6.1.2 Design Policy

(1) Stream factor

The annual number of days of operation of Kyangin LPG Extraction Plant is set to be 330 days.

(2) Process

The extraction process, refrigerated absorption method similar to that adopted in Mann GOCS LPG Extraction Plant in Phase II is adopted in this project. Since C_3 LPG and C_4 LPG are produced separately in this process, a de-propanizer is provided for separation of these LPG fractions. In designing the processing system and equipment, related JIS Specifications, Laws Governing Pressurized Gases and Fire Prevention Laws are applied.

This time, the Burmese side requested to improve recovery rate of C_3 LPG as much as possible and to study expander method for appling to this project.

As LPG recovery process, flash separation method, absorption separation method by oil, adiabatic expansion method are generally adopted. Proper process is selected in due consideration of recovery rate, equipment cost and running cost upon feedstock gas conditions.

In the absorption separation method by oil, software know-how such as multi-step absorption system, gas circulation recovery system and selection of operation conditions (low temperature, high-pressure, increase in amount of absorption liquid, type of absorption liquid) and hardware know-how such as increase in number of trays of absorption column, adoption of highly efficient tray are considered as improvement measures of recovery rate of C_3 LPG. Low temperature in operation can be obtained by using some refrigeration system and expander system.

In this planning, process and equipment were selected upon the respective points described above, and recovery rate of C_3 LPG will be attained to be 90% and that of C_4 LPG to be 99%.

The expander system is studied with prior condition, and then advantage and disadvantage are cleared by comparison with refrigerated absorption method. The

results of studies are given in Appendix-III. In the Kyangin LPG Extraction Plant, no large difference is in the future economy because the plant scale isn't large, however, there are judged from the standpoints of maintenance and control, operation ease, adoption of expander system is not appropriate.

(3) Tanks

As the LPG Extraction Plant site and Kyangin LPG Terminal site are apart in this project, product tanks are installed in the extraction plant site. Products are planned to be transported everyday, and 2 tanks of 200 m^3 each for C_3 LPG and 2 tanks of 250 m^3 each for C_4 LPG are to be installed considering cushion effect. However, 1 tank of 500 m^3 for LPG SLOP is to be installed for storage of off-specified LPG for startup and shutdown needs.

The feed gas and lean gas are directly received and shipped by pipeline without tanks, however, one tank of 600 m^3 for naphtha is to be installed. The average inventory of naphtha is set to be 234 tons.

(4) Shipping facilities

C_3 LPG and C_4 LPG are transported to Kyangin LPG Terminal at a flow rate of 2 ~ 3 m/s by pipeline by using each shipping pumps.

Loading pumps are also provided in the plant for transfer of naphtha product, and the naphtha product are directly transfered at a flow rate of 2 m/s by pipeline to the oil barges via the Kyangin LPG Jetty.

While low-pressure lean gas is transferred by newly installed pipeline under self-pressure from the plant to users. High-pressure lean gas is pressurized more by compressor and transferred by connecting the newly installed pipeline from the plant and existing associated gas line and methanol plant feed gas line at the Htantabin Gas Control Station.

(5) Utility facilities

Electricity in the utilities required in the LPG Extraction Plant is supplied from outside and new facilities for other required utilities are to be installed in the plant.

Water and nitrogen out of utilities required in the Kyangin LPG Terminal are supplied from the utility facilities in the LPG Extraction Plant.

Drinking water and electricity to be used in the residential area for operators and managers of the LPG Extraction Plant and LPG Terminal are supplied from the utility facilities in the LPG Extraction Plant.

(a) Electricity

Electricity is supplied from the Myanaung Power Station. As for details, see electric supply facilities plan. Then here considered is a power receiving/ distribution system in the plant.

(b) Water

Water to be used in LPG recovery project in Kyangin area is taken from the Irrawaddy River by the Water Intake Pump installed on the Kyangin LPG Jetty and purified by flocculating process to become water for industrial use. Volume of water consumed is 170 tons/hr. The facilities are composed of water processing, water supply and manufacturing facilities for drinking water. The cooling water is circulated and re-used. Then the water cooling system is to be installed and replenishing water is supplied.

(c) Fuel

By-product lean gas is used for fuel required in this plant. However, gas oil is used for emergency diesel generator.

(d) Instrument air

A new instrument air generation facility is to be installed.

(e) Nitrogen

Nitrogen gas necessary at the time of startup and shutdown for purging is supplied from a new nitrogen generation facillity to be installed.

(f) Waste water treatment facility

This is to be newly installed.

(6) Fire prevention and fire-fighting facilities

Since there are no Burmese domestic regulations governing fire prevention and fire-fighting facilities, these facilities are designed in conformance with related Japanese laws and regulations.

(7) Blowdown facility

As a safety measure for handling safety valve blow-off gas as well as for treating depressurized gas at the time of plant shutdown, a flare stack is provided for combustion and exhausion of discharged gas.

Provided that, gas out of a safety valve to be installed on the LPG Spherical type tank should be discharged from own stack into air.

(8) LPG cylinder filling facility

LPG for domestic use is filled mainly in Mann Oil Refinery, however, in due consideration of regional distribution to industries in the area, LPG cylinder filing facility is to be installed in the yard of the Kyangin Extraction Plant.

(9) Operational management

The Kyangin LPG recovery plant is to be controlled by an independent management organization. Plant operation is achieved by a 5-team, 4-shift system of shift workers and day workers for control, management business and main maintenance works.

A Control Room is provided in the LPG Extraction Plant and operation and management is made in this room. Laboratory is to be provided for test analysis business around the Control Room.

(10) Spare parts

Spare parts necessary for two years of operation are supplied.

6.1.3 Description of Facilities

(1) Process plan

Fig. 6-2 shows the block flow diagram of the LPG Extraction Plant designed on the basis of the conditions described in Section 5.2.1 and 6.1.2.

The Fig. also shows the raw material conditions of base case, production amount of products, quality property and LPG recovery rate.

The plant's design capacity is 50 x 10^6 SCFD, and variation in processing capacity is made to allow for fluctuation of feed gas property.

The following table shows the production balance.

	Feed gas composition	Processing capacity (10^6 SCFD)	LPG recovery rate
Case 1. Fig. 6-3	Standard base	50	Design base
Case 2. Fig. 6-4	Standard base	50	Reduction (LPG production volume fix base)
Case 3. Fig. 6-5	Htantabin 100%	50	Design base

The process flow of the plant is described below in accordance with Fig. 6-2.

(a) Compression section

The feed gas received from MOC at the plant's battery limit is pressurized from 28 kg/cm^{2}g to a pressure of 42 kg/cm^{2}g necessary for the following recovery process by means of a 2-stage compressor. This compressor is driven by the gas turbine that is fired with by-product lean gas.

(b) Dehydration section

The pressurized feed gas is dehydrated by means of dryers in order to prevent generation of hydrates in the subsequent absorption process. Two dryers are used for alternate adsorption of moisture and regeneration of adsorbent.

(c) Absorption section

The dehydrated feed gas is next cooled with a heat exchanger and a propane chiller for liquefaction and separation of its heavy fraction (C_5^+ fraction and a portion of LPG fraction), and the separated liquid is sent to the subsequent distillation section after recovering heat with a heat exchanger directly.

While the gas is induced into the absorption tower where it undergoes cross-contact with the absorption liquid (naphtha), by which its residual LPG fraction is extracted into the absorption liquid (naphtha) while the gas rises in the tower for discharge from the tower top as lean gas. The absorption liquid (naphtha) absorbing the LPG fraction is then sent to the distillation section.

(d) Distillation section

The distillation section consists of three towers, the de-ethanizer, de-butanizer and de-propanizer.

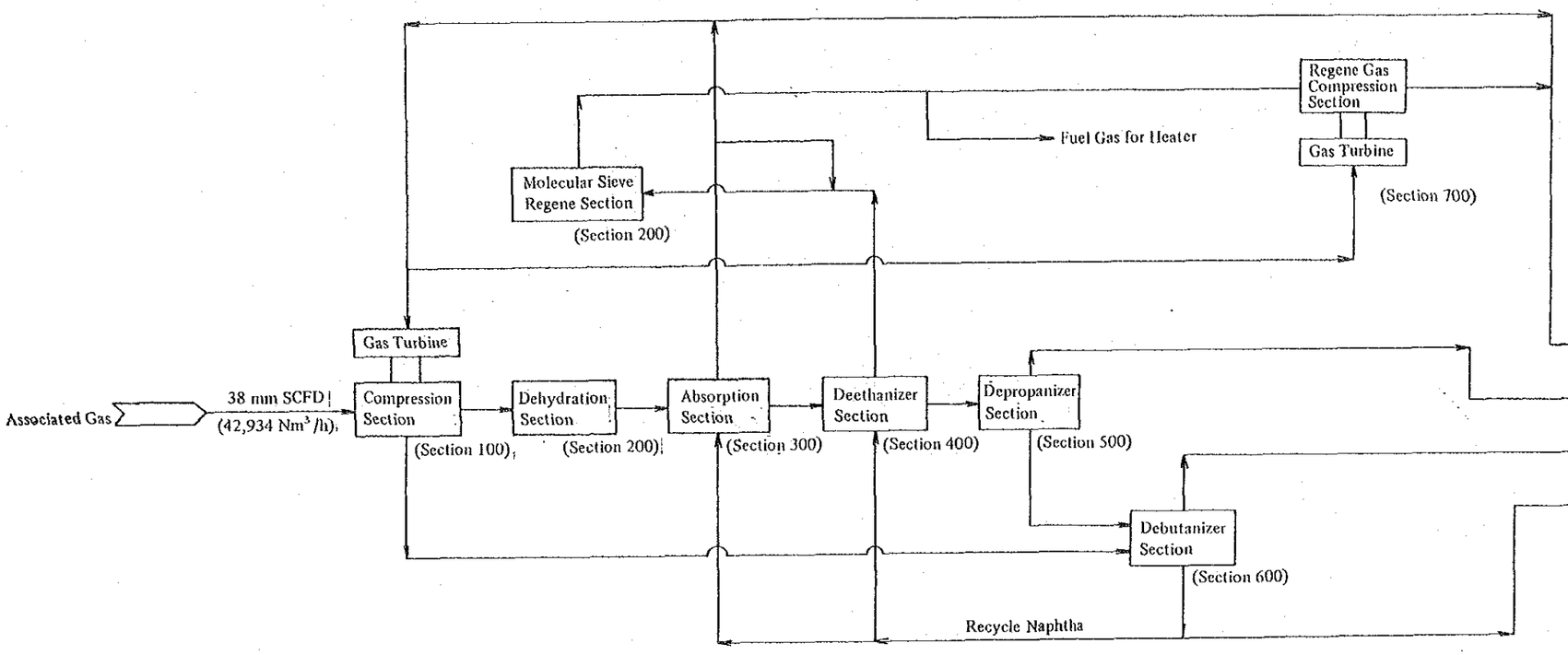
Naphtha sent from the absorption process after having absorbed LPG fraction as well as the heavy fraction (C_5^+ fraction and a portion of LPG fraction) liquefied by the propane chiller are induced into the de-ethanizer where C_1 and C_2 gas (lean gas) are separated at the tower top. The tower bottom liquid is sent to the debutanizer where LPG is separated at the tower top and naphtha at the tower bottom. A portion of the naphtha collected at the tower bottom is recovered as product while a portion of it, after being cooled by the heat exchanger is returned to the absorption tower and de-ethanizer tower top.

The LPG distillate generated at the de-butanizer tower top is sent to the de-propanizer for separation into C_3 LPG and C_4 LPG. The heat required by the three towers of the distillation section is supplied from the plant's Hot Oil System.

(e) Refrigeration section

C_3 LPG is used as the coolant by the absorption section chiller as well as by the condensers of the absorption tower and de-ethanizer. The C_3 LPG used in the refrigeration section is compressed by means of a motor-driven com-

Fig. 6-2 Block Flow Diagram : Base Case



Product Rate		
	kg/h (Nm^3/h)	ton/y (10^6 SCFD)
Lean Gas	(37,244)	(33.36)
C3 LPG	3,270	25,600
C4 LPG	4,432	35,400
Naphtha	405	3,208
Home Fuel Gas	(2,280)	(2.04)

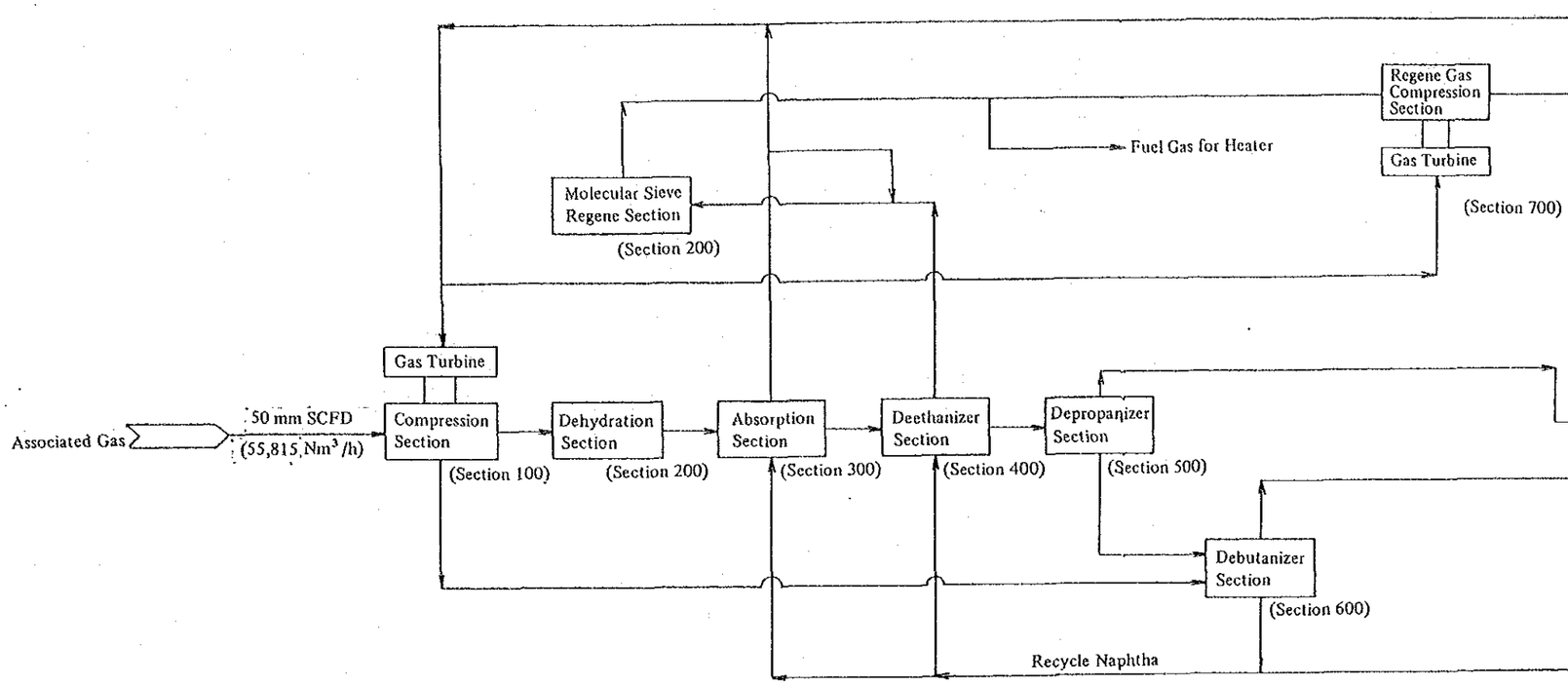
Remarks

1. Operation service factor : 330 days/year
2. Gas flow rate is shown at regenerating operation of molecular sieve.
3. Feed AG flow rate is dry base.
4. AG composition
   - N_2 : 0.00 mol %
   - O_2 : 0.00 mol %
   - CO_2 : 0.12 mol %
   - C_1 : 83.98 mol %
   - C_2 : 6.96 mol %
   - C_3 : 4.33 mol %
   - C_4 : 3.99 mol %
   - C_5 : 0.50 mol %
   - C_6+ : 0.12 mol %
5. Low heat value
   - Associated gas : 10.540 kcal/Nm^3
   - Lean gas : 9.196 kcal/Nm^3
6. LPG recovery rate
   - C_3 : 90%
   - C_4 : 99%
7. Lean Gas Composition
   - CO_2 : 0.13 mol %
   - C_1 : 91.63 mol %
   - C_2 : 7.43 mol %
   - C_3 : 0.45 mol %
   - C_4 : 0.02 mol %
   - C_5 : 0.31 mol %
   - C_6+ : 0.03 mol %
8. C3 LPG · C4 LPG Composition

	C3 LPG	C4 LPG	(mol %)
C_2	0.5		
C_3	99.0	1.0	
C_4	0.5	98.0	
C_5		1.0	

Reduced Operation
Feed Gas 38 MMSCFD

Fig. 6-3 Block Flow Diagram : Case 1



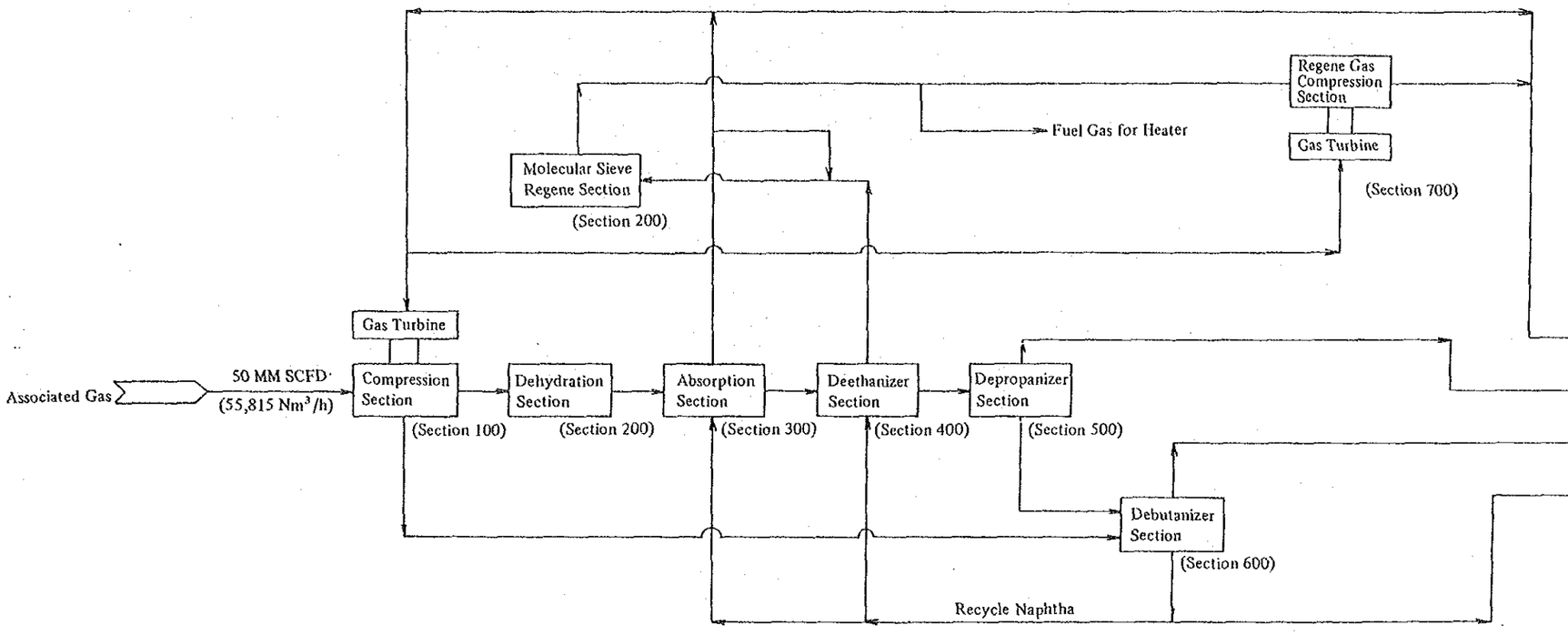
Product Rate		
	kg/h (Nm^3/h)	ton/y (10^6 SCFD)
Lean Gas	(48,378)	(43.34)
C3 LPG	4,302	34,072
C4 LPG	5,831	46,182
Naphtha	533	4,221
Home Fuel Gas	(2,850)	(2.55)

Remarks

1. Operation service factor : 330 days/year
2. Gas flow rate is shown at regenerating operation of molecular sieve.
3. Feed AG flow rate is dry base.
4. AG composition
   - N_2 : 0.00 mol %
   - O_2 : 0.00 mol %
   - CO_2 : 0.12 mol %
   - C_1 : 83.98 mol %
   - C_2 : 6.96 mol %
   - C_3 : 4.33 mol %
   - C_4 : 3.99 mol %
   - C_5 : 0.50 mol %
   - C_6+ : 0.12 mol %
5. Low heat value
   - Associated gas : 10.540 kcal/Nm^3
   - Lean gas : 9.196 kcal/Nm^3
6. LPG recovery rate
   - C_3 : 90%
   - C_4 : 99%
7. Lean gas composition
   - CO_2 : 0.13 mol %
   - C_1 : 91.63 mol %
   - C_2 : 7.43 mol %
   - C_3 : 0.45 mol %
   - C_4 : 0.02 mol %
   - C_5 : 0.31 mol %
   - C_6+ : 0.03 mol %

Feed Gas : 50 mm SCFD
Expected : Yield base

Fig. 6-4 Block Flow Diagram : Case 2



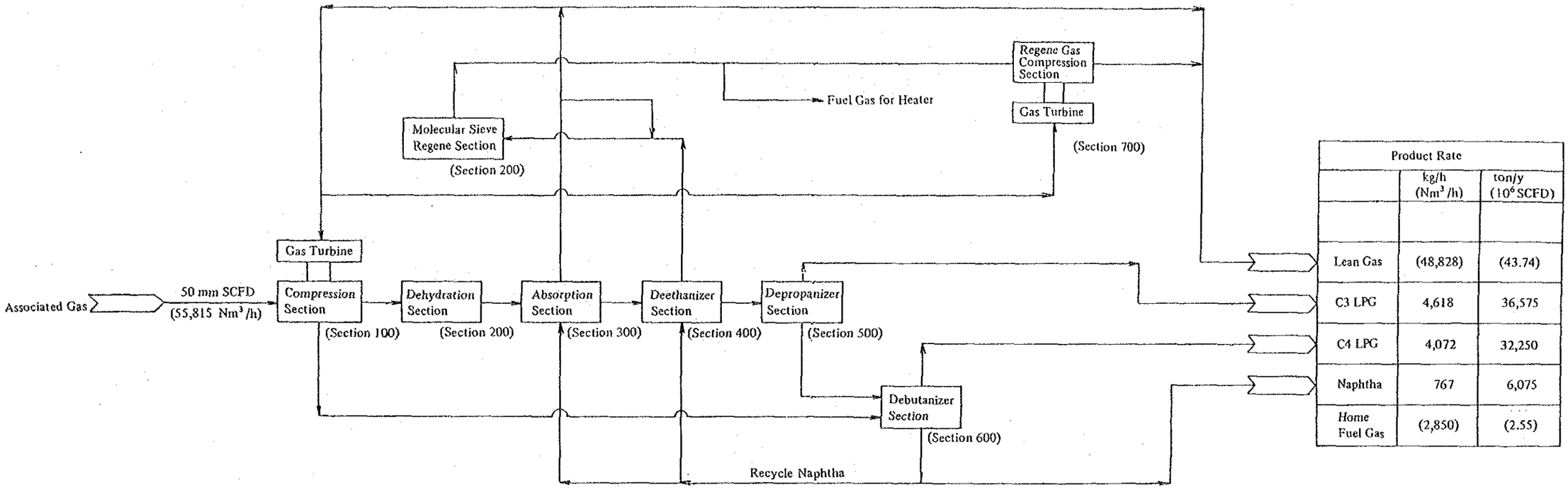
Product Rate		
	kg/h (Nm^3/h)	ton/y (10^6 SCFD)
Lean Gas	(49,442)	(44.29)
C3 LPG	3,270	25,898
C4 LPG	4,432	35,102
Naphtha	533	4,221
Home Fuel Gas	(2,850)	(2.55)

Remarks

1. Operation service factor : 330 days/year
2. Gas flow rate is shown at regenerating operation of molecular sieve.
3. Feed AG flow rate is dry base.
4. AG composition
   - N_2 : 0.00 mol %
   - O_2 : 0.00 mol %
   - CO_2 : 0.12 mol %
   - C_1 : 83.98 mol %
   - C_2 : 6.96 mol %
   - C_3 : 4.33 mol %
   - C_4 : 3.99 mol %
   - C_5 : 0.50 mol %
   - C_6+ : 0.12 mol %
5. Low heat value
   - Associated gas : 10.540 kcal/Nm_3
   - Lean gas : 9.335 kcal/Nm^3
6. LPG recovery rate
   - C_3 : 69%
   - C_4 : 76%
7. Lean gas composition
   - CO_2 : 0.13 mol %
   - C_1 : 89.66 mol %
   - C_2 : 7.28 mol %
   - C_3 : 1.50 mol %
   - C_4 : 1.09 mol %
   - C_5 : 0.31 mol %
   - C_6+ : 0.03 mol %

Feed Gas : 50 mm SCFD
Gas Source : Design base
Operation : Reduced yield

Fig. 6-5 Block Flow Diagram : Case 3



Product Rate		
	kg/h (Nm^3/h)	ton/y (10^6 SCFD)
Lean Gas	(48,828)	(43.74)
C3 LPG	4,618	36,575
C4 LPG	4,072	32,250
Naphtha	767	6,075
Home Fuel Gas	(2,850)	(2.55)

Remarks

1. Operation service factor : 330 days/year
2. Gas flow rate is shown at regenerating operation of molecular sieve.
3. Feed AG flow rate is dry base.
4. AG composition
   - N_2 : 0.00 mol %
   - O_2 : 0.00 mol %
   - CO_2 : 0.00 mol %
   - C_1 : 83.96 mol %
   - C_2 : 5.76 mol %
   - C_3 : 4.72 mol %
   - C_4 : 2.00 mol %
   - C_5 : 0.50 mol %
   - C_6+ : 0.16 mol %
5. Low heat value
   - Associated gas : 10.323 kcal/Nm^3
   - Lean gas : 9.137 kcal/Nm^3
6. LPG recovery rate
   - C_3 : 88%
   - C_4 : 99%
7. Lean gas composition
   - CO_2 : 0.00 mol %
   - C_1 : 92.96 mol %
   - C_2 : 6.10 mol %
   - C_3 : 0.57 mol %
   - C_4 : 0.02 mol %
   - C_5 : 0.32 mol %
   - C_6+ : 0.03 mol %

Feed Gas : 50 mm SCFD
Expected : Yield base

pressor, cooled with water, liquefied and recycled to the chiller and condensers.

(f) Hot oil system

The heat required by the three towers of the distillation section is supplied from the Hot oil system that uses gas oil as heat medium. This system is composed of the gas oil receiving tank, gas oil circulation pump, heating furnace and gas oil circulation line.

(2) Utility facilities

(a) Consumption of utilities and subsidiary materials requirement

The rates of consumption of various kinds of utilities as well as the volumes of subsidiary materials required by Kyangin LPG Extraction Plant are as follows.

1) Utilities — Assumed mean consumption rate

Electricity	3,100 kW
Water (for cooling tower)	100 tons/hr
Fuel gas	2,300 m^3 /hr
Instrument air	350 Nm^3 /hr

2) Subsidiary material requirement

Naphtha (initial charge)	150 k*l*
Gas oil (initial charge)	70 k*l*
Hot oil section	(30 k*l*)
Diesel generation section	(40 k*l*)
Refrigeration C_3 LPG (initial charge)	12 tons
Refrigeration C_3 LPG (loss supplementation)	8 tons/y
Cooling tower chemicals	
Aluminiumsulfate	340 kg/d
Polyelectryte	1.4 kg/d
Hypochloride	330 kg/d

(b) Utility facilities

The utility facilities to be installed in the LPG Extraction Plant and their capacity and specifications are shown below.

1) Power receiving/distribution facilities

Electricity is to be received from the Myanaung Gas Turbine Power Station through a single circuit exclusive-use transmission line of 66 kV. A substation is to be constructed alongside the Control Room for power receiving and distribution in the plant.

The principal design standards are as follows.

· Classification as a dangerous place:
In compliance with API PR-500

· Working voltage

Receiving voltage	66,000 V, 3ϕ, 50 Hz
For power under 150 kW	400 V, 3ϕ, 50 Hz
over 150 kW	6,600 V, 3ϕ, 50 Hz
For illumination	230 V, 1ϕ, 50 Hz
For instruments	100 V, 3ϕ, 50 Hz

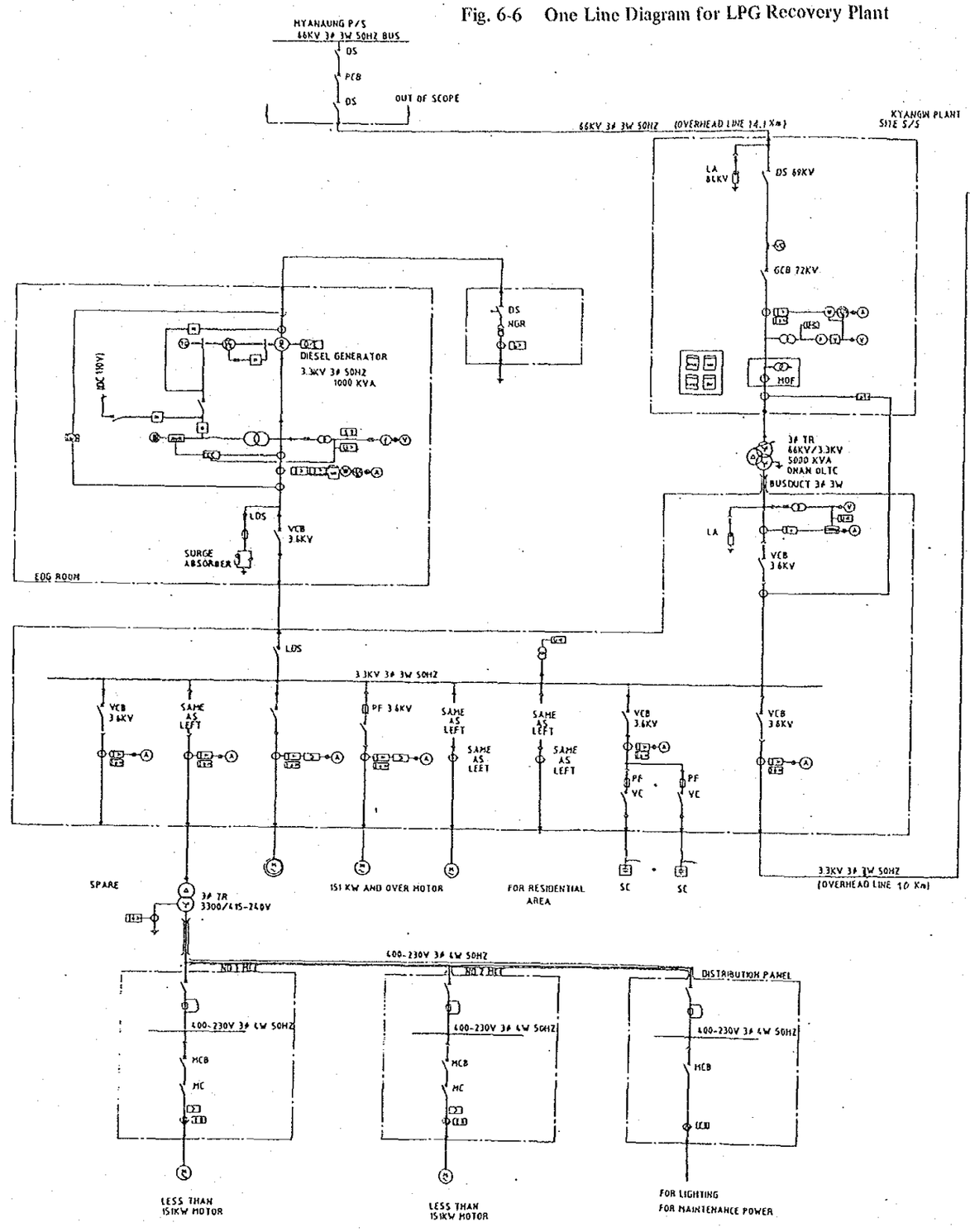
· Capacity of main transformer 5,000 kVA, 3ϕ, 50 Hz
primary 66,000 V
secondary 6,600 V,

Fig. 6-6 shows the on-line diagram of the substation. 3.3 kV feeders are to be provided for supplying electricity to the Kyangin Terminal and residential area.

2) Water processing facilities

The water taken from the Irrawaddy River is to be stored in the raw water tank and sent to the industrial water tank after being purified by the flocculating processing device and filtering device (sand filter). The processing capacity is 190 tons/hr. The industrial water is supplied to the plant site as replenishment water of the cooling water facilities and water for plant use, and supplied to the drinking water facilities.

Fig. 6-6 One Line Diagram for LPG Recovery Plant



LEGEND

Symbol	Mark	Description
	GCB	Gas circuit breaker
	VCB	Vacuum circuit breaker
	ACB	Air circuit breaker
	HCB	Holland gass circuit breaker
	FF	Power fuse
		Disconnector
		Vacuum contactor
	MC	Magnetic contactor
	TR	Transformer delta-star with neutral
		Diesel engine generator
		Induction motor
		Welding panel
		Lighting panel
		Exciter
		Tachometer-generator
		Watt-hour meter
		Wattmeter
		Varmeter
		Power factor meter
		Frequency meter
		Synchroscope
		Voltmeter
		Ammeter
		Automatic voltage regulator
		Cross current compensator
		Voltage relay
		Undervoltage relay
		Overvoltage relay
		Overcurrent relay
		Overcurrent ground relay
		Overcurrent relay for neutral
		Reverse power relay
		Short circuit line selective ground relay
		Temperature relay
		Fluid level relay
		Pressure relay
		Buchholz relay
		Frequency relay
		Speed relay
		Thermal relay
		Differential relay
		3E relay
		Earth fault relay
		Zero-phase-sequence current transformer
		Current transformer
		Potential transformer
		Battery
		Earth
	LA	Lighting arrester
		Inverter
		Converter

10 tons/hr of industrial water is supplied to the Kyangin LPG Terminal from here by means of pipeline.

3) Drinking water supply facilities

Water in the industrial water tank is pressurized by the pump and processed by adding chlorine, and supplied by pipeline. The processed water as drinking water supplied to the plant site and residential area at the feed rate of 20 tons/hr.

4) Cooling water facilities

The cooling water facilities of this plant are designed as a circulation system consisting of cooling water users (cooler, pump and compressor), a water cooling tower, circulating pumps and distribution piping are to be constructed. The capacity is set to be 2,500 tons/hr.

As the power source of the circulating pump, diesel type power gencrator and automatic startup diesel engine are used, a portion is electricity from the EPC. Thc make up water feed raete is set to be 100 tons/hr.

5) Fuel gas facility (2,850 Nm^3/H) (Max case)

Since by-product lean gas is utilized, the Fuel Gas Header System only is is used.

6) Instrument-air facilities (350 Nm^3/H)

Two instrument-air compressors each having a capacity of 600 Nm^3/H are to be installed. One is to be used for regular service. The compressors are also used for supplying air to the nitrogen generator. Two dryers are to be provided in the instrument-air section and used by change-over.

7) N_2 generation facility (100 Nm^3/H)

An adsorption type nitrogen generator is to be installed. It employs a system by adsorption and regenration cycle.

8) Emergency Power Gencrator facility (1,000 KVA)

A diesel engine driven emergency power generator having a capacity of 1,000 kVA is provided as power source in case of power failure. The generator is designed for automatic startup by receiving a voltage drop signal and is capable of attaining its rated voltage within one minute.

The emergency generator gives backup to the following equipment.

- Instrument-air compressors
- Instrument power source
- Emergency illumination system
- Cooling water circulation pump (one of the three)
- Auxiliary engine of the compressor and reflux pump

(3) Off-site facilities and auxiliary facilities

The following facilities are to be provided as ancillary facilities for this LPG Extraction Plant except the above utilities.

(a) Tank — Cushion tank for transportation of LPG product

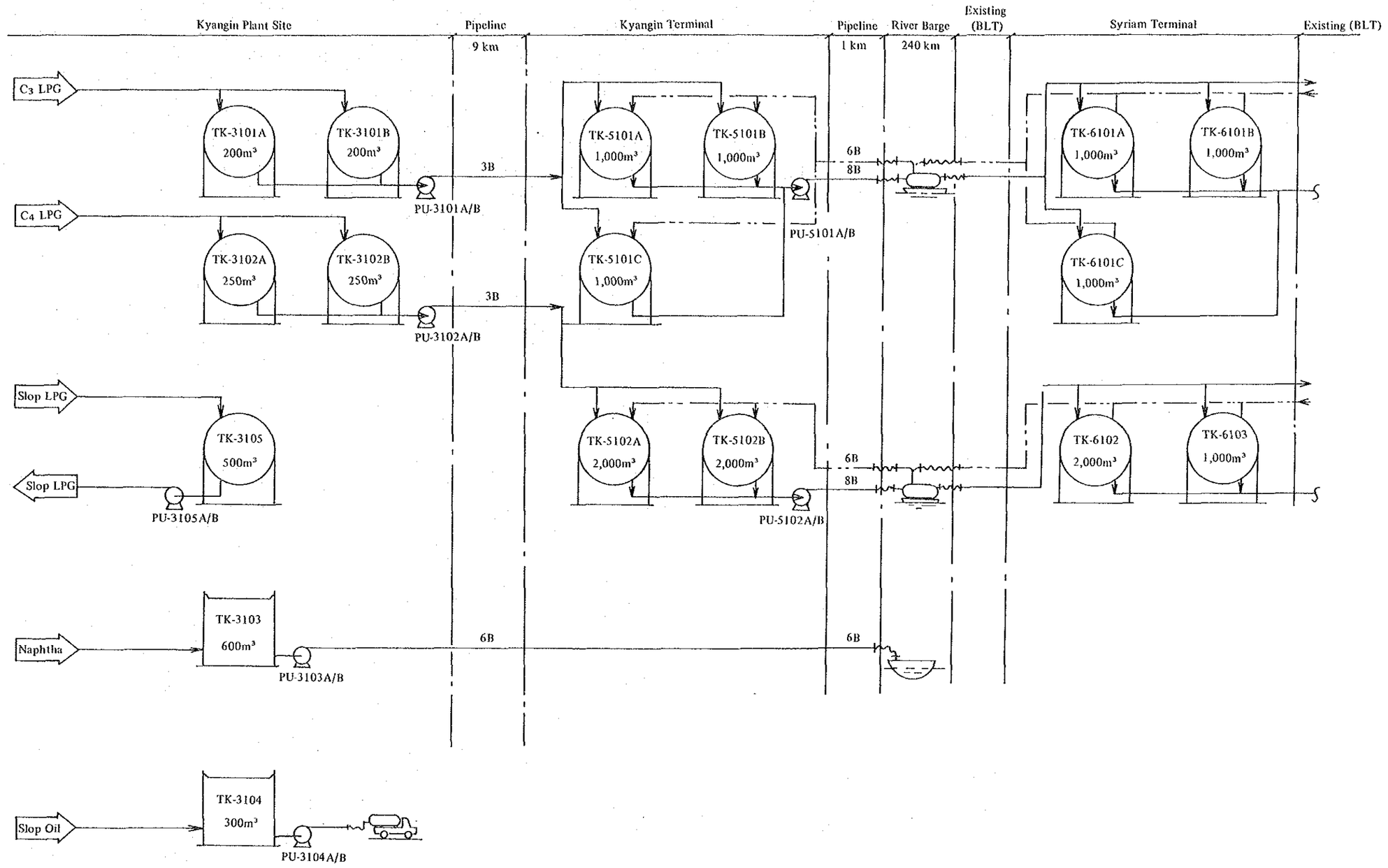
· C_3 LPG	Spherical type	200 M^3 x 2
· C_4 LPG	Spherical type	250 M^3 x 2
· LPG slop	Spherical type	500 M^3 x 1
	For receiving off-specification LPG	
· Naphtha	Floating type 600 M^3 x 1 for naphtha	
· Slop oil	Floating type 300 M^3 x 1 for slop oil	

(b) Shipping facilities

C_3 LPG is transferred to the receiving tanks by means of pumps and C_4 LPG and naphtha are by self-pressure from the plant respectively, and shipped by pipelines by means of transfer pumps. LPG is transferred to the Kyangin Terminal and naphtha is directly transferred to the Kyangin LPG Jetty's oil barges. Therefore pumps and piping only are necessary. Fig. 6-7 shows the process flow. Lean gas is separated into two types, one that is compressed by the compressor installed in the plant and transferred by pipeline.

(c) Waste water treatment facility

Fig. 6-7 LPG Phase III Tank Flow Scheme



The waste water discharged by this LPG Extraction Plant is comparatively clean, then simple gravity type oil/water separation is to be provided. The treated waste water and other clean waste water are to be discharged via Guard Basin.

(d) Blowdown facilities

The flare stack system is to be provided for blowdown facilities. The system consists of relief gas piping, flare stack, ignition facility, oil fraction transfer pump and ancillary piping. The flare stack is a water-sealing type, 40 m height and regular ignition system is to be employed.

(e) LPG cylinder filling facilities

Filling facilities of LPG cylinders of 400 kg, 50 kg and 25 kg are to be provided for C_3 and C_4 LPG.

(f) Fire prevention and fire-fighting facilities

To permit the Plant's water storage tank as the water source for fire-fighting facilities, sprinklers for sprinkling over the LPG tank are planned to be installed. Their water feed capacity is 600 tons/hr and driven by diesel engine. Two pumps of 300 tons/hr are to be installed. The volume of the storage tank is planned to be capable of continuous supply of water for more than 30 minutes.

(g) Maintenance shop

The machines and equipments are prepapred in the maintenance shop which are constructed by Burmese side as follows.

Maintenance equipment	Specification	Quantity	Remarks
1. Bench Drilling Machine	23 x 450 mm	1	
2. Lapping Machine	600 mm Lapping Plate Dia.	1	
3. Floor Grinder	355 mm	2	
4. Hydraulic Pipe Bender	4"	1	
5. High Press Jet Cleaner	300 kg/cm^{2}g, 100ℓ/min.	1	
6. Tube Cutter and Puller	19.0 25.4 mm	1	
7. Tube Expander & Controller	19.0 25.4 mm	1	
8. Cable Jointer	100 t	1	

6.1.4 Plant Plot Plan

Fig. 6-8 shows the plot plan of the LPG Extraction Plant in the site.

The following points are given due consideration when drafting the plot plan.

(1) Division of the plant compounds into the process region and utility facilities, tanks and shipping facilities, and management facilities are arranged around. Each region is planned to be encircled by roads.

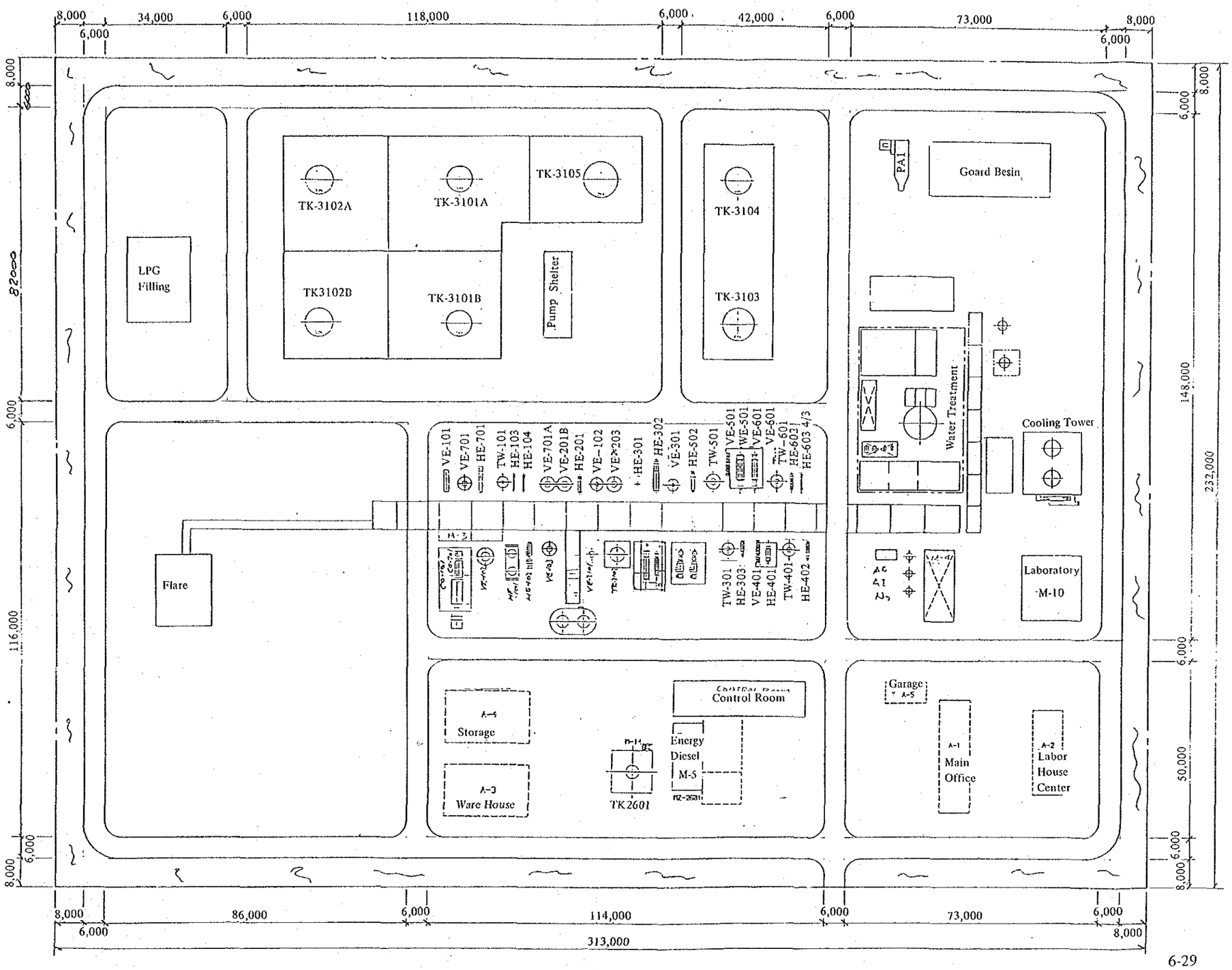
(2) The Control Room alongside the substation is planned to be installed in the utility facilities region.

(3) The heating furnace is arranged in the end of the plant site for safety and planned to be monitored from the Control Room.

(4) The process region and tank yard region are enclosed on all four sides with roads for ease of fire-fighting and maintenance operations.

(5) According to the conditions of the Burmese side, space between tanks is provided 30 m or more and green areas are provided along the site.

Fig. 6-8 Plot Plan of Kyangin Plant Site



6.1.5 Infrastructures

The following infrastructures excluding power transmission and tele-communication facilities are to be prepared by the Burmese side.

(1) Traffic

A single-track railway is laid on from Kyangin to Henzada and Bassein via Myanaung, and one train shuttles between them a day.

Along this railway, gravel roads of approx. 5 m wide is laid on from the Cement Mill to Myanaung via Kyangin on the Irrawaddy River. This road can be utilized for construction works. On 1.5 km down stream of the River from Kyanging is Pashin Greek, and the railway bridge is used for crossing. Since this bridge is old, heavy vehicles like dump trucks cannot use.

For Rangoon, ships can be utilized from the site to the MOC Ferry, Gwema on the Irrawaddy River, and next vehicles can be used for Prome to Rangoon by the national road. The time required is 6 – 7 hours including the time on ships.

The residents near the site go to Prome, principal town on the east side of the Irrawaddy River by ships, and get on buses or trains to Rangoon.

(2) Housing

New housing facilities shall be constructed for plant workers. The site for housing facilities should be near the Plant, the area adjacent to the east side of the residential area of the Cement Mill or the area of east of the Plant. The facilities are planned for 300 families, the average number of one family is assumed to be four. Markets, school, play grounds are planned to be constructed in the facilities.

(3) Water

The water to drink is supplied from the LPG Extraction Plant to the residential region. The water is fed by pumps by means of pipeline. The water supply capacity is 20 tons/hr.

(4) Electricity

The Myanaung Gas Turbine Power Station now in operation, at approx. 14 km from the Kyangin LPG Extraction Plant has a maximum supply capacity of 67.65 MW, and the present supply load is 32.4 MW.

Therefore it would have a surplus capacity even if 5,000 KVA were transmitted to the LPG recovery facilities. The Phase III Plant could receive electricity from this Power Station if a 66 kV new transmission line were constructed.

(5) Telecommunications

According to the Burma Telephone Communication Network Diagram, the Kyangin Microwave Repeater Station (PTC Kyangin) is situated near the LPG Extraction Plant. There are 4 channels of trunk line capacity available from Kyangin to Prome, and 2 to Rangoon. The waiting time for putting calls through from Rangoon to PTC Kyangin varies from 15 minutes to 4–5 hours depending on the condition of the line and the traffic. Under these conditions, it would be very difficult to make use of the existing facilities. We shall install anew necessary facilities. An automatic exchange must be installed as well as private telephones in the Kyangin LPG Extraction Plant for telecommunication.

There are installing wire telephones or power-line-carrier telephones in the Kyangin LPG Extraction Plant, Kyangin Terminal, Jetty, the residential area, MOC Myanaung, Kyangin Cement Mill, Seiktha Methanol Plant, Myanaung Gas Terbine Power Station, and PTC Kyangin for inter communication. A simplex SSB communication transmitter/receiver set is to be installed in the Kyangin LPG Extraction Plant, and also the Rangoon H.O. Paging facilities and general on-site broadcasting facilities are to be installed in the Kyangin LPG Extraction Plant.

6.2 Kyangin LPG Terminal

6.2.1 Design Conditions

(1) LPG receiving and shipping

Kyanging LPG Terminal's LPG receiving and shipping conditions are to be accomplished by the following Table 6-2. Both C_3 LPG and C_4 LPG are to be pressurized and stored and shipped in the form of LPG.

Table 6-2 Design Conditions of Kyangin LPG Terminal

LPG Receiving and Shipping	Volume Handled T/Y		LPG Transport System	LPG Condition	
	C_3 LPG	C_4 LPG		C_3 LPG	C_4 LPG
Receiving Kyangin Ext. Plant → Kyangin Terminal	25,600	35,400	Pipeline	Max. Vap. Pressure 14.6 kg/cm²g at 37.8°C	Max. Vap. Pressure 4.9 kg/cm²g at 37.8°C
Shipping Kyangin Terminal → Syriam Terminal	25,600	35,400	Riverbarge		
	61,000				

(2) Site conditions

1) Soil conditions

As shown in Fig. 6-9, the LPG Terminal is near the Jetty. The site for the Terminal is paddy field at present and area near the Jetty is grassy plain. The ground conditions are different, but the soil under the ground seems to be similar. As the plain area along the Irrawaddy River is assumed to be silty soil plain made of earth and sand carried by the flow of the river, the strata are considered to be horizontal. Judging from this point, observation on the bank facing the Irrawaddy River will help assumption of the strata under the ground of inland part. The bank on the river has a slope of 45°. At the time of this survey carried out at the end of dry season, the water level was considerably lowered, about 1.0 m over LML. The top height of the bank is SP + 21 m and the present water level was SP + 11 m, then the relative height is 10 m. According to the conditions of the soil on the cliff, the stratum of 9 m from the top of the bank consists of soft clay and the lower stratum does hard clay. When the concrete piles are to be driven, they will be stopped at this hard clay stratum.

That is, when this hard clay stratum of SP + 12 m is assumed to be the bearing stratum of the pile, a surplus length is added to the length of piles.

However, as the above is an assumption based on the results of observation, in actual design, the soil survey boring should be carried out and the length of piles should be determined.

2) Natural conditions

Water level

The Terminal site is to be located on the paddy field surrrounded by dike. The height of the ground is not clear as the level survey has not been performed, however, it may be SP + 20 m ~ SP + 21 m or so. The water level of the Irrawaddy River, the outside water level of dike is set to be SP + 23 m at maximum according to the data supplied by the Burmese side. Since the site is surrounded by the dike, the water level of the site does not become higher even if the water level of the river is up. However, if the higher water level continues for a long time, the water level in the area surrounded by dike is gradually up due to the water flowed from the upper stream area, and in the worst case, the water level there becomes the same as that of the river.

Therefore it is necessary to make the ground height of the terminal site at least the same as the height of the dike. Provided that, when the past maximum water level is found by the detail survey in the site, a surplus height of 1.0 m from the maximum level is assumed to be sufficient. The design conditions on earthquake, rainfall, wind, lighting and sandstorm are the same as those for the Kyangin LPG Extraction Plant in Section 6.1.1.

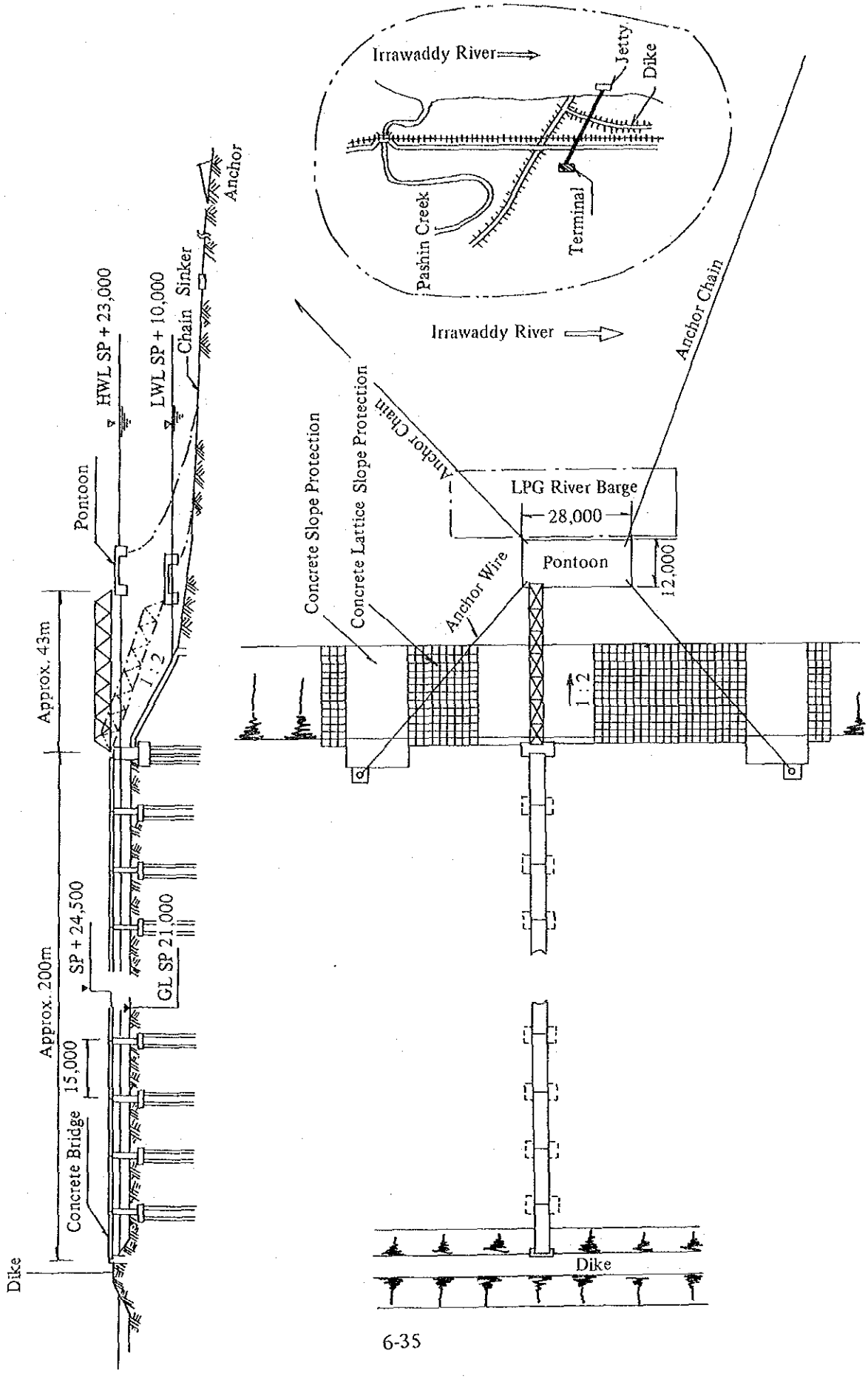


Fig. 6-9 Kyangin LPG Shipping Jetty

6.2.2 Design Policy

(1) Service factor

The service factor in connection with LPG receiving and shipping is set at 330 days/y.

(2) LPG tank

(a) The required LPG tank capacity is determined by means of the following formula.

$$Q = \frac{V \times D}{W \times \rho}$$

where Q : Required tank capacity (m^3)
V : LPG handling volume (tons/SD)
D : Number ofdays of storage (days)
W : Working factor (0.9)
ρ : Fluid specific gravity (tons/m^3)

(b) Number of days of storage

The number of days of LPG storage is determined as 15 days as planned in Chapter 5.

(3) Leagal restrictions

Tank height:
No specific regulations exist with respect to spherical tanks.

Distance between tanks: (same as above)
30 m should be taken as holding area by the request of the Burmese side.

Fire dike capacity:
Over 10% the capacity of the other tank in the dike + the maximum tank in an integrated fire dike.

(4) Tank configuration

The spherical tank configuration is adopted in view of the handling of pressurized LPG.

(5) LPG receiving and shipping facilities

The capacities of LPG receiving and shipping facilities are determined on the basis of the following conditions.

(a) Transportation of LPG from Kyangin LPG Extraction Plant to Terminal by pipeline:

Distance between them is about 9 km. The transportation work shall be in day time and adoption of velocity requiring no return gas line is made.

(b) Transportation from Kyanging LPG Terminal to river barges:

Adoption of velocity requiring completion of loading to river barges in day time is required. Loading of LPG of 600 tons should be completed within 8 hours.

(6) Utility facilities

The utilities required except instrument air and drinking water in the Kyangin LPG Terminal are supplied from the Kyanging LPG Extraction Plant. However, from the point of view of construction cost, instrument air facilities and drinking water facilities of small capacity are to be provided.

(7) Pollutant treatment facility

LPG Terminals, from the properties of LPG, do not generate or handle pollutants, so no pollutant treatment facility is necessary.

(8) Blowdown facility

As a safety measure for handling blow-off gas from safety valves and vent-gas from terminal facilities at shut-down of terminal, high-ventilation facility is to be installed

for discharging gas. Ventilation is to be proved on the top of the spherical tank.

(9) Fire-fighting facility

Since there are no Burmese domestic provision governing hydrants and water spraying facilities with respect to spherical tanks, the fire fighting facility is designed in conformance with related Japanese provisions and specifications.

(10) Operation management

Operation organization of the Kyangin LPG Terminal will be under the jurisdiction of the Kyangin LPG Extraction Plant and integrated management is to be made.

Operation is achieved by a 5-team, 3-shift system of shift workers and day workers, and a control room is provided in the terminal, and management is to be performed here.

(11) Spare parts

Spare parts necessary for two years of operation are supplied.

6.2.3 Description of Facilities

(1) Process flow diagram and list of facilities for Kyangin LPG Terminal

Fig. 6-7 shows the process flow diagram for Kyangin LPG Terminal as designed on the basis of the design policy and the basic plan described in Chapter 5, while Table 6-3 lists the facilities of Kyangin Terminal.

Table 6-3 List of Facility at Kyangin LPG Terminal

	Facility	Capacity of Facility
1	LPG Tank	C_3 LPG Tanks: 1,000 m^3 x 3 C_4 LPG Tanks: 2,000 m^3 x 2
2	Shipping pump	C_3 LPG Shipment: 300 m^3/H x 2 C_4 LPG Shipment: 300 m^3/H x 2
3	Jetty	Loading onto Riverbarges: New jetty is installed.
4	Utilities Facility (1) Water	(a) Water to be supplied from Kyangin LPG Extraction Plant. (b) Water pond: Capacity 700 m^3 (c) Supply pump: Capacity 350 m^3/H x 2 with Diesel Engine. (d) Portable water: Supply system 10 T/H
	(2) N_2	To be supplied by Kyangin LPG Extraction Plant.
	(3) Instrument Air	To be installed.
	(4) Power Receiving and Distribution	To be installed at both location of Terminal and Jetty.
	(5) Emergency	Non

(2) LPG tank facilities

The number of LPG tanks and their unit capacity are determined after making detailed studies of the following factors:

(a) Volume of LPG handled by the terminal and LPG receiving and shipping frequency.

(b) Maintenance requirements of tanks.

(c) Construction costs.

(3) LPG receiving and shipping facilities

(a) Each piping facilities for C_3 LPG and C_4 LPG are to be provided for receiving

these products from the Kyangin Extraction Plant by pipeline and for shipping them to the river barges, then simultaneous receiving and shipping can be made.

(b) Shipping pump capacities are determined with the aim at permitting river barges of 300 m^3/hr for C_3 LPG and C_4 LPG respecitvely. Two pumps are to be installed respectively for C_3 LPG and C_4 LPG, and one of them is used as a spare against shipping trouble.

(4) Jetties

The LPG river barges are used for transporting LPG of 61,000 T/Y produced in the Kyangin LPG Extraction Plant from the Kyanging LPG Terminal to the Syriam Terminal.

The existing shipping jetty in the Kyanging Cement Mill has a fixed type frame structure in which reinforced concrete columns are constructed on the slope of the river side and the upper face is made of connecting girders and slabs.

However, the LPG shipping jetty to be constructed in this project is determined as the pontoon type one well used on the Irrawaddy River area as shown in Fig. 6-9, not the fixed type frame structural jetty.

The main reason of this is to avoid difficult works of excavation near the water.

(5) Utility facilities

(a) The capacity of these utilities in the Kyangin LPG Terminal and Jetty are determined on the basis of the following rates.

* Electricity
  - Terminal : 100 kWh/h (at the time of simultaneous shipping C_3 and C_4)
  - Jetty : 150 kWh/h (regular loads)
* Water : 6 tons/hr
* Instrument air : 100 Nm^3/hr
* N_2

(b) Water intake facilities

The water intake pumps and attached piping are to be installed on the pontoon of the jetty for water intake. The water is fed to the raw water tank in the Kyangin LPG Extraction Plant. The capacity of the pump is 190 tons/hr, and two pumps including one spare are to be installed.

(c) Instrument air facilities

A spare compressor having a capacity equivalent to 100% of the air consumption rate is to be provided adding to one regular service compressor.

(d) N_2 generation facilities

Nitrogen is supplied from the Kyanging LPG Extraction Plant by pipeline.

(e) Drinking water facilities are composed of chemical injection unit and piping.

(f) Power receiving/distribution facilities

Kyangin LPG Terminal:
Electricity is supplied from the substation in the Kyangin LPG Extraction Plant by distribution lines of 3.3 kV. A substation is to be installed at the Terminal for power receiving and distribution in the terminal. The principal design standards are as follows:

* Classification as a dangerous place:
  In conformance with API RP 500
* Working voltage

Receiving voltage	3,300 V, 3ϕ, 50 Hz
For power under 150 kW	400 V, 3ϕ, 50 Hz
over 150 kW	3,300 V, 3ϕ, 50 Hz
For illumination	230 V, 1ϕ, 50 Hz
For instruments	100 V, 1ϕ, 50 Hz

* Capacity of transformer 300 kVA, 3ϕ, 4W, 50 Hz

Primary voltage	3,300 V
Secondary voltage	415 V, 240 V

* To cope with inadvertent power interruption, a battery system with

30-min capacity is provided as a backup power source for instruments.

Fig. 6-6 shows the one-line diagram of the transformer facilities. One 3.3 kV feeder is to be installed for power supply to the jetty.

(g) Power receiving/distribution facilities

Kyangin LPG Jetty:
Electricity is supplied from the substation in the Kyangin Terminal by distribution lines of 3.3 kV. A substation is to be installed on the jetty for power receiving and distribution. The principal design standards are as follows:

* Classification as a dangerous place:
  In conformance with API RP 500
* Working voltage

Receiving voltage	3,300 V, 3ϕ, 50 Hz
For power under 150 kW	400 V, 3ϕ, 50 Hz
For illumination	230 V, 1ϕ, 50 Hz
* Capacity of transformer	300 kVA, 3ϕ, 4W, 50Hz
Primary voltage	3,300W
Secondary voltage	415 V, 240 V

Fig. 6.6 shows the one-line diagram of the transformer facilities.

(h) Emergency power facilities

The LPG receiving and shipping operations at the terminal are carried out not continuously but intermittently. Therefore, there is no danger even if the LPG receiving and shipping operations are stopped temporarily owing to power interruption.

However, a battery system with 30-min back up capacity is provided as a safety measure for instruments to cope with inadvertent power interruption, as described before.

(6) Fire prevention and fire-fighting facilities

To permit the terminal's water pond to be utilized as the water source for fire-fighting facilities, the plan is to be provide:

- Special-purpose pipe lines for pumping water to fire hydrants equipped in the entire compounds of the terminal.

- Sprinklers for sprinkling water onto LPG tanks in emergencies.

The pump is designed to be driven with diesel engine of capacity of 700 m^3/hr (350 m^3/hr x 2), and the pond is designed with a capacity of providing an ample supply of water for 30 minutes.

6.2.4 Terminal Plot Plan

Fig 6-10 shows the terminal's arrangement or plot plan. The following points are given due consideration in drafting the plot plan:

(1) Operation management of the terminal and jetty is to be performed in the control room.

(2) The LPG tanks are concentratedly arranged, and fire dike capacity is secured by means of an integrated fire dike system.

The distance between tanks is designed to be 30 m by the request of the Burmese side.

(3) A network of roads is to be provided around the terminal for easy fire-fighting operations.

(4) Green area is to be provided by the request of the Burmese side.

6.3 Syriam Terminal

6.3.1 Design Conditions

(1) LPG receiving and shipping

Syriam Terminal's LPG receiving and shipping conditions are to be accomplished by the following table.

Fig. 6-10 Plot Plan of Kyangin LPG Terminal

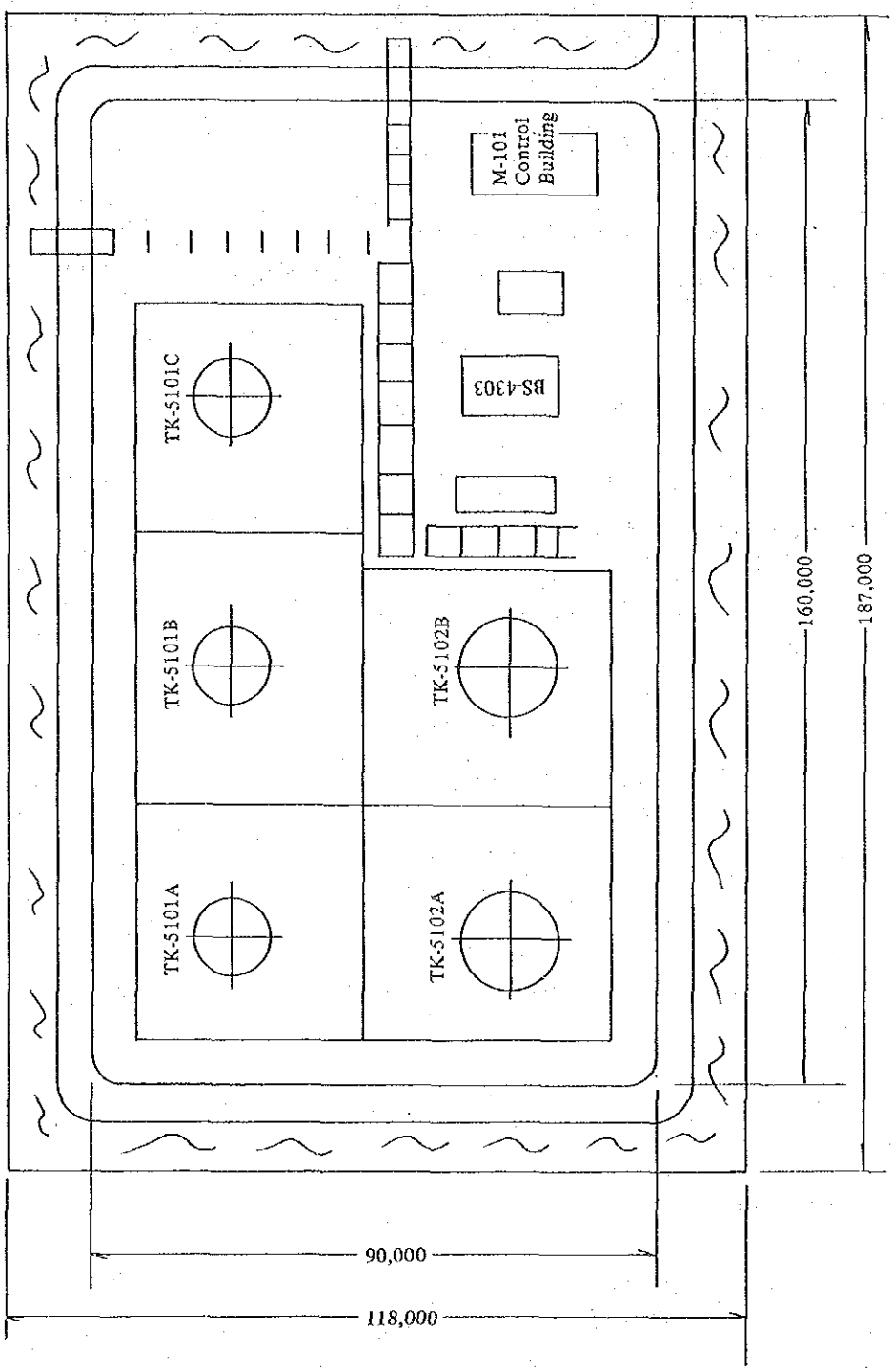


Table 6-4 Design Conditions of Syriam Terminal

LPG Receiving and shipping	Volume Handled T/Y		LPG Transport system	LPG Condition	
	C_3 LPG	C_4 LPG		C_3 LPG	C_4 LPG
Receiving					
1. Mann Terminal → Syriam Terminal	11,200	18,800	Riverbarge	Max. Vapor Pressure 14.6 kg/cm²g at 37.8°C	Max. Vaper Pressure 4.9 kg/cm²g at 37.8°C
2. Syriam Refinery → Syriam Terminal	1,970	3,930	Pipeline		
3. Kyangin Terminal → Syriam Terminal	25,600	35,400	Riverbarge		
	38,770	58,130			
	96,900				
Shipping					
Syriam Terminal → Export	38,770	58,130	LPG Ocean Tanker		
	96,900				

Both C_3 LPG and C_4 LPG are to be stored and shipped out in the form of pressurized LPG.

(2) Site conditions

1) Soil conditions

The construction of terminal was planned in Phase I-Part 2 and it is now under construction.

Prior to construction, the soil survey boring was carried out. According to the data supplied by the Burmese side, the underground water level lies 5 m below the ground surface and the soil bearing capacity near the ground surface is 2.5 t/m². The soil is generally soft silts, then the pile foundation is to be constructed without direct foundation of the structure to prevent settlement.

The tank under construction is provided with PC pile foundation of ϕ300,

22 m long. The spherical tank planned to be added to the existing facilities in the Phase III is designed to have similar pile foundation.

2) Natural conditions

Earthquake:
The seismic coefficient is set to 0.15.

Rainfall:
According to the data supplied by the Burmese side, the past maximum rainfall was 178 mm an hour, 200 mm in 24 hours. However, excessive design will be made if the above value is used for design, so the value of 100 mm/hr used in the design of the present terminal is adopted.

Wind:
A design wind velocity is set to b 50 m/sec at 10 m above the ground surface in accordance with the Burmese side.

Lighting:
Since thunderbolts are likely, the use of lighting arresters and other proper measures are adopted.

Sandstorm:
The site is free of sandstorm anxieties.

6.3.2 Design Policy

(1) Basic concept

The Syriam Terminal consturction is planned in the Phase I and is now undertaken, but it will be completed soon. In the project of the Phase III, all the facilities for the terminal are used with the increase in handling of LPG, those facilities of short capacity only are to be constructed.

Adding to the studies for change in operation, necessity of increase in terminal facilities in the Phase III is also studied.

(2) Service factor

Same as Section 6.2.

(3) LPG tank

(a) Computing formula for obtaining the capacity required for LPG tank is the same as Section 6.2.

(b) Number of days of storage

The number of days of LPG storage is determined as 20 days, as planned in Chapter 5.

(4) Legal restrictions

Same as Section 6.2.

(5) Tank configuration

Same as Section 6.2.

(6) LPG receiving and shipping facilities

The capacity of three river barges to be constructed newly is set to be 600 tons. The existing capacity is 500 tons and larger capacity is to be obtained, but the present loading facilities are used. Then about one hour of working time for unloading is increased but receiving and shipping operation is to be performed in 24-hour operation system by shift workers.

The standard classification of ocean tankers for exportation is set to be 1,500 tons of capacity. Comparing with the conventional capacity of 1,000 tons, lot is increased largely but working operation system is not changed only by prolonging loading time without increase in loading facilities.

The shipment of LPG from Syriam Terminal is to be accomplished by means of oceangoing vessels, while shipment for domestic consumption is to be done by existing cylinder charging facilities of Mann Refinery and Syriam Refinery. At the Kyangin LPG Terminal, LPG for export only is to be handled on the basis of basic plan, however, it is considered to construct cylinder filling facilities for domestic

use with thought of flexibility.

(7) Utility facilities

Existing facilities can be used.

(8) Pollution treatment facilities

Same as Section 6.2.

(9) Blowdown facility

Existing facility can be used.

(10) Fire fighting facility

Same as Section 6.2.

(11) Operation management

Existing facilities can be used. Operation is achieved by a 5-team, 3-shift system and unloading and loading operations are achieved by 24-hour working system.

(12) Spare parts

Same as Section 6.2.

6.3.3 Description of Facilities

(1) Process flow diagram and list of facilities for terminal

Fig. 6-11 shows the Process Flow Diagram for expansion of Syriam Terminal as designed on the basis of the design policy, while Table 6-5 lists the facilities of Syriam Terminal.

(2) LPG tank

Same as Section 6.2.

Fig. 6-11 Process Flow Diagram for Syriam Terminal

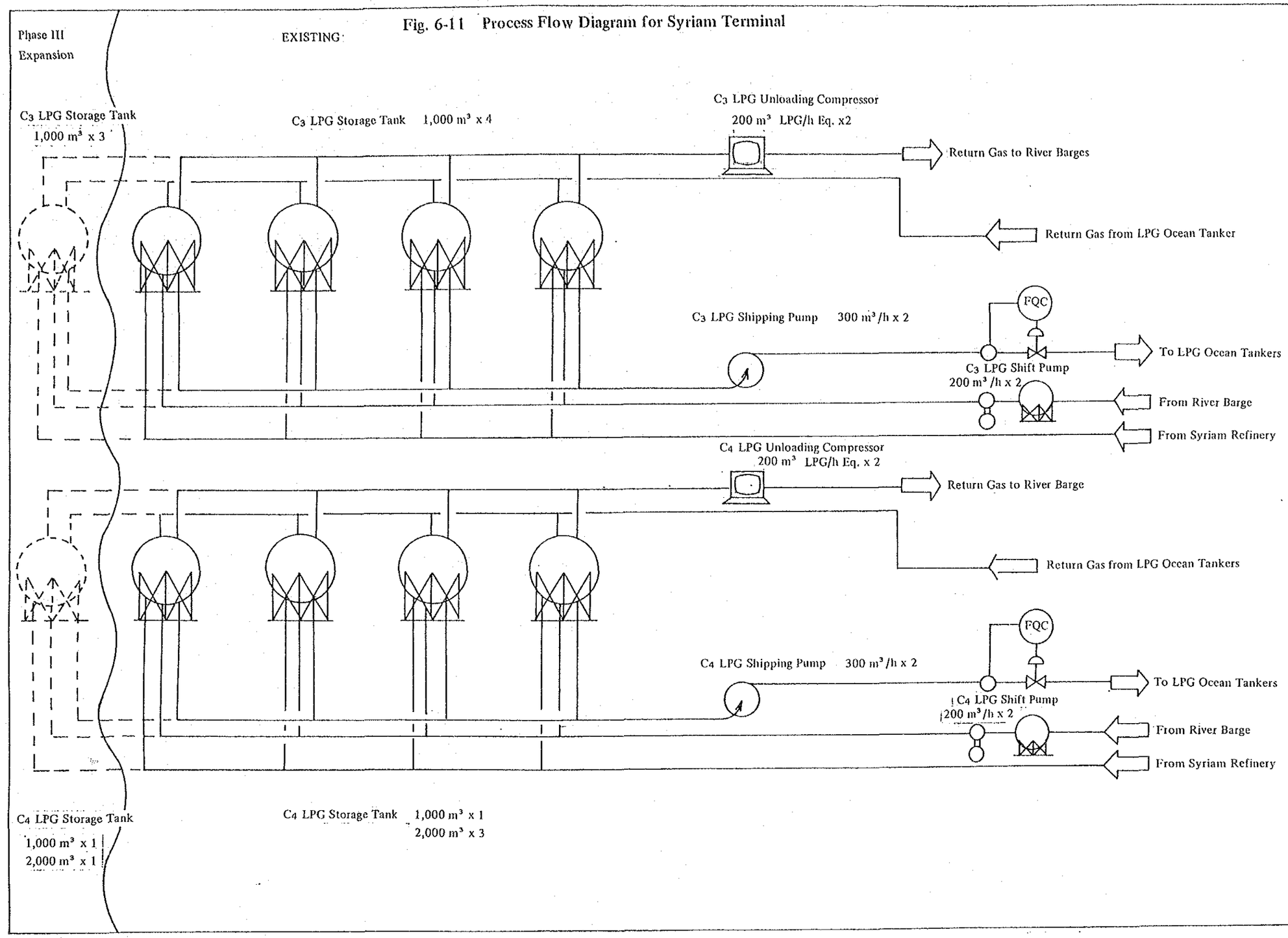


Table 6-5 List of Facilities at Syriam Terminal

Facility	Capacity	Remarks
1. LPG Tanks	C_3 LPG tanks: 1,000 m^3 x 4 & 1,000 m^3 x 3* C_4 LPG tanks: 1,000 m^3 x 1 & 1,000 m^3 x 1* 2,000 m^3 x 3 & 2,000 m^3 x 1*	* Expansion
2. Shipping Pumps and Unloading equipment	C_3 LPG shipment: 300 m^3/h x 2. unloading 200 m^3/h x 2 C_4 LPG shipment: 300 m^3/h x 2. unloading 200 m^3/h x 2	
3. Jetties	Unloading from river barges: and Loading into LPG Ocean Tankers: New jetty is to be installed.	for 500 DWT barge ~3,000 DWT tanker
4. Utility Facilities 1) Water Intake	(a) Water intake pump: Supply from PIC (b) Water treatment: 10 t/h (c) Water pond: 15 m x 40 m x 1.5 m (depth) (d) Water pipeline: From Syriam Refinery to Terminal (e) Hydrant pump: 40 m^3 /h x 2 (f) Sprinkler pump: 750 m^3/h x 2	
2) Cooling Water	(a) Cooling Tower: Spray Type (b) Cooling Water Circulation Pump: 10 m^3/h x 2	
3) Instrument Air	(a) Compressor: 200 Nm^3/h x 2 (Discharge pressure: 7 kg/cm^2g) (b) Dryer: 200 Nm^3 /h x 1 (Dew poin: 0°C . . . 6 kg/cm^2g)	
4) N_2 Generator	Generator: 100 Nm^3 /h x 1 (N_2 purity: 99% Pressure: min. 2.0 kg/cm^2g).	
5) Power receiving/ Distribution Facility	Capacity: About 830 kVA (Sub-station to be installed)	
6) Emergency Power Generator	Not to be installed.	

(3) LPG receiving and shipping facilities

Existing facilities can be used. Two pumps are now in operation for C_3 and C_4 LPG, and two spare pumps are to be installed. Total four pumps are to be provided. As existing facilities for unloading, one compressor and one shift pump are provided for C_3 and C_4 LPG respectively, and a spare compressor and a shift pump are to be installed.

(4) Jetties

Jetties for berthing river barges and LPG ocean tankers will be necessary for receiving and shipping LPG at Syriam Terminal. The volumes of LPG handed from the Phase I to Phase III are as follows:

- Unloading of 91,000 T/Y of LPG by LPG river barges (Up to Phase II, 30,000 T/Y transported from Mann Terminal and up to Phase III, 61,000 T/Y from Kyangin Terminal)

- Receiving of LPG of 5,900 T/Y from Syriam Refinery by pipelines.

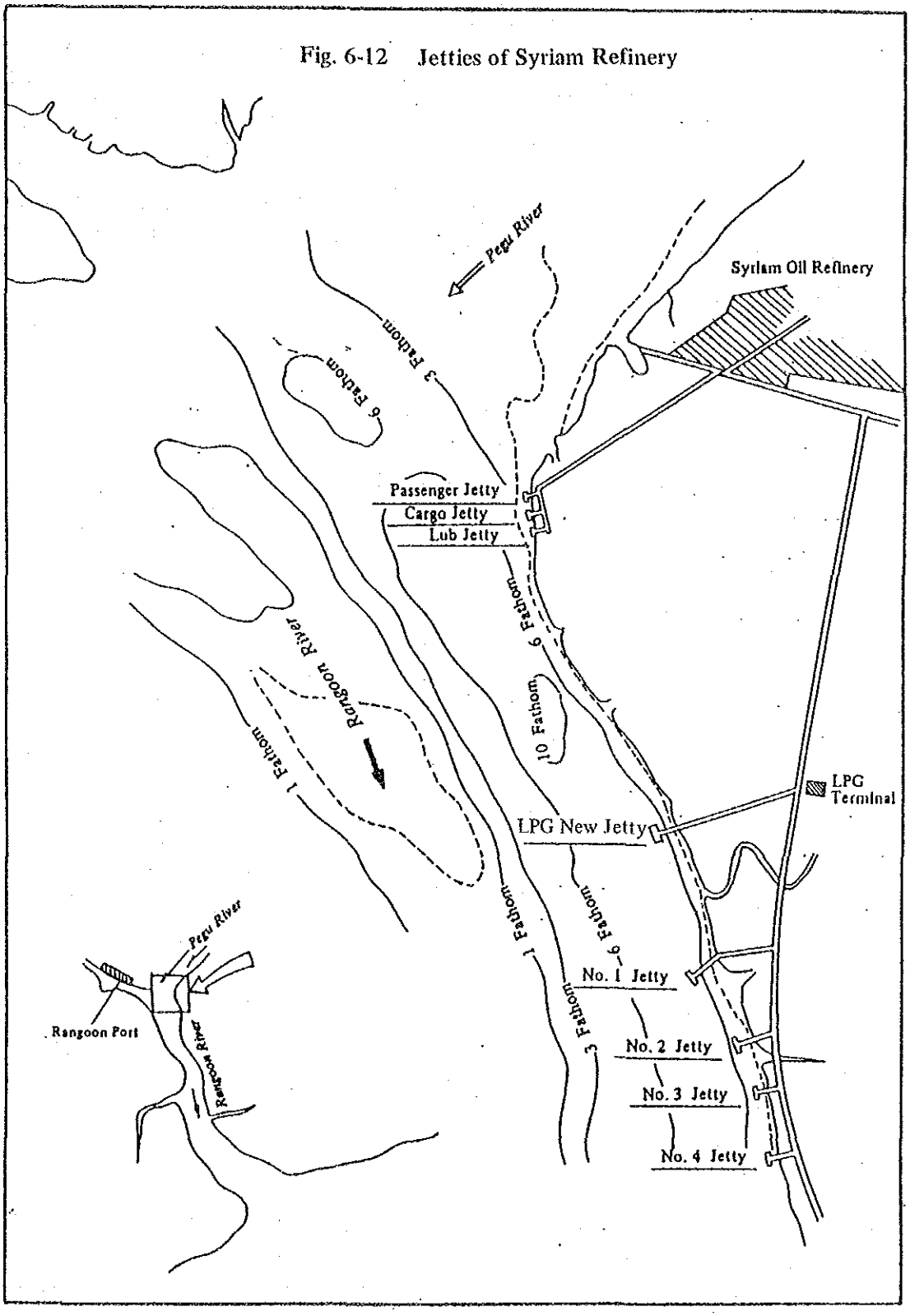
- Loading of 96,900 T/Y of LPG into tankers for export to foreign destinations from Syriam Terminal.

The vessels to be employed for these purposes are river barges having deadweight tonnage of 500 tons (four vessels from Mann and Kyangin) and of 600 tons (three vessels from Kyangin).

The deadweight tonnage of the ocean LPG tankers is generally to be 1,500 tons.

As Syriam Terminal, existing No. 1 to No. 4 jetties are available as shown in Fig. 6-12, and LPG jetty is newly constructed recently. Type of jetties is pontoon type for No. 1 ~ No. 4 jetties and the newly constructed LPG jetty is a fixed type using steel pipe pile. Working conditions of respective jetties are as follows:

Fig. 6-12 Jetties of Syriam Refinery



- No. 1 Jetty (completed in 1946)
  The pontoon at the end was removed and also bridge is recovered. Use of this jetty is impossible at present.

- No. 2 Jetty (completed in 1958)
  For crude and heavy oil export, also for transfer to domestic coastal regions. Capable of berthing vessels of 10,000 DWT for ocean tankers and 1,500 DWT for coastal tankers.

- No. 3 Jetty (completed in 1970)
  For oil products loading for river barges of Irrawaddy River.

- No. 4 Jetty (completed in 1974)
  For crude oil unloading from Myanaung Oil Field near Prome on Irrawaddy and for unloading of methanol from Seiktha Methanol Plant under construction.

As described above, frequency of use of Jetties from No. 1 to No. 4 is very high and there is no room for handling LPG. Fig. 6-13 shows the LPG new jetty which was constructed for handling LPG of Phase I ~ Phase II including a portion of Phase III as preceding.

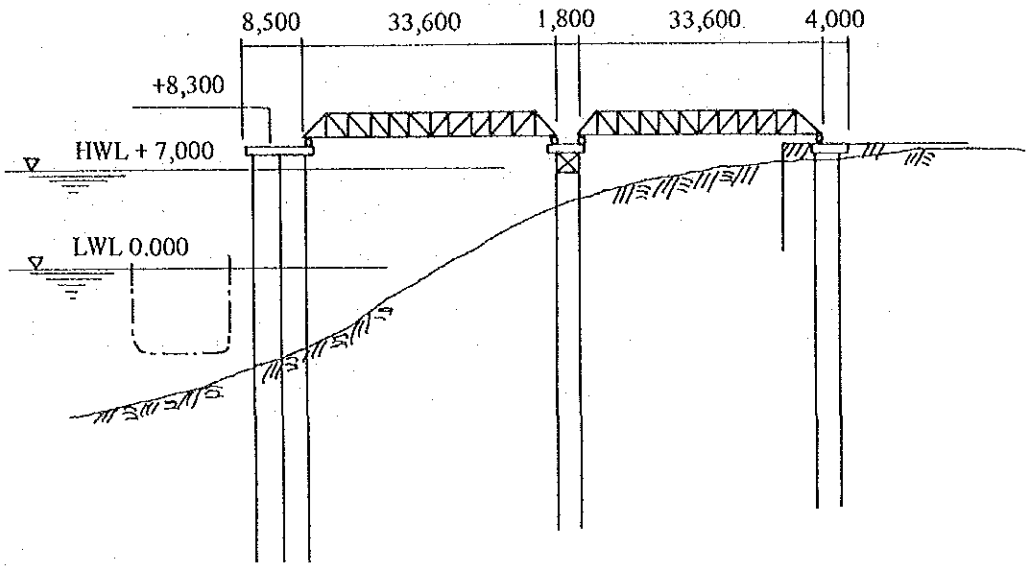
The vessels to be employed were river barges having deadweight tonnage of 500 tons and LPG ocean tankers having deadweight tonnage of 1,500 tons.

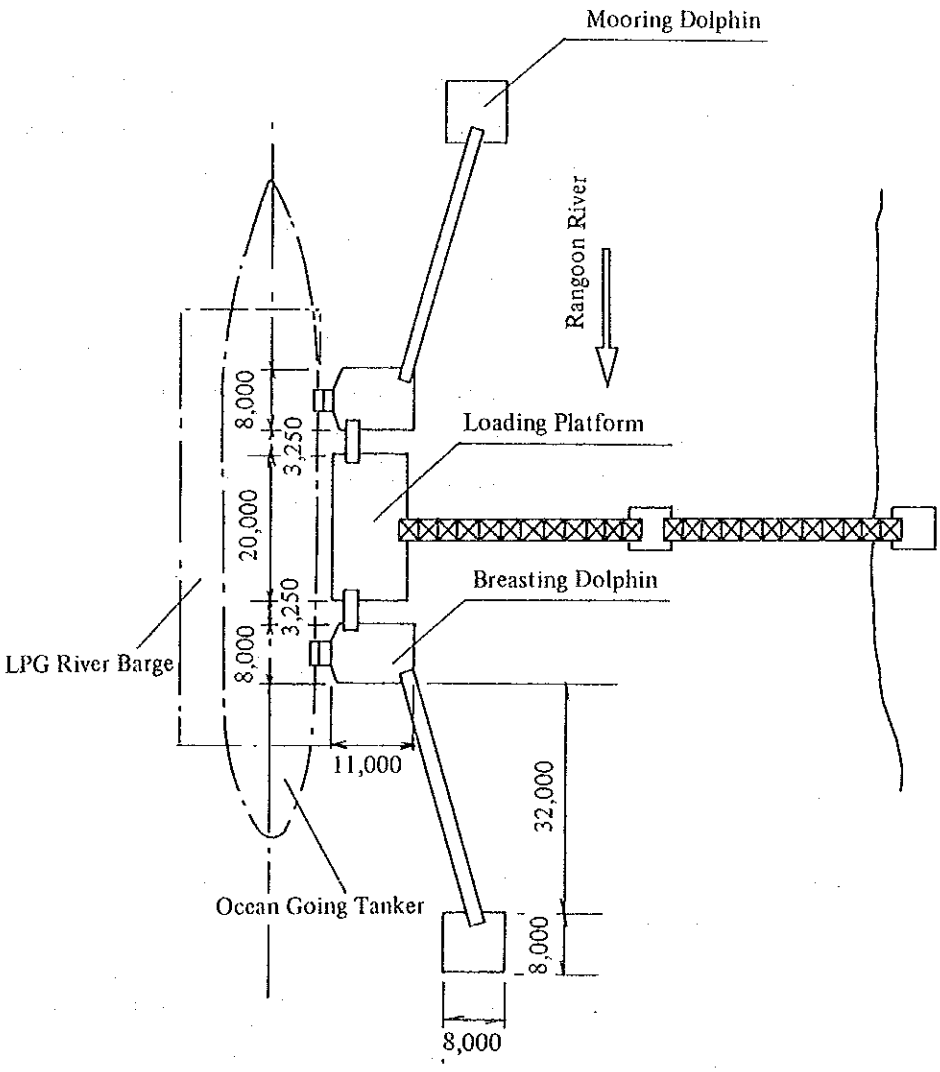
When LPG of 96,900 tons a year is handled for export and that of 91,000 tons a year for unloading on this jetty, the number of vessels required is calculated as follows:

96,900 T/Y ÷ 1,500 T ÷ 12 M	=	5.4 vessels/month
91,000 T/Y ÷ 500 ~ 600 T ÷ 12 M	=	14.9 "
Total		20.3 "

Judging from the above calculation, if unloading and loading operations are made only in day time, utilization frequency is too high. Then to improve economic efficiency, unloading and loading operations are planned to be carried out during night. In this case, berthing and dispatch of ocean tankers should be carried out in daytime for safety.

Fig. 6-13 Syriam LPG New Jetty





In Phase III project, no construction of new jetty is planned and existing LPG new jetty is used for unloading and loading of LPG.

The water level difference of Rangoon Port at time of high tide and ebb tide is 5.13 m and the maximum tidal current speed is 7 knots at maximum. LPG ocean tankers are to be berthed between 5:30 in the morning and 2:30 in the afternoon when the tidal current generated between high tide and ebb tide becomes minimum. About 20 days each month are required for berthing under this condition. As the number of tankers berthing is 5.4 vessels, no problem will occur.

(5) Utility facilities

No increase in loads of capacities is considered in Phase III. With the increase in working ratio, consumption amount is increased. Then existing facilities can be used.

However, with the increase in number of spherical tanks for LPG, piping and cable laying construction becomes necessary for supplying electricity, instrument air and sprinkling cooling water as ancillary facilities. They are extended from existing piping and feeder.

(6) Fire-fighting facilities

On the assumption that simultaneous occurence of disaster such as fire will not be in existing tank yard and expansion tank yard in Phase III, no expansion of facilities are made. Piping for fire-fight and fire hydrants are to be provided in the new tank yard.

(7) Other facilities

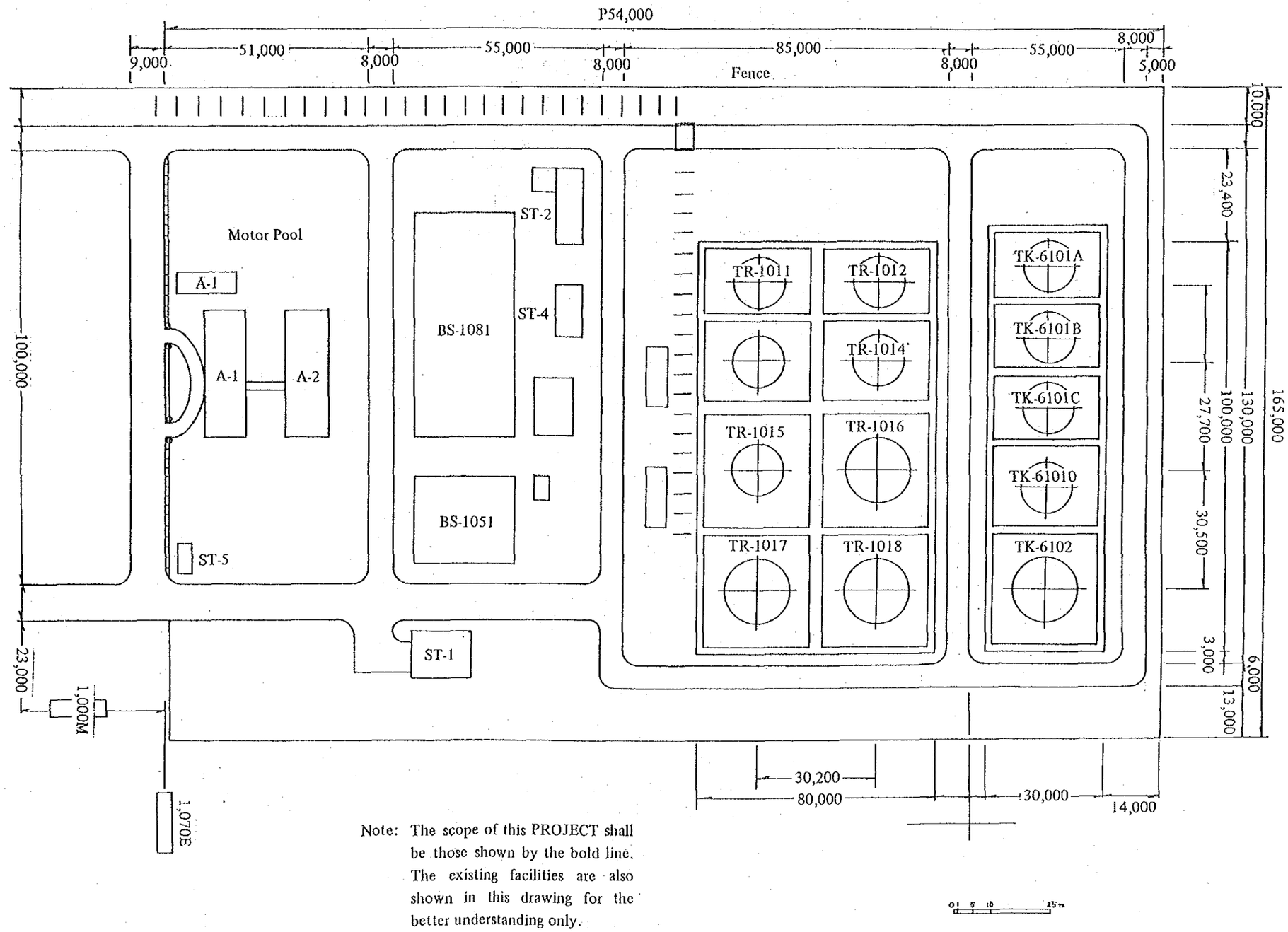
Existing facilities are used.

6.3.4 *Terminal Plot Plan*

Fig. 6-14 shows the terminal's arrangement or plot plan. The following points were given due consideration in drafting the plot plan.

- According to the basic concept of arrangement plan of existing Syriam Terminal.
- The tank yard to be expanded is adjacent to existing tank yard.

Fig. 6-14 Plot Plan for Seriam Terminal



Note: The scope of this PROJECT shall be those shown by the bold line. The existing facilities are also shown in this drawing for the better understanding only.

– An integrated dike system is adopted by separating the expanded tanks as one section.

6.3.5 Infrastructure

(1) Traffic

Syriam having long been an oil refining region, the adjacent Syriam Town is a large town having a population of more than 100,000. However, since the town is separated from Rangoon by Rangoon River and not connected directly by roads, Rangoon and Syriam are today linked by means of regular ferry boats.

As for traffic between Syriam side jetty and Syriam Refinery, two lane paved road is provided, while a paved road having an effective width of 4.8 m is provided between the refinery and the terminal site. These roads can be used for the present construction and for Phase III expansion construction as well as with jetty.

(2) Housing

No increase in workers is estimated for expansion of terminal in Phase III, and no housing plan is made.

(3) Water

The terminal facilities in Phase I-Part 2 is to be supplied with water from the well equipped in Syriam Refinery. This water supply facility is also to be used for Phase III.

6.4 River Barges for LPG Transportation (Self-propelled type)

The entire volume of LPG is to be transported from Kyangin Terminal to Syriam Terminal over the Irrawaddy River by means of LPG river barges. The Irrawaddy River and the Rangoon River are connected by means of Twante Canal, permitting river transportation to Syriam. The volume of LPG to be transported will be 61,000 T/Y.

6.4.1 Design Conditions

The situation of conditions influencing river transportation over the Irrawaddy River is as follows:

Water level difference in rainy and dry seasons	13 m approx. (near Kyangin)
Current speed rainy season	Max. 3.12 m/s
	Mean 2.23 m/s
dry season	Max. 1.13 m/s
	Mean 0.5 m/s
Days required for navigation (Kyangin – Syriam)	
both seasons	Kyangin – Syriam 3 days
	Syriam – Kyangin 5 days
Number of navigable days	Navigable at any time through the year

Size of barge:

River barges for Phase III (600-ton loading capacity)

Length of 55 ~ 65 m x Breadth of 18 m x Draft of 1.4 m

6.4.2 Design Policy

In view of the conditions described above, the following policies are adopted for designing the LPG river barges:

(1) Pusher tugboats have been used for non-self-propelled type river barges up to date, however, four LPG river barges are increased in Phase I-Part 2, and more barges are required for transporting methanol from Seiktha. Therefore utilization of pusher

tugboats is decreasing and in Phase III, use of tugboats is not planned. As the construction cost of new tugboat is higher, self-propelled river barges are to be constructed.

(2) As for barge dimensions, the breadth of 18 m is adopted in view of type of barges in service hitherto and for navigational safety, while the draft is made as small as possible 1.4 m to permit non-interrupted navigation in dry seasons.

(3) Loading capacity is set to be 600-ton and two 300-ton cylinder tanks are installed horizontally to lower the center of gravity of barge.

(4) The number of days required for shuttling between Kyangin and Syriam will be as follows:

Kyangin – Syriam	3 days
Syriam – Kyangin	5 days
Loading, unloading	2 days
Total	10 days

6.4.3 *Description of Facilities*

Carrier

Number required	: 3
Type	: Self-propelled barge
Loading capacity	: LPG 300 tons x 2
Dimensions	: 18 m W x 55 ~ 65 m L
Draft	: 1.4 m
Horse power	: 650 hp x 2

The required number of barges can be obtained from the following formula, on the assumption that 10 days are required for one shuttling cycle and 61,000 tons of LPG are to be transported annually.

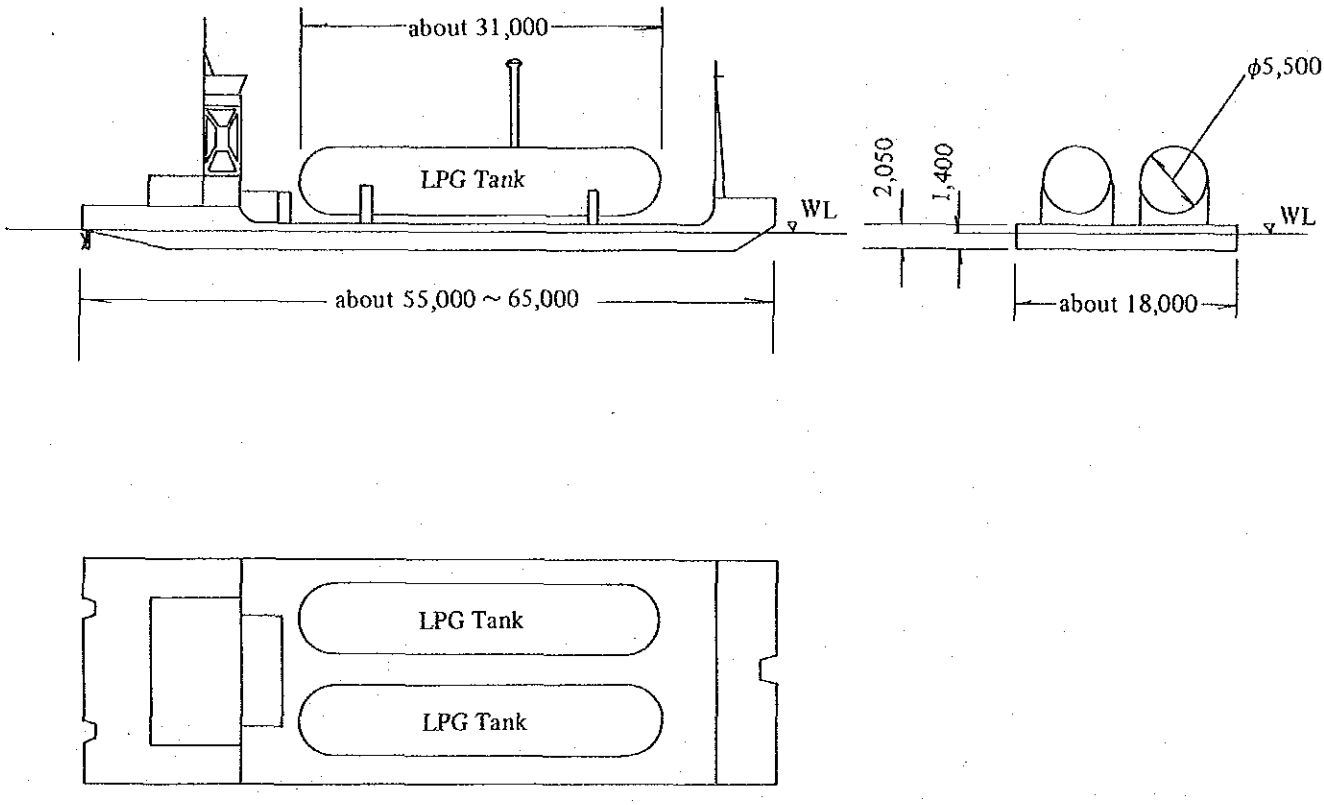
$$N = 61{,}000/(365/10) \times 600 = 2.8 \text{ vessels}$$

The use of 3 barges provides an idling time of 25 days/barge annually. As the barge is self-propelled type, the term for inspection and maintenance will become longer. Then surplus of number of barges seems to be less, but a little surplus of LPG barges constructed in Phase I-

Part 2 can be added to produce the time of inspection and maintenance, and essentially to save the problems by the idling time in operation.

Fig. 6-15 shows the general arrangement of LPG river barge.

Fig. 6-15 General Arrangement of LPG River Barge (600 ton)



6.5 Piping Plan

Piping plan was produced on the basis of basic plan of Section 5.4. Main points of piping plan are shown in Fig. 6-16.

The following points are given due consideration and the items are added in planning the piping.

(1) The volumes of associated gas of respective wells are given in Fig. 6-16 as basic values, but in future main part of feed gas 50 x 10^6 SCFD of associated gas will be produced by increase by Htantabin. Existing piping in Htantabin area is to be used as pipeline for associated gas until the time when it will not be able to use. When the capacity becomes of shortage, the piping system will be expanded or large-caliber piping system will be adopted.

(2) Pressure classification by each systems is given according to the conditions of intake points of the Kyanging LPG Extraction Plant. Pressure loss is set to be less than 50 psi.

(3) The diameter of pipe is computed with pressure loss calculation formula of every short section.

(4) Pressure regulation system of gas feeding system is made to be secondary pressure control system, and it is determined that gas users take the volume necessary to them and gas supplier side regulates pressure.

In executing this project, sufficient agreement should be obtained between PIC, MOC side and engineering maker.

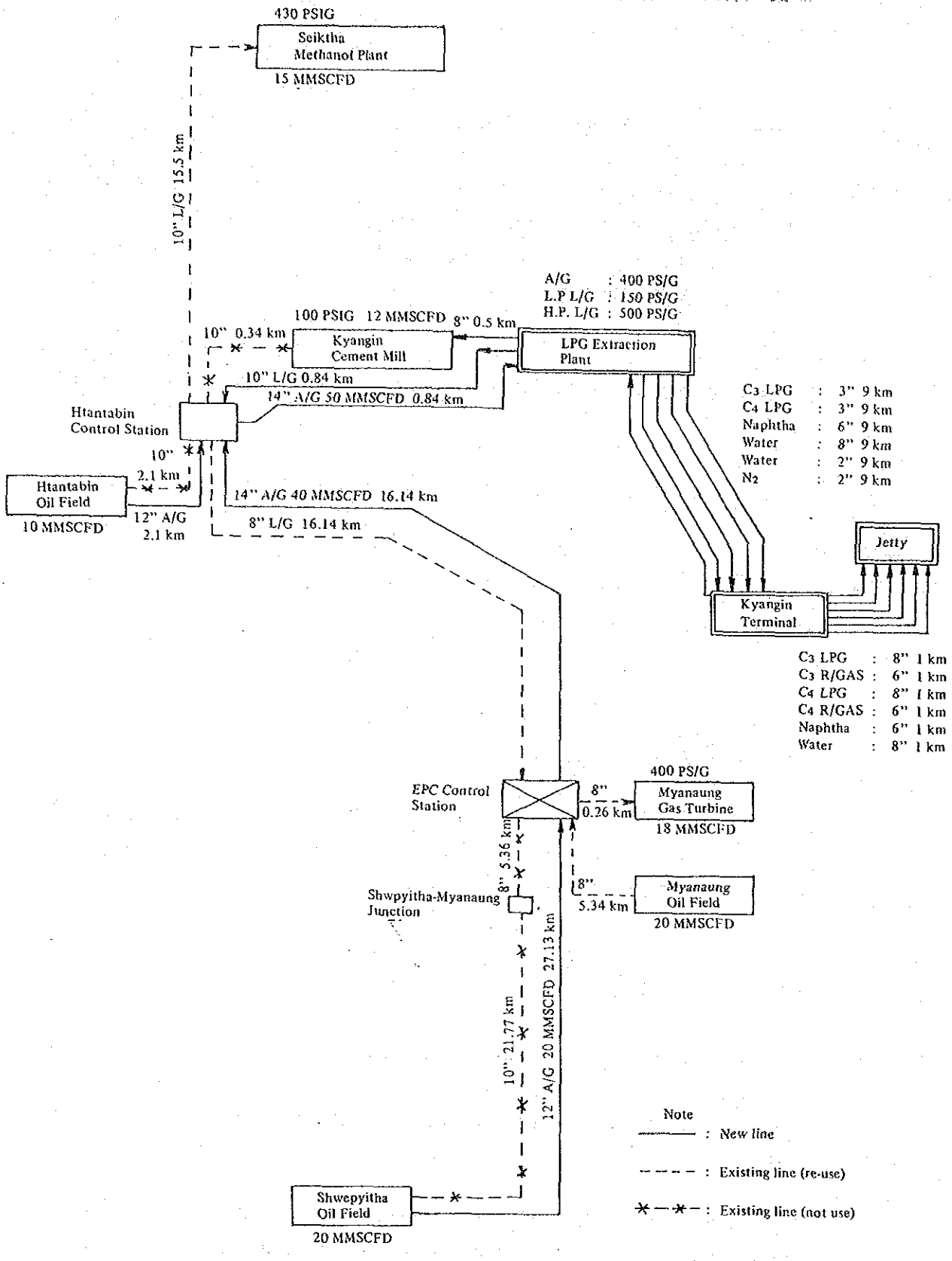
(5) Existing pipeline between Shwepyitha and EPC control station has been use for 10 years while being repaired partially, however, it is corroded. Then in this project, it is to be replaced.

(6) When condensate is mixed in the associated gas and feeding load is sufficiently large, any trouble is to be estimated.

Sufficient separation of gas and liquid by using some appropriate device in the oil field and in the rise portion of piping and control station should be required. Sufficient adjustment with contractors at the state of detailed design of piping is necessary.

(7) Pipeline for associated gas and lean gas is in underground lyning system as a rule and that between the plant site and terminal, jetty is in pipe slipper system. Piping route

Fig. 6-16 Block Flow Scheme of Shwepyitha, Myanaung, Htantabin and Kyangin Area



is as in Fig. 5-4 in Chapter 5. As for details, it is necessary to adjust with contractors including crossings of roads and railway in the stage of execution.

(8) Specification for anti-corrosion measures of piping should be determined in the stage of detailed design.

(9) As piping material, seamed pipe is to be used.

6.6 Power Supply Facilities

6.6.1 Design Conditions

(1) Power supply for the LPG recovery facility and power supply conditions of LPG recovery facility are as follows:

Table 6-6 Design Conditions of Power Supply

Item	Design Conditions
Voltage	66 kV
Phase	3 ϕ
Capacity for normal use	5,000 kVA
Number of circuits	1

(2) Site conditions

(a) Soil conditions

The ground bearing force for the existing transmission line (between Myanaung and Kyangin) is 10 T/m^2. As the value of the bearing force for the new transmission line route under consideration is thought to be almost the same as that for the existing line, then the force shall be set at 10 T/m^2.

(b) Natural conditions

Earthquake:
According to the data supplied by the Burmese side, the seismic coefficient is 0.2.

Wind:
According to the data supplied by the Burmese side, the wind pressure values shall be set at follows:

Steel tower	1.5 x 100 kg/m^2
Wire, insulators	0.66 x 100 kg/m^2

Lightning:
Since thunderbolts are likely, the use of lightning arresters and other proper measures shall be adopted.

Sandstorm:
Occurrence of sandstorms must be considered.

6.6.2 Design Policy

(1) Selection of the construction route of the transmission line

In selecting the route for the transmission line, the following basic policies should be adhered to:

- Low construction cost
- Maintenance of stable power transmission
- Minimized transmission loss
- Easy maintenance

In selecting routes, the following places should be avoided as much as possible.

- Parks, historic remains, cultural assets, natural scenery, areas with high animal populations
- Areas planned for cities, rivers, and roads
- Popular highly frequented places

There are proposed construction routes for new transmission lines in light of the above conditions, and in consultation with the Burmese side, found no such major impediment in the vicinity of the routes.

As a results of studies; it is designed the new route to be constructed along existing transmission line between Myanaung Gas Turbine Station and Kyangin Cement Mill. The length of the route is approx. 14 km. Fig. 6-17 shows the new transmission line route.

(2) Selection of type of steel tower

The tower is an angle square section steel tower type, with bolt clamping construction. The following types are available.

- Suspension type
- Tension type
- Dead-end type

(3) Determination of height

Determination of the height of the steel towers shall be made according to the EPC restrictions on standing height listed in Table 6-7 below.

The areas crossing roads and railways shall be protected by nets for the safety purposes.

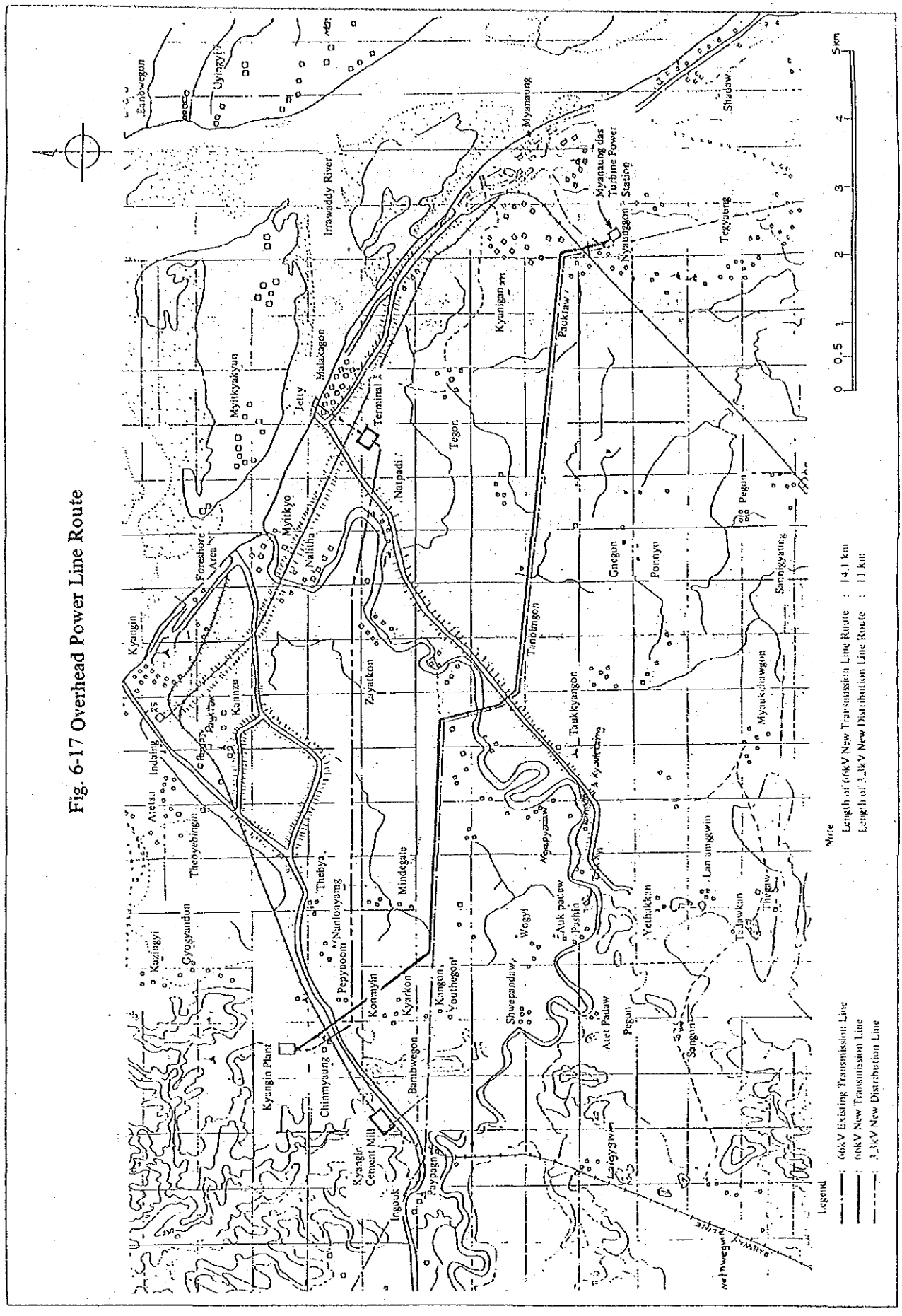


Fig. 6-17 Overhead Power Line Route

Fig. 6-18 Standard Drawing for Tower Type "A"

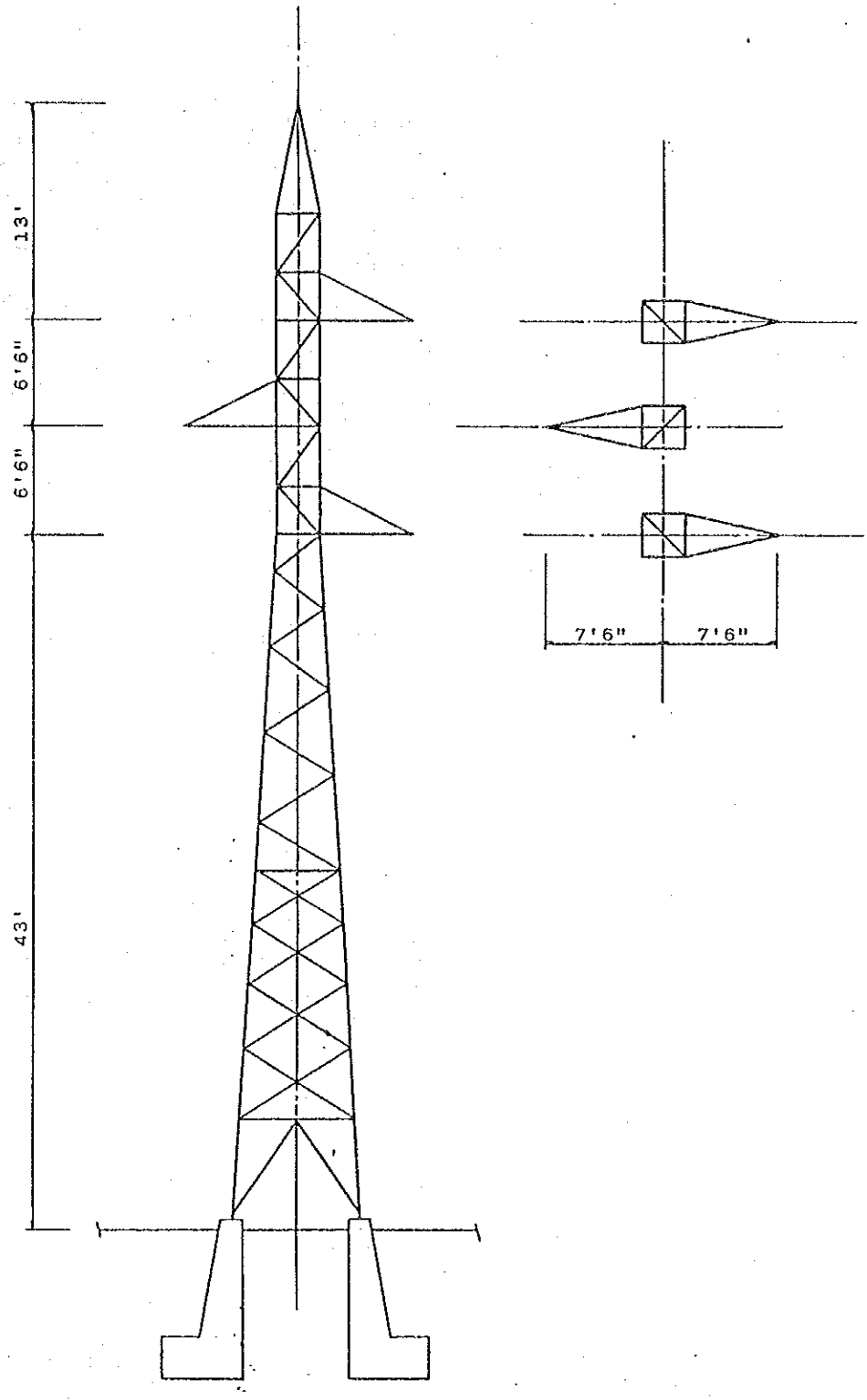


Table 6-7 Standing Codes for Transmission Lines

Item	Surface Feature	Regulation Height (min)
Surface	Ground	20 feet
River crossing	Highest water level	75 feet
Railway crossing	Railway line	25 feet
Road crossing	Road	22 feet
Distribution line crossing	Distribution line	8 feet
Telephone line crossing	Telephone line	8 feet

(4) Selection of foundations for steel towers

The foundations of the existing transmission line are an inverse T-shape type. As the bearing force on the existing route (between Myanaung and Kyangin) is 10 T/m^2, a similar inverse T-shape foundation shall also be used for the new transmission line. Foundation piles are considered to be unnecessary.

(5) Prevention of damage by salt

Since the new transmission line route is about 200 km from the coast and information supplied by the Burmese side gives no indication of salt damage to the line due to monsoons and cyclones, special countermeasures against damage by salt are considered unnecessary.

(6) Conductor size

The minimal size for 66 kV conductors is prescribed as 266.8 MCM ACSR in EPC.

(7) Overhead ground wire size

The size of overhead ground wires prescribed as GS 7/no. 9 SWG in EPC shall be adhered to.

(8) Safety factors

Safety factors for steel towers shall be determined as follows:

Normal	2.0
Emergency	1.5

(9) Span of steel tower

The maximum span between steel towers shall be set at 880 feet, in accordance with the standards of EPC.

6.6.3 Outgoing Line Plan from Myanaung Gas Turbine Station

Seven outgoing lines are provided in the 66 kV substation in Myanaung Gas Turbine Power Station. The composition of these lines is as follows:

- No. 1 Line : Spare
- No. 2 Line : Kyangin Cement Mill
- No. 3 Line : Prome
- No. 4 Line : Sinde
- No. 5 Line : Henzada
- No. 6 Line : Bassein Jute Factory
- No. 7 Line : Spare

At present two spare lines exist, and one of them is to be used for power supply to the Seiktha Methanol Plant now under construction. The other is not scheduled for any particular purpose now, so it should be possible to use it for power supply to the LPG recovery plant. As the new route is along the existing line to Kyangin Cement Mill, use of the No. 1 Line is recommended.

Fig. 6-19 shows the plot plan for Myanaung Gas Turbine Power Station. Fig. 6-20 shows the plot plan for the substation and Fig. 6-21 shows the plot plan for the substation in cross sectional view.

Fig. 6-19 Plot Plan for Myanaung Gas Turbine Power Station

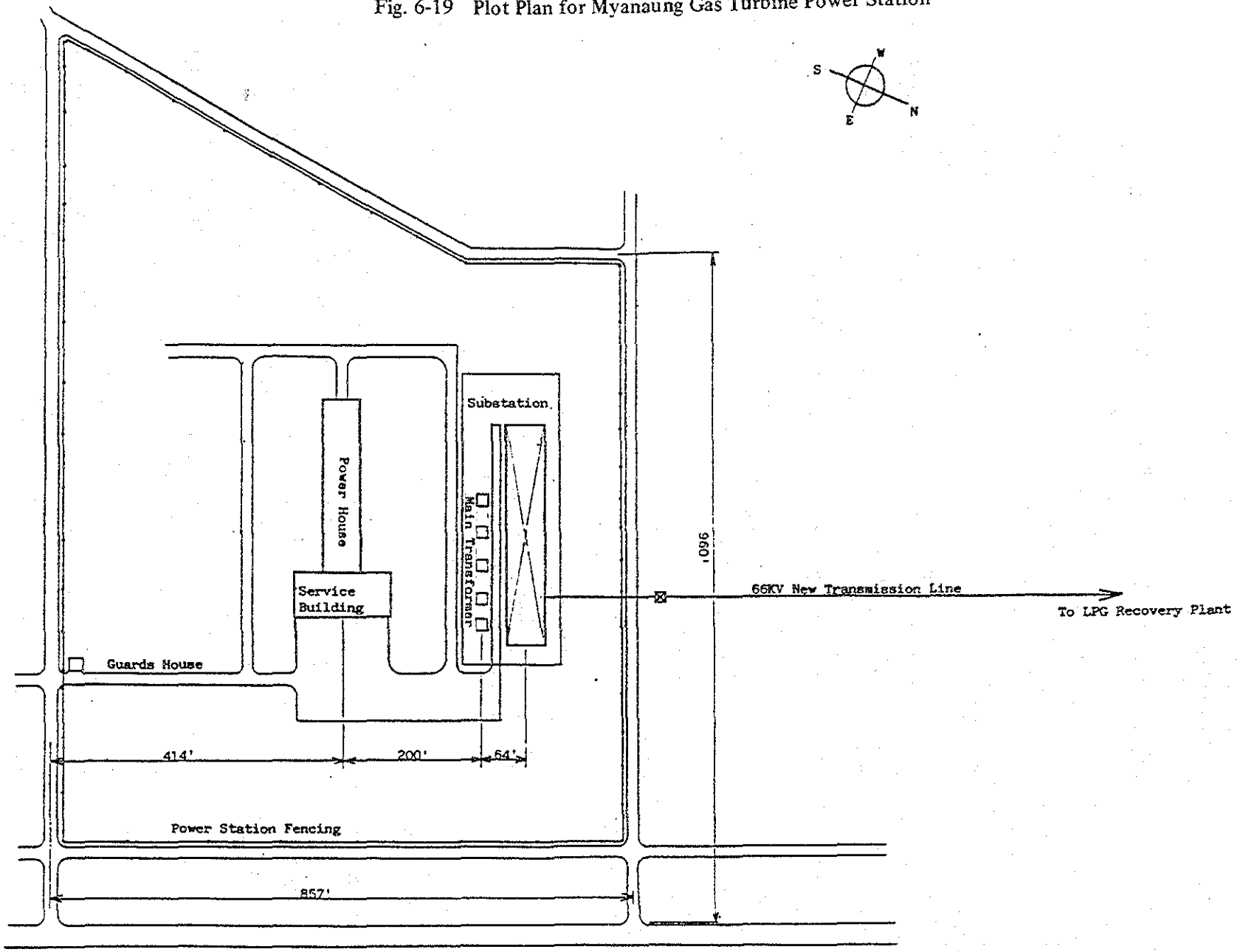


Fig. 6-20 Plot Plan for Substation of Myanaung Power Station (1/2)

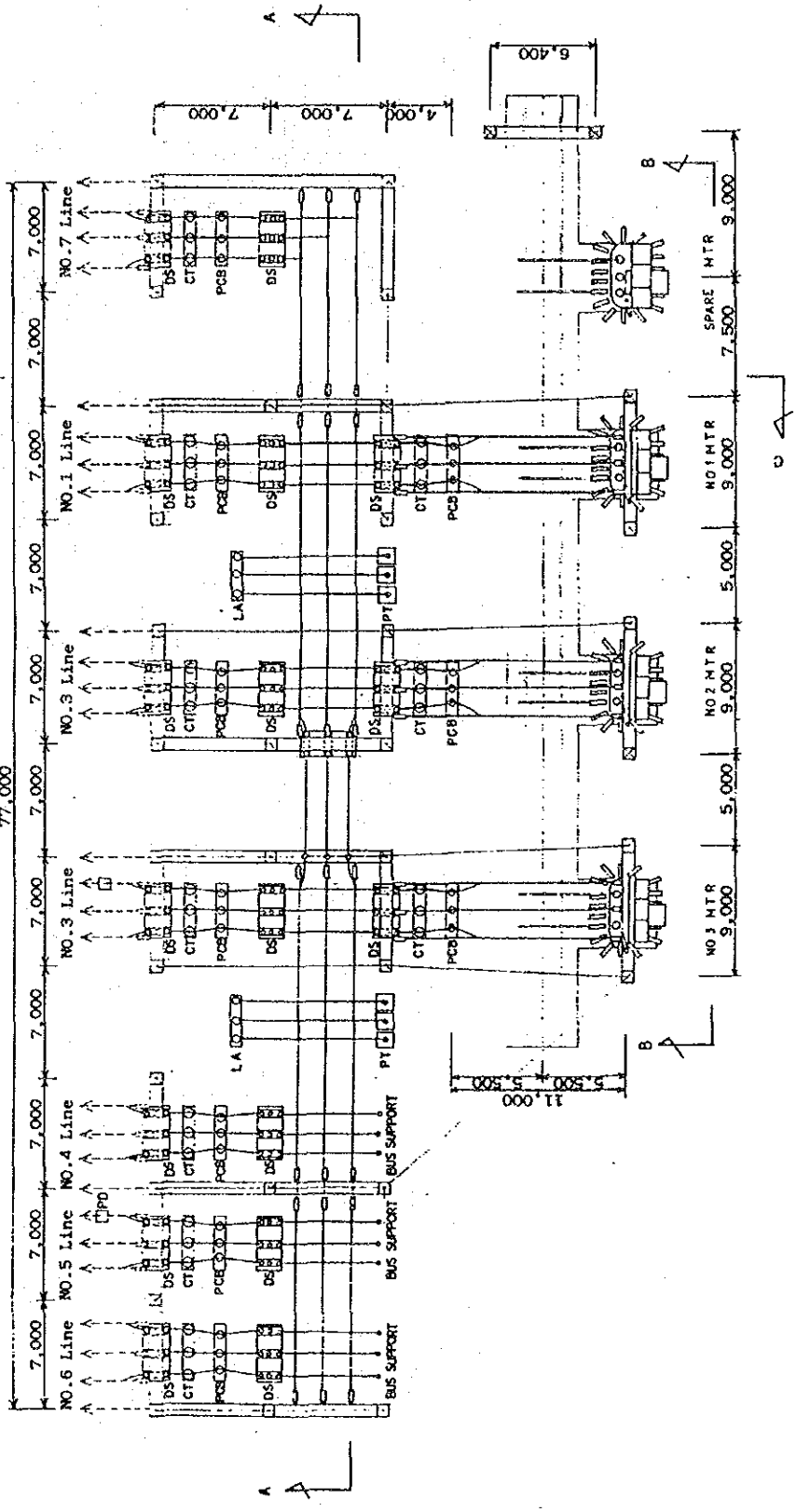


Fig. 6-21 Plot Plan for Substation of Myanaung Power Station (2/2)

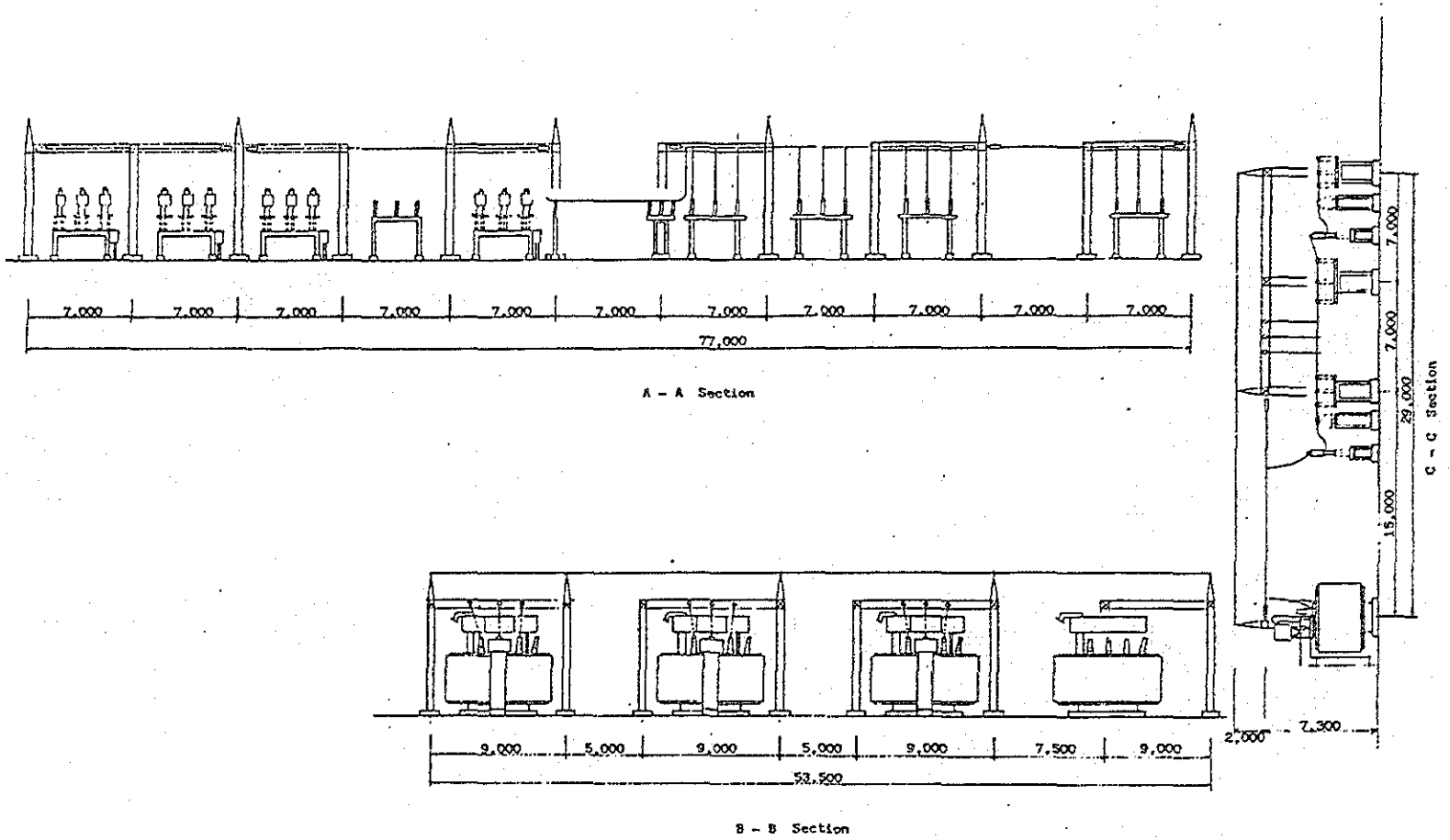
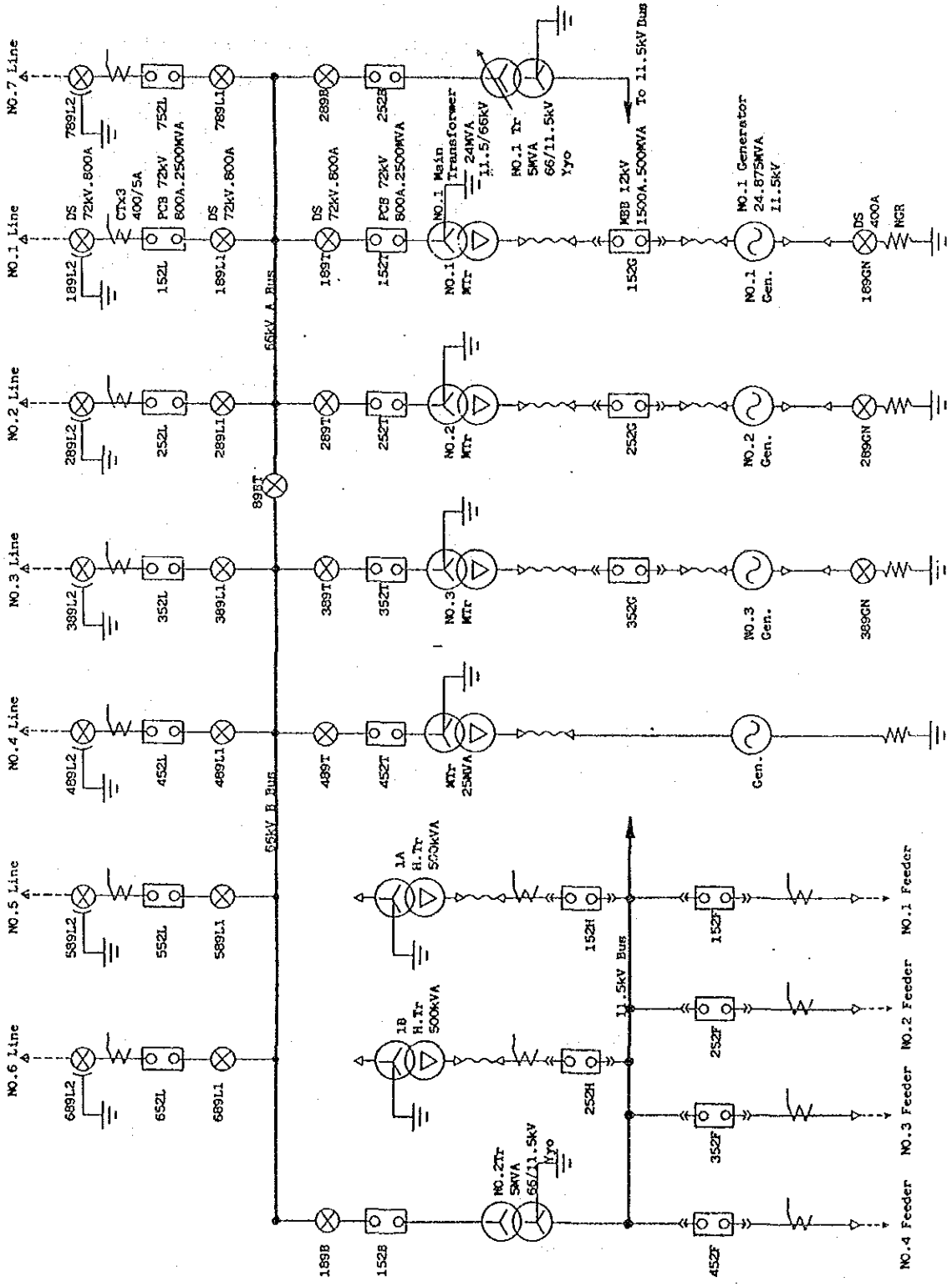


Fig. 6-22 Main One Line Diagram for Myanaung Power Station



6.6.4 Scope of New Transmission Line

Fig. 6-22 shows the main one-line diagram for Myanaung Gas Turbine Power Station. The scope of the power supply for the new transmission line is from the feeding side terminal of the No. 1 Line disconnecting switch to the terminal of the lead-in side disconnecting switch on the LPG recovery facilities.

6.7 Telecommunication Facilities

6.7.1 Telephone Facilities

An automatic exchange is to be installed in the Kyangin Plant site and 30 private telephones are to be provided. Telephones subscribed to the exchange are to be installed in terminals, jetties, Kyangin Cement Mill, PTC Kyangin, residential area, and two external lines from the local public telephone exchange are to be led in.

Fig. 6-23 shows the telephone system.

6.7.2 Paging Facilities

(1) Kyangin Plant Site

Hand sets, speakers shall be installed in the tank in the terminal area.

(2) Syriam Terminal

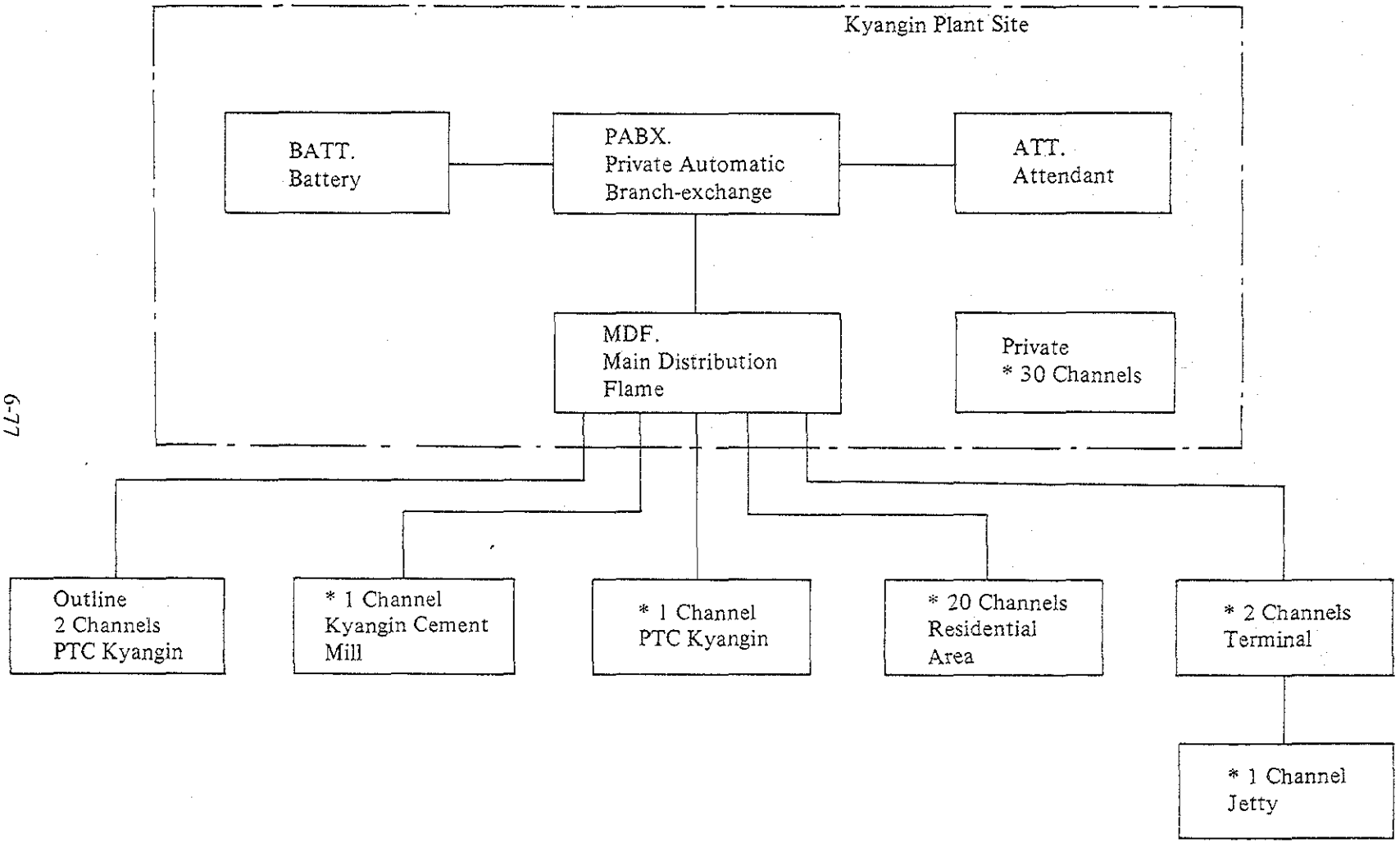
Hand sets and speaker shall be installed in the tank yeard to be expanded this time. Existing amplifiers shall be used.

6.7.3 General On-site Broadcasting System

Facilities provided with the following functions shall be installed in the Kyangin LPG Extraction Plant site.

- Microphone broadcasting
- Radio broadcasting
- Tape recording, playback broadcasting
- Electric clock, broadcasting of time signal chime

Fig. 6-23 Outline for Telephone System



- Playback broadcasting of record player
- Broadcasting through paging

6.7.4 Power-line-carrier Communication System

Power-line-carrier communication facilities are to be installed on the following transmission lines. One speaking circuit type facilities are to be connected to the automatic exchange of Kyangin LPG Extraction Plant.

- Myanaung Gas Turbine Power Station (66 kV transmission line)
- Seiktha Methanol Plant (66 kV transmission line)
- MOC Myanaung (6 kV transmission line)

6.7.5 Radio Communications System

Simplex SSB (communication single side wave band system) transmitter/receiver unit of common frequency system is to be installed in the Kyangin LPG Extraction Plant site and Rangoon Head Office respectively for into communication. Prior to use, assignment of 2 MHz band shall be obtained from the Burmese Government.

Chapter 7

CONSTRUCTION OF LPG RECOVERY FACILITIES

Chapter 7. CONSTRUCTION OF LPG RECOVERY FACILITIES

7.1 Kyangin LPG Extraction Plant

7.1.1 Survey of Site

A survey of the construction site should be completed before conclusion of a contract with the contractor in order to have the findings of the survey amply reflected in the design of the plant and facilities.

(1) Land surveying

As the Kyangin LPG Extraction Plant is located close to the existing Kyangin Cement Mill, it is recommended that standard bench mark, cordinates and so forth used for the Cement Mill are used so that their mutual relation can be suitably obtained.

Topographic survey

Scope :	Plant site and access road
Purpose :	For land adjustment, construction of access road and layout of facilities
Scale :	1/200 ~ 1/300
Contour pitch :	0.5 m

(2) Soil survey

A boring survey is conducted for designing the foundations for principal structures such as tanks and buildings.

Boring :	6 points
Depth :	10 m
N-value :	Every 1.0 m of depth
Uniaxial compression strength test :	Conducted at three boring points, 3 ~ 5 places per boring point
Physical properties test :	Conducted each time when the stratum changes (particle size test, moisture content, density)

7.1.2 Transport

The machinery, equipment and steels procured from outside of Burma for construction of the Kyangin Extraction Plant will be reloaded at the Rangoon Port from ocean carrier to river barges. The barges will run through the Twante Canal, enters the Irrawaddy River and will reach Kyangin. Z-crafts (ferry type; cargoes can be shipped as loaded on a truck or a trailer) are used for transport of heavy articles. In Kyangin, cargoes are reloaded to trucks or trailers by making use of the unloading point used for construction of the Cement Mill and are carried to the site on roads. If it is necessary to quickly transport materials to the site from Rangoon, transport by trucks can be made through the course indicated below.

That is, Gwema River crossing point located on the east side of Irrawaddy River is reached when branched from the road connecting Rangoon and Prome. This is the river corssing point to reach the Seiktha Methanol Plant construction site at the present time. The truck is loaded on a Z-craft at this point and reaches Kyangin where the truck is unloaded to the land to drive to the plant site. However, the volume/weight of materials is limited when transported on the land in such a manner, and therefore, transport of machinery and equipment should generally be made using barges which run through the Irrawaddy River.

Besides, cement to be procured locally is transported from the Kyangin Cement Mill located nearby. The gravel and sand for concrete are collected from the Irrawaddy River and are carried to the plant site as required.

7.1.3 Construction Plan

(1) Temporary works

(a) Water

Water is received from the Irrawaddy River by temporary pipeline.

(b) Electric power

Supply of electric power will be easy if supply is made from the Kyangin Cement Mill located nearby. But it is not possible because the power capacity for the cement mill does not have a sufficient margin.

As temporary power supplies, therefore, two diesel engine generators of 525

kVA each possessed by the Burmese side will be used. The high tension switch board, temporary substation and distribution board required for transmission of power from these diesel engine generators as well as lighting equipment on the field, wiring materials and so forth will be newly purchased and installed.

(c) Concrete plant

A motor-driven batcher plant of capacity 1.0 m^3 will be provided.

(d) Building

The following temporary buildings will be constructed by the Burmese side in the initial period of construction, and they will be used throughout the construction period.

- Cement warehouse
- Temporary office
- Workers' office
- Materials warehouse
- Working buildings for electricity, instrumentation, heat insulation

(2) Civil engineering and construction works

Civil engineering and construction works include works on access roads, land adjustment, tank foundation, machine foundation, buildings and water supply/discharge. These works should be executed in a good order in order not to cause problems in the installation of equipment. Structures are built on direct foundations, and no piling is required.

(3) Installation works

Installation works are mainly classified into works for process equipment, group of tanks, other general equipment and pipeline to the Kyangin Terminal.

(a) *Construction of tanks*

Seven tanks at the plant are composed of five spherical tanks and two floating tanks. For assembly of spherical tanks at site, all of the tank materials are

bevelled and bent prior to shipment to the site. Therefore, these materials shall be suitably arranged after sufficiently checking the tank number, countermark and so forth, and thus management should be made in order not to allow occurrence of confusion in the assembly.

(b) Installation of process equipment and other general equipment

The plant construction is generally advanced in the order for installation, pipings, electric wiring instrumentation, heat insulation and painting, with the individual tasks coordinated by the supervisors.

Long size towers are shipped as split into a number of the proper section because of the limitation of shipping space. These tower sections are welded together on the turning rollers installed at the plant site and are formed to tower and the tower construction will be completed.

The tower of the largest size is the debutanizer. Installation of large size equipment including this tower is carried out at the site using a large size truck crane or a crawler-type crane.

Prior to installation of towers, heat exchangers, tanks, etc., underground piping works around these equipment are carried out in advance in order not to allow interference with other works. Furthermore, installation of equipment and units such as furnaces which are mainly assembed in the field is started as early as possible.

Erection of steel structures and of pipe racks is started next. Prefabrication of pipings is started at this time. The piping works in the battery limit are started with large diameter pipes and pipes on pipe racks and gradually make transition to branched small diameter pipes. The pipelines to the Kyangin Terminal for transport of products are constructed regardless of complication of works in the battery limit. Welding of these pipelines is made using engine-driven welders because no power is available.

When the works advance to electricity and instrumentation, the shape of the plant gradually appears. Works such as cleaning (flushing) of piping systems, individual running of rotating machine and curing of furnaces are started as preparations for starting of the plant. It is necessary that utilities such as

electricity, water and steam are provided for these works.

(4) Pipeline works

The total weight of required pipes is as much as about 5,000 tons. On the ground piping and underground piping are used as piping styles.

Pipes are prefabricated at shop in advance in accordance with the piping plan drawing. These prefabricated pipes are brought to the site and are laid as matched with the actual topography. It is therefore necessary to conduct a suitable field survey of the piping route before orders for the pipeline works are placed with a contractor by the PIC side.

(a) Underground piping works

- The underground piping will be used for transport of natural gas, LPG and Naphtha. The pipe diameter is 6B ~ 14B and steel pipes are used. The extension from the Shwepyitha Oil Field to the plant site is about 45 km by way of the Myanaung Oil Field.

- The underground piping is wound with polyethylene films in two layers used as corrosion protection tapes. Thorough care should be exercised at the time of working in order not to include foreign matters such as sand and dust.

- Long size (fixed length 11 m) pipes are used for the underground piping. These long size pipes are welded together and are laid in an excavated ditch as hoisted with a truck crane. Sufficient sand layers should be secured at the bottom of the ditch at time time.

- Burial marking boards should be provided at important points in order to secure safety of running.

(b) Aboveground piping works

- The aboveground pipings are used for transport of nitrogen, drinking water and industrial water. Steel pipes of 2B ~ 8B are used and these pipes are laid on pipe sleepers. The section in which they are laid is from

the plant to the jetties by way of the terminal. The extension is about 10 km.

- A road for inspection and maintenance should be provided along the entire length of the pipelines, and patrols for watching the situations should be sufficiently executed in order to secure safety during running.

- Class 2 inspection standard specified in JIS (Japanese Industrial Standard) is adopted for the pipe welding strength. (Same for underground pipings)

7.2 Kyangin LPG Terminal and Shipping Jetty

7.2.1 Survey of Site

(1) Land surveying

The same standard bench marks used in the construction of the Cement Mill are to be used.

Topographic survey

Scope :	Environs of terminal and jetty
Purpose :	Land adjustment and layout of facilities
Scale :	1/200 ~ 1/300
Contour pitch :	0.5 m

Profile levelling

Scope :	Jetty centerline
Purpose :	Layout of jetty facilities
Scale :	Lateral : 1/200, longitudinal : 1/100

(2) Soil survey

Boring surveys will be conducted at the terminal site and at the jetty site.

Boring :	4 points at the terminal
	5 ~ 7 points along jetty center lines
	2 points for mooring posts

Test items

Depth : 5 m below the bearing stratum having N-value 20 ~ 30 or more, which is hard cohesion soil stratum

N-value : Every 1.0 m of depth

Uniaxial compression strength test :

To be conducted in around three places per boring point; at two boring points in the terminal site and at 3 ~ 5 boring points for the jetty.

Physical properties test :

To be conducted each time when the stratum changes; including particle size, moisture content and density

7.2.2 Transport

The basic method related to transport is not different from the case of the plant site. The unloading point on the west side of the Irrawaddy River, however, will be newly constructed with the river side suitably adjusted near the jetty point in the downstream of confluence of Pashin Creek.

It is because if the unloading point that is common with that for the plant site is used, it is necessary to cross the Pashin Creek using a railway bridge, and there is a limit in the load. An unloading point will be newly constructed in order to avoid such load restriction.

7.2.3 Construction Plan

(1) Temporary works

(a) Water

At the beginning of construction water will be taken by means of temporary water intake pumps to be installed by the Irrawaddy River and will be delivered to the site through a temporary pipeline. Switching will be made to the water intake equipment and water delivery pipeline for the plant when they are completed.

(b) Electric power

Two diesel engine generators of 150 kVA each will be used for works and one diesel engine generator of 30 kVA will be used for security and for the office, as temporary power supplies.

At the jetty site, works will be executed using engine welders and pneumatic tools.

(c) Concrete plant and buildings

They correspond to temporary works for the plant site.

(2) Civil engineering and construction works

The terminal site is currently used as paddy fields and is flooded during the rainy season. Therefore, banking is required. If the banking height is equal to the height of the surrounding dikes, it is considered necessary to perform banking to a height of around 4 m, and it requires soil of about 88,000 m^3. Sandy soil which well consolidates is desirable as the soil to be used for banking. As the railroad bridge on the Pashin Creek does not allow passage of heavy vehicles such as dump trucks, it is desirable that the soil is brought from the direction of Myanaung. In order to increase the efficiency of carriage of soil it is necessary that the borrow pit is located close to the site, and from this viewpoint it is recommended that the borrow pit is located in the vicinity of Myanaung. As the soil volume required for banking is considerably large it is necessary to prepare dump trucks of a sufficient number in order to finish the work within the time limit.

It is considered that pile foundations are required for the facilities of the terminal and jetty because the soil is considered to be soft compared to that at the plant site. Piling should be performed with care so that pile tops are not destroyed by hammers when piling becomes hard due to the fact the pile tips come across a hard stratum.

The jetty site in the land portion is higher than river water level except for rainy season. Therefore, there is no problem in particular in the construction. But concrete placing for lower parts of protection of slopes of river sides should be executed in the dry season. It is therefore necessary to consolidate construction machinery on the field and to carry out works at high efficiency.

(3) Installation works

In Kyangin Terminal installation works are mainly construction on five spherical tanks. The execution procedure for installation corresponds to the description in the proceeding Section.

The project is generally advanced in the order of installation work, pipings, electrical wiring, instrumentation, heat insulation and painting, with the individual tasks coordinated by super visors. Installation is made using a large size truck crane or a crawler crane. Underground piping works and so forth should be carried out in advance prior to installation of equipment in order not to allow interference with other works. Erection of steel structures and pipe racks are then carried out.

Prefabrication of pipings is started at this time. Acceptance of products to the site and piping work for shipping are advanced regardless of complication of works in the battery limit. Welding of these pipelines is made using engine welders because no power is available. The pipelines for transport of products from the Kyangin Plant to the Kyangin Terminal are constructed simultaneously with construction of LPG recovery facilities.

When the works advance to electricity and instrumentation and the shape of the plant gradually appears, works such as flushing of piping systems and individual running of rotating are commenced as preparation for running.

Lines for utilities for this works such as electric power and water should naturally be able to supply utilities at this time.

7.3 Syriam Terminal Expansion

7.3.1 Survey of Site

(1) Soil survey

Boring survey was conducted in the design for Phase I-Part 2, but boring survey will be conducted again in order to check the location of the pile foundation bearing stratum for the additional tanks.

Boring : 2 points
Test items :
Depth : 5 m below the bearing stratum of N-value 40 ~ 50

N-value : Every 1.0 m of depth

7.3.2 Transport

The site is not directly connected with Rangoon by roads, as the Rangoon River is located between the site and Rangoon. Accordingly, machinery and equipment, steels and PC concrete piles procured from outside of the country are reloaded to river barges from ocean freighters at the Rangoon Port for tarnsport to Syriam.

At Syriam, each barge is docked to the existing cargo jetty for unloading. An existing road is available between the cargo jetty and the site, and the equipment and materials are carried using a truck or a trailer. Materials procured in the country such as cement and concrete pipes are also carried in the same manner.

The Rangoon Port where ocaen freighters make entry is a river port located at a place reached by going up the Rangoon River by 35 km. Its outline is shown in Fig. 7-1.

Two wharves, i.e., Sule and Brooking, are available for handling of general cargo. They are of the extension of 740 m and 270 m respectively, and the water depth is 7.0 m.

A sand bank is located at the entrance to the port. As it obstructs navigation of ships, large size ships make entry/exit by making use of full tide. The tidal difference is 5.13 m in spring tide average.

The maximum ship size that is capable of making entry/exit is usually 10,000 D.W.T. class.

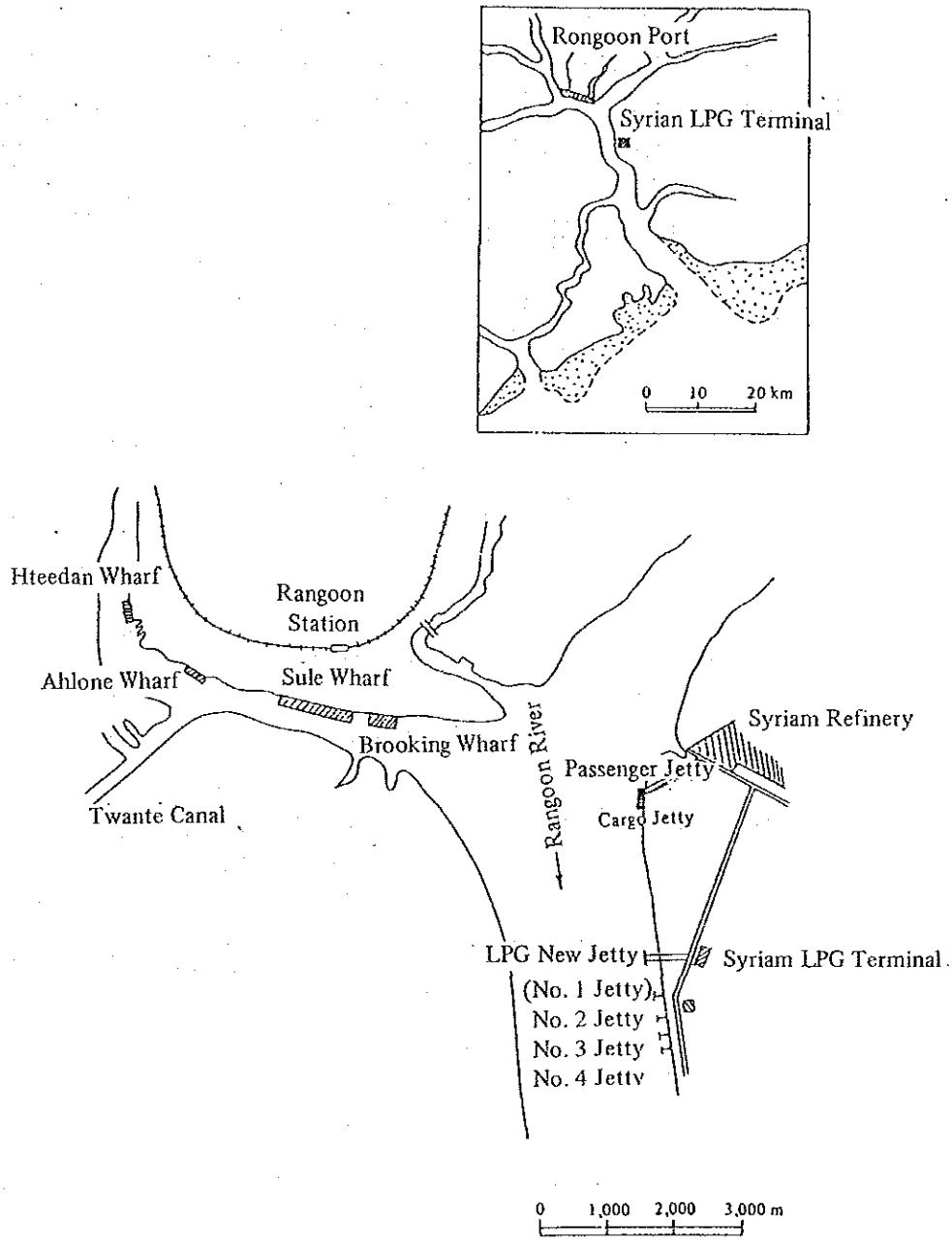
7.3.3 Construction Plan

(1) Temporary works

As for water and buildings, the temporary facilities for the terminal construction works of Phase I-Part 2 being in execution at the present time will be utilized. Electric power will be taken out of the spare feeder in the electrical room of the plant and will be used as it is.

(2) Civil engineering and construction works

Fig. 7-1 Rangoon Port



The foundation works for additional tanks are main works. The foundations are pile foundations.

(3) Installation works

5 spherical tanks will be additionally installed accompanying increase of the LPG handling volume in the vicinity of the existing spherical tanks. The execution procedure for installation corresponds to the description in the preceding section.

7.4 River Barges for Transport of LPG (Self-propelled Type)

7.4.1 Shipbuilding Plan

It is sufficient if a period of about 15 months is taken into account including design as the shipbuilding period. Therefore, shipbuilding will be made based on the examination of the market situations and vacancy of building berths of shipbuilding companies.

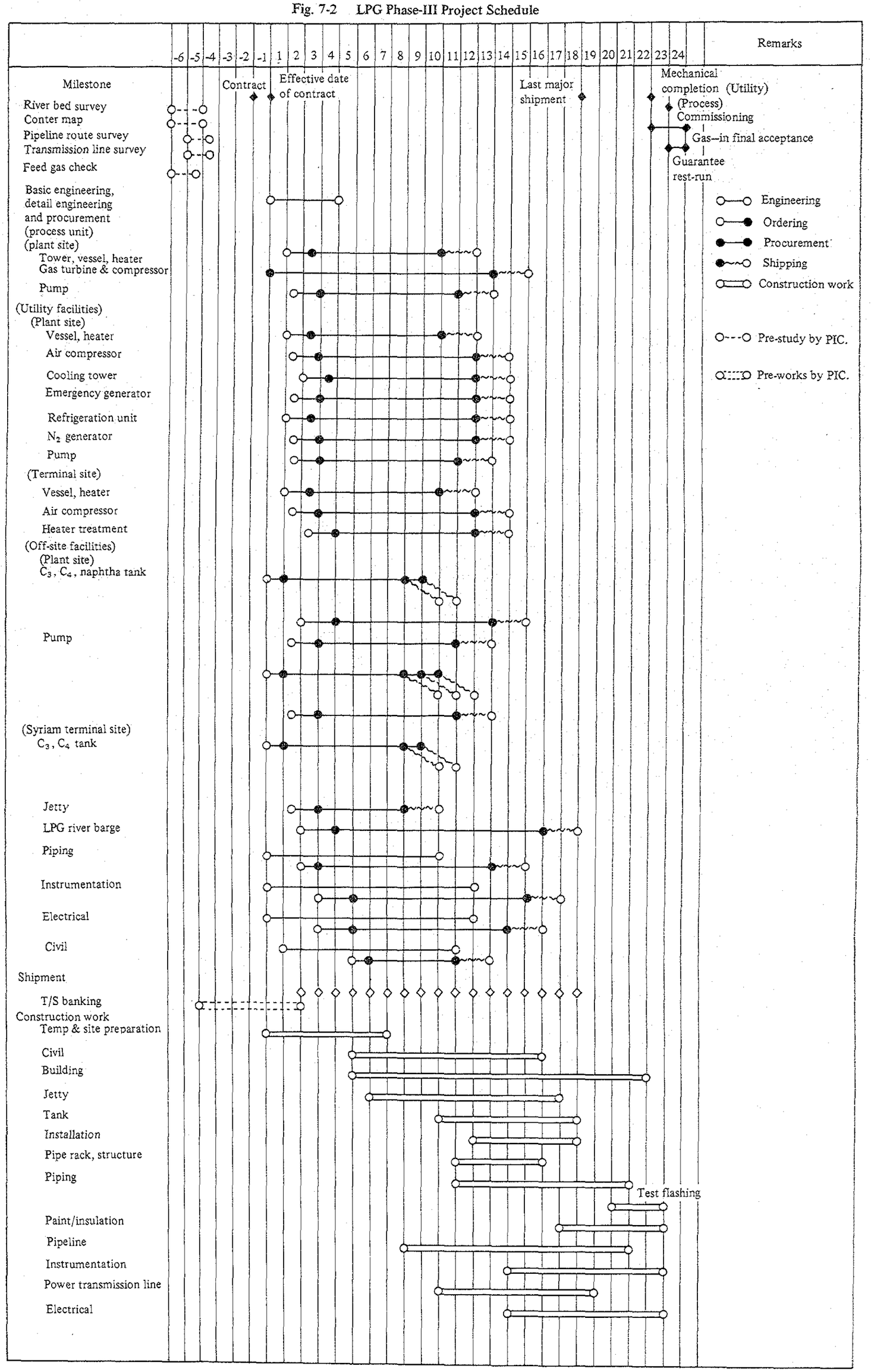
7.5 Construction Schedule

This project will be implemented in accordance with the following schedule.

(1)	June 1, 1987	:	Signing of contract
(2)	July 1, 1987	:	Effectuation of contract
(3)	)	:	Construction period (24 months)
(4)	July 1, 1989	:	Commencement of commercial running

The details of the construction schedule based on the time schedule indicated above is shown in Fig. 7-2.

Fig. 7-2 LPG Phase-III Project Schedule



7.6 Construction Machinery & Equipment Plan

7.6.1 Construction Machinery Plan

As Burma has purchased construction machinery for construction of the Mann Terminal and the Syriam Terminal in project of Phase I-Part 2, and now Burma is in possession of construction machinery of a certain extent. It is therefore considered that machines can be appropriated except for spare parts for construction machinery and some equipment. On the other hand, however, the construction machinery used for construction of the Mann Oil Refinery Plant were diverted later on other fields and it is considered that some of them have terminated their service lives. The construction machinery which are considered necessary for construction of Phase III are shown in Table 7-1. The number of equipment which are considered to be available based on the machines supplied to the Burmese side in the past and the machines possessed by public corporations including TSC is shown in Table 7-2. The equipment to be supplied by the contractor based on these figures are shown in Table 7-3.

The following points were taken into account for drawing up this table.

(1) It is regarded that all of the machinery on the Burmese side have been serviced and may be used.

(2) It is considered that the machinery used for construction of Phase I-Part 2 Syriam Terminal and Mann Terminal as well as in Phase II Mann GOCS LPG Extraction Plant may be diverted.

Besides, supply of one Z-craft (capable of loading 100 tons) for carriage of heavy articles from Rangoon to Kyangin and one FRP boat for crossing the Irrawaddy River is planned.

A list of Z-crafts possessed by PIC is shown in Table 7-4. As some of them are very old, and it is observed that Z-crafts are insufficient as the number of plants increases.

As fabrication and assembly of a Z-craft is made by the Burmese side, the only requirements on the Z-craft are supply of materials. These Z-craft and FRP boat can, of course, be used for operation after completion of construction of the plant.

Table 7-1 List of Construction Machinery

Construction Machinery	Specification	Required Quantity			Remarks
		Kyangin	Syriam	Total	
1. Truck Crane	136 ton	1	–	1	
2. Truck Crane	35 ton	4	1	5	
3. Truck Crane	20 ton	4	–	4	
4. Crawler Crane	35 ton	2	1	3	
5. Trailer	100 ton	1	–	1	
6. Trailer	30 ton	1	–	1	
7. Long Body Truck	10 ton	2	1	3	
8. Truck	4 ton with 2 ton Crane	4	–	4	
9. Truck	4 ton	5	1	6	
10. Fork Lift	2 ton	1	–	1	
11. Bulldozer	24 ton	4	1	5	
12. Bulldozer	9 ton	1	1	2	
13. Motor Scraper	Capacity 16 m^3	1	–	1	
14. Back Hoe	0.8 m^3	6	1	7	
15. Back Hoe	0.6 m^3	1	–	1	
16. Loader	0.8 m^3	2	–	2	
17. Loader	1.5 m^3	–	1	1	
18. Load Roller	15 ton	1	1	2	
19. Dump Truck	8 ton	8	2	10	
20. Dump Truck	6 ton	10	4	14	
21. Agitator Car	3 m^3	4	1	5	
22. Agitator Car	2 m^3	1	–	1	
23. Concrete Pump Car	90 m^3/hr	1	–	1	
24. Batcher Plant	1 m^3/ batch	1	1	2	
25. Pile Hammer	Capacity 3.5 ton	1	1	2	
26. Motor Grader		1	–	1	
27. Pot Mixer		5	2	7	
28. Rammer		4	2	6	
29. Sump Pump	3 B	3	5	8	
30. Sump Pump	6 B	5	–	5	
31. Vibrator		8	3	11	
32. Concrete Breaker		3	1	4	
33. Arc Engine Welder	Diesel	10	–	10	
34. Tig Engine Welder	Diesel	4	–	4	
35. DC Arc Welder	500 Amp	5	3	8	
36. A.C. Arc Welder	500 Amp	30	15	45	
37. A.C. Arc Welder	300 Amp	25	–	25	
38. TIG Welder	500 Amp	8	3	11	
39. Air Compressor	Engine 7 kg/cm^2	6	–	6	
40. Air Compressor	Motor 30 kg/cm^2	2	–	2	
41. Air Compressor	Engine 100 kg/cm^2	1	–	1	
42. X-ray Equipment	250 KVA	2	1	3	
43. X-ray Equipment	200 KVA	3	1	4	
44. Heat Treatment Apparatus		1	1	2	
45. S.R. Apparatus		1	–	1	

Table 7-2 List of Locally Available Machinery

Construction Machinery	Specification	Quantity	Remarks
1. Gin Pole	100 ton	1	
2. Truck Crane	136 ton	1	
3. Truck Crane	35 ton	3	
4. Truck Crane	20 ton	2	
5. Crowler Crane	35 ton	2	*
6. Trailer	100 ton	1	
7. Trailer	30 ton	1	
8. Long Body Truck	10 ton	3	
9. Truck	4 ton with 2 ton Crane	3	
10. Truck	4 ton	6	
11. Truck	2 ton	4	
12. Fork Lift	2 ton	1	
13. Bulldozer	40 ton	2	
14. Bulldozer	24 ton	3	
15. Bulldozer	9 ton	2	
16. Motor Scraper	Capacity 16 m^3	1	
17. Back Hoe	0.8 m^3	7	*
18. Back Hoe	0.4 m^3	1	
19. Loader	0.8 m^3	2	*
20. Loader	1.5 m^3	1	
21. Load Roller	15 ton	2	
22. Dump Truck	8 ton	5	
23. Dump Truck	6 ton	14	*
24. Agitator Car	3 m^3	5	
25. Agitator Car	2 m^3	1	
26. Concrete Pump Car	90 m^3/hr	1	
27. Batcher Plant	1 m^3/batch	2	
28. Pile Hammer	Capacity 3.5 ton	2	
29. Motor Grader		1	
30. Pot Mixer		7	
31. Rammer		6	
32. Sump Pump	3 B	8	
33. Sump Pump	6 B	5	
34. Vibrator		11	
35. Concrete Breaker		4	
36. Arc Engine Welder	Diesel	6	
37. Tig Engine Welder	Diesel	3	
38. D.C Arc Welder	500 Amp	6	
39. A.C Arc Welder	500 Amp	45	
40. A.C Arc Welder	300 Amp	25	
41. TIG Welder	500 Amp	7	
42. Air Compressor	Engine 7 kg/cm^2	6	
43. Air Compressor	Motor 30 kg/cm^2	2	
44. Air Compressor	Engine 100 kg/cm^2	1	
45. X-Ray Equipment	250 KVA	3	
46. X-Ray Equipment	200 KVA	3	
47. SR Apparatus		1	

* Including the machinery borrowed from other public corporations.

Table 7-3 Supply List of Construction Machinery and Tool

Construction Machinery	Specification	Quantity	Remarks
1. Truck Crane	35 ton	2	
2. Truck Crane	20 ton	2	
3. Crawler Crane	35 ton	1	
4. Dump Truck	8 ton	5	
5. Truck	4 ton with 2 ton Crane	1	
6. Arc Engine Welder	Diesel	4	
7. TIG Engine Welder	Diesel	1	
8. D.C Arc Welder	500 Amp	2	
9. TIG Welder	500 Amp	4	
10. Heat Treatment Apparatus		2	
11. Z-Craft	100 ton	1	Supply of Material
12. FRP-Boat	30 persons	1	
13. Batcher Plant	1 m^3/batch		
14. Installation Tool			

Table 7-4 Existing Z-Craft

Name	Capacity	Completion	Home port
Ayeyar Min Gyi	120 ton	1970	Rangoon
Ye Sin	60	1968	Kyunchaung
Ayeyar Min (1) + (2)	80	1978	Mann
Kyawzwa Gyi	200	1982	Kyawzwa

7.6.2 Construction Materials

The construction materials include materials for civil engineering and construction and consumable materials for installation. The materials for civil engineering and construction can be procured in Burma except for steels and special auxiliary materials. However, many of consumable materials for installation are rather special and it is necessary to procure large quantities at a suitable time, and therefore, it is considered difficult to procure them in Burma, and accordingly, it is planned the contractor supplies these materials.

The materials for civil engineering and construction to be procured in Burma are shown in Table 7-5, and consumable materials for installation are shown in Table 7-6 for reference.

7.7 Supervisor Dispatch Plan

The construction and running of this project will be conducted under the guidance of supervisors to be dispatched by the contractor based on a request from Burma. When the number of supervisors to be dispatched is trially computed, 275 man-month (20 persons at peak time) is required for Kyangin LPG Extraction Plant and Terminal, and 43 man-month (5 persons at peak time) is required for Syriam Terminal Expansion, that is, 318 man-month in total.

Table 7-5 List of Major Materials Locally Supplied for Civil and Architecture

Material		Unit	Required quantity					
Name	Specification		Kyangin Plant	Kyangin Terminal	Kyangin Jetty	Syriam Terminal	Power Trans. Line	Total
Cement		ton	3,600	1,800	1,350	300	650	7,700
Sand		m^3	7,000	3,500	2,250	400	1,000	14,150
Gravel		"	9,000	4,000	3,250	500	1,500	18,250
Timber		"	600	250	170	40	100	1,160
Brick		pcs.	617,000	288,000	6,000	61,000	–	972,000
Asbestos Roof		m^2	8,000	900	100	–	–	9,000
Asbestos Wall		"	2,100	600	100	–	–	2,800
Hume Pipe	9 B	m	400	170	40	90		700
"	12 B	"	550	100	80	80		810
"	15 B	"	700	100	60	100		960
"	18 B	"	–	–	–	–		–
"	24 B	"	800	80	–	–		880
"	30 B	"	–	–	–	–		–
"	36 B	"	500	80				580

Table 7-6 List of Major Consumable Materials for Installation

Material		Unit	Kyangin LPG extract plant	Kyangin LPG terminal	Kyangin jetty	Syriam terminal expansion	Power trans line	Total
Name	Specification							
1. Electrical welding rods		ton	80	20		10		110
2. TIG welding rods		kg	6,000					6,000
3. Cabon arc gausing rods		kg	40	140		140		320
4. X-ray film		sheet	38,000	8,400		7,400		53,800
5. Developer for X-ray film	10 ℓ/can	cans	250	60		50		360
6. Colour check reagent	450 cc/can	cans	600					600
7. Argon gas	7 m^3/cylinder	Nos.	600					600
8. Other various consumable material		set	—	—	—	—	—	—

The scope of duty of supervisor is limited to guidance only as a rule, and there will be no cases where supervisors engage in works. For works of special contents, however, supervisors indicate examples as required, and they will train workers on the field.

It was determined to execute welding of main body of spherical tanks requiring techniques of high degree by the contractor this time.

	Kyangin area	Syriam area
(1) Construction works		
Management, general affiars, transportation	15 man-month	7 man-month
Design	28	—
Civil + architecture	19	8
Installation work	182	26
Sub total	244	41
(2) Guidance of trial running	31	2
Total	275	43
Grand total	318 man-month	

Chapter 8

CONSTRUCTION COST

Chapter 8. CONSTRUCTION COST

8.1 Estimation Basis of Construction Cost

1) Prices of required machinery, equipment and materials supplied by the contractor include following costs:

   - F.O.B. prices at each loading port
   - Required engineering cost
   - Cost of dispatching supervisors required for construction
     (Construction works at the site are to be conducted by Burmese side under the guidance of supervisors)

2) Marine transportation cost is shown in items No. Six of 8.2 (Foreign Currency Portion); marine insurance fee is paid by the Burmese side.

3) Required machinery, equipment and materials procured locally in Burma are to be arranged for by the Burmese side in conformity with the lists prepared by the contractor.

4) Required machinery, equipment and materials supplied by the contractor are assumed to be procured in Japan, but may be procured in Burma whenever necessary.

5) The foreign exchange rate of US$1.00 = 8.60 kyats, and 3.50 kyats = 100 yen are to be adopted for cost calculation.

6) The construction costs calculated in foreign currency portion are based on the assumptions of the conditions of the contract signed on June 1, 1987, and effectuation of the contract on July 1, 1987. The trial operation will be completed within 24 months after effectuation of the contract, according to the construction schedule described in Chapter 7. Construction of LPG Extraction Palnts.

7) The construction costs in local currency portion are based on the following assumptions:

   (1) Labor cost

Based on data supplied by Burmese side, the labor cost is calculated on the bases of 25 working days per month.

(2) Civil engineering and construction work cost

The costs of such as cement, sand, gravel, timber and fuel are applied to the materials cost in local procurement. The rental fees and administrative expenses given by the Burmese side are adopted as calculating the costs of main construction machinery provided by the Burmese side.

Costs are estimated for construction machinery, whose unit fees and costs are not specified by the Burmese side. The rental fees for construction machinery prepared by the contractor are not calculated.

(3) Installation cost

The price reference provided by the Burmese side is used for calculating the cost for local procurement materials such as fuel.

The rental fees and administrative expenses given by the Burmese side are adopted, for calculating the costs of main construction machinery provided by the Burmese side.

Costs are estimated for construction machinery, whose unit fees and costs are not specified by the Burmese side. Rental fees for construction machinery prepared by the contractor are not calculated.

8) As of June 1985, of base plant cost, foreign currency portion is 12,000,000,000 yen, and local currency portion is 59,500,000 K. And of total cost in which contingency costs are added to the base plant cost, the foreign currency portion is 12,300,000,000 yen, and the local currency portion is 63,000,000 K.

9) At the time of signing of contract of June 1, 1987, of the base plant cost, the foreign currency portion is 12,500,000,000 yen, and the local currency portion is 63,000,000 K.

10) The payment for the construction cost is made for 2 years after the effectuation of contract and is annual equal installment for the foreign currency portion. As for

the local currency portion, 40% of payment in the first year and 60% of that in the second year are made.

8.2 Construction Cost

The construction cost are estimated as follows, based on the 8.1.

1) Foreign currency portion

(Unit: 1,000 yen)

Item	Construction cost	Remarks
1. Kyangin LPG Extraction Plant	6,516,000	LPG recovery facilities, refrigeration facilities, sewage treatment facilities, water cooling facilities, air compression facilities, nitrogen producing facilities, power receiving/distribution facilities, transmission line facilities, emergency power generation facilities, oil/water separator flare facilities, fire-fighting facilities, tank facilities, building, telecommunication facilities, pipelines, industrial water and drinking water, materials for electrical wiring, subsidiary materials, temporary works equipment and materials, LPG filling facilities, maintenance equipment and tools, analysis equipment, safety and protective equipment, first-aid supplies and spare parts (for two years), chemical reagents, tools for operation, engineering fee, cost for dispatch of installation supervisors.
2. Kyangin LPG Terminal and Shipping Jetty	1,492,000	Tank facilities, LPG shipping facilities, water intake facilities, air compression facilities, power receiving/distribution facilities, fire-fighting facilities, building, temporary works equipment and materials, LPG shipping Jetty, spare parts (for two years), engineering fee, cost of dispatching installation supervisors.
3. Syriam Terminal Expansion	747,000	Tankyard facilities, temporary works equipment and materials, spare parts (for two years), engineering fee, cost for dispatch of installation supervisors.
4. LPG Barges (self-propelled barges)	1,890,000	LPG transportation river barges (600 T capacity x 3).

Item	Construc-tion cost	Remarks
5. Construction Machinery and Tools	600,000	Construction machinery, tools and Z-craft, FRP boat, compressing connector for electric wiring, pig cleaner.
6. Marine Transportation	755,000	Rangoon Port of destination.
7. Base Plant Cost	12,000,000	
8. Physical Contingency	300,000	
9. Price Contingency	200,000	
10. Total Plant Cost	12,500,000	

(2) Local currency portion

(Unit: 1,000 K)

Item	Construc-tion cost	Remarks
1. Construction Cost	32,000	Field survey, civil engineering works, architectural and installation works, local manufacture of equipment, subsidiary materials and supply costs.
• Kyangin LPG Extraction Plant	(26,600)	
• Kyangin LPG Terminal and Shipping Jetty	(4,500)	
• Syriam Terminal Expansion	(900)	
2. Rental Fee for Construction Machinery	21,000	
3. Transportation and Insurance	6,500	Including inland transportation cost for imported materials and equipment as well as insurance fee for marine transportation.
4. Base Plant Cost	59,500	
5. Physical Contingency	3,500	
6. Price Contingency	—	
7. Total Plant Cost	63,000	

Chapter 9

OPERATING PLAN

Chapter 9. OPERATING PLAN

9.1 Operating Plan

Upon drafting operation plan for Kyangin LPG Extraction Plant, Kyangin Terminal and Syriam Terminal, the following factors are taken into consideration:

(1) LPG production plan
(2) LPG export and domestic consumption plan
(3) LPG transportation plan from Kyangin and Mann terminals to Syriam terminal by LPG river barges.
(4) Consumption plan for by-product lean gas.
(5) The fact that the project under survey is a part of Integrated Project consisting of three phases.

Table 9-1 shows LPG production, export and domestic consumption plans.

Table 9-1 LPG Handling Volume by Plant Unit: T/Y

Year	Mann Refinery	Syriam Refinery	Mann GOCS	Kyangin LPG E.P.	Domestic Consumption	Export
1982	2,550				50	–
1983					100	–
1984					500	–
1985	6,700				700	6,000
1986	10,500	4,500			3,000	12,000
1987	12,000	5,800	30,000		4,800	43,000
1988	13,500	6,200	30,000		6,000	43,700
1989	13,500	6,500	30,000	30,000	8,000	72,000
1990	13,500	6,900	30,000	61,000		

Mann refinery started its commercial operation in 1982. Since then LPG for the domestic use is filled into cylinders by filling system equipped in Mann refinery for the local

marketing. However, LPG production will increase rapidly from this year since Cokers, one of main LPG production equipment, will come into full-scale operation within the yar. Accordingly, after domestic demands are secured, the rest may be exported. Future LPG production at Mann refinery is expected 13,500 T/Y.

Completion of Phase I – Part 2 is scheduled for Nov., 1985. And in 1986, after setting aside 3,000 T/Y for the domestic use from expected LPG output of 10,500 T/Y at Mann refinery, the remaining 7,500 T/Y will be transported to Mann Terminal through the newly constructed pipeline, and then to Syriam Terminal by river barges. In the future, say in 1989, export portion of total LPG production at Mann refinery is expected 5,500 T/Y.

Completion of Phase I – Part 2 is scheduled for the end of Sep., 1985 expediting progress of the construction. At Coker Complex Plant at Syriam refinery, 4,500 T/Y LPG will be produced in 1986, and transported to Syriam Terminal through the new exclusive pipeline, thus the handling volume at Syriam Terminal in the initial fiscal year will amount to 12,000 T/Y.

Completion of Phase II is schedule for the end of Dec., 1986. From 1987 onward, 30,000 T/Y LPG production is expected at Mann GOCS LPG Extraction Plant, and will be transported to Mann Terminal through the new exclusive pipeline, then to Syriam Terminal by river barges. As a result, handling amount of LPG at Syriam Terminal will amount to 43,000 T/Y in 1987.

Phase III will set in operation in the middle of 1989. At Kyangin LPG Extraction Plant, 30,000 T/Y in 1989 and 61,000 T/Y LPG will be produced from 1990 onward, and transported to Kyangin Terminal through the new exclusive pipeline, then to Syriam Terminal by LPG river barges. At this stage, handling volume at Syriam Terminal will amount to 72,000 ~ approx. 100,000 T/Y. LPG consumption in Burma is predicted 3,000 T/Y in 1986, largely increased to 8,000 T/Y in 1989, and expected 14,500 T/Y in further future. LPG filling system at Mann refinery is a major operating force at present, however, Syriam and Kyangin Terminals will also be equipped with the similar filling system of smaller.

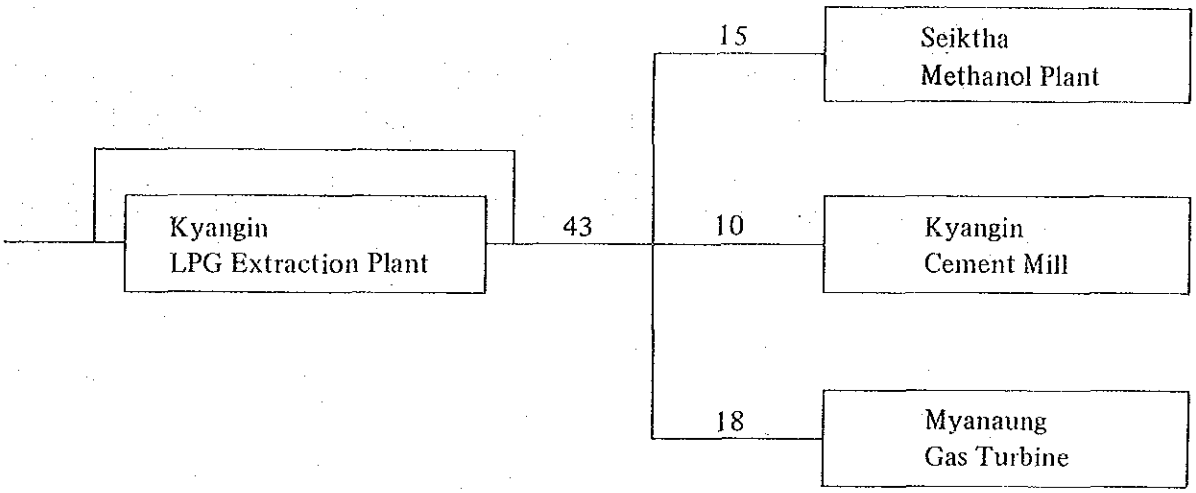
For the LPG transportation plan by river barges utilizing the Irrawaddy, refer to Chapter 5. The LPG river barge is under the administration of PIC (Crude Move Department).

Operation of methanol plant at Seiktha for by-product lean gas consumers is scheduled for 1986, expansion of Kyangin cement mill will be completed by Oct., 1985, and

Myanaung gas power plant is in operation at present. By-product lean gas from Kyangin LPG Extraction Plant scheduled for Phase III will be consumed satisfactorily. Refer to Table 9-2 for the demand and supply plan of the by-product gas.

Table 9-2 Lean Gas Using Plan

Unit: x 10^6 SCFD



With respect to interrelation between the operation and management organization under Phase III Plan and the existing organization, a new organization will be established for the operation and management of LPG extraction plant, terminals and LPG jetty at Kyangin area, and Syriam Terminal and LPG river barges will be operated by an organization planned under Phase I and II maintaining an appropriate scale for the overall plans under Phase I ~ III.

9.2 Organization and Personnel

9.2.1 Basic Drafting Conditions

Upon drafting organization and personnel plan for the respective facilities, the following factors shall be considered in general.

(1) Contents of the facility
(2) Scale of the facility
(3) Geographic conditons and relationship with other neighboring industries
(4) Quality and quantity of available labor force
(5) Laws and local customs relating to labor
(6) Other local conditions

Especially in Kyangin area, LPG extraction plant, terminal and shipping jetty are located in th close vicinity of within approx. 10 km distance without any other similar industry, a new independent organization will be established. General Manager, Deputy General Managers as well as clerical departments such as administrative department, accounting department, and backup departments such as quality control, maintenance will share a common organization, whereas operation departments will have their own organizations for the integrated operation.

Organization at Syriam Terminal after the expansion under Phase III will come under the organization of Syriam refinery applying the same concept planned for Phase I.

The required number of operators is determined based on the following fundamental factors:

(1) Number of working days

o	Shift workers	365 days/Y
o	Day workers	260 days/Y

The 260 days/Y was calculated on the basis of 5 working days/week.

(2) Working hours

o	Shift workers	5-team, 3-shift system
o	Day workers	40 hours/week (8 hours/day)

9.2.2 Kyangin LPG Extraction Plant

Upon drafting organization and personnel for Kyangin LPG Extraction Plant, the fundamental working conditions stated in item 9.2.1 were based on as well as taking into account of the following factors:

(1) Assign a newly organized managing department to Kyangin LPG Extraction Plant, and a operation department of LPG extraction facilities.

(2) Particulars of Kyangin LPG Extraction Plant

(a) For LPG production plant, a similar facility to that of Mann GOCS under Phase II is being scheduled.

(b) Continuously supply by-product lean gas to neighboring plants.

(c) LPG will be transported to adjoining Kyangin Terminal through the new pipeline for the shipping service.

(d) Gasoline material will be transported directly to the shipping jetty and loaded into river barges.

(e) Supply utility to LPG extraction facilities, neighboring residential areas and Kyangin Terminal. Since the production facilities will be operated without interruption, operation department and utility supply department will be placed on shift work while the shipping department of LPG and gasoline material on day work.

(3) Organization of Kyangin LPG Extraction Plant

Taking account of these factors, personnel at Kyanging LPG Extraction Plant shall be classified into the following groups:

(a) Shift workers

- o Process operation group
- o Utility operation group
- o Part of maintenance group

(b) Day workers

- o Shipping group
- o General affairs group
- o Accounting group
- o Management group

Based on the above fundamental policy and considering the following basic concept for Kyangin Terminal, a draft of the organization chart is summarized in Table 9-3. The required number of personnel for the entire Kyangin area will amount to 475.

9.2.3 Kyangin Terminal

Upon drafting organization and personnel for Kyangin Terminal, the fundamental conditions stated in item 9.2 are referred to as well as considering the following factors:

(1) Kyangin Terminal is an incorporated part of the organization of Kyangin LPG Extraction Plant.

(2) Particulars of Kyangin Terminal

(a) Conducts shipping service for LPG river barges as an LPG relay station.

(b) Kyangin Terminal site and Kyangin jetty are located at approx. 800 m distance.

(c) Conducts LPG receiving service through the pipeline from Kyangin LPG Extraction Plant.

(d) Except for the instrument air, all the utilities used at Kyangin Terminal are supplied from Kyangin LPG Extraction Plant.

Since LPG shipping operation is conducted exclusively during the daytime in principle, shipping and handling groups consisting of day workers will be assigned to this operation, while shift workers will be assigned only to security work.

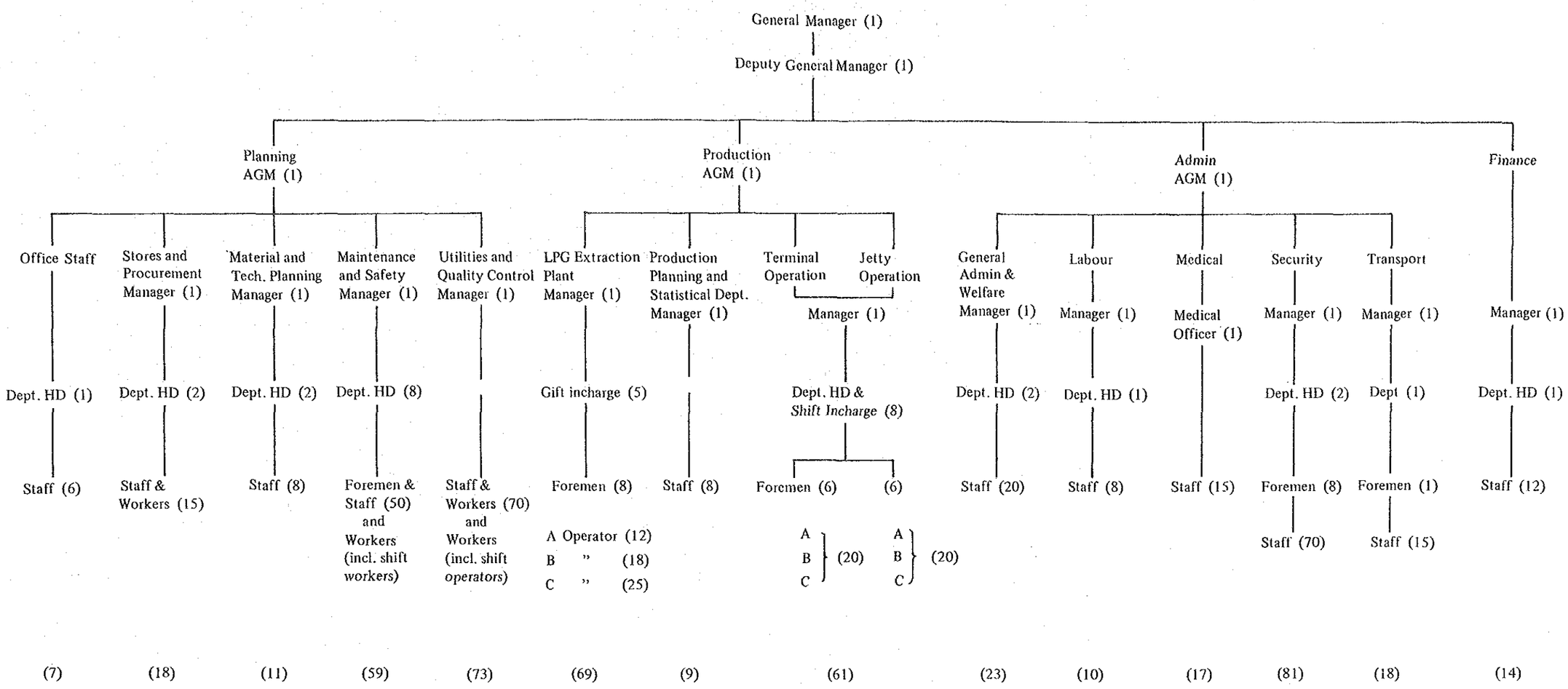
(3) Organization of Kyangin Terminal

Taking account of factors described above, operation personnel in Kyangin Terminal will be classified into the following groups:

(a) Shift workers

o Security group

Table 9-3 Organization of Kyangin LPG Plant, Kyangin Terminal and Loading Jetty



Total (475)

(b) Day workers

- o LPG shipping group
- o Loading group

9.2.4 Syriam Terminal

Upon drafting organization and personnel for Syriam Terminal after the expansion plan under Phase III, fundamental conditions drafted in item 9.2.1 are based on taking account of the following factors and referring to the organization and staffing composed under Phase I.

(1) Syriam Terminal will be incorporated into the organization of Syriam refinery. For the existing organization of Syriam refinery, refer to Table 9-4.

(2) Particulars of Syriam Terminal

(a) Conducts shipping service for oceangoing LPG vessels as an export LPG station.

(b) Conducts receiving service by means of LPG river barges from Mann and Kyangin areas.

(c) Conducts receiving service through the LPG pipeline from the Coker plant at Syriam refinery.

(d) Conducts part of LPG filling service for the local demands.

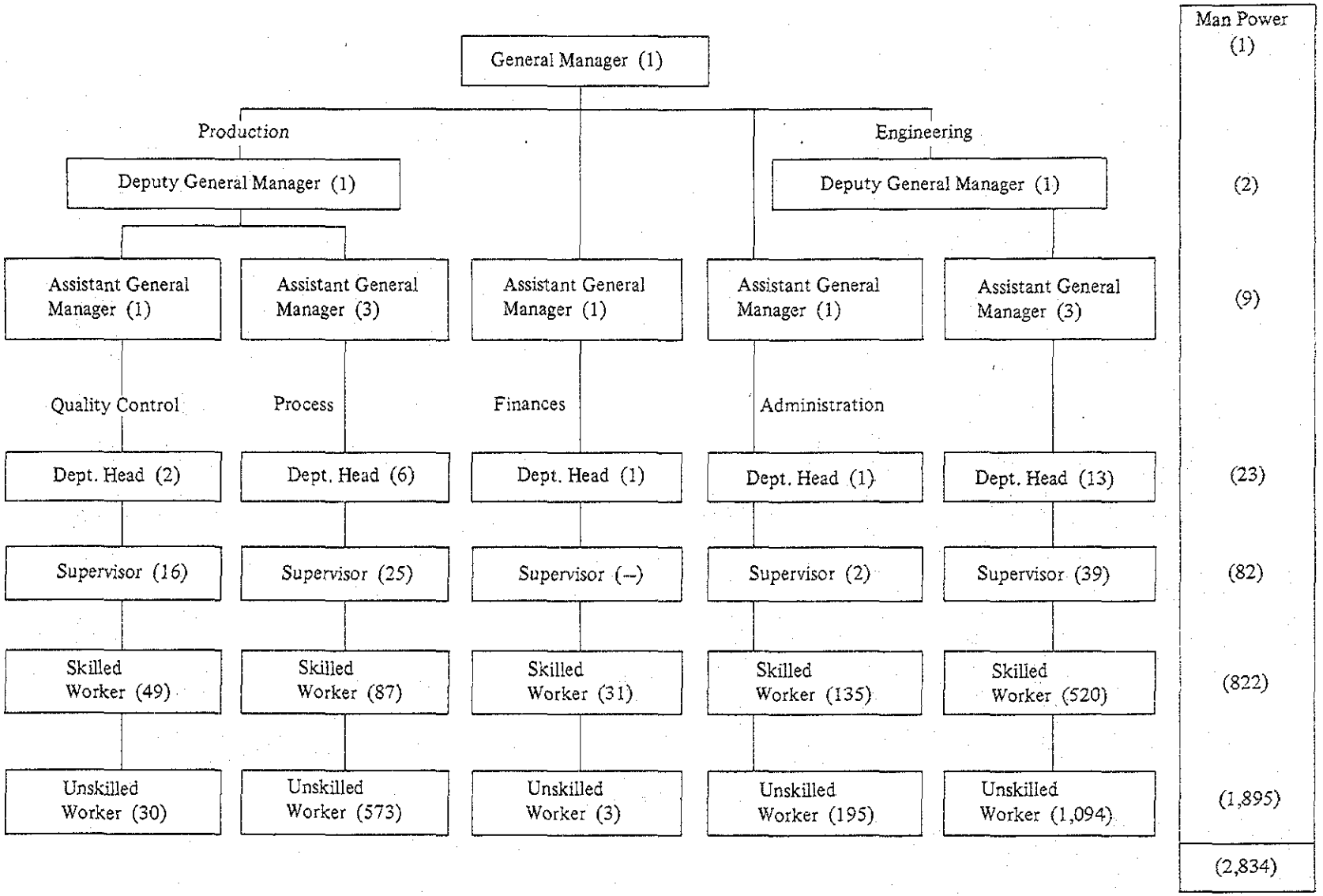
(e) Distance between Syriam terminal and refinery is approx. 2 km.

Since receiving and shipping work stated in items (a) and (b) above are conducted regardless of day or night, shift work system will be applied.

(3) Organization of Syriam Terminal

Taking account of factors described above, operation personnel in Syriam Terminal will be classified into the following groups:

Table 9-4 Organization of Syriam Refinery



(a) *Shift workers*

- o Terminal operation and security group
- o LPG receiving and shipping handling group

(b) Day workers

- o Managers and clerical staff

Based on the above fundamental policy, a draft of the organization chart is summarized in Table 9-5. The number of required personnel will be total 134. Under Phase I, receiving and shipping handling group is on the day work system, and total number of required personnel is also 134 which is identical with the figure for new plan shown above. Since the handling volume is expected to increase gradually under Phase III plan, it is recommended to reevaluate the number of personnel accumulating experience of actual receiving and shipping work.

9.3 Operation Guidance and Training Plan

9.3.1 Basic Drafting Conditions

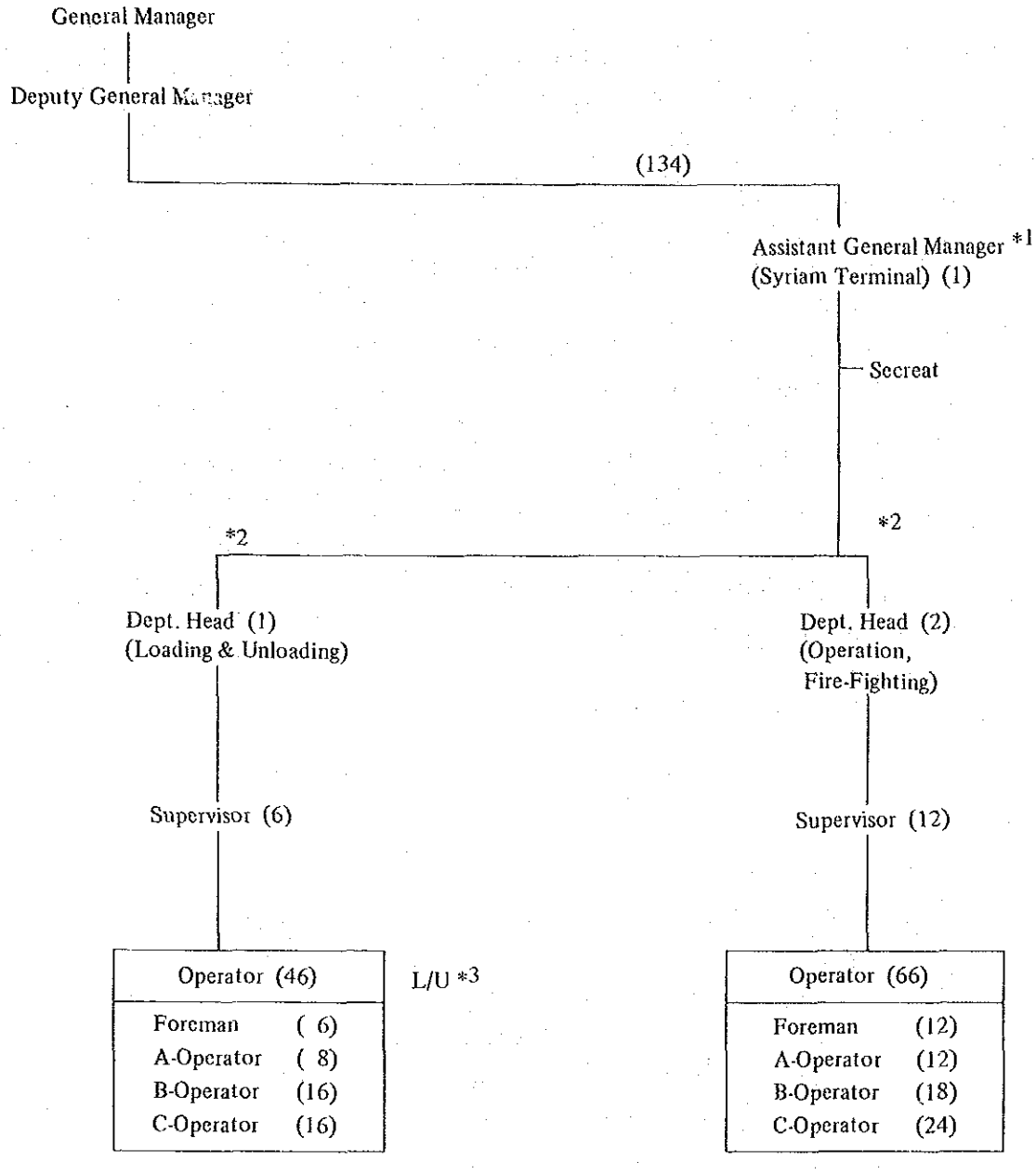
Upon drafting operation guidance and training plans for individual facilities, the following factors shall be taken into consideration:

(1) Contents and scale of facilities
(2) Extent of operational difficulty
(3) Involvement of new type equipment
(4) Particular of facilities
(5) Involvement of similar facilities
(6) Quality and expertise conditions of personnel
(7) Other local conditions

9.3.2 Kyangin LPG Extraction Plant

Study on Kyangin LPG Extraction Plant adopting the basic drafting conditions stated in item 9.3.1 above reveals the following facts.

Table 9-5 Organization of Syriam Terminal



*1 : Full-time worker
*2 : Shift worker
*3 : Loading & Unloading

As for the contents and scale of facilities, the plant consists of LPG extraction facility, utilities and off-site facilities, and requires a certain extent of experience in operation of heating furnace, compressor, etc. Further, LPG should be handled under sub-zero temperature, which also require some extent of experience in operation and management of dehydration process, refrigeration system, etc. However, considering operational experience in Mann refinery and precedent GOCS, it should not be difficult if the above experience is fully utilized.

Taking account of these facts, operation guidance and training program for Kyangin LPG Extraction Plant was drafted under the following conditions:

(1) Pre-operation training shall be conducted in Burma in principle, and education is to be extended by Burmuse teachers primarily on the handling of heating furnace and compressor, etc. as well as operation and management of LPG extraction process by utilizing the Mann GOCS LPG Extraction Plant and the facility of Mann Refinery.

(2) Particular operation guidance will not be conducted after the completion of faiclities, instead it will be performed as a form of instruction and supervision during the commissioning service period.

Contents of pre-operation training consist of basic training and general training conducted normally at Mann refinery. The general training is mainly based on the previously provided operation manual for Kyangin LPG Extraction Plant. Trainees will attain their training goal through education materials and on-the-job training at Mann GOCS LPG extraction plant and Mann refinery besides simulation training at nearly completed Kyangin LPG Extraction Plant. In addition, practical training through operation guidance during the commissioning will follow.

Curriculums of th trial operation personnel training course, which is the primary objective of the general training, are stated as follows:

(1) Outline of plant
(2) Description of process flow sheet
(3) Description of mechanical flow sheet
(4) Description of off-site and utility facilities
(5) Normal operation procedure
(6) Routine inspection items

(7) Operation starting procedure
(8) Normal stopping procedure
(9) Emergency stopping procedure
(10) Heating furnace operation procedure
(11) Pump and compressor manipulation
(12) Valve manipulation
(13) Instruments handling method
(14) Chemicals handling method
(15) Safety precautions
(16) Reporting and transfer method of operation duty
(17) Liaison and notification method
(18) Others

9.3.3 Kyangin Terminal

Study on Kyangin Terminal adopting the basic drafting conditions stated in item 9.3.1 reveals the following facts.

With regard to the contents and scale of facilities, which consist merely of storage, shipping and water intake facilities with the provision of 5 spherical tanks, shipping pumps, few utilities, safety facility and piers. Considering its contents and scale, operation work should not be difficult, besides, particularly new equipment is not observed viewing from Burmese side. Since the similar facilities will be put into operation at Mann Terminal under Phase I, it will be practicable to familiarize the personnel with safety training and equipment operation through the pre-operation training.

Taking account of these facts, operation guidance and training program for Kyangin Terminal is drafted under the following conditions:

(1) Pre-operation training shall be conducted utilizing facilities at Mann and Syriam Terminals, and Burma side possesses the training initiative.

(2) Particular operation guidance will not be conducted after the completion of facilities, and contents of this training consist of basic training, conducted at the existing refinery and training center, and general training, conducted at the above Terminals. The general training is mainly based on the previously provided operation manual for Kyangin Terminal, and trainees will attain

their training goal through such education materials and on-the-job training at Mann and Syriam Terminals besides simulation training at nearly completed Kyangin Terminal.

Curriculum of the trial operation personnel training course, which is the primary objective of the general training, are stated as follows:

(1) Outline of facilities
(2) Description of process flow sheet
(3) Description of mechanical flow sheet
(4) Description of off-site and utility facilities
(5) Normal operation procedure
(6) Routine inspection items
(7) Operation start up procedure
(8) Normal shutdown procedure
(9) Emergency shutdown procedure
(10) Valve manipulation
(11) Pump manipulation
(12) Instruments handling method
(13) Safety precautions
(14) Reporting and transfer method of operation duty
(15) Others

9.3.4 Syriam Terminal

At Syriam Terminal required number of operation personnel were secured, and operation guidance and training are being conducted in the Phase I project. Only expansion work to this Terminal is additional installation of 5 spherical tanks, however, receiving and shipping work will become 24-hours shift system to cater for the increase of LPG handling volume. In addition, oceangoing LPG vessels will be graded up to a 1,500 D.W.T. class. Since the number of personnel will not be increased in principle, necessary training and guidance shall be given to the existing personnel. Safety training and guidance on nighttime cargo handling and arrival and departure to and from jetty are deemed sufficient.

Taking account of these facts, operation guidance and training program for Syriam Terminal after the expansion work is drafted under the following conditions:

(1) Pre-operation training will be conducted by Burma side at Syriam Terminal.

(2) Operation guidance will not be conducted after the completion of facilities.

Pre-operation training will be conducted utilizing facilities at Syriam Terminal after its expansion and perfect the training through the nighttime OJT.

9.4 LPG Transportation River Barges

Upon drafting organization and personnel for LPG river barges, the following points are considered:

(1) Since LPG transportation river barges are placed under the supervision of Crude Movement Directorate, a department under PIC, skippers and their crew members are only accounted for.

(2) Under Phase I, four 500 T non-self-propelled type barges are allocated, however, three 600 T self-propelled type barges are scheduled to be added under Phase III plan. LPG transportation by river barges (from Mann and Kyangin Terminals to Syriam Terminal) will be operated jointly.

(3) Engineering crew members shall assume fire-fighting and maintenance duties during navigation.

(4) Common crew members other than skipper, chief navigator and chief engineer shall work on a 2-shift system.

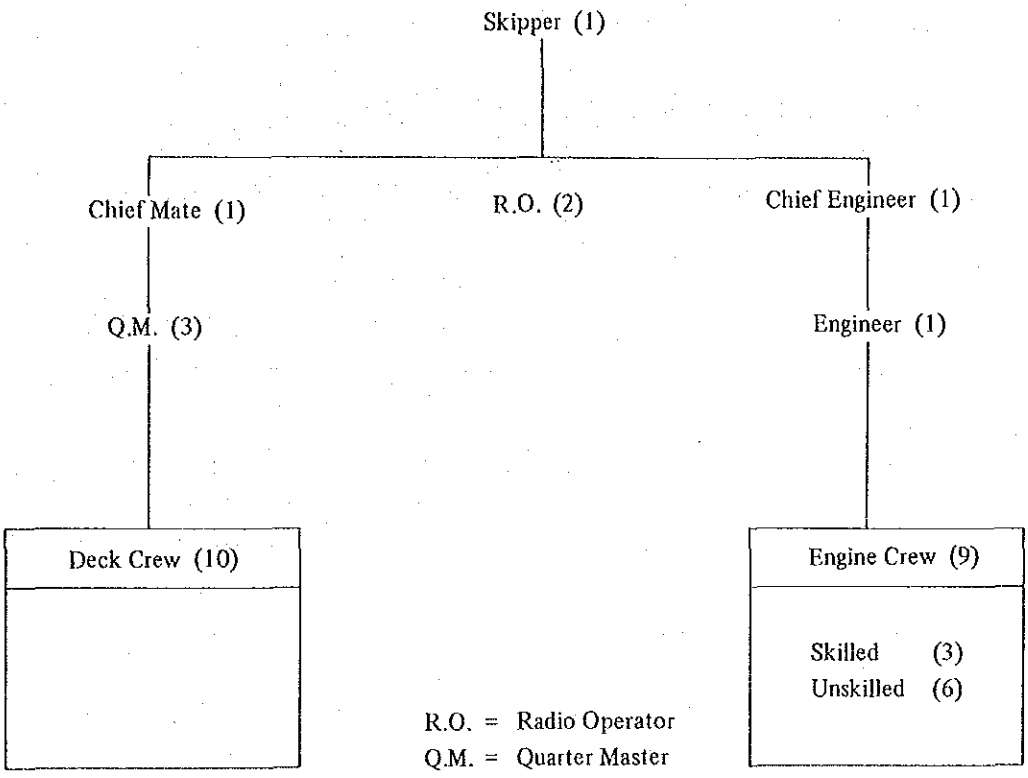
Based on the above fundamental policy, a draft of the organization chart is summarized in Table 9-6. The number of required crew members per barge will be 28, accordingly, crew members will be increased by 84 after three additional barges are assigned under Phase III.

9.5 Operation Cost

9.5.1 Basic Conditions of Operation Cost Computation

Operation cost of Kyangin LPG Extraction Plant, Kyangin Terminal and Syriam Terminal are computed based on the following factors:

Table 9-6 Organization of LPG River Barge



(1) For the relative unit prices, prices provided by Burma side will apply.

(2) As for utility cost, electricity and chemicals for Kyangin area, and water and electricity for Syriam Terminal are taken into account. Syriam Terminal will be supplied with water from Syriam refinery, however, Kyangin Area shall produce its own water. For the fuel, lean gas will be used and self-consumed.

(3) For the LPG transportation, the following cost provided by Burma side will apply.

(4) For the gasoline transportation, the following cost provided by Burma side will apply.

(5) The maintenance and repair cost will be assumed to 2.8% of total amount of equipment cost.

(6) Total number of work days per year will be 330 days.

Unit prices applied to the computation are stated as follows:

o	Electricity	0.12 Kyat/kWh
o	Water	0.11 Kyat/kl. (0.5 Kyat/1,000 I.G.)
o	LPG transportation	60 Kyat/T, Kyangin – Rangoon (Refer to Table 9-8.)
o	Gasoline transportation	25 Kyat/T, Kyangin – Rangoon
o	Labor cost	Refer to Table 9-7.
o	Maintenance and repairing cost	2.8% total amount of equipment cost

9.5.2 Kyangin LPG Extraction Plant

The following values represent the operation cost of Kyangin LPG Extraction Plant computed based on the basic conditions stated in item 9.5.1.

(1) *Utility*

o	Electricity	3,100 kWh/H	2,946,000 Kyat/Y
o	Chemicals		1,512,000 Kyat/Y

(2)	Gasoline transportation	3,200 T/Y	80,000 Kyat/Y
(3)	Labor cost		2,608,000 Kyat/Y
(4)	Repairing cost		6,772,000 Kyat/Y
	Total		13,918,000 Kyat/Y

Table 9-7 Salary Structure at Kyangin LPG Recovery Plant and Terminal

Class	Position	Wage, K/month	Note
1	General Manager	1,400	
2	Deputy Manager	1,200	
3	Assistant General Manager	1,000	
4	Department Head	1,000	
5	Supervisor	800	
6	Staff	500	
7	Secretary & Clerk	400	
8	Foreman	600	
9	A-Operator	500	
10	B-Operator	400	
11	C-Operator	350	

Table 9-8 Salary Structure of LPG River Barge

Class	Position	Wage, K/month	Note
1	Skipper	1,100	
2	Mate	1,000	
3	Chief Engineer	1,100	
4	Engineer	1,000	
5	R/O	740	
6	Q.M.	530	
7	Deck Crew	470	
8	E-Crew	530	
9	E-Crew	470	
10			
11			

9.5.3 Kyangin Terminal

The following values represent the operation cost of Kyangin Terminal computed based on the basic conditions stated in item 9.5.1.

(1)	Utility		
	o Electricity	36,600 kWh/Y	4,000 Kyat/Y
(2)	LPG transportation	61,000 T/Y	3,660,000 Kyat/Y
(3)	Labor cost		386,000 Kyat/Y
(4)	Repairing cost (includ. 3 river barges)		3,115,000 Kyat/Y
	Total		7,165,000 Kyat/Y

9.5.4 Expanded Portion of Syriam Terminal

The following values represent the operation cost of expanded portion of Syriam Terminal computed based on the basic conditions stated in item 9.5.1.

(1)	Utility		
	o Electricity	218,000 kWh/Y	26,000 Kyat/Y
	o Water	5,000 T/Y	1,000 Kyat/Y
(2)	Repairing cost		700,000 Kyat/Y
	Total		727,000 Kyat/Y

Chapter 10

CAPITAL REQUIREMENT AND ITS PROCUREMENT

Chapter 10. CAPITAL REQUIREMENT AND ITS PROCUREMENT

This Chapter describes structurally itemized total capital requirement for the basis of financial analysis being evolved in the next chapter, as well as the capital procurement proceeding.

10.1 Total Capital Requirement

Total capital requirement for the Project is an accumulative amount of capital investment required until the commencement of the plant operation, and includes the following items:

1) Plant construction cost
2) Commissioning fee
3) Pre-operation cost
4) Interest during plant construction

These costs are calcualted based on lump-sum fixed cost contract in 1987 for the plant construction and commissioning fee and pre-operation cost on the basis that the plant will be commissioned in 1989, and are shown in Table 10-1.

Amount of capital expenditure during the plant construction will be paid from own funds for local currency portion, and from long-term loan for foreign exchange portion as stated in Section 10.2. Interest during the construction period will be the same as the interest terms of long-term loan, and amount of interest will be added to the principal.

Accordingly, the total capital requirement for the Project is estimated at US$60,073,000 as shown in Table 10-1.

Table 10-1 Total Capital Requirement

Item	Foreign Exchange (¥1,000)	Local Currency (K 1,000)
Plant Cost Item		
1. Kyangin LPG Extraction Plant	6,516,000	26,600
2. Kyangin LPG Terminal & Shipping Jetty	1,492,000	4,500
3. Syriam Terminal Expansion	747,000	900
4. LPG River Barge	1,890,000	–
5. Construction Machinery & Tools	600,000	21,000*
6. Transportation	755,000	6,500**
Base Plant Cost	12,000,000	59,500
Physical Contingency	300,000	3,500
Price Contingency	200,000	0
Total Plant Cost	12,500,000	63,000
Commissioning Fee	100,000	–
Pre-operation Cost	–	3,246
Initial Working Capital	–	250
Interest During Construction	260,870	–
Total	12,860,870	66,496
Grand Total (US$)	US$60,073,000	

* Rental fee
** Including insurance expense

Further details of the above items are described as follows:

10.1.1 Plant Construction Cost

Amount of the plant construction cost is the estimate stated in Chapter 8, and itemized details of the cost are consolidated into Table 10-2 below.

Table 10-2 Plant Construction Cost

Item	Foreign Exchange (¥1,000)	Local Currency (K 1,000)
1. Kyangin LPG Extraction Plant	6,516,000	26,600
2. Kyangin LPG Terminal & Shipping Jetty	1,492,000	4,500
3. Syriam Terminal Expansion	747,000	900
4. LPG River Barge	1,890,000	–
5. Construction Machinery & Tools	600,000	21,000
6. Transportation	755,000	6,500
Base Plant Cost	12,000,000	59,500
Physical Contingency	300,000	3,500
Price Contingency	200,000	0
Total Plant Cost	12,500,000	63,000
(US$1,000)	(50,872)	(7,326)
(US$)	(US$58,198,000)	

10.1.2 Commissioning Fee

Commissioning fee is the expense that is required to conduct initiation and performance warranty operation on the entire equipment when the title of the plant is transferred to the plant owner after the mechanical completion of the plant by the contractor. The amount of ¥100,000,000 of supervisory cost (33 man-month) is estimated for the instruction supervisors to be dispatched from the contractor based on supervisor dispatch plan stated in Section 7.7.

10.1.3 Pre-operation Cost

A variety of pre-operation cost as shown in Table 10-3, is required until the plant is put into operation.

Table 10-3 Pre-operation Cost

Item	Foreign Exchange (¥1,000)	Local Currency (K 1,000)
Training Expenses	–	786
Trial Operation Cost	–	2,460
Total	–	3,246 (US$377,000)

(1) Training expenses

Training expenses are wages to be paid to trainees during the training period. The amount of K786,000 is estimated as the training expenses which consist of K500 average monthly expense per trainee during the training period, and assuming that the number of trainee for each department shown below shall be trained for six months according to the training plan stated in Section 9.3.

Department	Nos. of Trainee
Maintenance & Safety	59
Utilities	73
LPG Extraction Plant	69
Terminal	61

(2) Trial operation cost

Costs of feed gas, utilities and chemicals required for one month operation are estimated as the tiral operation cost as follows:

Raw Material (Rich Gas):	K2,052,000
Utilities & Chemicals:	K408,000
Total	K2,460,000

10.1.4 Initial Working Capital

Upon completion of the plant, initial working capital is required to maintain smooth operation of the plant.

Cost of spare parts is usually accounted for this purpose, however, since this cost is included in the plant construction cost, K250,000 of labor cost for a month is estimated as the initial working capital.

10.1.5 Interest During Construction

Interest to be incurred during the plant construction is estimated based on payment schedule of the plant construction cost.

Investment schedule of the required capital during the plant construction is presumed as shown in Table 10-4.

Table 10-4 Expenditure Schedule of Investment Cost

Year	-2		-1	
	Foreign Exchange (¥1,000)	Local Currency (K 1,000)	Foreign Exchange (¥1,000)	Local Currency (K 1,000)
Equipment & Machinery	6,250,000	–	6,250,000	–
Civil & Building	–	25,200	–	37,800
Commissioning Fee	–	–	100,000	–
Pre-operation Cost	–	–	–	3,246
Initial Working Capital	–	–	–	250
Total	6,250,000	25,200	6,350,000	41,296

Amount of the above capital outlays during the construction period is paid from own funds for the local currency portion, and from long-term loan for the foreign exchange portion as stated in Section 10.2.

Interest rate of loan during the construction period is based on the rate of interest on long-term loan, and amount of interest will be added to the principal according to the investment schedule.

10.2 Procurement of Required Capital

Total capital required for the project will be procured complying with the following proceeding:

(1) *Local currency portion*

Provided by own funds on Burmese side.

(2) Foreign exchange portion

Provided by long-term loan, financing source of which has not been determined, however, it is desirable that the government-to-government loan is applied to the Project. The following financial terms will be adopted.

Interest rate:	2.75% p.a.
Repayment method:	Unfiorm semi-annual installment of principal and interest.
Repayment term:	Thirty years after the start of operation, including a grace period of ten years.

10.3 Capital Investment Plan

Based on the payment schedule of the plant construction cost stated in Chapter 8, annual outlays of the total capital required for the project shown in Table 10-1 are consolidated into Table 10-5 below.

Table 10-5 Capital Investment Plan

(US$1,000)

Year	-2 (1987/88)		-1 (1988/89)	
	Foreign Exchange	Local Currency	Foreign Exchange	Local Currency
Plant Construction Cost				
Equipment & Machinery	25,436	—	25,436	—
Civil & Building	—	2,930	—	4,395
Commissioning Fee	—	—	407	—
Pre-operation Cost	—	—	—	378
Initial Working Capital	—	—	—	29
Interest During Construction	175	—	887	—
Total	25,611	2,930	26,730	4,802
	28,541		31,532	

Chapter 11

FINANCIAL ANALYSIS

Chapter 11. FINANCIAL ANALYSIS

11.1 General

The Project will be financially analyzed in this Cahpter. Namely, the financial revenue and expenditure which will be taken place by implementing the Project are reviewed and analyzed. The profitability of the Project will also be evaluated from the financial point of view.

This financial analysis will be made for the project scope defined as Phase III of the Integrated LPG Project.

The Project is regarded as a business entity in this financial analysis. The methodology of the financial analysis is to contrast all cost elements of expenditure with revenue, namely, the total amount of the investment cost, operating cost, etc. with income obtained by sales of the products to calculate for preparing profit-and-loss statement, cash flow statement, etc. incorporating all financial and institutional premises and conditions set forth for this Project.

The profitability of the Project is assessed by calculating Financial Internal Rate of Return (FIRR), Payback Period and so on, based on the Discounted Cashflow Method (DCF Method).

11.2 Major Premises for Financial Analysis

The major premises for the financial analysis, having been established after discussion with the Burmese side, are as follows.

11.2.1 Basic Premises of the Project

(1) Project Life:

Construction period:	July 1987 to June 1989
Operation period:	July 1989 to June 2009 (for 20 years)

The project economic life of twenty (20) years is determined taking the following factors into consideration:

1) The equipment and machinery of the Project are designed durable enough for a period of more than twenty (20) years.

2) Supply of feedstock gas is considered stable during the project life as mentioned in Chapter 3.

(2) Plant Capacity:

LPG production:	61,000 T/Y
By-product naphtha:	3,200 T/Y

(3) Operation Rate of Plant:

The onstream factor of the plant will be 100%. The plant will be operated 330 days annually from the first operational year.

11.2.2 Basis of the Cost

(1) Basis of the Cost

The costs are all based on fixed prices of 1989;

- The plant cost is estimated fixed throughout construction period up to 1989, with some amount included escalation (price contingency).

- All cost components such as sales prices, feedstock price, labour cost, utilities costs are kept constant at 1989 value during the project life for the purpose of evaluating financial viability of the Project.

(2) Foreign Exchange Rate:

US$1 = 8.60 Kyats
3.50 Kyats = 100 Yen

The above-mentioned rate is the fixed rate effective for the period from April 1 to September 30, 1985, officially proclaimed by the Burmese Government which maintains a semi-annual renewed system for major foreign currencies. These exchange rates are adopted for the financial analysis as the exchange rates in Burma have been prominently constant in the last few years at above quoted rates and it is anticipated that the rates close to the current one will continue for a while in the future.

11.2.3 Capital Investment Plan

The total capital requirement for the Project will be procured by the means as described in Chapter 10 "CAPITAL REQUIREMENT AND ITS PROCUREMENT" and this financing plan is used in this financial analysis. The financing conditions including those for short-term loan applied in case of shortage of funds during the period of the plant operation are as follows:

(1) Method to raise funds for the total capital requirement:

- The local currency portion of the total capital requirement is to be covered by owner's equity.
- The foreign exchange portion is considered covered bi-lateral long-term loan.

(2) Presumed conditions of long-term loan:

- Interest: 2.75% p.a.
- Debt repayment: 40 installments (20 years), semi-annual equal installment of principal and interest accrued for unpaid principal.
- Grace period for repayment of the principal: Ten (10) years after the start of operation.
- The interest incurred during construction will be superimposed to the principal.

(3) Conditions for short-term loan:

- o Interest: 5% p.a.
- o Debt repayment: All debts are assumed to be repaid in the next year of borrowing.

11.2.4 Taxation/Contribution

(1) Fixed Assets Tax:

Fixed assets tax for this Project will not be imposed.

(2) Import Duty:

The equipment, machinery and materials imported for the Project are to be imposed import duty of 15% based on the import prices CIF Rangoon Port. Accordingly, the import duty will be paid in annual equal installments extending over five years from the second year after the start of the plant operation.

(3) Contribution to State (CTS)

In conformity with Burmese laws, the rate of contribution to state is set forth at 30% of the annual net income. The rate, however, is increased to 40% against the annual net income exceeding 50,000,000 Kyats (US$5,814,000).

11.2.5 Depreciation

The basis for depreciation are as follows:

Item	Method of Depreciation	Salvage Value
Equipment & machinery	Straight line method in 20 years	12%
Civil works & buildings	Straight line method in 50 years	10%
Pre-operation cost & interest during construction	Straight line method in 5 years	0

11.2.6 Working Capital

Working capital is the capital fund required for the operation of the plant. The amount of working capital is defined as the balance calculated by deducting the current liabilities from the current assets mentioned below and is indicated in Table 11-1.

(1) Current Assets:

- o Cash: The amount to cover the costs of labor, overhead, utilities and chemicals for one month is reserved in cash.
- o Accounts receivable: Sales revenue of one month is counted to the accounts receivable assuming that sales proceeds will be collected after one month later.
- o Inventory of products: As examined in Chapter 5, the amount of average inventory of LPG and by-product naphtha at Kyangin and Syriam Terminals is appropriated. The volume of inventory for LPG at Syriam Terminal, however, is calculated by proportional allotment of 61,000 tons of quantity produced in Phase III Project to 96,900 tons of annual volume of transactions.

- Average inventory of LPG:
  1,636 tons at Kyangin Terminal,
  2,663 tons at Syriam Terminal,
- Average inventory of naphtha: 234 tons

(2) Current Liabilities:

o Accounts payable: The costs of raw material, utilities and chemicals for one month are calculated in accounts payable assuming that payment will be made one month later.

Table 11-1 Working Capital

Item	Amount (K 1,000)
(1) Current Assets	
Cash	782
Accounts Receivable	7,240
Inventory of Products	5,629
(2) Current Liabilities	
Accounts Payable	2,460
Working Capital = (1) – (2)	11,191
(US$1,000)	(1,301)

11.3 Sales Plan

11.3.1 Sales Volume of Products and Operation Rate

It is planned to export overseas the whole quantity of LPG and by-product naphtha produced in Phase III Project together with the products produced in Phase I and Phase II Projects. And, as described in Chapter 4 "LPG DEMAND", the products corresponding to production capacity of the plant is expected to be sold from the first operational year.

The plant will be operated at 100% capacity from the first operational year and the sales volume of the products will be as shown in Table 11-2 in accordance with Section 3.4 "LPG Production Plan".

Table 11-2 Onstream Factor and Sales Volume

Onstream factor	100% from First Operational Year
Sales Volume	
– LPG Export	61,000 T/Y
– Naphtha Export	3,200 T/Y
– Lean Gas	11,009 x 10^6 SCF/Y

The total quantity of LPG produced as by-product at Mann Oil Refinery and a portion of LPG produced as by-product at Coker Plant of Syriam Oil Refinery executed as Phase I – Part 1 are allocated for domestic consumption.

The whole quantity of LPG and by-product naphtha produced in Phase III Project is transported to Syriam Terminal by river barges for export from the terminal.

On the other hand, lean gas is pipelined to the cement mill, the methanol plant and the power station in the neighborhood of the plant site to be used for feedstock or fuel gas.

11.3.2 Product Sales Prices

The sales prices of the products are determined as follows:

(1) LPG Export Price (FOB Price, Rangoon)

The LPG export price is set at US$140/ton. As described in Chapter 4, major market for LPG export is assumed to be Singapore, and consequently, the LPG price-setting is based on Singapore's market price expected to be applicable at the time of starting operation of the plant.

(2) By-products Sales Prices

The sales prices of by-product naphtha (C_5^+ distillate) and lean gas which are produced by the LPG extraction plant are set as follows:

1) By-product naphtha

Whole quantity of by-product naphtha is to be exported and its export price (FOB price, Rangoon) at the time of start of operation is set at US$225/ton.

2) Lean gas

Since lean gas can be used in place of associated gas, MOC receives it at the same price of rich gas in volume. The selling price of lean gas is set at 1.80 Kyats/10^3 SCF (US$0.209/$10^3$ SCF).

As these products will be exported or supplied to users by the pipeline, sales costs of each product are regarded as to be zero in this financial calculation.

11.3.3 Sales Revenue

The annual sales revenue of the Project is calculated based on the above mentioned definitions and indicated in the following Table 11-3.

Table 11-3 Annual Sales Revenue

Item	Quantity	Unit Price	Annual Revenue (US$1,000)
LPG	61,000 T	US$140 / T	8,540
Naphtha	3,200 T	US$ 225 /T	720
Lean Gas	11,009 x 10^6 SCF	US$0.209/$10^3$ SCF	2,304
Total	–	–	11,564

11.4 Total Capital Requirement

11.4.1 Breakdown of Total Capital Requirement

The total capital requirement of the Project is shown in Table 11-4.

Table 11-4 Total Capital Requirement

Item	Cost (US$1,000)	Depreciation Method
Plant Cost		
– Equipment & Machinery	50,872	20 Years Straight Line (Salvage Value: 12%)
– Civil & Building	7,325	50 Years Straight Line (Salvage Value: 10%)
Commissioning Fee	407	5 Years Straight Line
Pre-operation Cost	378	ditto
Interest During Construction	1,062	ditto
Initial Working Capital	29	Non Depreciable
Total Capital Requirement	60,073	–

11.4.2 Expenditure Schedule of Total Capital Requirement

The above-mentioned total capital requirement is scheduled to be expended in each year of the construction period as prescribed in Section 10.3 and listed in Table 11-5.

Table 11-5 Capital Expenditure Schedule

(US$1,000)

Year (Nominal Year)	-2 (1987)		-1 (1988)	
	Foreign Exchange	Local Currency	Foreign Exchange	Local Currency
Plant cost				
– Equipment & Machinery	25,436	–	25,436	–
– Civil & Building	–	2,930	–	4,395
Commissioning Fee	–	–	407	–
Pre-operation Cost	–	–	–	378
Initial Working Capital	–	–	–	29
Interest During Construction	175	–	887	–
Total	25,611	2,930	26,730	4,802
	28,541		31,532	

11.5 Operating Cost

11.5.1 Variable Operating Cost

As variable operating costs which vary according to the rate of operation, unit consumption, unit price and annual cost of raw material and utilities for LPG production are shown in Table 11-6.

(1) Feed gas purchasing price

Feed gas is purchased at K1.80/10^3 SCF from MOC, which manages oil & gas development and production. MOC plans to increase production of the associated gas to cope with production schedule for the Project.

(2) Utility and chemical cost

The prices and costs of utilities and chemicals are specified in Section 9.5.

Table 11-6 Summary of Variable Operating Cost

Item	Unit Consumption	Unit Price	Annual Cost *	
			K 1,000	(US$1,000)
Raw Material				
– Rich Gas	205.6 10^3SCF/T-LPG	K1.80/10^3SCF	22,572	(2,625)
Utilities & Chemicals				
– Electricity	406.7 kWh/T-LPG	K0.12/kWh	2,976	(346)
– Industrial Water	0.08 m^3/T-LPG	K0.11/m^3	1	(Nil)
– Chemicals	–	–	1,512	(176)
River Transportation	–	–	3,740	(435)
Total	–	–	30,801	(3,582)

* at 100% Operation Base

11.5.2 Fixed Operating Cost

The fixed operating costs excluding depreciation and interest on loan are as follows:

(1) Labor Cost

Based on the organization chart and labor cost prescribed in Chapter 9, the annual labor cost of personnel and workers directly required for operation is calculated and is listed in Table 11-7. Since the labor cost in Burma is very stable, the wages by job classification presented by the Burmese side is regarded as the wage level at the time of start of operation.

Table 11-7 Operation Labor Cost

Facility	Required Numbers of Personnel	Annual Labor Cost	
		K 1,000	(US$1,000)
LPG Extraction Plant	414	2,608	(303)
Kyangin Terminal	61	386	(45)
Total	475	2,994	(348)

It is planned that Syriam Terminal is operated by the personnel and workers of the existing facility.

(2) Maintenance Cost

As described in Section 9.5, annual maintenance cost is estimated at 10,587,000 Kyats (US$1,231,000), which is 2.8% of the cost of equipment and machinery (FOB price). The foreign exchange portion of this cost item is calculated as 1.5% (US$659,000) of the equipment and machinery cost.

(3) Insurance Cost

Annual insurance cost is calculated at US$180,000 which is 0.31% of the plant construction cost.

(4) Fixed Assets Tax

As mentioned in Item 11.2.4, fixed assets tax for the Project is exempted.

(5) Overhead Cost

Annual overhead cost is estimated at 50% of the annual labor cost.

(6) Land Cost

The site for constructing the plant is available free of charge since the land is owned by the Government.

11.5.3 Summary of Operating Cost

Operating costs (excluding depreciaiton cost and interest on loan) for each operating year are summarized as listed in Table 11-8.

Table 11-8 Summary of Operating Cost

(US$1,000)

Item \ Year		1 – 20
Variable Operating Cost	Raw Material (Rich Gas)	2,625
	Utilities & Chemicals	522
	River Transportation	435
	Sub-Total	3,582
Fixed Operating Cost	Labor Cost	348
	Maintenance Cost	1,231
	Other Expenses	354
	Sub-Total	1,933
Total		5,515

11.6 Financial Analysis

In this section, the financial analysis based on the above-mentioned premises and definitions is made in order to grasp the financial position of the Project by calculating various financial indicators employing the DCF Method.

11.6.1 Indicator of Profitability in Financial Analysis

The following two indicators are normally used as the indicator to evaluate financial profitability of a project.

(1) IRR on Investment (IRROI)

The term IRROI indicates the internal rate of return on total capital investment, and assesses the profitability of the Project as a whole and the ability to recover funds invested in the Project.

In case of IRROI, the calculation is made assuming that the whole capital investment is covered by its own capital. Therefore, financial conditions such as the loan conditions on borrowed capital, changes of the ratio of equity to total capital requirement and so on have no effect on the IRROI. Accordingly, IRROI indicates the profitability of the Project itself?

(2) IRR on Equity (IRROE)

The term IRROE indicates the internal rate of return on equity, and assesses the profitability only with respect to equity and the ability to recover funds invested in the Project as equity. Here, IRROE is calculated on the basis of such financial conditions proper to the Project as the loan conditions on borrowed capital and amount of owned capital.

11.6.2 Calculation Methodology of Indicator

The formula for calculating IRR in this financial analysis is:

$$\sum_{i=1}^{n} \frac{(CFE)\,i}{(1+R)^{i-1}} + \frac{S+W}{(1+R)^{n-1}} = 0$$

where, CFE (Cash Flow Element) indicates cash flow in each year, and CFE of IRROI and CFE of IRROE are composed of the following elements respectively.

IRROI	IRROE
(CFE) = (-) Investment excluding IDC	(CFE) = (-) Equity
(+) Revenue	(+) Revenue
(-) Operating Cost	(-) Operating Cost
(-) Import Duty	(-) Import Duty
(-) CTS	(-) Interest
	(-) CTS
	(-) Repayment of Debt

R: Rate of return.
i : i-th year on the project including construction period.
n: Years from initial cash outlay to the end of the project
W: Working capital plus non-depreciable investment.
S: Salvage value.
IDC: Interest during construction.
CTS: Contribution to state