
7 (1989)	-	-	-	5,108	2,328	2,780	1,724	663	393	118	275	-	1,999
8 (1990)	-	-	-	5,108	2,328	2,780	1,724	663	393	118	275	-	1,999
9 (1991)	-	-	-	5,108	2,328	2,780	1,515	663	602	181	421	-	1,936
10 (1992)	-	-	-	5,108	2,328	2,780	1,515	663	602	181	421	-	1936
11 (1993)	-	-	-	5,108	2,328	2,780	1,515	663	602	181	421	-	1,936
12 (1994)	-	-	-	5,108	2,328	2,780	1,515	663	602	181	421	366	1,570
13 (1995)	-	-	-	5,108	2,328	2,780	1,515	650	615	185	430	1,103	842
14 (1996)	-	-	-	5,108	2,328	2,780	1,515	621	644	193	451	1,473	493
15 (1997)	-	-	-	5,108	2,328	2,780	1,515	588	677	203	474	1,473	516
16 (1998)	-	-	-	5,108	2,328	2,780	1,515	555	710	213	497	1,473	539
17 (1999)	-	-	-	5,108	2,328	2,780	1,515	522	743	223	520	1,473	562
18 (2000)	-	-	-	5,108	2,328	2,780	1,515	489	776	233	543	1,473	585
19 (2001)	-	-	-	5,108	2,328	2,780	1,515	456	809	243	566	1,473	608
20 (2002)	-	-	-	5,108	2,328	2,780	1,515	423	842	253	589	1,473	631
21 (2003)	-	-	-	5,108	2,328	2,780	1,515	390	875	263	612	1,473	654
22 (2004)	-	-	-	5,108	2,328	2,780	1,515	356	909	273	636	1,473	678
23 (2005)	-	-	-3,515	5,108	2,328	2,780	1,515	324	941	282	659	1,473	4,216

Cash Flow of Subsequent Years: Yr 24 (2006): -1,676, Yr 25 (2007): -1,653, Yr 26 (2008): -1,630, Yr 27 (2009): -1,607, Yr 28 (2010): -1,583, Yr 29 (2011): -1,561, Yr 30 (2012): -1,537, Yr 31 (2013): -1,514, Yr 32 (2014): -1,124, Yr 33 (2015): -371

IRROE: 30.81%

Notes: *1 I.D.C.: Interest During Construction, *2 W.C.: Working Capital, *3 Op. Costs: Operating Costs excluding Depreciation and Interest, *4 P.B.T.: Profit Before Tax
*5 Tax = Contribution to state, *6 P.A.T.: Profit After Tax

Chapter 11.

ECONOMIC EVALUATION

Chapter 11. ECONOMIC EVALUATION

A financial evaluation of the Project (Phase I – Part 2 and Phase II) was conducted in detail in the preceding chapter. In this chapter, the financial evaluation of the project is advanced in greater depth in order to further clarify the nature of this project, a matter of vital importance, by taking into consideration several aspects which were not included among the items of criterion in the preceding chapter.

That is, the following six aspects are taken fully into consideration since we feel that the project deserves a financial evaluation of greater depth than that offered in the preceding chapter:

1) The influence of this project on the future economic development and improvement of living standards in Burma through the development of the domestic LPG market.

2) The influence of the price for procuring LPG from Mann and Syriam Refineries on the profitability of the project.

3) Evaluation of the entire Integrated LPG Recovery Project, inclusive of Phase I – Part 1 and 2, Phase II and Phase III.

4) Foreign Currency Revenue Effect of LPG Recovery Project.

5) Effect of Technology Transfer Through LPG Recovery Project.

6) Employment Promotion Effect of LPG Recovery Project.

11.1 The Influence of the Project on the Future Economic Development and Improvement of Living Standards in Burma

The basic plan of this project is to divert 3,000 tons/yr of the 18,000 tons/yr of LPG produced by Mann Refinery for domestic consumption and to export the remaining 15,000 tons/yr of LPG, together with the 8,000 tons/yr of LPG produced by Syriam Refinery Coking Plant and the 30,000 tons/yr of LPG produced from associated gas by Mann GOCS LPG Extraction Plant.

This plan was adopted since there is as yet no sufficiently large LPG market in Burma, and since PIC that is an executing agency of this project plans to convert the energy requirements of industrial plants, public facilities such as hospitals and schools as well as general households to the use of LPG in the future by adopting active measures for developing the domestic LPG market.

Specifically, by coverting to LPG consumption the present consumption of heavy oil, kerosene and other fuel resources by industrial plants in general, public facilities such as hospitals and schools as well as general households, the plan is to increase the country's export of oil products. The plan also aims to improve national living standards by converting to LPG consumption the present consumption of wood, charcoal, kerosene and other energy resources by general households, which also has the added merit of permitting timber resources to be put to other effective industrial applications or for boosting timber exports.

PIC realizes that a substantial period of time will be required for converting the domestic energy consumption pattern to that based on LPG consumption, so it plans to first convert industrial plants in general as well as public facilities such as hospitals and schools to the pattern of LPG consumption, after which general households are to be made the target of popular acceptance of LPG consumption.

In this respect, HIC is already engaged in the development of LPG combustion systems and appliances which are expected to display a heat efficiency that is double that of existing kerosene combustion systems and appliances.

The realization of this plan to convert the domestic energy consumption pattern to that based on LPG consumption will have resounding effects on Burma not only by way of drastically improving national living standards but as well by way of improving the national economy through more effective utilization or larger export of timber resources and through a larger volume of export of oil products.

11.2 The Influence of the Price for Procuring LPG from Mann and Syriam Refineries on the Profitability of the Project

In this Feasibility Study, the price for LPG procurement from Mann and Syriam Refineries for use in this project was determined at US$60/ton or at the same price as the domestic LPG selling price, following deliberations with PIC, and the project's financial evaluation was made on the basis of this procurement price.

However, if this project failed to materialize, this volume of non-procured LPG will inevitably have to be consumed partly by these refineries as fuel and th remainder flared off uselessly, or piped for example to power stations and other facilities presently using natural gas or associated gas as fuel, resulting in an extremely low level of added value.

When observed in the light of this assumption, the LPG procurement price of US$60/ton appears to deserve serious reconsideration in view of the poor results indicated by the project's financial evaluation when derived on the basis of this proposed LPG procurement price.

For example, if we assume that this volumeof LPG was used in the same way as natural gas or associated gas, and its procurement price was calculated in terms of its calorific value from the equivalent price of K1.05/1,000 SCF for natural gas or associated gas, we get an LPG procurement price of US$5.5/ton. This may be suggested as the price for the procurement of LPG from Mann and Syriam Refineries.

In the financial evaluation conducted in the preceding chapter, a sensitivity analysis of this projects' IRROI was made on the basis of the LPG procurement price. In this respect, attention is called to the fact that an IRROI of 5.12% has been confirmed by calculation if the LPG procurement price was set at US$5.5/ton.

11.3 Evaluation of the Entire Integrated LPG Recovery Project, Inclusive of Phase I – Part 1 and Part 2, Phase II and Phase III

The Phase I – Part 2 and Phase II portion of the Integrated LPG Recovery Project was selected as the target of this Feasibility Study partly in view of the situation of procurement of the capital required for project implementation and partly in view of the time lag in the implementation of Phase II of the project. That is, the Feasibility Study extends over only a portion of the entire project.

Accordingly, when evaluating this project, it will also be necessary to evaluate the project in its entirety in order to grasp the nature of this project most accurately.

Incidentally, the Phase I – Part 2 portion of this project, in particular, involves the construction of LPG receiving and shipping facilities, and may therefore be regarded as assuming the role of substantiation of project infrastructures, or the role of contributing to the other phases of the entire project.

In addition, the Syriam Terminal is designed with a scale for accommodating 25,000 tons/yr of LPG, the output anticipated at the stage of completion of Phase III of the project, and may be regarded as a form of preemptive investment.

Also, when evaluating the project as a whole, Phase I – Part 1 will lie outside the scope of this project, so the evaluation will have to be made on the basis of data supplied by PIC and those presumed by the Survey Team. And as judged from the purpose of evaluating the project as a whole, no special problem is conceivable in the use of presumed data.

By the same token, Phase III will also lie outside the scope of this project, and since vital factors necessary for evaluating this phase of the project are unavailable, as with respect to such factors as the composition of the natural gas used as feedstock, plant site and scales of the respective LPG extraction plants, Phase III shall be excluded from the evaluation.

Calculating the entire project's IRROI on the basis of these preconditions gives us a value of 26.01%. This value indicates that the overall project has a high profitability potential, and that implementation of the project in entirety is highly feasible, inclusive of the Phase I – Part 2 portion of this project that assumes the role of provision of infrastructures necessary for the other portions of the overall project.

Details on calculation of IRROI index for the Entire Project are shown below:

1) Preconditions

Assuming that the Phase I – Part 2 and Phase II portions of the Integrated LPG Recovery Project would conform to the preconditions adopted in "Chapter 10 and for Phase I – Part 1, following preconditions were adopted.

(1) Capital Requirement for Phase I – Part 1

Table 11-1 shows the capital requirement for constructing Syriam Coking Plant (Phase I – Part 1), and Table 11-2 shows total capital investment plan for Phase I – Part 1, Phase I – Part 2 and Phase II of the project.

Table 11-1. Capital Requirement (Phase I – Part 1)

Item	Foreign Currency Portion (1,000 ¥)	Local Currency Portion (1,000 K)
Construction Cost		
Machinery & Equipment and Erection Work	8,000,000	36,000
Building and Civil Work	-	3,000
Commissioning Cost	32,109	152
Pre-operation Cost	-	1,956
Working Capital	-	24,976
Sub-total	8,032,109	66,084
Sub-total (1,000 US$)	34,771	8,718
Total (1,000 US$)	43,489	

Table 11-2. Total Capital Investment Plan

(1,000 US$)

	Phase I – Part 1				Phase I – Part 2			Phase II		
	1982	1983	1984	1985	1983	1984	1985	1984	1985	1986
Total Construction Cost	9,943	14,917	14,917	-	18,704	19,735	-	16,399	17,268	-
Commissioning Cost	-	-	159	-	-	-	-	-	156	-
Pre-operation Cost	169	59	30	-	137	72	-	169	59	-
Working Capital	-	-	-	3,295	-	-	1,133	-	-	148
Total	10,112	14,976	15,106	3,295	18,841	19,807	1,133	16,568	17,483	148

(2) Sales Revenues

Table 11-3 shows the products produced by Syriam Coking Plant as well as their export prices. The Table does not take LPG into account since it is to be shipped out to Phase I – Part 2 of the project.

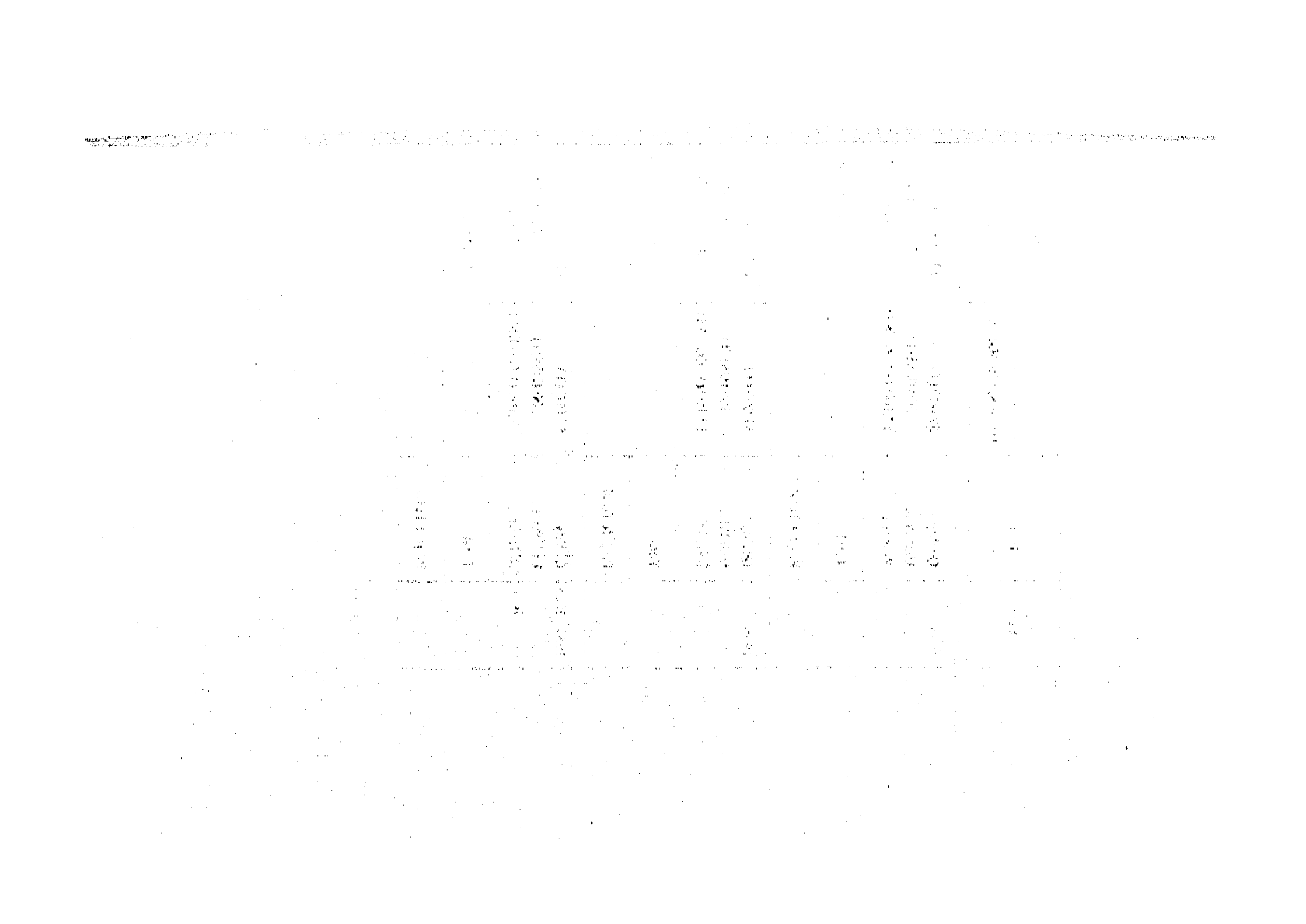
Table 11-4 indicates the annual sales revenues in Phase I – Part 1, Phase I – Part 2 and Phase II of the project.

Table 11-3. Products and Prices (Phase I – Part 1)

Product	Quantity (T/Y)	Unit Price (U.S.$/T)
Coker Gasoline (Motor Spirits Material)	57,000	300
Coker Gas Oil	129,000	202
Coke	38,000	55

Table 11-4. Summary of Sales Revenue

Year	Item	Phase I – Part 1			Phase I – Part 2	Phase II		
		Motor Spirits Material	Gas Oil	Petroleum Coke	LPG	LPG	Lean Gas	Motor Spirits Material
1985	Quality	57,000 (T)	129,000 (T)	38,000 (T)	21,100 (T)	-	-	-
	Unit Price	300 (US$/T)	202 (US$/T)	55 (US$/T)	170 (US$/T)	-	-	-
	Revenue	17,100 (1,000 US$)	26,058 (1,000 US$)	2,090 (1,000 US$)	3,587 (1,000 US$)	-	-	-
	Total	45,248 (1,000 US$)			3,587 (1,000 US$)	-		
	Project Total	48,835 (1,000 US$)						
1986	Quality	57,000 (T)	129,000 (T)	38,000 (T)	22,600 (T)	30,000 (T)	6,850,800 (MSCF)	2,900 (T)
	Unit Price	300 (US$/T)	202 (US$/T)	35 (US$/T)	170 (US$/T)	170 (US$/T)	0.139 (US$/MSCF)	295 (US$/T)
	Revenue	17,100 (1,000 US$)	26,058 (1,000 US$)	2,090 (1,000 US$)	3,842 (1,000 US$)	5,100 (1,000 US$)	952 (1,000 US$)	856 (1,000 US$)
	Total	45,248 (1,000 US$)			3,842 (1,000 US$)	6,908 (1,000 US$)		
	Projedt Total	55,998 (1,000 US$)						
1987–2005	Quality	57,000 (T)	129,000 (T)	38,000 (T)	23,000 (T)	30,000 (T)	6,850,800 (MSCF)	2,900 (T)
	Unit Price	300 (US$/T)	202 (US$/T)	55 (US$/T)	170 (US$/T)	170 (T)	0.139 (US$/MSCF)	295 (US$/T)
	Revenue	7,100 (1,000 US$)	26,058 (1,000 US$)	2,090 (1,000 US$)	3,910 (1,000 US$)	5,100 (1,000 US$)	952 (1,000 US$)	856 (1,000 US$)
	Total	45,248 (1,000 US$)			3,910 (1,000 US$)	6,908 (1,000 US$)		
	Project Total	56,066 (1,000 US$)						



(3) Operating Cost

Table 11-5 indicates the raw material and utility consumption situation of Syriam Coking Plant, and Table 11-6 the annual operating costs in Phase I – Part 1 & 2 and Phase II of the project.

Table 11-5. Raw Material and Utility Consumption (Phase I – Part 1)

	Requirement	Unit Price	Annual Cost (1,000 US$)
Raw Material (Residue Oil)	4,680 (B/CD)	58.03 (U.S.$/KL)	15,761
Cooling Water	3,000 (T/H)	0.5 (K/1,000 I.G)	348
Electricity	2,460 (KVA)	0.15 (K/kWh)	351
Steam	20 (T/H)	2.31 (U.S.$/KL)	370
Home Fuel Oil	0.87 (KL/H)	58.03 (U.S.$/KL)	404

Table 11-6. Summary of Operating Cost

(1,000 US$)

Year	Item	Phase I – Part 1	Phase I – Part 2	Phase II
1985	Raw Material	15,761	-	-
	Labor	50	60	-
	Maintenance	500	519	-
	Insurance	200	185	-
	Overhead	25	30	-
	Utility	1,473	45	-
	LPG Transportation	-	130	-
	Mot. Sp. Mat. Transportation*	-	-	-
	Total	18,009	969	-
	Project Total		18,978	
1986	Raw Material	15,761	-	1,100
	Labor	50	60	49
	Maintenance	500	519	513
	Insurance	200	185	183
	Overhead	25	30	25
	Utility	1,473	112	454
	LPG Transportation	-	441	-
	Mot. Sp. Mat. Transportation*	-	-	4
	Total	18,009	1,347	2,328
	Project Total		21,684	
1987–2005	Raw Material	15,761	-	1,100
	Labor	50	60	49
	Maintenance	500	519	513
	Insurance	200	185	183
	Overhead	25	30	25
	Utility	1,473	113	454
	LPG Transportation	-	445	-
	Mot. Sp. Mat. Transportation*	-	-	4
	Total	18,009	1,352	2,328
	Project Total		21,689	

Notes: o Except the interest and depreciation costs.
o Mot. Sp. Mat. Transportation = Motor Spirits Material Transportation.

(4) Results of Analysis

As indicated by the financial projection shown in Table 11-7, the profitability (IRROI index) of the entire project, inclusive of Phase I -- Part 1, Phase I -- Part 2 and Phase II, is 26.01% and indicates an extremely high project profitability index.

Table 11-7. Financial Projection of the Entire Project

(Unit: 1,000 US$)

Year	Investment (1)	Working Capital (2)	Gross Sales (3)	Operating Cost* (4)	Gross Revenue (5)=(3)-(4)	Profit before Contribution to State (6)=(5)	Cash Flow (before Contribution to State) (7)=(6)-(1)-(2)
1 (1982)	10,112	-	-	-	-	-	-10,112
2 (1983)	33,817	-	-	-	-	-	-33,817
3 (1984)	51,481	-	-	-	-	-	-51,481
4 (1985)	17,483	4,428	48,835	18,978	29,857	29,857	7,946
5 (1986)	-	148	55,998	21,684	34,317	34,317	34,166
6 (1987) ~ 23 (2004)	-	-	56,066	21,689	34,377	34,377	34,377
24 (2005)	-	-15,765	56,066	21,689	34,377	34,377	50,142

Note: * Operating cost, excludes depreciation

IRROI : 26.01%

11.4 Influence of the Project on Burma's Foreign Currency Revenues

Burma's international balance of payments being characterized by an unfavorable balance of trade, her deficit is being supplemented by financial revenues such as foreign aid funds. Accordingly, this project is analyzed here from the aspect of its influence on Burma's foreign currency revenues.

1) Method of Analysis

As judged from the preconditions which were adopted for conducting a financial evaluation of this project, the principal factors influencing Burma's foreign currency revenues are conceived to be the following:

(a) Foreign currency inflow:
Sales revenues accruing from export of LPG and motor spirits material.

(b) Foreign currency outflow:
Repayment of long-term loans, payment of interest, and foreign currency expenses for maintenance and repairs.

The difference between the above-mentioned foreign currency inflow and outflow is regarded as the net foreign currency earnings accruing from this project. Table 11-8 indicates the net foreign currency earnings for the foreseeable future.

2) Results of Analysis

From Table 11-8, we see that the total sum of net foreign currency earnings accrued during the life span of this project runs up to US$98,761,000, which clearly indicates the decisive role played by this project in improving Burma's foreign currency revenue situation.

Table 11-8. Net Foreign Currency Earnings

(1,000 US$)

Year	Foreign Currency Input			Foreign Currency Output				New Foreign Currency Flow (1)-(2)
	LPG Export	Motor Sprit Material Export	Sub-Total (1)	Maintenance Cost	Interest on Foreign Loan	Repayment of Foreign Loan	Sub-Total (2)	
1 (1983)	0	0	0	0	187	0	187	-187
2 (1984)	0	0	0	0	727	0	727	-727
3 (1985)	3,587	0	3,587	278	1,246	0	1,524	2,063
4 (1986)	8,942	887	9,829	553	1,413	0	1,966	7,863
5 (1987)	9,010	887	9,897	553	1,413	0	1,966	7,931
6 (1988)	9,010	887	9,897	553	1,413	0	1,966	7,931
7 (1989)	9,010	887	9,897	553	1,413	0	1,966	7,931
8 (1990)	9,010	887	9,897	553	1,413	0	1,966	7,931
9 (1991)	9,010	887	9,897	553	1,413	0	1,966	7,931
10 (1992)	9,010	887	9,897	553	1,413	0	1,966	7,931
11 (1993)	9,010	887	9,897	553	1,413	416	2,382	7,515
12 (1994)	9,010	887	9,897	553	1,399	1,614	3,566	6,331
13 (1995)	9,010	887	9,897	553	1,353	2,767	4,673	5,224
14 (1996)	9,010	887	9,897	553	1,286	3,137	4,976	4,921
15 (1997)	9,010	887	9,897	553	1,215	3,137	4,905	4,992
16 (1998)	9,010	887	9,897	553	1,146	3,137	4,836	5,061
17 (1999)	9,010	887	9,897	553	1,075	3,137	4,765	5,132
18 (2000)	9,010	887	9,897	553	1,004	3,137	4,694	5,203
19 (2001)	9,010	887	9,897	553	933	3,137	4,623	5,274
20 (2002)	9,010	887	9,897	553	864	3,137	4,554	5,343
21 (2003)	9,010	887	9,897	553	793	3,137	4,483	5,414
22 (2004)	9,010	887	9,897	553	721	3,137	4,411	5,486
23 (2005)	9,010	887	9,897	553	652	3,137	4,342	5,555
24 (2006)	0	0	0	0	581	3,137	3,718	-3,718
25 (2007)	0	0	0	0	510	3,137	3,647	-3,647
26 (2008)	0	0	0	0	439	3,137	3,576	-3,576
27 (2009)	0	0	0	0	369	3,137	3,506	-3,506
28 (2010)	0	0	0	0	298	3,137	3,435	-3,435
29 (2011)	0	0	0	0	228	3,137	3,365	-3,365
30 (2012)	0	0	0	0	157	3,137	3,294	-3,294
31 (2013)	0	0	0	0	87	2,728	2,815	-2,815
32 (2014)	0	0	0	0	30	1,530	1,560	-1,560
33 (2015)	0	0	0	0	4	368	372	-372
Total	183,719	17,740	201,459	11,338	28,608	62,752	102,698	98,761

11.5 Effect of Technology Transfer Through LPG Recovery Project

At the present stage, LPG demand in Burma is limited to glass factories, dry cell factories and few other types of factories, and the total volume of demand runs up to only several hundred tons annually. Also, the future demand for LPG is expected to remain at a level of 3,000 tons/yr for some time, as described in Chapter 3 (Demand for LPG).

A major factor suppressing the domestic demand for LPG in Burma is the difficulty of handling LPG. That is,

LPG being a gas that is liquefied under high pressure, its handling demands a relatively high level of technology which, at the present stage, is deficient in Burma.

In view of this situation, the realization of the proposed Integrated LPG Project is expected to benefit Burma conspicuously by way of upgrading industrial technology and the technical aptitudes of citizens in general, specifically through:

1) Acquisition of pressurized LPG producing technology.

2) Acquisition of pressurized LPG handling technology.

3) Stimulation of domestic demand for LPG.

   (a) Development of LPG-fired boiler systems.
   (b) Development of LPG-fueled household burners (kitchen ranges, heaters, etc.)
   (c) Promotion of wider use of industrial systems and equipment utilizing LPG.

Therefore, the realization of this project is certain to contribute immensely to Burma's future industrial progress in many direct and indirect phases.

11.6 Employment Promotion Effect of LPG Recovery Project

Since the basic plan of this project is to install LPG recovery facilities in the proximity of existing refineries and oil fields, the project's employment promotion effect will not be as great as that of a project for constructing an refinery, for example, at an entirely new site.

However, roughly 230 employees and altogether about 800 persons including their family members, will be given a stable source of income through Phase I – Part 2 and Phase II of this project.

In Burma where her Third 4-Year Economic Development Program is being advanced actively, even a seemingly insignificant employment promotion effect, as through the implementation of this project, should be evaluated highly for its contribution to the stability of Burmese economy and public welfare.

Chapter 12.

RECOMMENDATION

Chapter 12. RECOMMENDATION

The Survey Team offers the following proposals in order to have this project completed and the facilities put in operation smoothly as scheduled (Phase I – Part 2: Signing of contract by October 1, 1982, and start up of operations by January 1, 1985; Phase II: Signing of contract by October 1, 1983, and start up of operations by January 1, 1986).

12.1 Construction Plan

1) In this project, securing the designed LPG handling volume (Phase I – Part 2: 21,100 tons in 1985, 22,600 tons in 1986 and 23,000 tons in 1987–2005; Phase II: 30,000 tons in 1986–2005) will be imperative since it directly influences the profitability of this project. Therefore, Phase I – Part 1 (construction of Syriam Coking Plant) of this Integrated Project must be consummated by the timeof completion of Phase I – Part 2.

2) To prevent any delay in construction schedules, the following conditions must be observed most strictly:

a) Detailed survey of site conditions must be completed by the Burmese side prior to the bidding of this project.

b) The power transmission line for the Syriam Terminal must be completed by the end of January, 1984, and that of the Mann GOCS LPG Extraction Plant by the end of January, 1985.

c) The prescribed fleet of specialized ships must be securec for transporting required machinery and equipments and materials for plant consturciton over Irrawaddy Rivet.

d) The No. 1 Jetty at Syriam must be repaired before the completion of Syriam Terminal (January 1, 1983) to permit its use in the work of laying the pipes for shiping of LPG by LPG ocean tankers.

3) It should be fully understood that changes in the proposed construction sites (Table 4-13) will greatly impair the profitability of this project.

4) Since the profitability of this project will also be largely influenced by rises in construction costs due to delayed schedules, the project must be advanced strictly according to the Construction Schedule (Fig. 6-2).

5) To avoid any changes in construction schedules and costs, the required machinery, equipments and materials for plant construction to be procured by the Burmese side for this project must be secured as scheduled so as not to obstruct the construction schedules.

12.2 Management Control

1) Regarding management control of terminals, LPG receiving and shipping schedules must be met strictly since there is a limit to terminal tank capacities. Also, regarding Syriam Terminal, due consideration must be given to smooth allocation of LPG ocean tanker and acquisition of related management skill.

2) Burmese laws and regulations relating to the handling of LPG must be enacted to permit smooth handling of LPG.

3) Skilled technicians must be fostered beforehand for handling LPG in order to prevent any inadvertent disaster arising from improper handling of the pressurized gas.

12.3 Marketing

1) Marketing operations must be commenced immediately after advancement of this project has been determined in order to secure stable LPG markets, and the utmost efforts must be made to conclude long-term contracts with importing countries.

2) When exporting LPG, adjacent countries should be given priority since the profitability of this project will be largely influenced by transportation costs which directly concerned FOB Rangoon price of LPG.

APPENDIX

APPENDIX – I

INTERIM REPORT

Dated: 14th October, 1981

Managing Director
Petrochemical Industries Corporation

Dear Sir,

Re: Feasibility Study on the Integrated Liquefied Petroleum Gas Project

In accordance with the "MINUTES OF THE MEETINGS ON THE FEASIBILITY STUDY ON THE INTEGRATED LIQUEFIED PETROLEUM GAS PROJECT IN THE SOCIALIST REPUBLIC OF THE UNION OF BURMA" August 26, 1981 Burma, we, the feasibility study team, have been sent to Burma by Japan International Cooperation Agency from September 26 to October 15, 1981.

We would like to express our sincere appreciation for your warmhearted welcome and cooperation given our study team during the stay in your esteemed country, without which we were unable to carry out the study so effectively and efficiently.

Although the final report will be prepared after our study team returns to Japan, we hereby submit our interim report and other documents related to the study made in Burma as follows:

1. Interim Report on the Feasibility Study on the Integrated Liquefied Petroleum Gas Project in the Socialist Republic of the Union of Burma (PLease see Annexure 1).

2. Basic conditions related to the Feasibility Study (Please see Annexure 2).

3. Notes of Discussion and Visit (Please see Annexure 3).

4. List of Members; the Japanese Side and Burmese Counterparts (Please see Annexure 4).

Following documents related to the study have been submitted to the study team by the Burmese side.

5. Data and information handed over and explained to the team by Burmese Counterparts.

6. Other documents in response to the study team's request; such as filled-up forms of the written request; Drawings of the Syriam Foreshore, Maps, etc.

Sincerely Yours,

(A. Hijikata)
Team Leader,
The Feasibility Study Team,
Japan International Cooperation Agency (JICA)

INTERIM REPORT

1. BACKGROUND

In accordance with "MINUTES OF THE MEETING ON THE FEASIBILITY STUDY ON THE INTEGRATED LIQUEFIED PETROLEUM GAS PROJECT IN THE SOCIALIST REPUBLIC OF THE UNION OF BURMA, August 26, 1981 Burma", the Japan International Cooperation Agency (JICA) sent a nine-member survey team (team) led by Mr. Akifumi Hijikata to Burma to study the feasibility of the Proposed Integrated LPG Project (this Project) from September 26 to October 15, 1981.

2. THE PURPOSE OF TEAM

The purposes of the team's activity in Burma are to collect supplementary information and data to examine the feasibility of Phase I – Part two and Phase II from economic and technical point of views.

3. INTERIM 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 Coker LPG from Refineries

In order to export product Coker LPG, it is recommendable that,

(a) Coker LPG from Mann Refinery is reduced the content of olefines by using the existing SPI Plant. But it is necessary to get confirmation by detail technical study.

(b) Coker LPG from Syriam Refinery should be treated in a de-olefinizer plant to be installed.

3.2 The Proposed Sites of this Project

The following proposed sites may be suitable for this Project.

(a) Syriam terminal site.
(b) Mann terminal site.
(c) Mann GOCS LPG Extraction Plant site near No. (3) GOCS.

3.3 The Existing Jetties

The following existing jetties may be suitable for this Project.

(a) Syriam No. (1) Jetty for ocean vessels after completion of the present repairment.
(b) Syriam No. (4) Jetty for River Barges.
(c) Mann No. (1) Jetty for River Barges after completion of the present construction.

4. SUBJECTS OF STUDY

(a) LPG production rate and properties from Mann and Syriam Refineries.
(b) Associated Gas reserves, production capability and properties of Mann GOCS.
(c) Marketing of LPG.
(d) Plans of terminals and Mann GOCS LPG Extraction Plant facilities.
(e) Plan of River Barges.
(f) Construction.
(g) Economic evaluation.
(h) Others.

5. ACTIVITIES OF THE TEAM IN BURMA

To meet the requirements of the study the team collected information and data on various aspects of this Project regarding the said subjects of study through discussion with the Burmese officials and investigation in Mann and Syriam Area.

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

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

A. LPG production rate and properties from Mann and Syriam Refineries.

(1) Evaluation of LPG production rate and properties from Mann and Syriam Refineries.

B. Associated gas reserves and production capability of Mann GOCS.

(1) Evaluation of Mann GOCS reservoir for this Project.
(2) Productivity of Mann GOCS LPG.

C. Marketing of LPG

(1) Analysis of LPG demand.
(2) LPG demand forecast in Burma by using Burmese informations.
(3) International LPG demand forecast by using world wide informations about LPG.
(4) Estimation of LPG export price at Rangoon Port.

D. Plans of terminals and Mann GOCS LPG Extraction Plant facilities.

(1) Making conception designs

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

(2) Investigation as to the following items

(a) Utilities plan
(b) LPG pipeline
- Syriam Refinery to Syriam terminal
- Mann Refinery to Mann terminal
- Mann GOCS LPG Extraction Plant to Mann terminal

(c) Managements for terminals and Mann GOCS LPG Extraction Plant

(3) Evaluation of site conditions and design basis.

E. Plan of LPG River Barges

(1) Evaluation of transport condition of Irrawaddy River, existing jetties and Rangoon Port conditions.

(2) Making conception design of Special River Barges for transportation of LPG from Mann terminal to Syriam terminal.

(a) Capacity
(b) Number
(c) Management

F. Investment cost and Implementation Schedule.

(1) Investment cost shall be estimated in foreign currency portion and local currency portion respectively.

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

G. 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

Actual revenue and cost incurred from this Project will be used.

(2) Economic analysis

The analysis will be made from the viewpoint of this Project's contribution to Burmese Economy.

BASIC CONDITIONS

RELATED TO THE FEASIBILITY STUDY

Basic Conditions Related to the Feasibility Study

No.	Items	Basic Conditions
1.	Sites	(1) The proposed Syriam Terminal Site. (2) The proposed Mann Terminal Site. (3) The proposed Mann GOCS LPG Extraction Plant Site near No. 3 GOCS.
2.	Jetties	(1) Syriam existing No. 1 Jetty for Ocean Vessels. (2) Mann existing No. 1 Jetty for River Barges.
3.	Production Rate	(1) LPG from Syriam Refinery – 8,000 MT/Year. (2) LPG from Mann Refinery – 18,000 MT/Year. (3) LPG from Mann GOCS LPG Extraction Plant – 30,000 MT/Year.
4.	Domestic Demand of LPG	3,000 MT/Year.
5.	Amount of Export LPG	53,000 MT/Year.
6.	Products Prices	(1) Export LPG – 170 US$/MT at Rangoon FOB. (2) LPG from Refineries to Terminals – 60 US$/MT (changeable). (3) Domestic LPG – 60 US$/MT (changeable). (4) Associated Gas from Mann GOCS to LPG Extraction Plant – 1.05 K/1,000 SCF (1 US$ = 7.12 K). (5) Lean Gas from LPG Extraction Plant to Mann GOCS – 1.05 K/1,000 SCF. (6) Motor Spirit from Mann GOCS LPG Extraction Plant to domestic use – 1.50 K/LPG al.

NOTES OF DISCUSSION AND VISIT

Notes of Discussion and Visit

Sep. 26th (Sat.)	Arrive at Rangoon by TG305 General discussion at Airport with PIC.
Sep. 27th (Sun.)	Discussing within the team.
Sep. 28th (Mon.)	Visit the Japanese Ambassador in the morning. Discussing at the Technical Services Corporation with PIC and TSC in the afternoon.
Sep. 29th (Tue.)	Discussion at TSC with PIC and TSC.
Sep. 30th (Wed.)	Discussing at TSC with PIC, TSC and MOC.
Oct. 1st (Thu.)	Discussing at TSC with PIC and TSC.
Oct. 2nd (Fri.)	Visit the Syriam Oil Refinery with PIC and TSC.
Oct. 3rd (Sat.)	Survey the Proposed Site for the Syriam LPG Terminal and Existing Jetties with PIC and TSC.
Oct. 4th (Sun.)	Discussing within the team.
Oct. 5th (Mon.)	Tour from Rangoon to Malun HIC guest house with PIC and TSC by PIC Mini-Bus.
Oct. 6th (Tue.)	Study the Mann Refinery and Survey the Proposed Site for the Mann LPG Terminal and Existing Jetty with PIC and TSC.
Oct. 7th (Wed.)	Study the Mann Oil Fields and Survey the Proposed Site for the Mann GOCS LPG Extraction Plant with PIC, TSC and MOC in the morning. Visit the Matsushita Electric Factory at HIC Malun with PIC, TSC and HIC in the afternoon.
Oct. 8th (Thu.)	Tour from Malun to Rangoon with PIC and TSC by PIC Mini-Bus.

Oct. 9th (Fri.)	Discussing at TSC with PIC and TSC in the afternoon.
Oct. 10th (Sat.)	Discussing within the team.
Oct. 11th (Sun.)	Discussing within th team.
Oct. 12th (Mon.)	Discussing at PIC with PIC and TSC. Visit the Japanese Ambassador and reporting to Japanese Embassy in the afternoon.
Oct. 13th (Tue.)	Discussing at PIC with PIC and TSC.
Oct. 14th (Wed.)	Finally discussing at TSC with PIC and TSC. Explaining the Interim Report to PIC and TSC. Acknowledgement of receipt of data for the Integrated LPG Project handed over by PIC Side letter No. 1770/1504(1)/55/81 dated 12th October 1981. Handing over of Interim Report to PIC by JICA Feasibility Mission.
Oct. 15th (Thu.)	Leave Rangoon by TG 306.

LIST OF MEMBERS

List of Members

JAPANESE SIDE :

Mr. AKIFUMI HIJIKATA	Team Leader
Mr. KUNIAKI KUDO	Assistant Leader
Mr. MASATOSHI HARADA	Project Engineer
Mr. AKIRA NAGUMO	Civil Engineer
Mr. YASUHIRO KURIYAMA	Economist
Mr. YASUKI MURAKAMI	Industrial Engineer
Mr. MASAHIDE FURUZONO	Process Engineer
Mr. SHOJIRO MORI	Industrial Economist
Mr. JUNSAKU KOIZUMI	Advisor
Mr. TOORU SHINOHARA	Japanese Embassy

BURMESE SIDE :

P.I.C. (Head Office)

U KYAW KHIN	Managing Director
U TIN MAUNG AYE	Director (Planning)
U TIN HLA	Director (Finance)
U HLAING MYINT SAN	Assistant Director (Planning)
U MAUNG MAUNG GYI	Head of Department
U TIN TUT	Head of Department (Finance)
U THEIN AUNG	Advisor

P.I.C. (Syriam Refinery)

U KHIN OO	General Manager
U KYAW SEIN	Deputy General Manager
U NGWE	Chief Engineer
U TIN TUN MAUNG	Elect. Engineer
U HLA TUN	Asst. Chemist

P.I.C. (Mann Refinery)

U THAN WIN	Project Director
U MAUNG MAUNG MYINT	Deputy Project Director
U AYE KYAW	Deputy Refinery Manager
U KYAW WIN MAUNG	Project Engineer

T.S.C.

Lt: Col. KHIN MG THEIN	Managing Director
U MAUNG MAUNG (2)	Director (Planning)
U WIN MYINT	Deputy Assistant Director
U KYAW SOE	Head of Department
DAW TIN TIN HLA	Head of Branch

M.O.C.

U NYUNT	Chief Geologist
U WIN PE TIN	Manager of Mann Oil Field

H.I.C. (MATSUSHITA Electric Factory)

MAJOR AUNG PE	General Manager
MAJOR KYAW WIN	General Manager

APPENDIX II

MINUTES OF THE MEETING

ON

THE FEASIBILITY STUDY

ON

THE INTEGRATED LIQUEFIED PETROLEUM GAS PROJECT

IN

THE SOCIALIST REPUBLIC OF THE UNION OF BURMA

August 26, 1981 Burma

Minutes of the Meetings

The Preliminary Survey Team sent by the Japan International Cooperation Agency (JICA) (Schedule of the Preliminary Survey Team is attached in Annexure I) and the Burmese counterparts have discussed the study of the Integrated Liquefied Petroleum Gas Project (the Study) in the Socialist Republic of the Union of Burma (Member lists of both sides are attached in Annexure II).

Based on the above discussion the Preliminary Survey Team has clarified the contents of the Integrated Liquefied Petroleum Gas Project proposed by the Government of the Socialist Republic of the Union of Burma and both sides agreed on the Scope of Works attached in Annexure III.

(SHIZUO KISHIDA)	(U KYAW KHIN)
Team Leader	Managing Director
The Preliminary Survey Team	Managing Director
Japan International Cooperation Agency (JICA)	Petrochemical Industries Corporation

Schedule of the Preliminary Survey Team

Aug. 22nd	Arrive at Rangoon by TG 305.
Aug. 23rd	Discussion within the team.
Aug. 24th	To discuss Scope of Work at the Technical Service Corporation with PIC and TSC.
Aug. 25th	To visit the Syriam Oil Refinery Complex.
Aug. 26th	Courtesy Call on FERD. Signing of the Minutes of the Meeting on the Scope of Work.
Aug. 27th	Reporting to the Japanese Embassy. Leave Rangoon by TG 306.

Annexure II

Member List of the Attendants of the Meeting

Japanese Side	Burmese Side
Mr. Shizuo Kishida Team Leader (JICA)	U Kyaw Khin Managing Director (PIC)
Mr. Ryouichi Namikawa Facilities (MITI)	U Tin Maung Aye Director (PIC)
Mr. Satoshi Kondo Refinery (ANRE)	U Maung Haung (2) Director (TSC)
Mr. Shinya Nakai Coordinator (JICA)	U Win Myint Dy. Asst. Director (TSC)
Mr. Toru Shinohara First Secretary Japanese Embassy	U Thein Aung Advisor (PIC)
Mr. Keichi Takeda Technical and Administrative Staff Japanese Embassy	

SCOPE OF WORKS

OF

THE TECHNICAL COOPERATION

BETWEEN

THE JAPAN INTERNATIONAL COOPERATION AGENCY

AND

THE PETROCHEMICAL INDUSTRIES CORPORATION

ON

THE FEASIBILITY STUDY

ON

THE INTEGRATED LIQUEFIED PETROLEUM GAS PROJECT

IN

THE SOCIALIST REPUBLIC OF THE UNION OF BURMA

Scope of Works of The Technical Cooperation

I. Background

In response to the request of the Socialist Republic of the Union of Burma, the Government of Japan dispatched a preliminary survey team headed by Mr. Shizuo Kishida from 22nd to 27th August, 1981, through the Japan International Cooperation Agency (hereinafter referred to as "JICA"), the official agency responsible for the implementation of the technical cooperation of the Government of Japan, to carry out the preliminary survey for the feasibility study on the Integrated Liquefied Petroleum Gas Project in the Socialist Republic of the Union of Burma (hereinafter referred to as "the Study") and to discuss the scope of works of the Study with the Ministry of Industry Number Two, Petrochemical Industries Corporation and authorities concerned in the Socialist Republic of the Union of Burma.

II. Basic Project Conception Proposed by the Government of the Socialist Republic of the Union of Burma

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 BPSD using topped crude as feedstock at the Syriam Refinery equipped with facilities to produce approximately 12,000 metric tons of internationally acceptable quality liquefied petroleum gas (LPG) including de-olefiniser in addition to premium motor-spirit, regular motor-spirit, diesel-oil and petroleum coke.

Phase I: Part Two

(1) Installation of terminals for LPG at Syriam Refinery Complex and Mann Refinery Complex.
The terminal at Syriam is to be adequately sized to accommodate 85,000 metric tons on final annual basis as follows.

(i) LPG production from Syriam Refinery (12,000 metric tons)

(ii) Mann Refinery (18,000 metric tons)

(iii) Mann oil-fields (30,000 metric tons)

(iv) Chauk, Ayadaw and Shwephitha oil fields (25,000 metric tons)

(2) The terminal at Syriam is to be equipped to receive LPG from special river crafts (barges) and to load LPG into export tankers.

(3) Procurement of 4 Nos. special river crafts (barges) to enable transport of LPG from terminal at Mann Refinery complex to Syriam terminal.

Phase II:

(1) Installation of one LPG extraction plant with capacity of 24,000,000 standard cubic feet per day (SCFPD) using associate gas as feedstock at Mann oil-fields.

(2) Installation of LPG pipe line from the Extraction Plant to terminal at Mann Refinery Complex.

Phase III:

(1) Installation of three units of LPG Extraction Plant with capacity of 12,000,000 SCFPD using natural gas as feedstock one each at Chauk, Ayadaw and Shwephitha.

(2) Auxiliary facilities to receive, store and load LPG production into special river crafts (barges).

(3) Procurement of 3 special river crafts (barges) to enable transport LPG from (3) sites, Chauk, Ayadaw and Shwephitha to Syriam terminal.

2. Expected Production of LPG per annum

12,000 metric tons from the Syriam Refinery (Phase I: part one)
18,000 metric tons from the Mann Refinery (Phase I: part two)
30,000 metric tons from Mann oil-fields (Phase II)
25,000 metric tons from Chauk, Ayadaw and Shwephitha (Phase III)
(Total production of LPG per annum is 85,000 metric tons.)

3. Expected Implementation Schedule of the Project

(1) Phase I part one and Phase I part two are planned to be launched simultaneously in fiscal year 1981–82.

(2) Phase II is planned to be launched in fiscal year 1982–83.

(3) Phase III is planned to be launched in fiscal year 1983–84.

III. Objective of the Study

The objective of the Study is to examine the feasibility of Phase I part two and Phase II from economic and technical point of views.

IV. Scope of Works

In order to achieve the above objective, the Study will cover the following items:

1. Areas

(1) Syriam

(2) Mann

(i) Refinery area

(ii) Oil-fields area

2. Data Collection

(1) Natural Condition

1) Location

2) Topography

3) Geography

(2) Feed Stock

1) Quantity
2) Quality
3) Composition
4) Price

(3) The Oil Refinery Complexes at Syriam and Mann

1) Facilities
2) Method of processing
3) Products

(4) LPG Production

1) Quantity
2) Qaulity
3) Composition
4) Price

(5) Storage, Loading Facilities and Transportation

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

(6) Infrastructure and Utilities

1) Electricity
2) Water
3) Others

3. Conception Design

(1) The terminals at Syriam and Mann for LPG

1) Capacity
2) Site
3) Layout
4) Facilities

(2) Special river crafts (barges) for transportation of LPG

1) Capacity
2) Number

(3) The LPG Extraction Plant at Mann oil-fields

1) Capacity
2) Site
3) Layout
4) Facilities
5) Processing

4. Managements

5. Marketing

6. Investment and Operating Costs

7. Implementation Schedule

8. Economic and Financial Analysis

9. Overall Evaluation and Recommendations

V. The Study Schedule

1. The Government of Japan will dispatch a feasibility study team (hereinafter referred to

as "the F/S Team") through JICA within approximately one (1) month after the preliminary survey.

2. The F/S Team will prepare and submit the following reports, including all related maps and plans, in English, within the time period indicated, to the Government of the Socialist Republic of the Union of Burma:

   1) Draft Final Report, at the end of January, 1982 (20 copies)
   2) Final Report, at the end of February, 1982 (50 copies)

VI. Roles of the Government of Japan

1. The Government of Japan will dispatch the F/S Team through JICA, and provide expertise.

2. The Government of Japan will extend the technical cooperation to transfer the technology related to the Project for the Burmese counterparts through their participation in the Study.

VII. Roles of the Government of the Socialist Republic of the Union of Burma

1. The Government of the Socialist Republic of the Union of Burma shall designate a sufficient number of full-time counterparts corresponding to the experts of the F/S Team at the starting date of the Study.

2. Petrochemical Industries Corporation (PIC), the Project implementing agency shall make best efforts to render assistance to the F/S Team to acquire all available information and data relevant to the Project including discussions with connected Government Agencies for the F/S Team to complete the work in time.

3. PIC shall provide the F/S Team with the following items.

   1) Suitable office with necessary office supplies and equipment.
   2) Local non-technical staff including secretaries, typists.
   3) Necessary means and equipments for the F/S Team activities in Burza such as motor vehicles, etc.

4. PIC shall arrange the F/S Team to conduct the field surveys upon request. PIC shall also do the best efforts to ensure the security of the members of the F/S Team during their stay in Burma.

[illegible] the F/S Team [illegible] [illegible]
[illegible] survey.

2. The F/S Team will prepare and submit the following reports [illegible] copies in English within the [illegible] to the Government of the Socialist Republic of the Union of Burma.

   1) Draft Final Report, at the end of January, 1987 ([illegible] copies)
   2) Final Report, at the end of February, 1987 ([illegible] copies)

VI. Duties of the Government of Japan

1. The Government of Japan will take [illegible] F/S [illegible].

2. The Government of Japan will [illegible] the Project for the [illegible].

VII. Duties of the [illegible] Government of the Socialist Republic of the Union of Burma

1. The Government of the Socialist Republic of the Union of Burma [illegible] sufficient number of [illegible] in the [illegible] of the starting date of the F/S.

2. Petrochemical Industries Corporation [illegible] to the F/S Team in respect of available [illegible] data relevant to the Project [illegible] for the F/S Team [illegible].

3. PIC shall provide the F/S Team with the following items:

   1) Suitable office with necessary office supplies and equipment
   2) Local [illegible] staff [illegible]
   3) Necessary means and [illegible] for the F/S Team [illegible] vehicles, etc.

4. PIC shall [illegible] the F/S Team [illegible] to the best of its efforts to ensure the security of the members of the F/S Team [illegible] in Burma.

APPENDIX III

NECESSITY OF DE-OLEFINIZATION OF COKER LPG AND ITS METHODS

Necessity of De-Olefinization of Coker LPG and Its Methods

1. Properties of Coker LPG

The coking process is a system for manufacturing LPG fraction cracked gasoline, diesel oil, and cokes of high added value by thermo-cracking, polymerization and condensation of heavy oil.

While the yield rate and quality of the products produced by this process may differ according to the properties of feedstock oil and the setting of operating conditions such as reaction temperature, coke drum pressure and circulation ratio, the LPG fraction is rich in olefine content. In general, the content of C_3 olefine in C_3 fraction and C_4 olefine in C_4 fraction is known to run up to as high as 50%.

The Coking Plant that is presently under construction at Mann Refinery in Burma, as well as the Coking Plant scheduled for construction at Syriam Refinery, both belong to the category of the Delayed Coker developed by UOP.

The LPG fraction produced by Mann Topped Crude Oil as feedstock contains 35% of C_3 olefine in C_3 fraction and 44% of C_4 fraction, so if LPG was recovered as produced, the LPG product will contain about the same percentages of these olefines.

2. Necessity of De-Olifinization of Coker LPG

LPG containing olefines may be acceptable depending on its specific use, but its maketability will be limited owing to the following reasons, making it necessary to remove the olefine content in order to stabilize its sale and secure greater profits:

1) The bulk of LPG products traded through international transactions do not contain olefines since these LPG products are recovered from natural gas or crude oil associated gas.

2) Depending on its use, LPG ocntaining olefines will be unsuitable.

3) Even when using LPG as a fuel for simple combustion, LPG containing lefines will not be accepted so readily by trading partners owing to anxieties in its combustibility.

4) Secondary LPG depot and filling stations, for example, are not equipped with special facilities such as tanks for LPG containing olefines.

3. Methods for Separation and Removal of Olefines

The following methods are generally adopted for separating and removing olefines from LPG:

1) Method of separation by distillation.
2) Method of removal by polymerization of olefine.
3) Method of hydrogenation and saturation of olefines.

A general description of these methods is offered hereunder:

(a) Method of Separating Olefines by Distillation

When separating fractions having slight differences in boiling points, as when treating propane and propylene, or butane and butylene, a distillation system having numerous stages will be necessary. Therefore, if simple separation is the sole objective, this method will be economically disadvantageous.

(b) Method of Removing Olefines by Polymerization

Several processes are available for this method, which have originally been developed for the manufacture of gasoline. For example, there is the Polymer Gasoline Process that uses a solid phosphatic catalyst for generating an olefine polymerization reaction, or the Alkylation Process that employs hydrogen fluoride or sulfuric acid for causing a reaction between olefine and iso-butane.

However, applying these methods for improving the quality of LPG would be unsuitable owing to the reactions involved. That is,

(1) The output of LPG will be decreased since the olefines are converted into polymerized gasoline.

(2) A slight quantity of non-reacting olefines will remain in the product LPG.

(c) Method of Hydrogenation of Olefines

In this process, catalysts such as Ni, Co, Mo and Pt course the hydrogenation of olefines in a hydrogen environment, just like in ordinary hydrodesulfurization systems; hydrogenation of olefines occurs simultaneously.

Therefore, if the required amount of hydrogen can be supplied and some suitable hydrogenation system can be utilized at the same time, this process will be highly advantageous. This process has the merit that the LPG output is not decreased.

3.1 Olefine Removal by Polymer Gasoline Process

This process is adopted by Syriam Refinery. Since there is no hydrogen source at this Refinery, there is no alternative but to adopt the aforementioned method (b).

Among the processes included in method (b), the Polymer Gasoline Process will be more advantageous as long as the following points are given due consideration:

1) The Polymer Gasoline Process utilizes the polymerization reaction occurring among olefines, as contrasted with the Alkylation Process that utilizes the reaction between olefines and iso-butane. Accordingly, the latter has the disadvantage that the LPG output is decreased since the saturated fractions are also converted into polymerized gasoline.

2) Whereas the Alkylation Process uses liquid chemicals such as hydrogen fluoride and sulfuric acid which accompany handling and corrosion problems, the Polymer Gasoline Process has no such problems since it essentially consists of a fixed bed catalytic reactor.

3.2 Olefine Removal by Hydrogenation Reaction Using SPI System

The SPI system is essentially a system for improving the smoke point of jet fuels and kerosene, which is accomplished by hydrogenation of the rings of aromatic compounds contained in these fractions in order to generate cyclo-paraffines.

At Mann Refinery, this system is adopted to treat LPG containing olefines and to obtain saturated LPG. This itself has not problem since, as observed from the aspects of

reaction, the hydrogenation reaction of C_3 and C_4 olefines is easier to accomplish than the hydrogenation of aromatic compound rings. However, this reaction accompanies an enormous quantity of heat, so there is a need to check the heat balance of the reaction section of the SPI system being utilized by Mann Refinery.

In Tokyo, the Survey Team members had a talk with the licensor, who revealed that independent treatment of LPG with the SPI System may be problematical since the SPI system used by Mann Refinery is not equipped with a quencher, but that operation will be possible if the 3,000 bbl/day of kerosene or jet fuel being treated presently was mixed with 500 bbl/day of LPG.

On the other hand, when giving thought to block operation of jet fuel, kerosene and LPG, the reactor will have to be remodeled and a quenching system induced, or the heat must be removed by circulation of product LPG when treating only LPG.

In the former case, the remodeling cost may be considerably high, and an intermediate LPG tank will have to be installed. Also, from the aspects of system operation, troublesome operations will be required each time there is a change of feedstock.

In the latter case, the circulation of product LPG for heat removal will require an expansion of capacity of the section used for LPG treatment, resulting in a decrease in capacity for treating jet fuel and kerosene. In extreme cases, as when the LPG circulation volume requirement exceeds 2,500 bbl/day, the jet fuel and kerosene treatment capacity will be decreased to nil. This situation will cast a problem on the plan of producing jet fuel and kerosene, and even if a balance was struck among these products, the aforementioned problem of troublesome system operation will still remain.

Accordingly, LPG treatment with the SPI system should preferably be achieved by a continuous system of treatment based on a mixture with kerosene or jet fuel.

Meanwhile, in connection with the distillation section, the present design gives thought only to separation of kerosene fraction and the light gas dissolved in it. Accordingly, in the case of its continuous treatment in a mix with LPG, it will be necessary to also treat the LPG fraction, so with the existing distillation tower, problems such as insufficiency of designed pressure and insufficient capacity of overhead system are conceivable.

In view of these observations, it will henceforth be necessary for the Burmese side to give exhaustive study to the matter of de-olefinization of Coker LPG by means of existing facilities.