THE FEASIBILITY STUDY REPORT
ON
THE INTEGRATED LPG PROJECT
IN
THE SOCIALIST REPUBLIC
OF THE UNION OF BURMA

(SUMMARY)

MARCH, 1982

JAPAN INTERNATIONAL COOPERATION AGENCY

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1. Background of Survey

1) Oil Situation in Burma

There are presently in operation in Burma three oil refineries having a total crude oil processing capacity of 34,000 BPSD. Upon completion of Mann Refinery in February, 1982, which is now under construction and has a crude oil processing capacity of 25,000 BPSD, its operation will greatly expand Burma's crude oil processing capacity.

The outputs of crude oil and natural gas are also increasing from year to year, and in fiscal 1980, 11 million barrels of crude oil and 20,000 million cubic feet of natural/associated gas were produced. Meanwhile, oil and gas wells are being developed actively.

In view of the country's growing crude oil processing capacity and increasing output of crude oil, and with the purpose of effective utilization of natural resources and promotion of exports as an economic measure, a plan to recover LPG from refinery gas and associated gas is being implemented in Burma as a national policy.

2) LPG Recovery Project

Regarding this LPG Recovery Project, the Petrochemical Industries Corporation (PIC) drafted a 'Project Proposal for Integrated LPG Project' on May 4, 1981, announcing the profitability of this project. Its proposal suggested implementation of an 'Integrated LPG Project' for LPG recovery, extraction, collection and shipment.

3) Dispatch of Feasibility Study Team

Prior to dispatching a feasibility study team to Burma to sound out the feasibility of this project, the Japan International Cooperation Agency (JICA) dispatched a preliminary survey team consisting of six members led by Mr. S. Kishida from August 22 to 27, 1981, and held discussions with the Burmese side on the scope and schedule of the feasibility study. As a result, both parties mutually exchanged the "Minutes of the Meeting on the Feasibility Study on the Integrated Liquefied Petroleum Gas Project in the Socialist Republic of the Union of Burma," dated August 26, 1981.

Based on these "Minutes," JICA dispatched to Burma the present survey team consisting of eight members headed by Mr. A. Hijikata from September 26 to October 15, 1981.

Incidentally, the scope of the present feasibility study was limited only to Phase I – Part 2 and Phase II of the project, in accordance with the provisions of the aforementioned 'Minutes.'

2. Objective of the Survey

The objective of the survey is to investigate the feasibility of Phase I – Part 2 and Phase II of the Burmese LPG Recovery Project, and specifically involves survey of the following items:

1) Study on the potential supply of LPG materials (reserves and production).

2) Demand for LPG.

3) Study on the scale and configuration of LPG recovery plants.

4) Study on the sites for construction of LPG recovery plant.

5) Study on the means of transportation of LPG materials and products.

6) Study on the means of transportation of machinery, equipment and materials at time of construction.

7) Study on machinery, equipment and materials for plant construction.

8) Study on the dispatch of supervisors for construction and test run.

9) Study on construction schedule.

10) Study on plan for operation of LPG recovery plants.

11) Study on related infrastructures.

12) Study on plan for construction of LPG recovery plants.

13) Estimation of required capital investment.

14) Financial evaluation of the project.

15) Economic evaluation of the project.

3. Composition of the Survey Team

The survey team was composed of the following members:

Team leader:	Mr. Akifumi Hijikata
Assistant leader:	Mr. Kuniaki Kudo
Project manager:	Mr. Masatoshi Harada
Civil engineer:	Mr. Akira Nagumo
Economist:	Mr. Yasuhiro Kuriyama
Industrial engineer:	Mr. Yasuki Murakami
Process engineer:	Mr. Masahide Furuzono
Industrial economist	Mr. Shojiro Mori
Advisor:	Mr. Junsaku Koizumi

4. Itinerary of the Survey Team

Sep.	26th (Sat)	Arrived at Rangoon by TG-305. Had discussion with Burmese side.
	27th (Sun)	Had discussions among members.
	28th (Mon)	Paid courtesy call on the Japanese Embassy in the morning, had discussions with the Burmese side (PIC and TSC) in the afternoon.
	29th (Tue)	Had disucssions with Burmese side (PIC, TSC and MOC).
	30th (Wed)	(Same as above)
Oct.	1st (Thu)	(Same as above)
	2nd (Fri)	Surveyed Syriam Refinery (accompanied by PIC and TSC members).
	3rd (Sat)	Surveyed the candidate site for construction of Syriam LPG Terminal, also existing jetties.
	4th (Sun)	Had discussions among members.
	5th (Mon)	Went to Malun to survey the Mann area (accompanied by PIC and TSC members).
	6th (Tue)	Surveyed Mann Refinery, candidate site for constructon of Mann LPG Terminal, and jetties.
	7th (Wed)	Surveyed the Mann oil field and candidate site for construction of Mann GOCS LPG Extraction Plant. At Malun, visited Matsushita Electric's Factory, also visited the Malun Refinery.
	8th (Thu)	Removed from Malun to Rangoon.

Oct.	9th (Fri)	Had discussions with Burmese side (PIC and TSC).
	10th (Sat)	Had discussions among members and prepared an inerim report.
	11th (Sun)	(Same as above)
	12th (Mon)	Had discussions with Burmese side (PIC and TSC) in the morning, and went to the Japanese Embassy to offer a general report on the field survey in the afternoon.
	13th (Tue)	Had disucssions with Burmese side (PIC and TSC).
	14th (Wed)	Had discussions with PIC and received Burmese answer to the questionnaire prepared by the survey team.
	15th (Thu)	Submitted interim survey report to PIC in the morning. Departed from Rangoon by TG-306 flight in the afternoon.

5. Summary of the Present Survey

1) Burma's LPG Recovery Project may be summarized as shown in the following table:

Phase	Outline of Plan	LPG Output	Commencement of Implementation
Phase I -- Part 1	Construction of coking plant (5,200 BPSD) at Syriam Refinery	8,000 T/Y	1981/82
Phase I -- Part 2	Construction of LPG terminals at Mann and Syriam Construction of river barges (500 T x 4 units) for transporting LPG from Mann to Syriam	18,000 T/Y (from Mann Refinery)	1981/82
Phase II	Construction of LPG extraction plant (24×10^6 SCFD) at Mann GOCS	30,000 T/Y (2,900 T/Y of gasoline materials)	1982/83
Phase III	Construction of LPG extraction plant (each 12×10^6 SCFD) at Chauk, Ayaoaw and Shwepyitha Construction of river barges for each extraction plant for transporting LPG from gas fields to Syriam Terminal	25,000 T/Y (and gasoline materials)	1983/84

2) Reserves of Feedstock Gas

The locations of LPG production in this project are Syriam Refinery, Mann Refinery and Mann GOCS. Accordingly, a survey was made of the reserves of crude oil/associated gas in the Mann area. Findings confirmed that the estimated reserves of associated gas in the Mann area were fully capable of supplying the quantity of feedstock gas required by these LPG extraction plants, and that both Syriam and Mann Refineries are advancing crude oil processing plans which are fully capable of meeting the needs of the LPG recovery plan.

3) Demand for LPG

The demand for LPG in Burma is presently about 700 T/Y, but the plan is to expand the domestic consumption of LPG henceforth by factories, hospitals, hotels and other public facilities.

Following discussions with the Burmese side, the domestic demand for LPG in Burma in the present feasibility study was assumed to 3,000 T/Y, which is the specific target of the LPG consumption expansion plan now in progress. Also, since LPG for domestic consumption is to be shipped by utilizing the facilities of Mann Refinery presently under construction, this quantity was excluded from the sphere of this feasibility study.

Consequently, 53,000 T/Y out of the entire quantity LPG to be produced at Mann Refinery, Syriam Refinery and Mann GOCS, are the quantity of LPG to be dealt with in the present feasibility study, all of which is intended for export.

4) By-products

Mann GOCS LPG Extraction Plant will produce 6,850 x 10^6 SCF/Y of lean gas and 2,900 T/Y of gasoline materials as by-products. Lean gas is to be piped back to Mann GOCS where it is to be utilized in the same manner as natural gas. Meanwhile, gasoline materials are to be diverted for export since Burma plans to export motor spirit upon commencement of operation of Mann Refinery.

5) Selection of Construction Sites

The construction sites for the respective facilities were selected as follows:

(1) Syriam Terminal:

Syriam Terminal will be constructed near the existing Syriam jetties since it is designed to export LPG and receive LPG from Mann Terminal and Syriam Refinery.

(2) Mann Terminal:

Mann Terminal will be constructed in theneighborhood of Mann oil-products terminal located near the Mann jetties in view of its need to receive LPG from Mann Refinery and Mann GOCS, and to control the operation of Mann Terminal.

(3) Mann GOCS LPG Extraction Plant:

This LPG extraction plant will be constructed within the compounds of Mann GOCS in view of its need to receive feedstock gas from Mann GOCS and to ship out by-product gas.

6) Means for Transportation of LPG and Other Products

The following means of LPG transportation were selected in consideration of the construction sites of the respective LPG production facilities:

Produced at	Destination	Transport by	Volume to be handled (T/Y)	Remarks
Syriam Refinery	Syrian Terminal	Pipeline	LPG 8,000	
Mann Refinery	Mann Terminal	Pipeline	LPG 15,000	
(Mann Refinery)	For domestic consumption	Cylinder	(LPG 3,000)	Not converted by present survey
Mann GOCS	Mann GOCS LPG Extraction Plant	Pipeline	Associated gas $7{,}920 \times 10^6$ SCF/Y	
Mann GOCS LPG Extraction Plant	Mann GOCS	Pipeline	Lean gas $6{,}850 \times 10^6$ SCF/Y	

Produced at	Destination	Transport by	Volume to be handled (T/Y)	Remarks
Mann GOCS LPG Extraction Plant	Mann Terminal	Pipeline	LPG 30,000	
Mann GOCS LPG Extraction Plant	Mann oil products terminal	Lorry	Gasoline materials 2,900	
Mann Terminal	Syriam Terminal	River barges	LPG 45,000	
Syriam Terminal	Export	Ocean tanker	LPG 53,000	

7) Scales of Terminals and LPG Extraction Plant

The scales of the terminals were determined by taking into account the volumes of LPG to be handled, while the capacity of the LPG Extraction Plant was determined from the potential supply of feedstock gas, as shown in the following table.

Facility	Scale
Syriam Terminal	C_3 LPG spherical tank: 1,000 m^3 x 4 units C_4 LPG spherical tank: 1,000 m^3 x 1 unit 2,000 m^3 x 3 units C_3 LPG shipping pump: 150 m^3/H x 3 units C_4 LPG shipping pump: 150 m^3/H x 3 units
Mann Terminal	C_3 LPG spherical tank: 800 m^3 x 2 units C_4 LPG spherical tank: 1,000 m^3 x 1 unit 2,000 m^3 x 1 unit C_3 LPG shipping pump: 100 m^3/H x 3 units C_4 LPG shipping pump: 100 m^3/H x 3 units
Mann GOCS LPG Extraction Plant	24 x 10^6 SCFD (Volume of gas to be processed)

As regards utility facilities, they will be constructed only where it is impossible to obtain necessary utilities from nearby existing facilities (Syriam Refinery, Mann Refinery or Mann GOCS).

Also Syriam Terminal was designed with an ultimate LPG handling capacity of 78,000 T/Y at the stage of completion of Phase III of the project, from the aspects of both economy and operational safety.

8) River Barges for LPG Transportation

Regarding the river barges for transportation of LPG (45,000 T/Y) from Mann Terminal to Syriam Terminal, the construction of four barges, each having a carrying capacity of 500 tons, was determined by taking into consideration the LPG collection and shipping schedule and the number of days required for barge navigation.

9) Auxiliary Facilities

The following are included among auxiliary facilities: waste water treatment facilities, firefighting systems, communications systems, pipelines, housings, maintenance equipment and tools, analyzing instruments, safety and protection systems and equipment, flarestack systems, spare parts (two years' stock), and construction machinery and equipments.

10) Required Construction Cost

The required construction cost is estimated as follows:

	Foreign Currency Portion (1,000 ¥)	Local Currency Portion (1,000 K)
Phase I – Part 2		
Mann Terminal	1,220,000	11,686
Syriam Terminal	2,985,000	
River barges	1,800,000	-
Construction machinery	760,000	21,560
Transportation and insurance	560,000	3,889
Contingency	336,250	1,857
Sub-total	7,691,250	38,992

	Foreign Currency Portion (1,000 ¥)	Local Currency Portion (1,000 K)
Phase II		
Mann GOCS LPG Extraction Plant	5,940,000	10,100
Construction machinery	235,000	17,530
Transportation and insurance	275,000	3,769
Contingency	322,500	1,580
Sub-total	6,772,500	32,969
Total	14,463,750	71,961

Note: 1) Interest incurred during the period of construction is not included in the amount.

2) The portion covered by local currency, does not include import duties for machinery and equipment.

3) The construction cost covered by foreign currency is based on the assumption that the Phase I -- Part 2 contract is signed on October 1, 1982, and becomes effective on January 1, 1983; that the Phase II contract is signed on October 1, 1983, and becomes effective on January 1, 1984; and that the delivery date for each Phase of the project is 24 months after the respective contracts become effective.

11) Feedstock Gas Procurement and LPG, By-product Selling Prices

Based on discussion with the Burmese side and as a result of detailed studies conducted by the survey team, the feedstock gas procurement price as well as the LPG and by-product selling prices were determined as shown below:

Item	Price	Pricing Based on	Remarks
LPG (for domestic use)	US$60/T	Current price of kerosene in Burma.	This is the price for LPG procurement from Mann and Syriam Refineries in this project.
Associated gas	1.05K/10^3 SCF	The same price PIC is now paying to MOC.	This is the price for procurement of feedstocking from Mann GOCS LPG Extraction Plant.
LPG (for export)	US$170/T	The LPG FOB Rangoon price was adopted the mean price of supposed destinations which would be competitive with the price of Middle East LPG.	For reference, the FOB price Rangoon by destination is: Japan: US$121/T South Korea: US$136/T Taiwan: US$170/T Philippines: US$179/T Hongkong: US$200/T Singapore: US$260/T
Lean gas	1.05K/10^3 SCF	The same price as that of associated gas.	
Gasoline materials	US$295/T	Estimated as equal to FOB price Singapore.	This is the delivery price of Mann oil products terminal.

12) Financial Evaluation

The financial evaluation of this project was made on the basis of the following preconditions:

(1) Project Life (Economic Life Span)

The project life of the respective phases of the project was determined as follows on the assumption that both Phase I – Part 2 and Phase II of the project would be completed at the same time:

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

(2) Foreign Exchange Rate

The foreign exchange rate of US$1.00 = ¥231 or 7.58 kyat, which was the mean rate during the month of September 1981, was adopted in this financial evaluation.

(3) Fund Procurement Plan

It was assumed that the foreign currency portion of the funds required for project implementation would be procured through a long-term inter-governmental loan under the following conditions:

Interest per annum: 2.25%

Method of repayment:
Repayment of principal and interest in uniform semi-annual installments

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

(4) Depreciation

The straight line method is adopted for depreciation. All machinery and equipment are depreciated in twenty years, with 10% salvage value. The depreciation period for commissioning cost, pre-operation cost, working capital and interest incurred during the construction period, was fixed as five years, without residual value.

(5) Contribution to State (Corporation Tax)

The contribution to state was fixed at 30% of the taxable income, in conformance with the Burmese taxation system.

The results of financial evaluation conducted on the basis of the preconditions described above gave the following:

Internal rate of return on invested capital (IRROI):	3.52%
Internal rate of return on equity (IRROE):	25.04%

From these results of analysis, the present project can be defined as follows:

1) While the IRROI index, which is the profitability indicator for the project itself, is 3.52% and not so high, it indicates that the project is profitable.

2) The IRROE index, the profitability indicator for the capital invested by PIC in this project, is 25.04%. This index is calculated on the basis of the estimated amount of PIC's owned capital (equity) and on the terms under which the funds necessary for implementation of this project are procured, and is therefore liable to change according to specific loan conditions.

That is, although the profitability of the project iself may not be so high, the implementation of this project will be sufficiently feasible as long as necessary funds can be procured at the extremely low interest rate and long repayment period as assumed in this project.

13) Economic Evaluation

The financial evaluation of this project was briefly described in the above section. However, it will be vitally important to study several other factors not taken up in the financial evaluation, in order to fully grasp the true nature of this project. These factors are:

(1) Influence of the project on the improvement of national living standards and economic development through expansion of the domestic LPG market

Of the total LPG output of 56,000 T/Y, only 3,000 T/Y are intended for domestic consumption, with the remaining 53,000 T/Y earmarked for export. This plan emerged from the consideration that the domestic LPG market has not yet been amply developed in Burma. In this respect, PIC the executing

agency of this LPG recovery project is engaged actively in the expansion of the domestic LPG market by promoting conversion from other fuels to LPG consumption by industrial plants, hospitals, schools and other public facilities as well as general households.

Realization of this fuel conversion strategy will be attended with a conspicuous improvement of national living standards, effective utilization of timber resources of their increased export, brisker export of oil products, and exert district influences on the country's economic development.

(2) Influence of the price for purchasing LPG from Mann and Syriam Refineries on the project profitability

The price for purchasing LPG from Mann and Syriam Refineries was set at the anticipated domestic market price of US$60/T following deliberations with the Burmese side (PIC), and financial evaluation 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 used partially as fuel by these refineries, and the remainder flared off wastefully or shipped to power plants and other facilities for use as fuel, resulting in LPG of extremely low added value.

As observed from this viewpoint, the aforementioned LPG purchasing price appears to deserve reconsideration. For example, if the LPG purchasing price was assumed to be the same as that of natural gas or associated gas, or K1.05/1,000 SCF, then the LPG purchasing price will be US$5.5/T in calorific equivalent.

Depending on one's way of thinking, this may be made the LPG purchasing price, in which case (US$5.5/T) the IRROI index will be improved from 3.52% to 5.12%, as has been confirmed by calculation.

(3) Evaluation of Entire Integrated LPG Recovery Project Inclusive of Phase I – Part 1 & 2, Phase II and Phase III

The present project comprises only a part of the entire Integrated LPG Recovery Project. Accordingly, when making a financial evaluation of the present project, it will be imperative to make a financial evaluation of the integrated project as a whole, in order to firmly grasp the true nature of the present project.

Since Phase I – Part 1 lies outside the scope of the present project, data supplied by PIC and data presumed by the survey team were adopted as the basic data for making an economic evaluation of this phase of the project. On the other hand, since Phase III also lies outside the scope of the present project, and since data relating to vital factors such as composition of feed-stock gas (natural gas) and plant site were unavailable, this phase of the project was excluded from the scope of the economic evaluation.

Calculating the IRROI index for the entire project on the basis of these preconditions gave an index of 26.01%. This index indicates that the project as a whole displays a high profitability, and that the present project assumes a vital role of providing the infrastructures necessary for the project as a whole.

(4) Influence of the Project on Burma's Foreign Currency Revenue

Burma's international balance of payments is characterized by an unfavorable balance of trade. An analysis of the inflow and outflow of foreign currency from the project showed that the total 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.

(5) Effect of Technology Transfer Through the LPG Recovery Project

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 enormous 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 propsoed Integrated LPG Recovery Project is expected to benefit Burma conspicuously by way of upgrading industrial technology and the technical aptitudes of citizens in general, specifically through:

a) Acquisition of pressurized LPG producing technology.

b) Acquisition of pressurized LPG handling technology.

c) Stimulation of domestic demand for LPG, which will lead to:

* Development of LPG-fired boiler systems.
* Development of LPG-fueled household burners.
* Promotion of wider use of industrial systems and equipment utilizing LPG.

(6) Effect of the Project to Promote Employment

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

6. Conclusion and Recommendations

1) Conclusion

The implementation of both Phase I – Part 2 (construction of LPG terminal) and Phase II (construction of LPG extraction plant) of the project is endorsed and justified by the results of this survey, although the IRROI is not so favourable.

2) Recommendation

(a) Construction Plan

In order to implement this project on schedule and to operate smoothly, following efforts should be made by the time when the construction works start;

- o Completion of Phase I – Part 1 (Syriam Refinery coking plant) by completion of this project
- o Survey of the site conditions
- o Installation of the power transmission lines
- o Securing ships for transportation of machinery, equipments and materials
- o Repairing Syriam No. 1 Jetty
- o No change of site location
- o Procuring required local materials timely, to keep construction schedule as originally planned

(b) Management Control

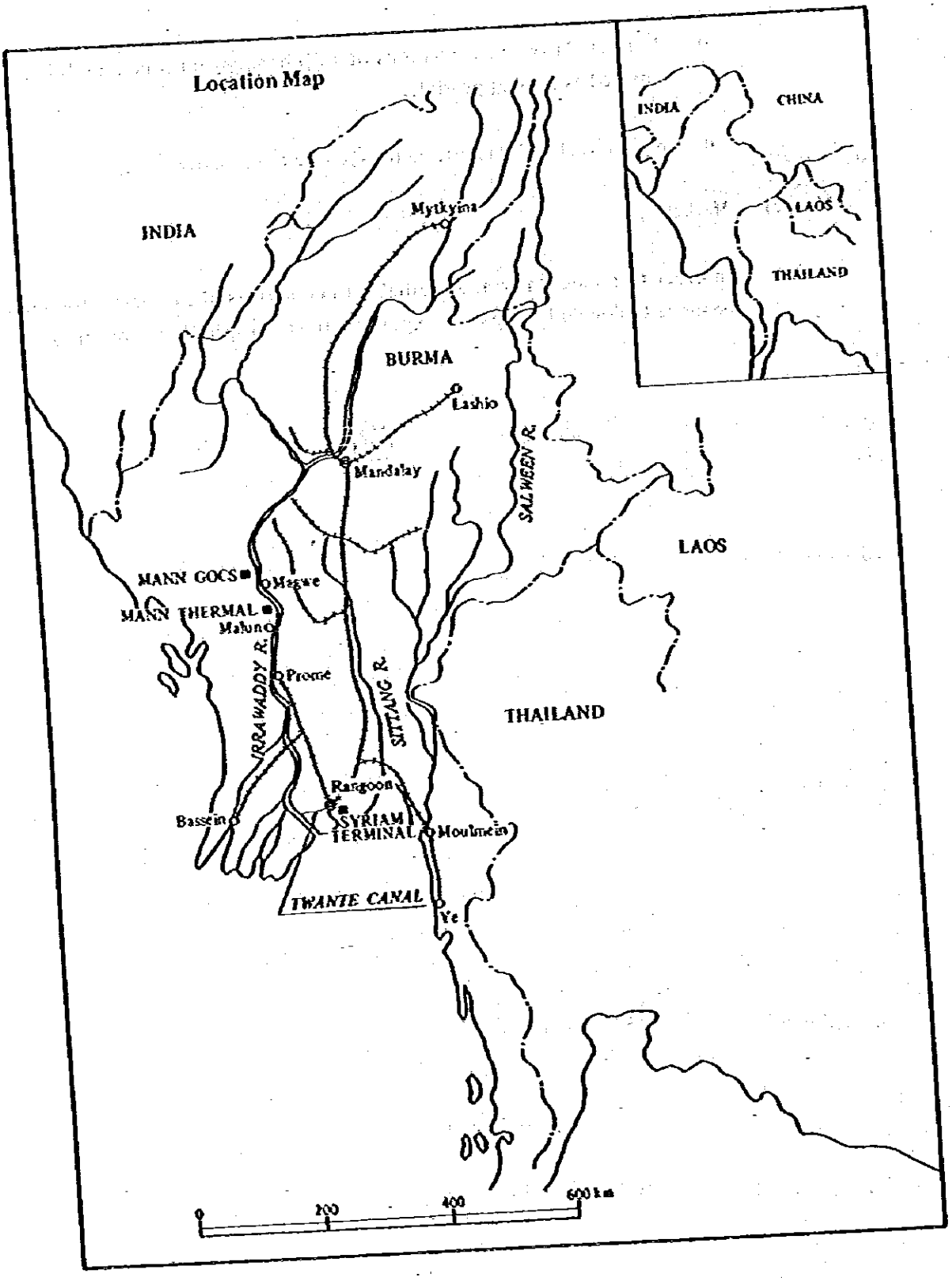
- o LPG receiving and shipping at Terminals must be controled strictly in accordance with schedule.

- Burmese laws and regulations of LPG handling must be established and enacted as soon as possible.

- Skilled technicians must be fostered by the time required.

(c) Marketing

In order to secure stable and profitable LPG markets, the utmost efforts must be made to conclude long-term export contracts with adjacent countries.


Location Map
INDIA
CHINA
LAOS
THAILAND
INDIA
Myitkyina
BURMA
Lashio
Mandalay
SALWEEN R.
LAOS
MANN GOCS
Magwe
MANN THERMAL
Malun
IRRAWADDY R.
Prome
SITTANG R.
THAILAND
Rangoon
Bassein
SYRIAM TERMINAL
Moulmein
TWANTE CANAL
Ye
0
200
400
600 km