Chapter 5.

CONCEPTUAL DESIGNS OF LPG RECOVERY FACILITIES

Chapter 5. CONCEPTUAL DESIGNS OF LPG RECOVERY FACILITIES

This chapter deals with the conceptual designs of the following facilities scheduled for construction in Phase I – Part 2 and Phase II of Burma's "Integrated LPG Project".

(1) Syriam Terminal
(2) Mann Terminal
(3) River barges for LPG transportation
(4) Mann GOCS LPG Extraction Plant

Data and information necessary for the conceptual designs were supplied by the Burmese side, or otherwise set by the Survey Team.

In preparing plans and designs for the respective LPG production facilities, the greatest emphasis was placed on operational ease, maintenance ease and system economy.

5.1 Syriam Terminal

5.1.1 Design Conditions

1) LPG receiving and shipping

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

Table 5-1. 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					
Mann Terminal ——→ Syriam Terminal	14,200	30,800	River barge	Max. Vapor Press. 14.6 kg/cm² at 37.8°C	Max. Vapor Press. 4.9 kg/cm² at 37.8°C
Syriam Refinery ——→ Syriam Terminal	2,670	5,330	Pipeline		
Gas Field ——→ Syriam Terminal	8,700	16,300	River barge		
Shipping					
Syriam Terminal ——→ Export	25,570	52,430	LPG ocean tankers		

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

2) Site conditions

(a) Soil conditions

Although definite soil conditions of the site are unknown since soil survey broing has not been conducted, the Burmese side assumed that the underground water level lies 5 m below the ground surface and that the soil bearing capacity near the ground surface is 2.5 t/m², making it necessary to drive piles into the ground in order to lay the structural foundation.

The site is located in the alluvial soil area of Rangoon River, and lies in a paddy field area facing the river. Examination of the sloped parts on the banks of Rangoon River indicated that the area consists of silty soil and, as assumed by the Burmese side, the soil bearing capacity near the ground surface may be regarded as being rather poor, and that settle-

ment of soil due to consolidation is conceivable if structures were erected intact on the soil.

Accordingly, it will be necessary to transmit the loads of structures to the bearing stratum consisting of dense and firm soil stratum by means of piles. Regarding the depth of the bearing stratum, accurate values must be obtained by soil survey boring before erection of structures, but in this Survey Report the depth of the bearing stratum was assumed to be 22 m below the ground surface as deduced from the depth of the jetty piles driven below the ground surface at the No. 2 Jetty provided in front of the construction site.

(b) Natural conditions

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

Rainfall:
Since the design rainfall intensity of 100 mm/hr was adopted in the Syriam Refinery expansion project, the same value was adopted in this project.

Wind:
Data supplied by the Burmese side gave a maximum wind velocity of 100 miles/hr, so this was made a design condition.

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

Sandstorm:
The site is free of sandstorm anxieties.

5.1.2 Design policy

1) Service factor

The service factor in connection with LPG receiving and shipping was set at 0.90 (330 days/yr).

2) LPG tank

(a) The required LPG tank capacity was determined by means of the following formula:

$$Q = (V \cdot D) / (W \cdot \rho)$$

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

(b) Number of days of LPG storage

The number of days of LPG storage was determined as 20 days, as planned in Chapter 4.

3) Legal restrictions

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

Distance between tanks: (Same as above)

Fire dike capacity:
Over 150% the capacity of the maximum tanks in a 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 Syriam Refinery to Syriam Terminal by pipeline; adoption of velocity requiring no return gas line.

(b) Velocity of unloading LPG from river barges to Syriam Terminal: within 7 hrs for unloading of 500 tons of LPG.

(c) Velocity of loading LPG from Syriam Terminal to LPG ocean tankers; use of LPG ocean tankers of standard classification of 1,000 tons capacity, capable of being loaded with 7 hrs.

The shipment of LPG from Syriam Terminal is to be accomplished by means of oceangoing vessels, as pointed out in Section 4.2.3, while shipment for domestic consumption is to be done by existing Mann Refinery facilities.

6) Utility facilities

Since there is no surplus capacity in the utility facilities of the adjacent Syriam Refinery, the following utility facilities are to be installed newly:

(a) Cooling water facility (Excluding water intake)

(b) Water treatment facility (Filtration facility of "Make Up Water" for cooling water)

(c) Instrument air facility

(d) N_2 generation facility

(e) Power receiving and distribution facility

(f) Water pond facility

(g) Piping system for pumping water from Syriam Refinery

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 for depressing at shutdown of terminal, a flare stack is provided for combustion and exhaustion of discharged gas.

9) Fire fighting facility

Since there are no Burmese domestic provisions 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

(a) Operation of Terminal is achieved by a 4-team, 3-shift system of shift workers, and day workers. Maintenance work during normal operations is achieved by terminal workers, but in full-scale inspection and repairs like shut down maintenance are accomplished with the aid of workers from Syriam Refinery.

(b) A Control Room is provided at Syriam Terminal to permit LPG receiving and shipping to be controlled by the Terminal itself, but the Terminal's operation organization will be under the jurisdiction of Syriam Refinery.

11) Spare parts

In response to a request from the Burmese side, spare parts necessary for two years of operation are supplied.

5.1.3 Description of Facilities

1) Process flow diagram and list of facilities for Syriam Terminal

Fig. 5-1 shows the Process Flow Diagram for Syriam Terminal as designed on the basis of the design policy and the basic plan described in Chapter 4, while Table 5-2 lists the facilities of Syriam Terminal.

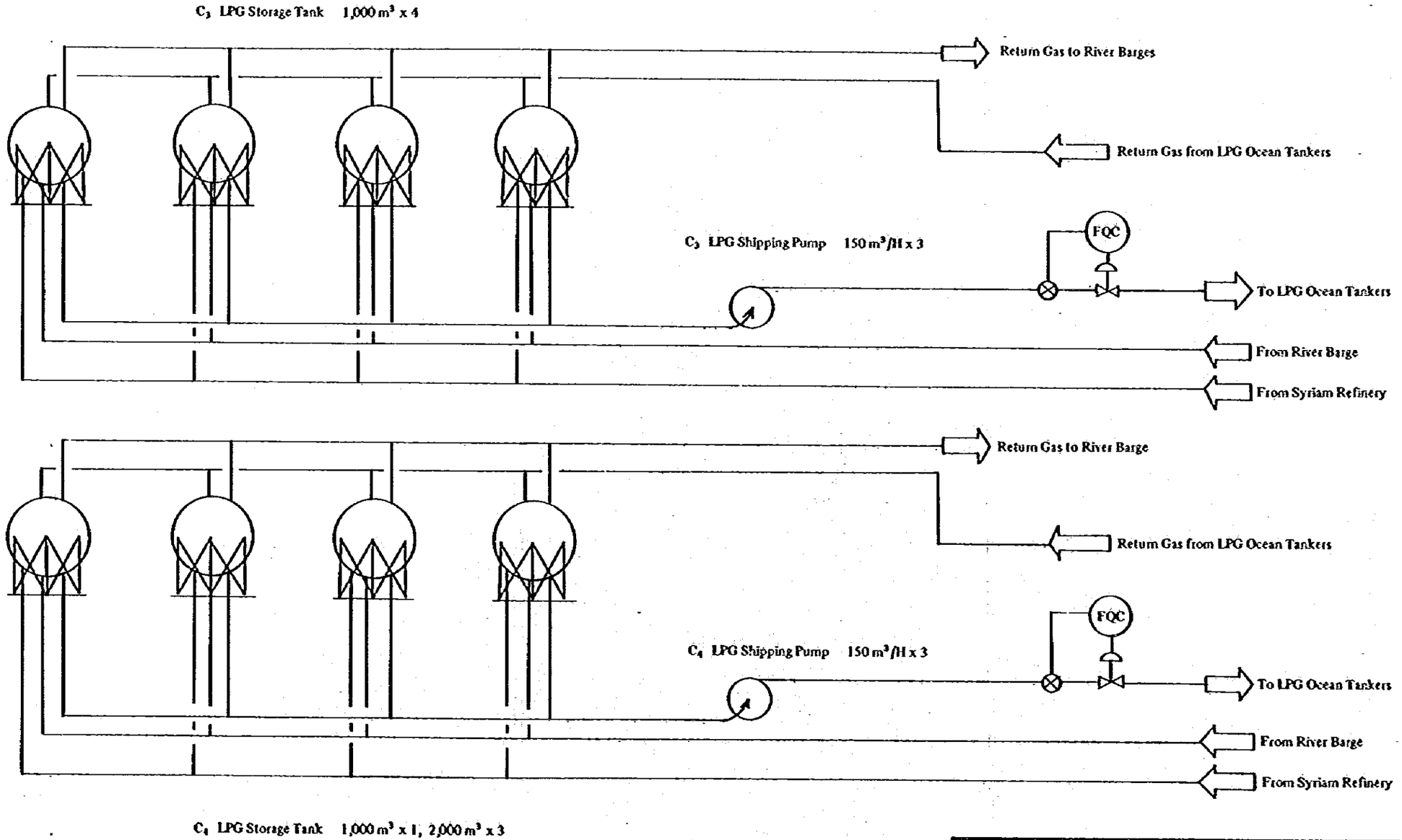


Fig. 5-1. Process Flow Diagram for Syriam Terminal

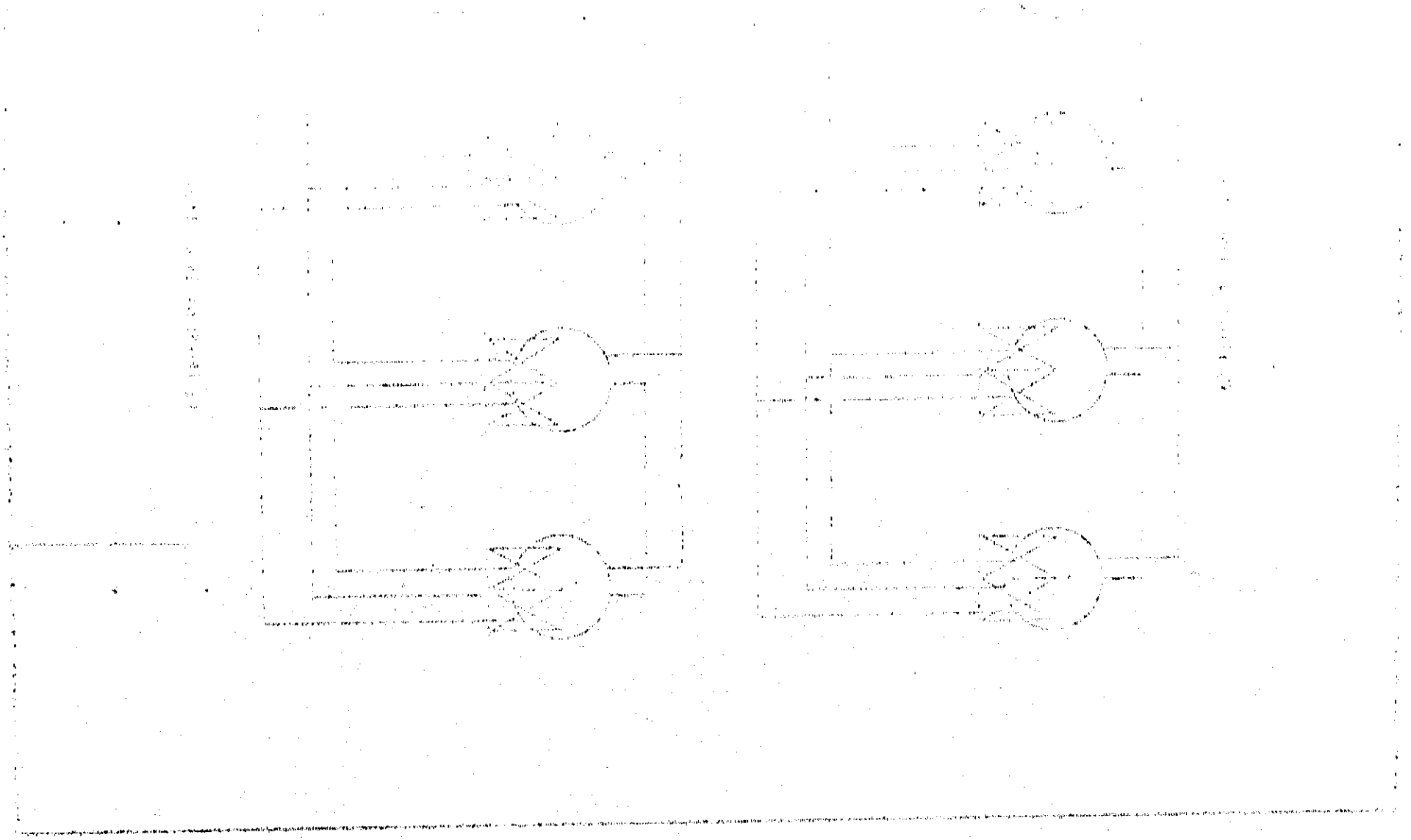


Table 5-2. List of Facilities at Syriam Terminal

Facility	Capacity of Facility	Remarks
1. LPG Tanks	C_3 LPG tanks: 1,000 m^3 x 4 C_4 LPG tanks: 1,000 m^3 x 1 2,000 m^3 x 3	
2. Shipping Pumps	C_3 LPG shipment: 150 m^3/h x 3 C_4 LPG shipment: 150 m^3/h x 3	
3. Jetties	Unloading from river barges: Existing No. 4 Jetty to be utilized. Loading into LPG ocean tankers. Existing No. 1 Jetty is to be utilized.	
4. Utility Facilities		
1) Water Intake	(a) Water intake pump: Supply from PIC (b) Water treatment: 10 T/Hr (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/Hr x 2 (f) Sprinkler pump: 750 m^3/Hr x 2	
2) Cooling Water	(a) Cooling Tower: Spray type (b) Cooling water circulation pump: 10 m^3/Hr x 2	
3) Instrument Air	(a) Compressor: 200 Nm^3/Hr x 2 (Discharge pressure: 7 kg/cm^2G) (b) Dryer: 200 Nm^3/Hr x 1 (Dew poin: 0°C ... 6 kg/cm^2G)	
4) N_2 Generator	Generator: 100 Nm^3/Hr 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.	

2) LPG storage tank facilities

The number of LPG storage tanks as well as their unit capacities 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) Separate piping facilities for C_3 LPG and C_4 LPG are to be provided for receiving these products from Syriam Refinery by pipeline, and for receiving them from river barges and loading them into LPG ocean tankers. This design permits simultaneous LPG receiving and shipping.

(b) Shipping pump capaciteis are determined with the aim of permitting LPG ocean tankers of 1,000-ton loading capacities to be loaded within 7 hrs in the daytime. Three pumps are to be installed, including one spare pump, as a safety measure against any inadvertent pump trouble.

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 handled are as follows:

- o Unloading of 45,000 T/Y of LPG transported from Mann Terminal by river barges
- o Loading of 78,000 T/Y of LPG into tankers (upon completion of Phase III of Project) 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 and LPG ocean tankers having a maximum deadweight tonnage of 3,000 tons, normally about 1,000 DWT. At Syriam Terminal, existing No. 1 to No. 4 jetties are

available near the site, as shown in Fig. 5-2. The principal particulars of these jetties are as follows:

No. 1 Jetty: For crude and heavy oil export, also for transfer to domestic coastal regions. Capable of berthing vessels of max. 12,000 DWT.	Completed in 1946
No. 2 Jetty: Same as No. 1 Jetty.	Completed in 1958
No. 3 Jetty: For river barges	Completed in 1970
No. 4 Jetty: For river barges	Completed in 1974

With the No. 1 Jetty, its swing bridge for connecting the outermost pontoon and jetty has fallen and presently under repair. Accordingly, only the No. 2 Jetty is available for tankers, and its frequency of usage is as follows:

LPG ocean tankers:	One in three months (Normally 5,000-6,000 DWT)
LPG coastal tankers:	Eight/month (Normally 1,500 DWT)

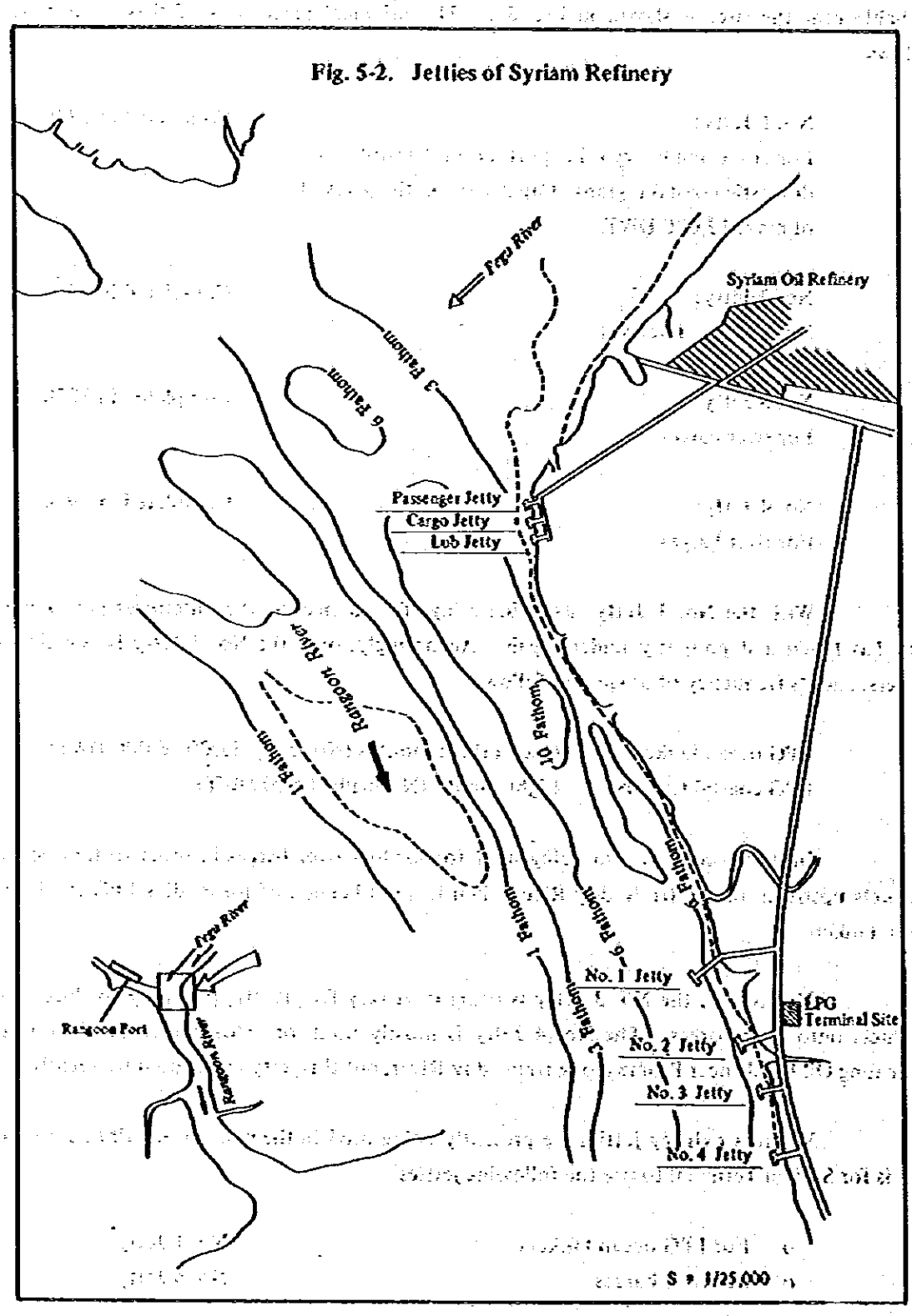
In addition, it is also being used for loading river barges in order to transport oil products upstream of the Irrawaddy River when it is not being used for loading LPG coastal and ocean tankers.

Meanwhile, the No. 3 Jetty is being used very frequently, primarily for loading oil products onto river barges. The No. 4 Jetty is mostly used for unloading crude oil from the Myanaung Oil Fields near Prome along Irrawaddy River, but this jetty is not used frequently.

Whereas existing jetties are presently being used in the manner described above, the plan is for Syriam Terminal to use the following jetties:

o For LPG ocean tankers	No. 1 Jetty
o For river barges	No. 4 Jetty

Fig. 5-2. Jetties of Syriam Refinery



While the jetties closest to the the site are the No. 2 and 3 jetties, the No. 1 and 4 jetties are selected for the following reasons:

The No. 1 Jetty is presently undergoing improvements such as replacement of four existing mooring buoys (for 12,000 DWT ships) with new ones, shortening of jetty and provision of a pontoon at the jetty's far end, with the schedule of completing these improvements by the end of 1981. Even if the completion of these improvements was slightly delayed, the Jetty will be ready for use by the early part of 1985 when Phase I – Part 2 of this project is completed.

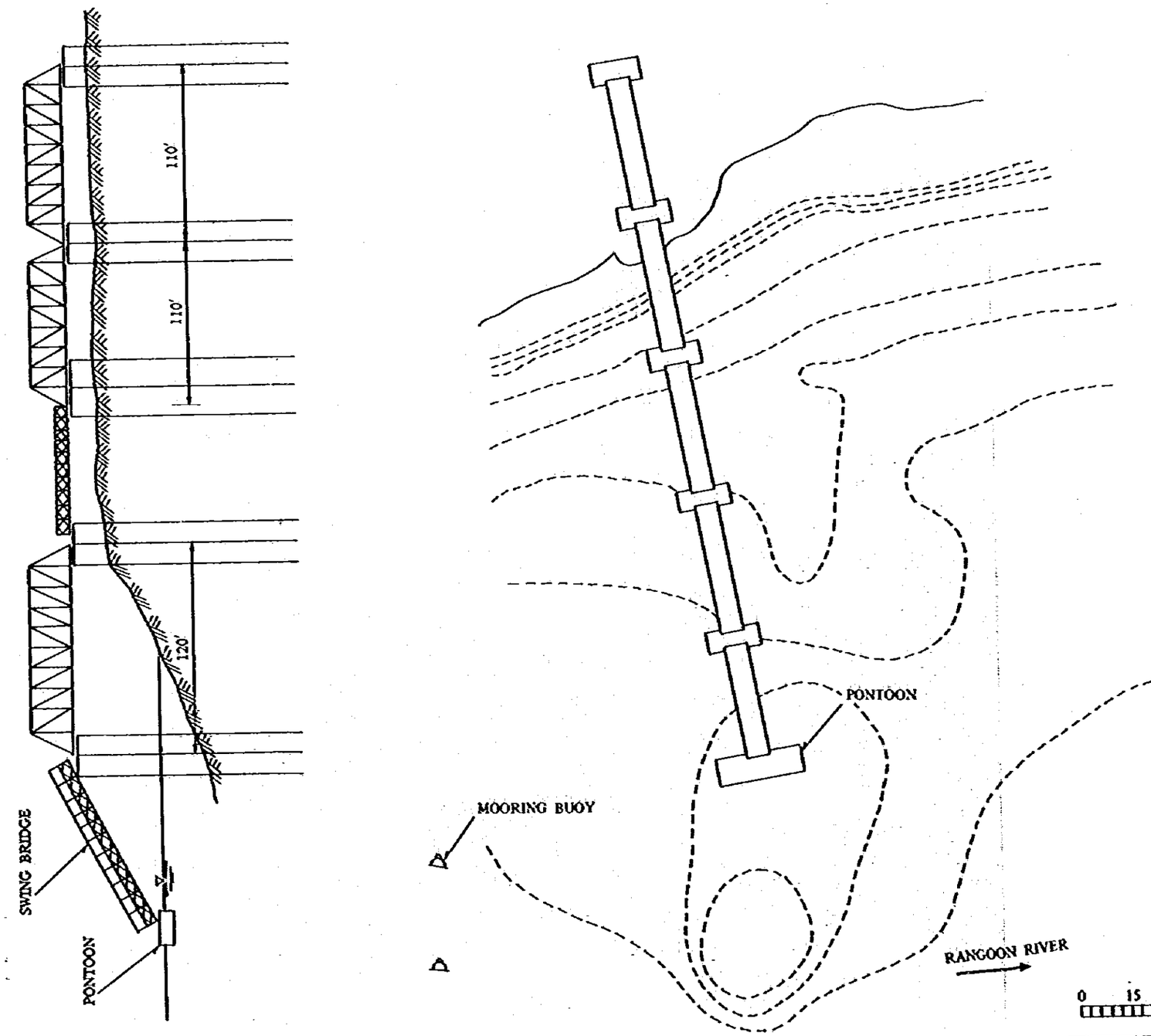
Incidentally, the greatest safety problem posed by the tanker mooring facilities at Syriam is the lack of reliability of mooring buoys, but the plan is to replace the buoys of this No. 1 Jetty with new Japanese buoys of excellent reliability, and to conduct detailed inspection and repairs of anchors, chains and other ancillary pontoon components when installing the new front-end pontoon, making the No. 1 Jetty far more reliable than the No. 2 Jetty and the object of selection for LPG ocean tankers.

Meanwhile, for river barges, the plan is to use the No. 4 Jetty since it is presently being used primarily for unloading crude oil, but not so frequently.

Fig. 5-3 shows the arrangement of the No. 1 Jetty, and Fig. 5-4 that of the No. 4 Jetty.

The tidal changes in these regions are the same as those of Rangoon Port, and in mean spring range, the water level difference at time of high tide and ebb tide is 5.13 m. As for the tidal current, it attains a maximum speed of 8–9 knots. LPG ocean tankers are to be berthed between 5:30 a.m. in the morning and 2:30 p.m. in the afternoon when the tidal current generated between high tide and ebb tide becomes minimum. About 20 days each month are available for berthing under this condition.

Fig. 5-3. No. 1 Jetty



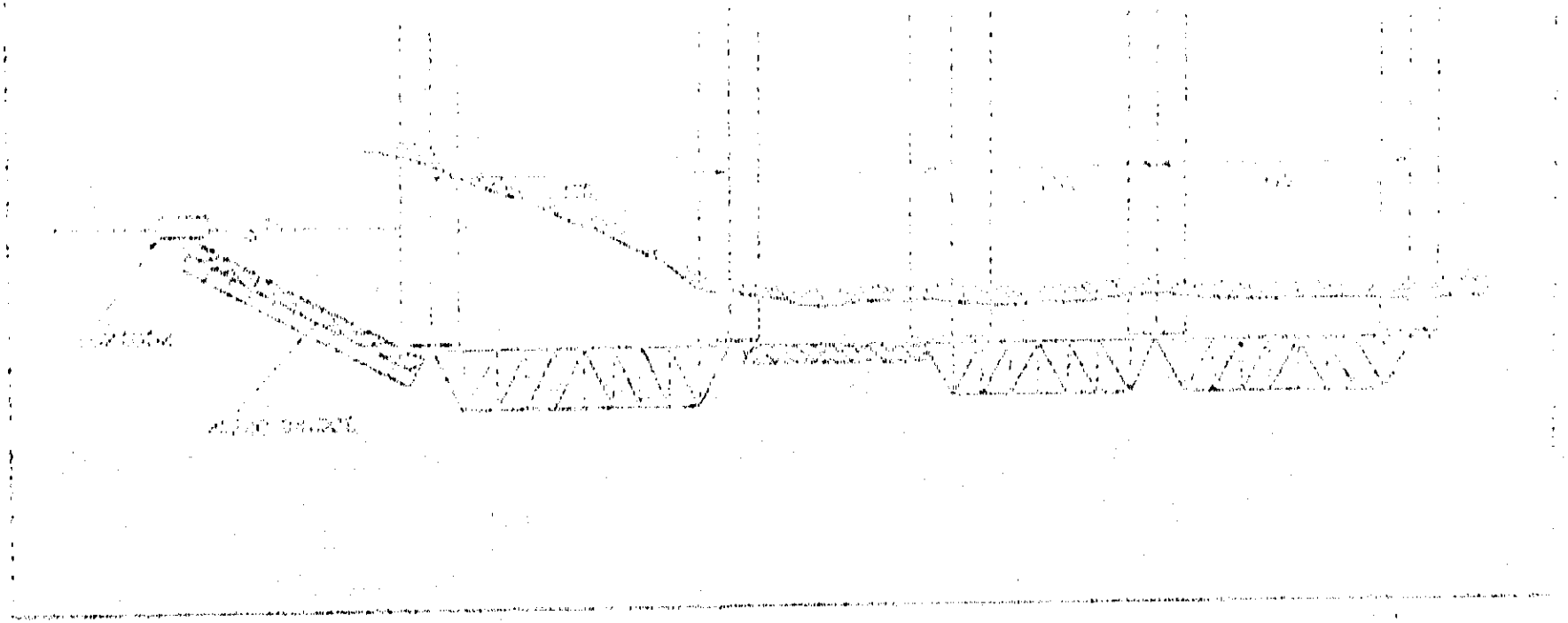
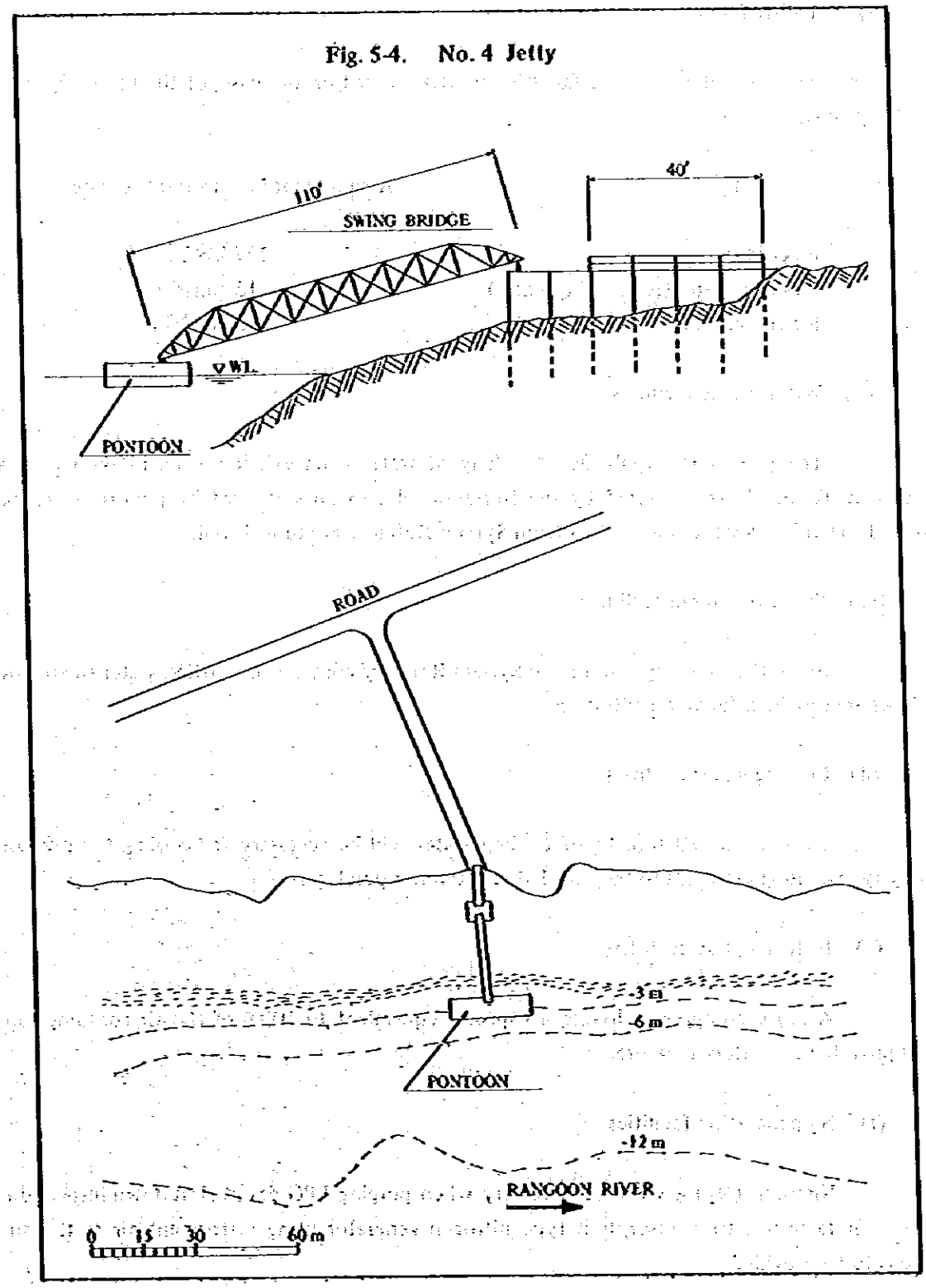


Fig. 5-4. No. 4 Jetty



5) Utility facilities

(a) The capacities of these facilities are determined on the basis of the following rates of utility consumption:

Utility	Assumed mean consumption rate
Electricity	227 kW/hr
Make-up water (for cooling water)	15 tons/hr
Instrument air	160 Nm^3/hr

(b) Water intake facilities

The plan is to supply 360 tons/day of water from existing water intake facilities to Syriam Terminal, as suggested by the Burmese side, so no water intake pumps are to be installed. That is, only feedwater pipes from Syriam Refinery are to be layed.

(c) Water treatment facilities

Since the make-up water from Syriam Refinery contains impurities, water treatment facilities are provided for water filtration.

(d) Cooling water facilities

Since about 10 tons/hr of cooling water will be necessary for cooling the pumps, a spray type cooling system is to be provided at the water pondage.

(e) Instrument air facilities

A spare compressor having a capacity equivalent to 100% of the air consumption rate is provided as a safety measure.

(f) N_2 generation facilities

Nitrogen (N_2) gas will be necessary when purging LPG gas at shut down inspection of terminal facilities, so a adsorption type nitrogen generator using instrument air as the air source is to be provided.

(g) Power receiving/Distribution facilities

Electricity is to be transmitted from Syriam Refinery power station, for which a substation is to be installed at the Terminal for power receiving and distribution in the Terminal.

The principal design standards are as follows:

- o Classification as dangerous place:
  In conformance with API RP 500
- o Working voltage
  For power
  Under 150 kW, 400 V, 3-phase, 50 Hz
  Over 150 kW, 3,300 V, 3-phase, 50 Hz
  For illumination
  Mercury-arc lamp
  230 V, single-phase, 50 Hz
  White incandescent lamp and fluorescent lamp
  230 V, single-phase, 50 Hz
  For instruments
  100 V, single-phase, 50 Hz
- o To cope with inadvertent power interruption, a battery system capable of 30-min backup is provided as backup power source for instruments.

(h) Emergency power facilities

The LPG receiving and shipping operations at the Terminal are carried out not continuously but intermittently. Therefore, no danger is accompanied even if the LPG receiving and shipping operations were stopped temporarily owing to power interruption, and since extremely adverse influences are not exerted to other operation, the provision of emergency power generator is regarded unnecessary.

However, the battery system for 30-min backup is provided as a safety measure for instruments to cope with inadvertent power interruption, as described earlier. The same system is also adopted for Mann Terminal.

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 provide:

- o Special-purpose pipelines for pumping water to fire hydrants equipped in the entire compounds of the Terminal.
- o Sprinklers for sprinkling water onto LPG tanks in emergencies.

The water pond is designed with a capacity capable of providing an ample supply of water for 30 minutes even if the fire hydrants and sprinklers are used simultaneously.

7) Other facilities

In addition to the facilities described above, the Terminal is to be provided with the following facilities:

(a) Control room

(b) Instrument air compressor house

(c) Telecommunications facilities, including

- o Inter-compound paging equipment
- o Telephone system for use between Syriam Terminal and Syriam Refinery
- o Paging system for use between Control Room and Jetty

5.1.4 Terminal Plot Plan

Fig. 5-5 shows the Terminal's arrangment or plot plan. The following points were given due consideration in drafting the plot plan:

- o Division of the Terminal compounds into LPG tank region, LPG shipping pumps region and utility facilities region (including Instrument Air Compressor house).

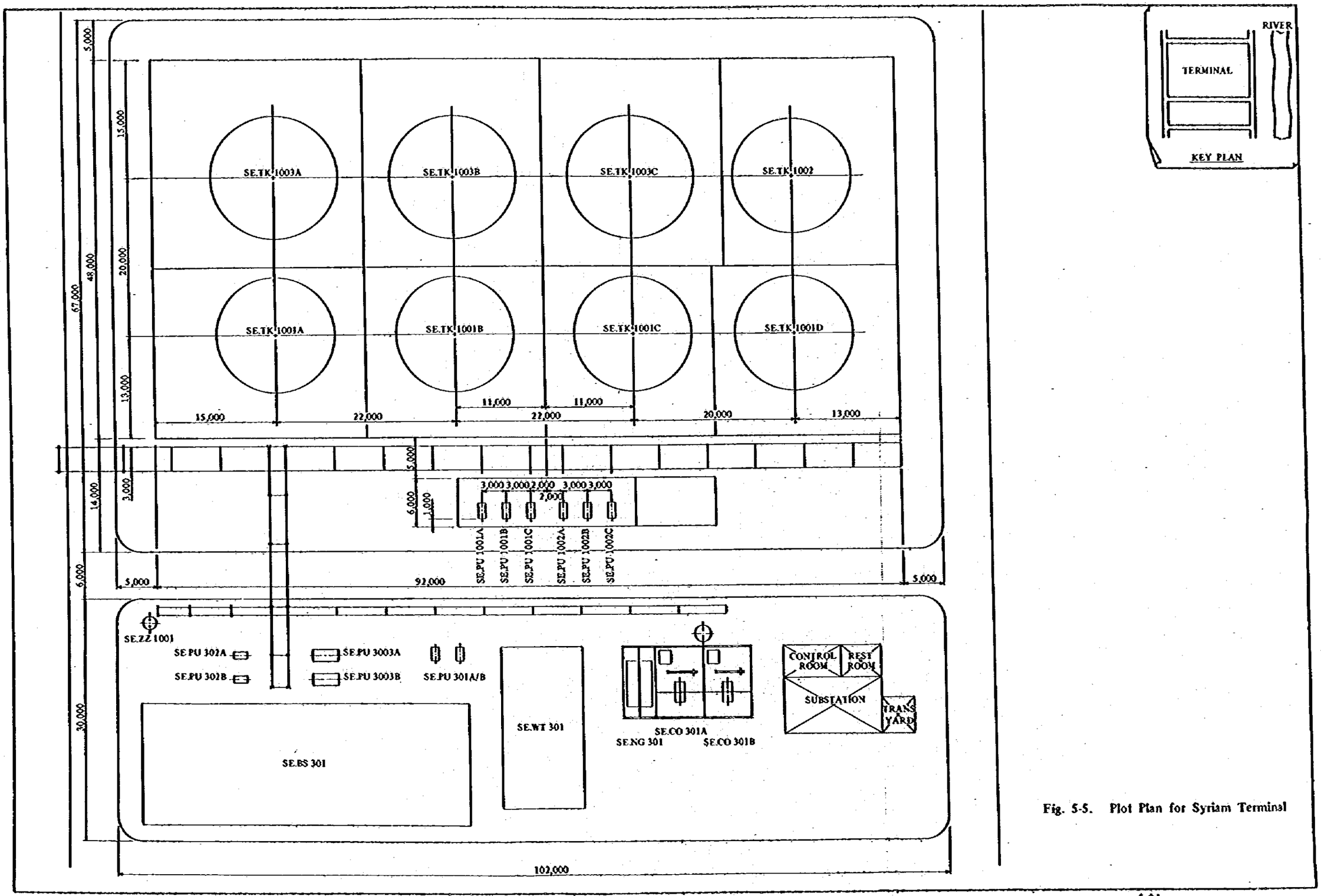
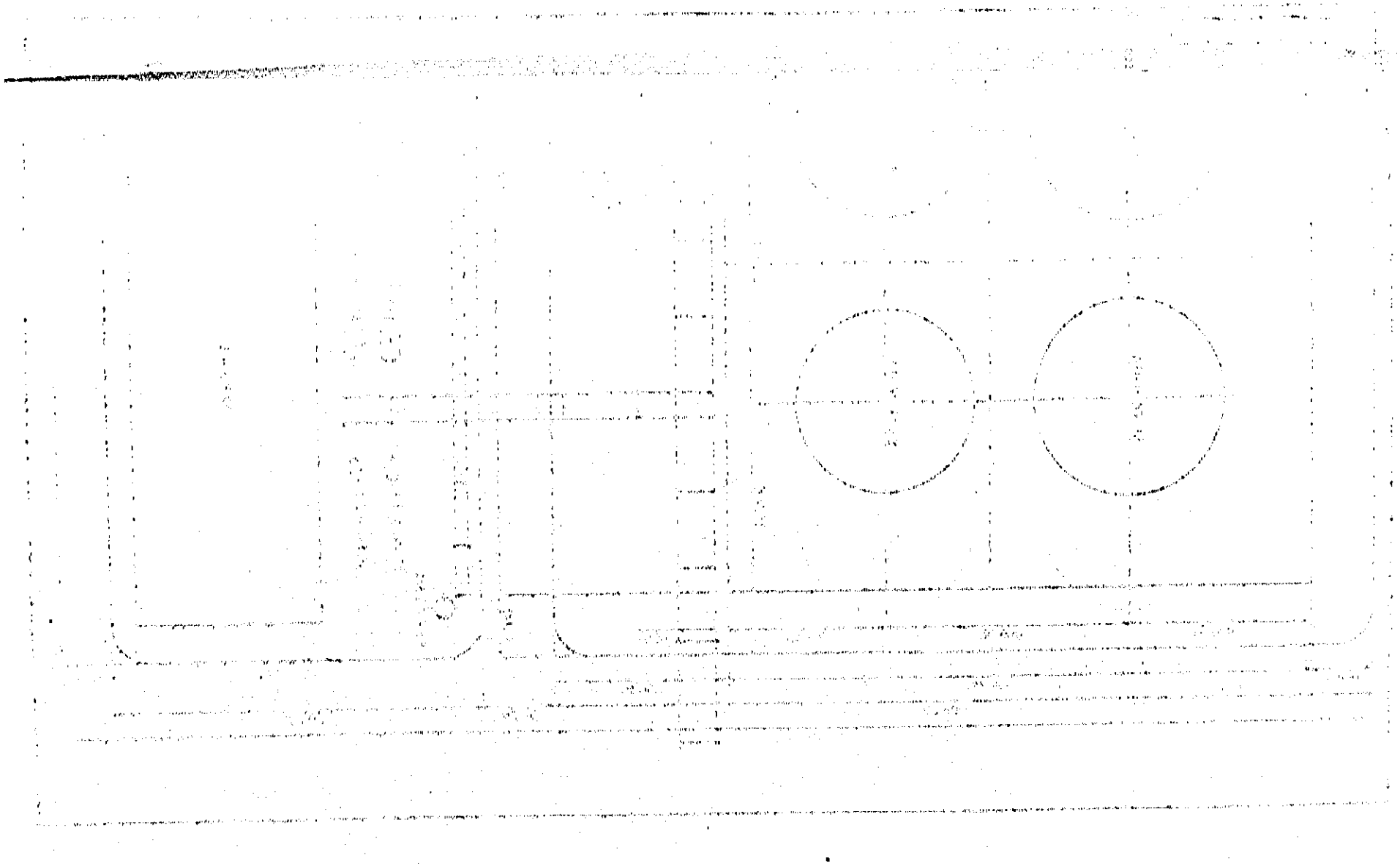


Fig. 5-5. Plot Plan for Syriam Terminal



- o The LPG tank region was arranged with three side facing the roads for ease of fire-fighting operations.

- o The LPG shipping pumps were arranged with their faces directed toward the road for operational and maintenance ease.

- o The utility facilities region (including Instrument Air Compressor Room) was arranged over 20 m away from the LPG tank region as a safety measure.

5.1.5 Infrastructure

(a) Traffic

Syriam having long been an oil refining region, the adjacent Syriam Town is a large town having a population of 90,000. However, since the town is separated from Rangoon by Rangoon River and not connected directly by land roads, Rangoon and Syriam are today linked by means of regular and irregular ferry boats.

As for traffic between Syriam side jetty and Syriam Refinery, a dual gravel road (partly paved) is provided, while a tar-paved road having an effective width of 4.8 m is provided between the Refinery and Terminal site. These roads can be utilized for the construction and operation of the Terminal.

(b) Housing

Housing facilities for Refinery employees are available in Syriam Town. These facilities can be utilized since the number of employees increased by this project is comparatively few, of only 43 persons.

(c) Water

Syriam Refinery is equipped with a water facility for storing and using rain water, so the required volume of water can be received from this facility, for which a water pipe system is to be layed from Refinery to Terminal site.

(d) Electric power

Since a heavy oil fired thermal power station constructed in 1979 is available at the Syriam Refinery, this power source can be utilized by laying a transmission line to the site.

(e) Telecommunications

A leased telephone system is in service for immediate use between Rangoon and Syriam Refinery. A leased telephone line is to be provided between Refinery and Terminal site.

5.2 Mann Terminal

5.2.1 Design Conditions

1) LPG receiving and shipping

LPG receiving and shipping of Mann Terminal are to be performed by the following system.

Table 5-3, Design Conditions of Mann 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					
Mann Refinery → Mann Terminal	3,000	12,000	Pipeline	Max. Vapor Press. 14.6 kg/cm²G at 37.8°C	Max. Vapor Press. 4.9 kg/cm²G 37.8°C
Mann GOCS → Mann Terminal	11,200	18,800	Pipeline		
Shipping					
Mann Terminal → Syriam Terminal	14,200	30,800	River barge		

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

2) Site conditions

(a) Soil conditions

This site adjoins Oil Products Terminal of Mann Refinery that is presently under construction. As for the surrounding topography, there is a plateau facing the Irrawaddy River, and a sharply inclined cliff exists on the river side. Soil survey boring has been achieved when constructing the Terminal, the results of which are shown in Fig. 5-6.

According to this soil survey, there is a silty sand and gravel surface stratum about 1.5 m deep, under which is a dense and firm sand and gravel stratum having an N value of over 40 by standard penetration test. Underneath this stratum is a highly compacted, rock-like fine sand stratum having an N value of over 100.

As judged from this soil condition, the sand and gravel stratum below the surface stratum is sufficiently firm as bearing stratum and permits direct laying of structures on it without any trouble. The Burmese side assumed the bearing capacity to be 15 tons/m^2, which is conceived as a safe value.

(b) Natural conditions

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

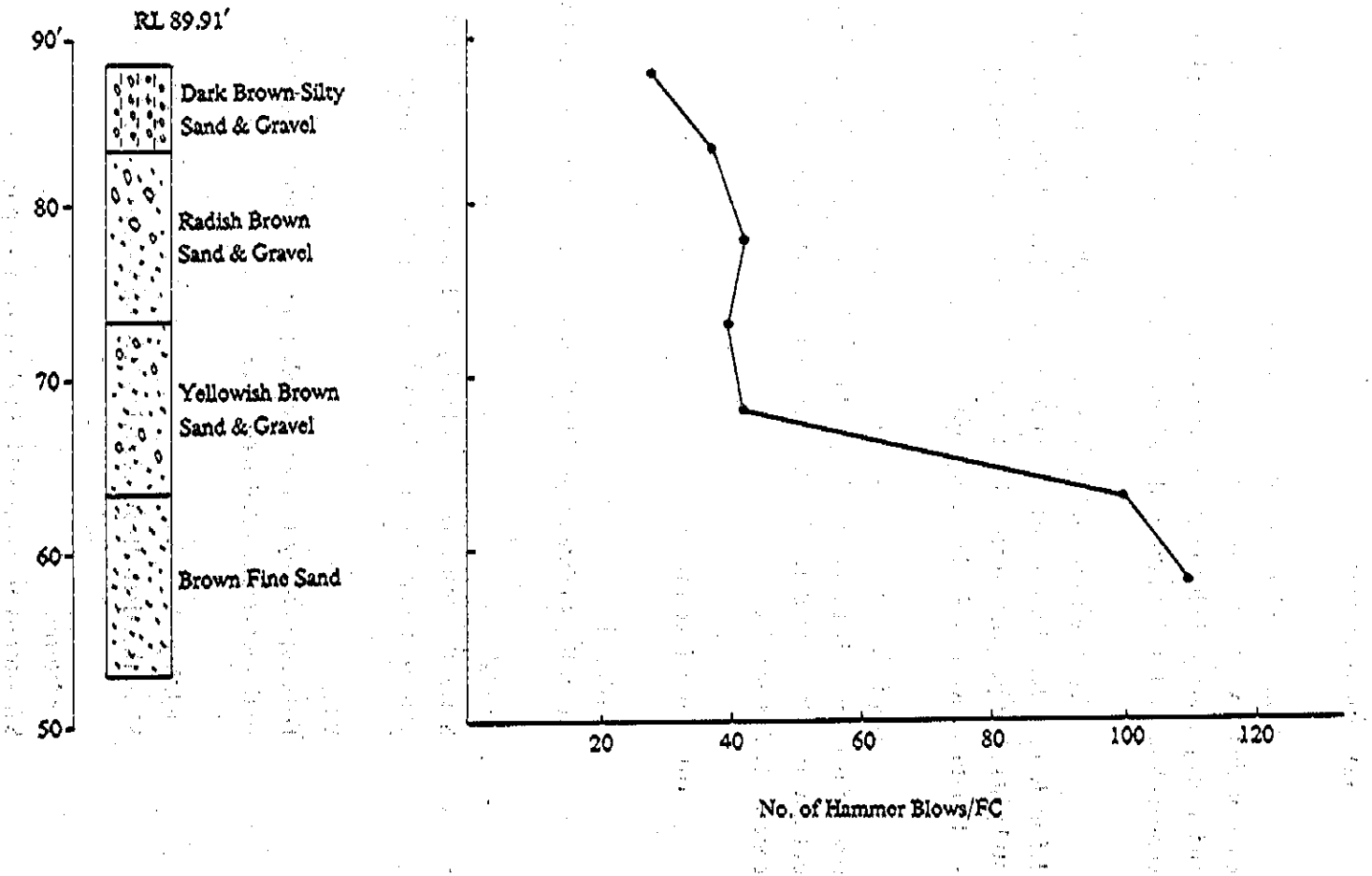
Rainfall:
Since the design rainfall intensity of 100 mm/hr was adopted in Mann Refinery construction project, the same value is adopted in this project.

Wind:
Data supplied by theBurmese side gave a maximum wind velocity of 100 miles/hr, so this was made a design condition.

Lighting:
Since thunderbolts are conceivable, proper measures are to be adopt as required.

Sandstorm:
Sandstorms are conceivable in this region, so proper measures are to be adopted as required.

Fig. 5-6. Soil Profile of Mann Terminal



5.2.2 Design Policy

1) Service factor

The service factor in connection with LPG receiving and shipping was set at 0.90 (330 days/yr).

2) LPG tank

(a) The required LPG tank capacity was determined by means of the following formula:

$$Q = (W \cdot V) / (W \cdot \rho)$$

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

(b) Number of days of LPG storage

The number of days of LPG storage was determined as 20 days, as planned in Chapter 4.

3) Legal restrictions

These are the same as Item (3), Section 5.1.2.

4) Tank configuration

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

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 Mann Refinery to Mann Terminal by pipeline; adoption of flow velocity requiring no return gas line.

(b) Transportation of LPG from Mann GOCS LPG Extraction Plant to Mann Terminal by pipeline; adoption of transportation velocity of 3–5 m^3/hr.

Since the pipeline for LPG transportation will extend over a long distance of 34 km as indicated in Fig. 5-7, and substantial pressure drop will occur in the pipeline during LPG transportation, it will be necessary to design the pipeline with high-head and small-capacity shipping pumps for installation in Mann GOCS LPG Extraction Plant, and for an LPG transportation velocity of 3–5 m^3/hr.

(c) Speed of LPG loading from Mann Terminal onto river barges: within 7 hrs for unloading 500 tons of LPG.

6) Utilities facilities

All utilities required by Mann Terminal are to be supplied by Mann Refinery.

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 safety valve blow-off as well as for treating depressurized gas at shut down of terminal facilities, a high vent is provided for exhaustion of discharged gas into the atmosphere.

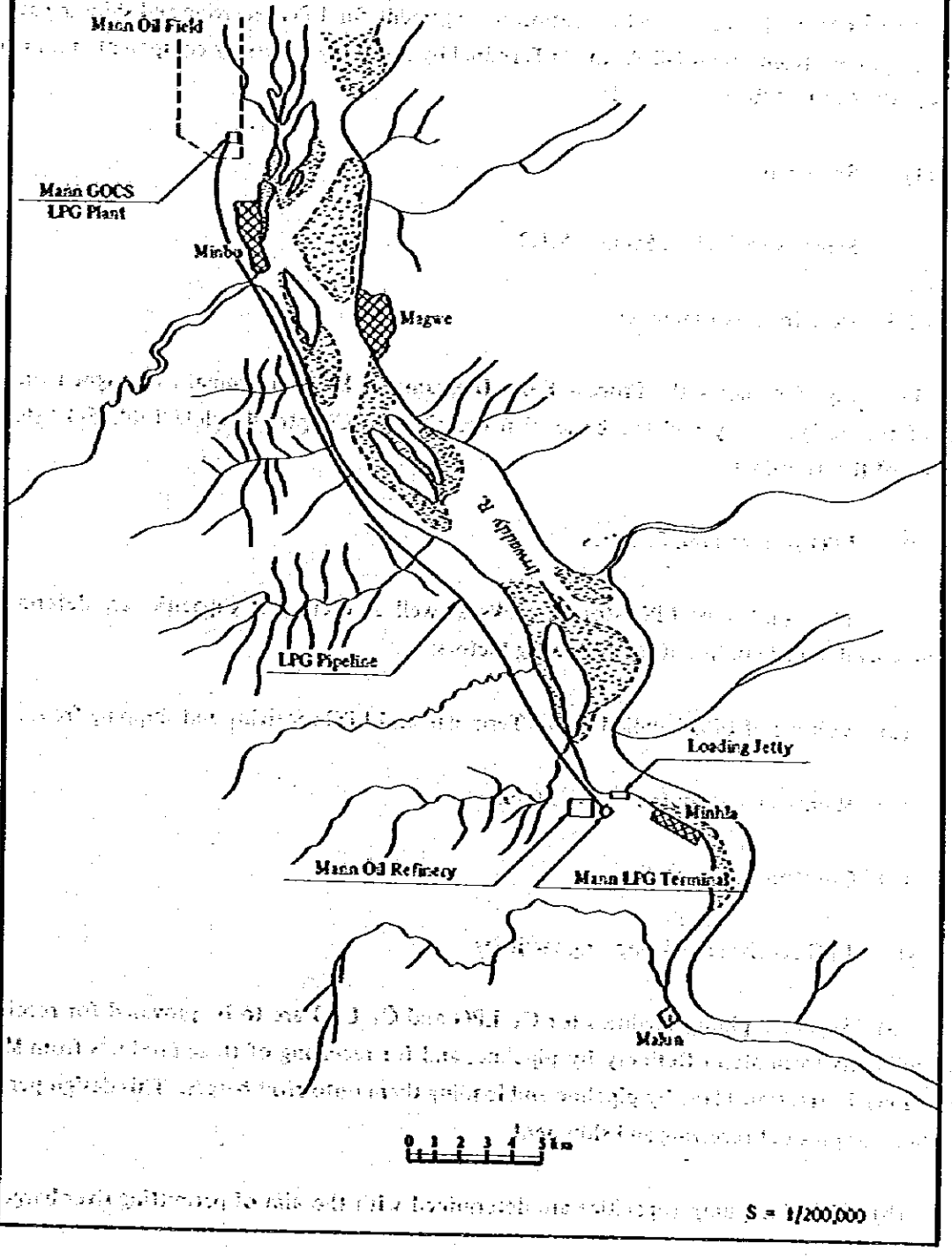
9) Fire-fighting facility

Same as Item (9), Section 5.1.2.

10) Operation management

(a) Operation is achieved by a 4-team, 3-shift system of shift workers, and day workers.

Fig. 5-7. Mann GOCS – Mann Terminal Pipe Line Route



Maintenance work during normal operations is achieved by terminal workers, but full-scale, regular inspection and repairs are accomplished with the aid of workers from Mann Refinery.

(b) The operation and management of Mann Terminal are to be placed under the supervision of Mann Refinery, and operation management for LPG receiving and shipping are to be accomplished from Mann Oil Products Terminal by installing necessary equipment and instruments in the Control Room.

11) Spare parts

Same as Item (11), Section 5.1.2.

5.2.3 Description of facilities

1) Fig. 5-8 shows the Process Flow Diagram for Mann Terminal as designed on the basis of the design policy and the basic plan described in Chapter 4, while Table 5-4 lists the facilities of the Terminal.

2) LPG storage tank facilities

The number of LPG storage tanks as well as their unit capacities 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) Separate piping facilities for C_3 LPG and C_4 LPG are to be provided for receiving these products from Mann Refinery by pipeline, and for receiving of these products from Mann GOCS LPG Extraction Plant by pipeline and loading them onto river barges. This design permits simultaneous product receiving and shipment.

(b) Shipping pump capacities are determined with the aim of permitting river barges of

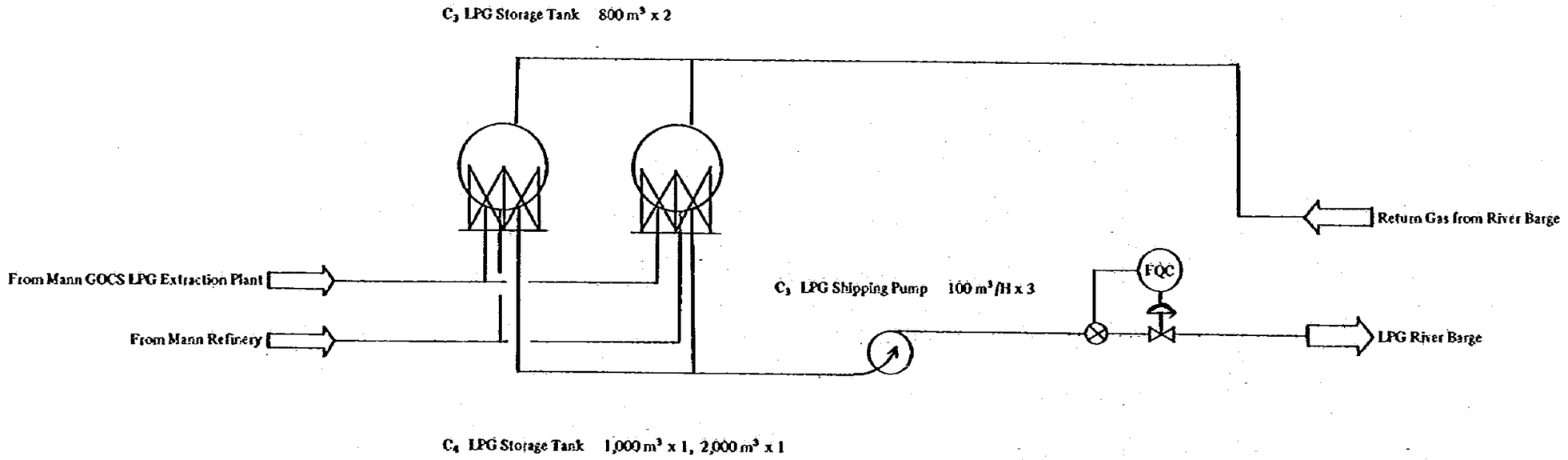
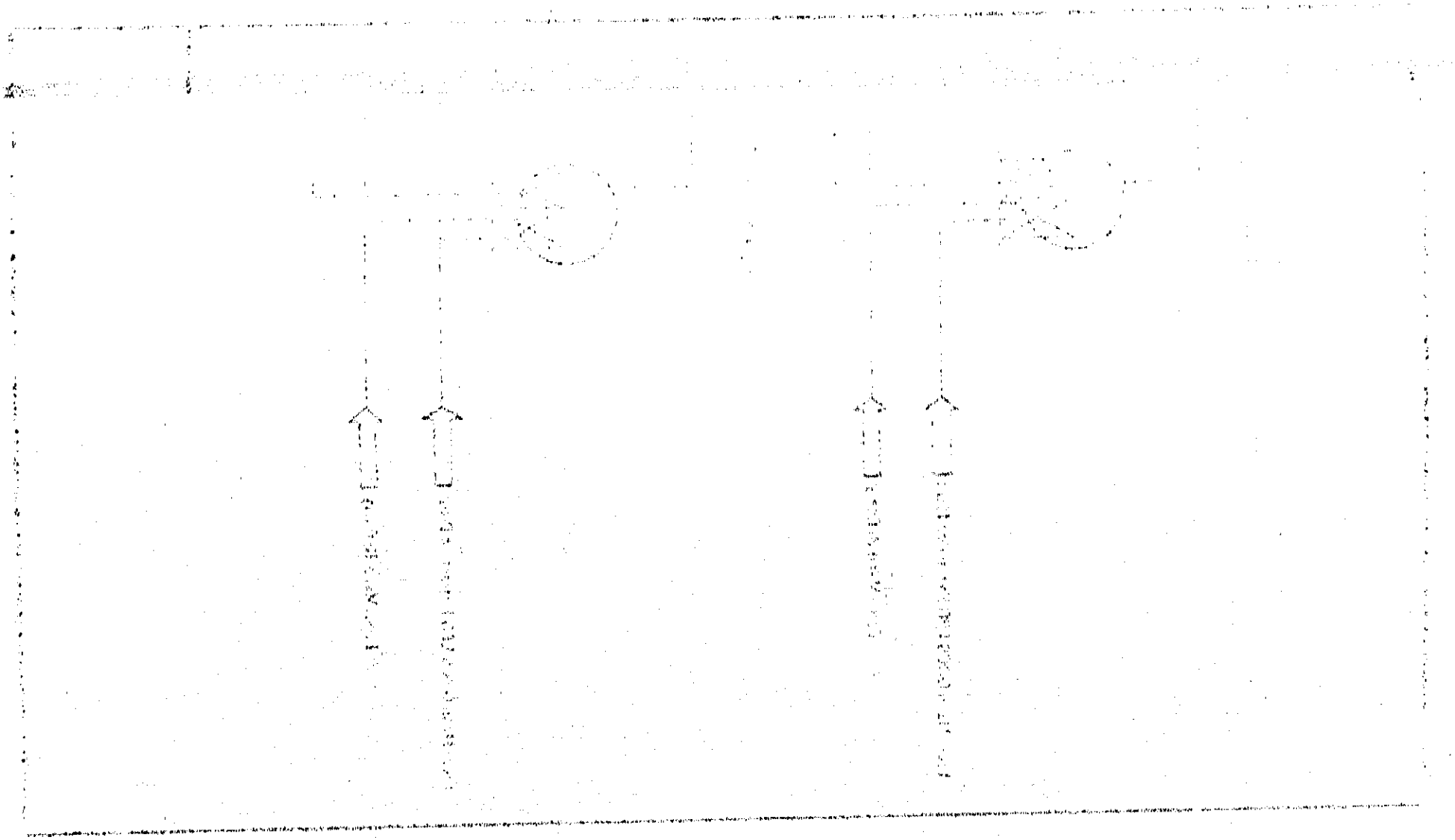


Fig. 5-8. Process Flow Diagram for Mann Terminal



500-ton loading capacity to be loaded within 7 hrs in the daytime. Three pumps are to be provided, including one spare pump (50% spare), as a safety measure against any inadvertent pump trouble.

Table 5-4. List of Facilities at Mann Terminal

	Facility	Capacity of Facility	Remarks
1.	LPG Tanks	C_3 LPG tanks: 800 m^3 x 2 C_4 LPG tanks: 1,000 m^3 x 1 2,000 m^3 x 1	
2.	Shipping Pumps	C_3 LPG shipment: 100 m^3/h x 3 C_4 LPG shipment: 100 m^3/h x 3	
3.	Jetties	Loading onto river barges: No. 1 Jetty presently under construction to be used.	
4.	Utilities Facilities		
	1) Water Intake	(a) Water to be supplied from Mann Refinery. (b) Water pond: 10 m x 30 m x 1.5 m (depth) (c) Hydrant pump: 40 m^3/h x 2 (d) Sprinkler pump: 350 m^3/h x 2 (e) Water treatment: Unnecessary	
	2) Cooling Water 3) Instrument Air 4) N_2 Generator	All to be supplied by Mann Refinery.	
	5) Power Receiving/ Distribution Facility	Power supplied by existing Mann Refinery.	
	6) Emergency Power Generator	Not to be installed.	

4) Jetties

A total of 45,000 tons/yr of LPG consisting of 15,000 tons/yr of LPG manufactured by Mann Refinery (excluding the portion for domestic consumption from the total output

of 18,000 tons/yr) and 30,000 tons/yr of LPG manufactured by Mann GOCS LPG Extraction Plant, must be transported from Mann Terminal to Syriam Terminal by river barges.

The jetties shown in Fig. 5-9 or shipping Mann Refinery products are presently under construction along the banks of the Irrawaddy River and scheduled for completion in 1981. Among these jetties, the No. 1 and No. 2 Bulk Jetties are designed for loading oil products onto river barges, and are also usable for LPG shipment.

Four river barges are necessary for transporting LPG, as described in 'Transportation of Product LPG,' Section 4.2.3, for which one jetty will be sufficient. The No. 1 Bulk Jetty is to be used for this purpose.

In this region, the water level of th Irrawaddy River differs by 15–16 m in the rainy and dry seasons, and the current flow runs up to a maximum of 5 m/sec. In regions characterized by these conditions, the pontoon type jetty shown in Fig. 5-9 is normally adopted. The pontoon and land-side fixed trestle are connected by means of a bridge revolvable in both vertical and horizontal directions. In the rainy season when the water level is high, the pontoon is drawn closer to the bank.

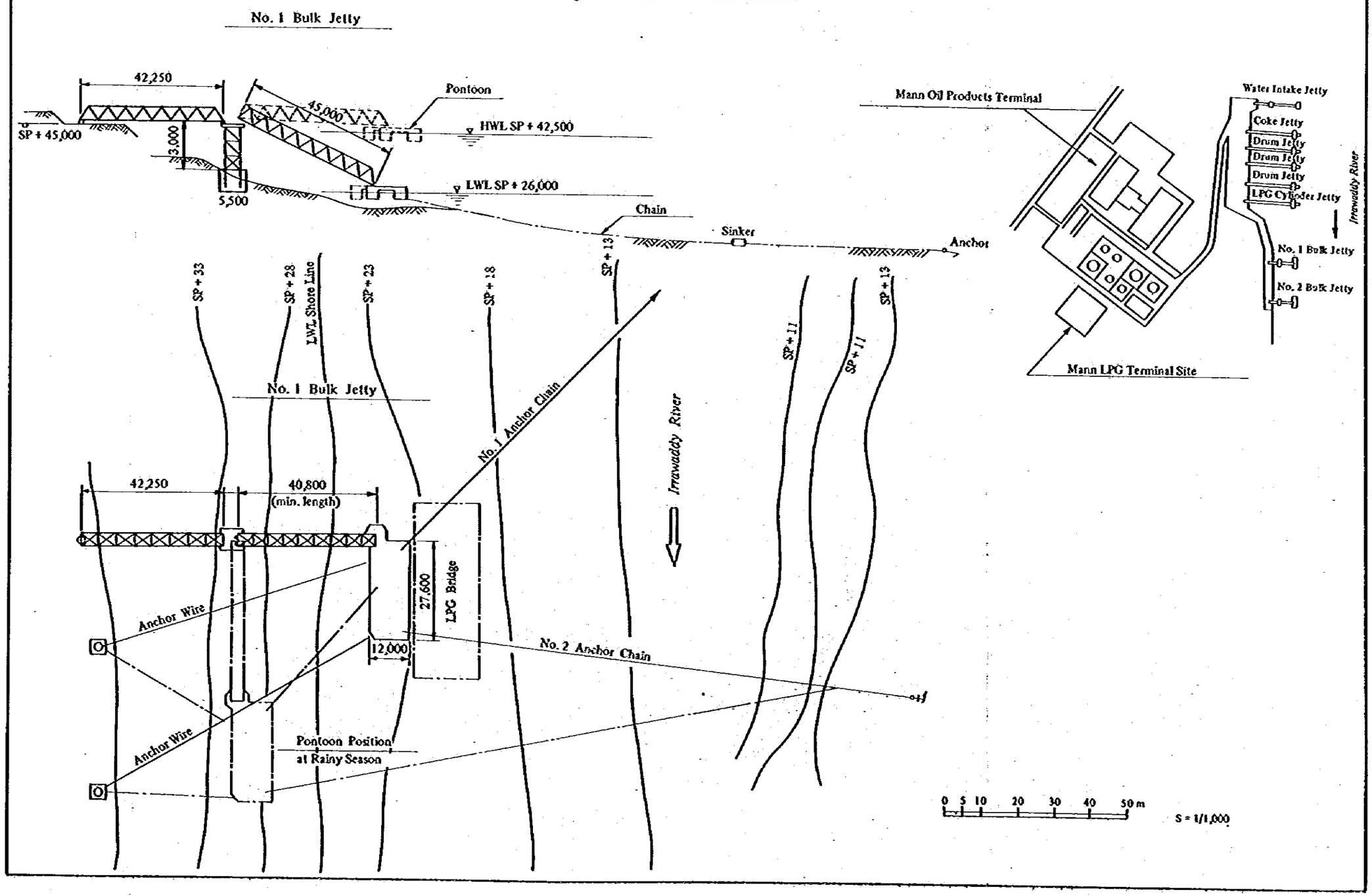
The pontoon is prevented from being drifted by currents by mooring it securely by means of two lines of anchor chains each connecting to a 25-ton anchor, and two lines of anchor wires connecting the pontoon securely to land mooring posts. The river barges are berthed to the pontoon for loading of LPG.

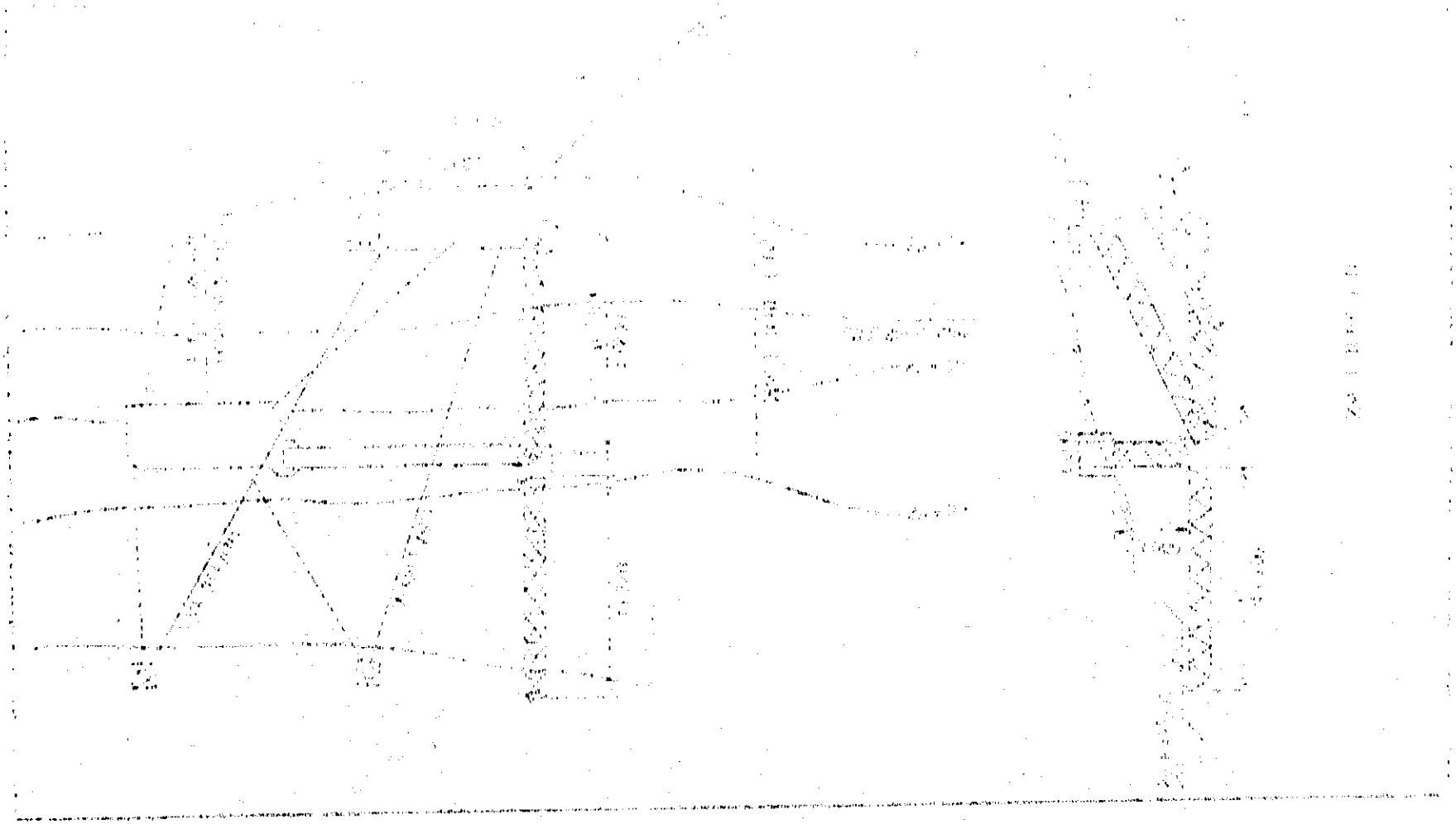
5) Utility facilities

The rates of cosumption of utilities at Mann Terminal are as shown in the following table. Since the utility facilities of Mann Refinery lack ample spare capacity to meet these utility requirements, utilities such as electricity, water and instrument air are to be supplied by the Mann Refinery.

Item	Estimated Mean Consumption at Mann Terminal	Utility Facility of Mann Refinery		
		Capacity	Consumptioon Volume	Surplus Supply
Electricity KW/Hr	118	18,000	4,000	12,000
Steam T/Hr	-	70	60	10
Water T/Hr	6	600	450	150
Instrument Air Nm^3/Hr	110	3,000	1,500	500
N_2 Nm^3/Hr		40	(30)	Max. (40)

Fig. 5-9. Jetties of Mann Terminal





6) Fire prevention and fire-fighting facilities

From the need of providing the Terminal with adequate safety measures as described in Item (6), Section 5.1.3, fire hydrants, LPG tank water-sprinkling facilities and a water pond providing an ample supply of water for 30 minutes are to be installed.

7) Telecommunications facilities

The Terminal is to be provided with telecommunications facilities, including an inter-compound paging system and a VHF radio communications system for communications between Mann Terminal and Mann GOCS LPG Extraction Plant.

5.2.4 Terminal plot plan

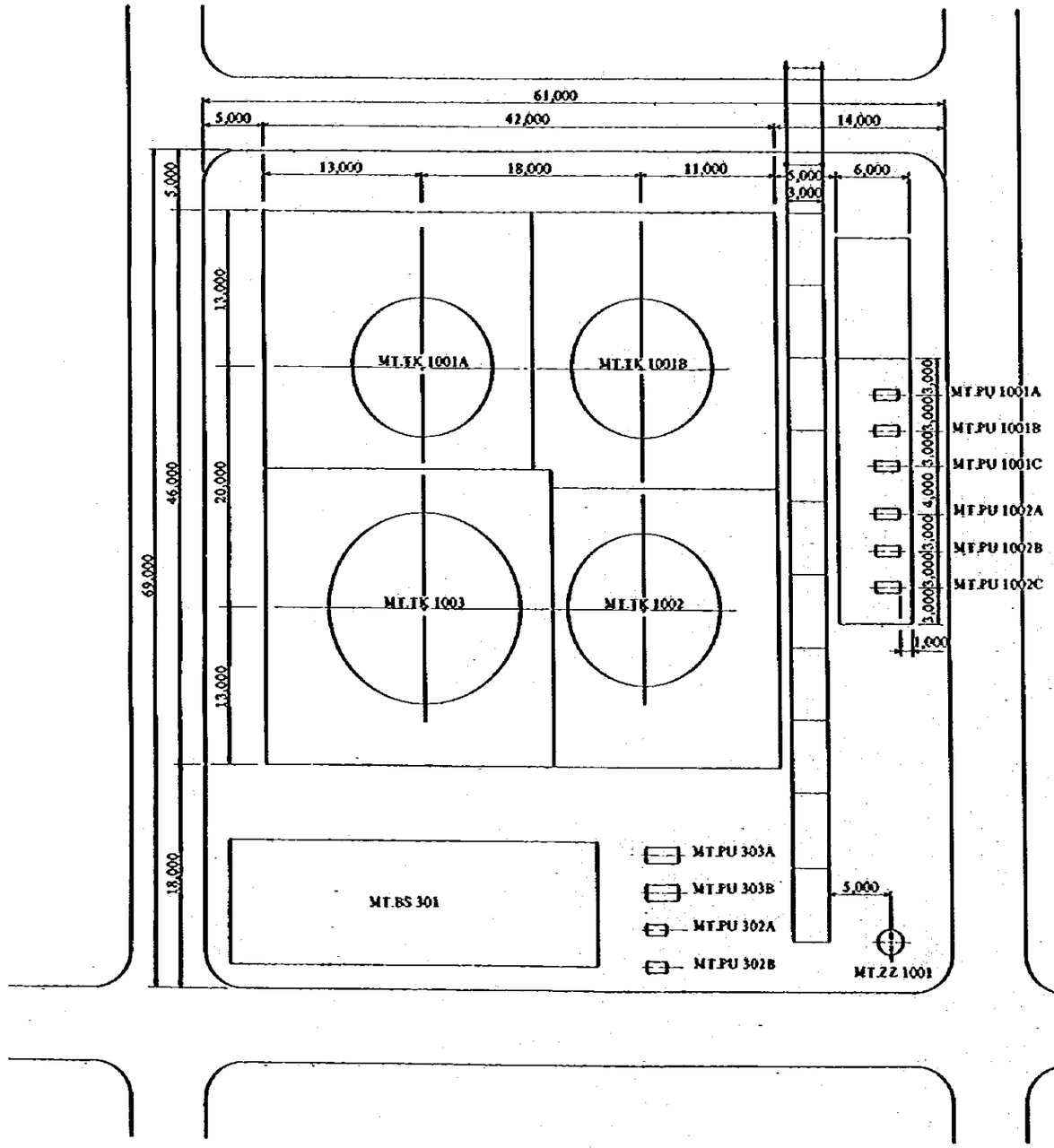
Fig. 5-10 shows the Terminal's arrangement or plot plan. The following points were given due consideration when drafting the plot plan:

- o Operation management of Terminal from the existing Control Room of the Mann Oil Products Terminal.
- o Concentrated arrangement of LPG tanks in order to secure a fire dike capacity by means of an integrated fire dike system.
- o Provision of a network of roads around the Terminal in order to easen fire-fighting operations.
- o Arrangement of LPG shipping pumps with their faces directed toward the road for operational and maintenance ease.

5.2.5 Infrastructures

(a) Traffic

The Terminal site adjoins Oil Products Terminal of Mann Refinery, and a gravel road about 5 m wide exists along the west bank of the Irrawaddy River, from Mann Fields in the north to Malun via Mann Refinery. Along the way, crossing over to the east bank of the Irrawaddy River is possible at Minbu, Minhla and Malun.



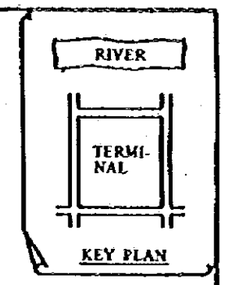
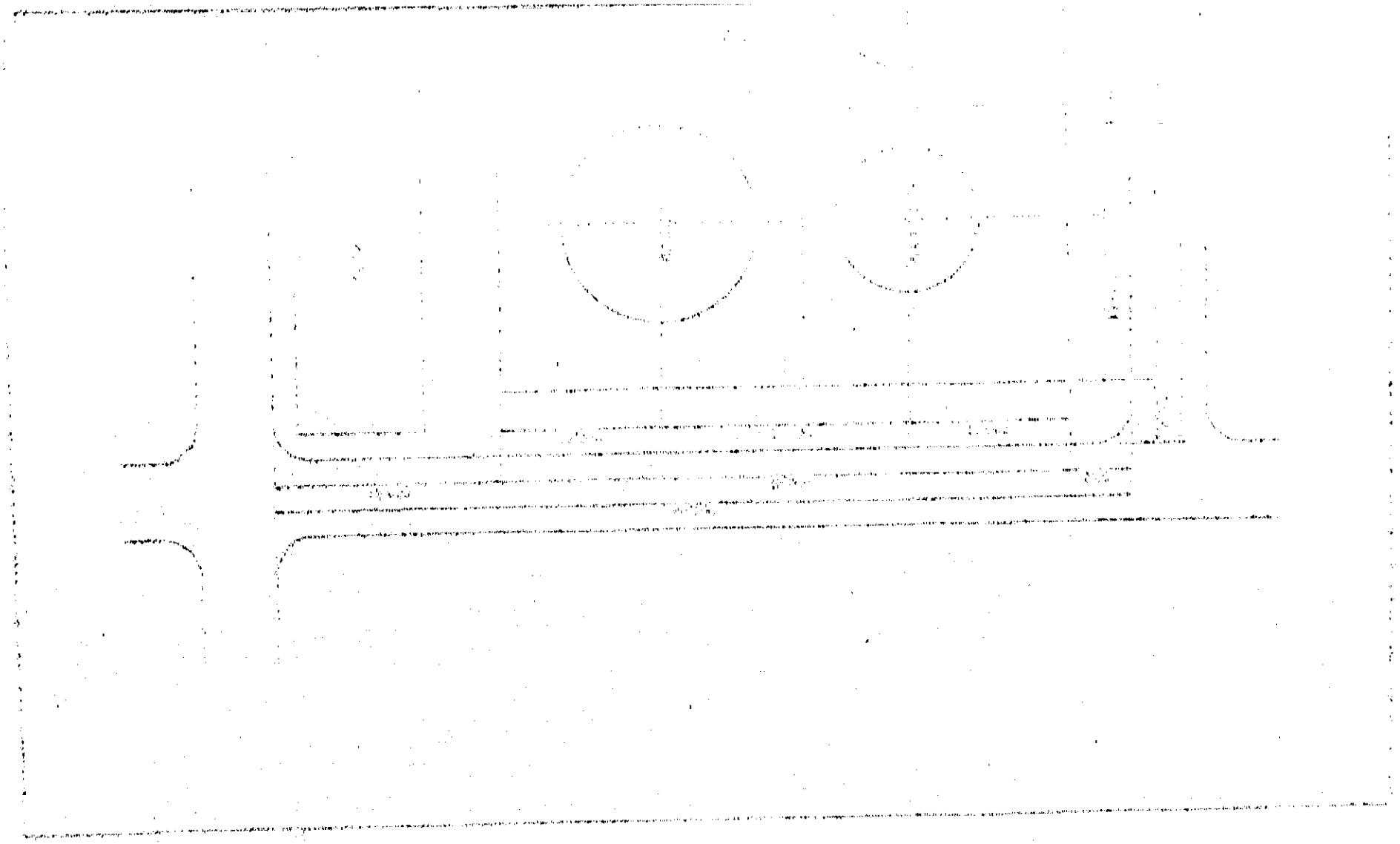


Fig. 5-10. Plot Plan for Mann Terminal



At Malun is a Z-Craft operated by HIC, and river crossing by automobile is possible. On the west bank, an asphalt road about 5 m wide extends to Rangoon via Prome, by which Rangoon can be reached in 12–13 hours by automobile. Also, once can cross to the east bank from Minbu to Magwe, then fly from Magwe to Rangoon by Burma Airways plane.

(b) Housing

The existing housing facilities provided for Mann Refinery employees can be utilized since the number of employees increased by this project is comparatively few, or only 34 persons.

(c) Water

Water facilities of Mann Refinery are to be utilized.

(d) Eelectric power

Electric power is to be received from the Oil Products Terminal of Mann Refinery.

(e) Telecommunications

The telephone and paging facilities of the Oil Products Terminal of Mann Refinery, are to be utilized.

5.3 River Barges for LPG Transportation

The entire volume of LPG for export is to be transported from Mann Terminal to Syriam Terminal over the Irrawaddy River by means of river barges.

The Irrawaddy is a large river having its sources in the northern tip of Burma and near the boundary between China and India. It is about 2,090 km long and its drainage basin is 430,000 km^2 wide. The current flow beyond Mandalay is moderate and suitable for river transportation. The lower reaches of the Irrawaddy River are connected to Rangoon River by means of Twante Canal, permitting river transportation to Rangoon.

The volume of LPG to be transported from Mann LPG Terminal will be 15,000 tons/yr upon completion of Phase 1 – Part 2 (Mann Refinery) of the project and 30,000 tons

/yr upon completion of Phase II (Mann GOCS LPG Extraction Plant) of the project, or a total of 45,000 tons/yr.

5.3.1 Design Conditions

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

Water level difference in rainy and dry seasons:		16 m apptox. (near Mann Termianl)	
Current speed:	Rainy season	Max. 5 m/sec	
		Mean 1.5 m/sec	
	Dry season	Max. 2 m/sec	
		Mean 0.5 m/sec	
Days required for navigation (Mann Terminal – Syriam Terminal):			
	Rainy season	Mann to Syriam	4 days
		Syriam to Mann	6 days
	Dry season	Mann to Syriam	5 days
		Syriam to Mann	6 days

Number of navigable days:
There is hardly any fear of the river becoming unnavigable at any time through the year.

Type of barge:
The largest barges presently in service on the Irrawaddy River are 500-ton loading capacity oil barges having a length of 48 m, breadth of 9 m and draft of 1.8 m. These barges are connected in a train of 2–4 barges (length 48–96 m, breadth 18 m) and deriven by a pusher tugboat.

5.3.2 Design policy

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

(a) Since the handling of LPG demands far greater caution than crude oil, the 1 pusher tugboat + 1 LPG river barge train configuration is adopted from the viewpoint of safety.

(b) As for barge dimensions, the breadth of 19 m was adopted in view of the types of barges in service hitherto and for navigational safety, while the draft was made as small as possible (1.3 m) to permit non-interrupted navigation even in dry seasons.

(c) Based on the conditions described above, the barge was designed with an LPG loading capacity of 500 tons, and two cylindrical tanks, each having 250-ton loading capacity, are arranged in parallel horizontally in order to lower the overall center of gravity of the barge as much as possible.

(d) The number of days required for shuttling between Mann Terminal and Syriam Terminal will be as follows, assuming that the pusher tugboat described earlier is used:

Mann to Syriam	5 days
Syriam to Mann	6 days
LPG loading and unloading	2 days
Total	13 days

5.3.3 Description of Facilities

(a) Pusher tugboats

Pusher tugboats presently possessed by PIC are to be diverted for river transportaton of LPG. These pusher tugboats had hitherto been used primarily for transporting crude oil from the oil fields in the upper reaches of Irrawaddy River to Syriam, but since crude oil is now being transported by means of a pipeline layed between Mann oil fields and Syriam Refinery, a surplus of pusher tugboats has been generated.

PIC presently possesses 28 pusher tugboats, a breakdown of which is offered in

Table 5-5. Four of these pusher tugboats are required for LPG transportation, and can be diverted from among these pusher tugboats for this purpose.

Table 5-5. Existing Pusher Tugboats

Horse-Power	Draft	Type of Driving Force	Number of Exsting	Age	Numberof Available
400 x 2	4' – 9"	Diesel Engine	5	25	Same as existing
420 x 2	4' – 3"	"	2	17	
545 x 2	4' – 10"	"	8	12	
610 x 2	4' – 10"	"	3	5	
360 x 2	5' – 3"	"	2	12	
360 x 2	4' – 5"	"	2	12	
360 x 2	4' – 0"	"	1	8	
360 x 2	4' – 9"	"	5	5	
Total			28		

(b) Barges

Number required:	4 barges
Type:	Non-self-propelled barge
Loading capacity:	LPG 250 tons x 2/barge
Dimensions:	Length 48 m x Breadth 19 m
Draft:	1.3 m
Facilities:	LPG unloading pumps, 200 m^3/hr x 2 units; electric supply by landbased wiring

The required number of barges can be obtained from the following formula, on the assumption that 13 days are required for one shuttling cycle and 45,000 tons of LPG are to be transported annually:

$$N = 45{,}000 / [(365/13) \times 500]$$

The use of 4 barges provides an idling time of 72 days/barge annually, which is ample for inspection and maintenance operations since these barges are of non self-propulsion type and free of wearable parts.

Fig. 5-11 shows the general arrangement of the LPG river barge.

5.4 Mann GOCS LPG Extraction Plant

5.4.1 Design Conditions

1) Feedstock gas

The feedstock gas used by this LPG Extraction Plant is the associated gas produced by Mann GOCS. The composition of this associated gas is as shown in Table 5-6. The gas is first led into the existing pipeline of Myanma Oil Corporation (MOC), then supplied to this Mann GOCS LPG Extraction Plant by means of a newly layed pipeline.

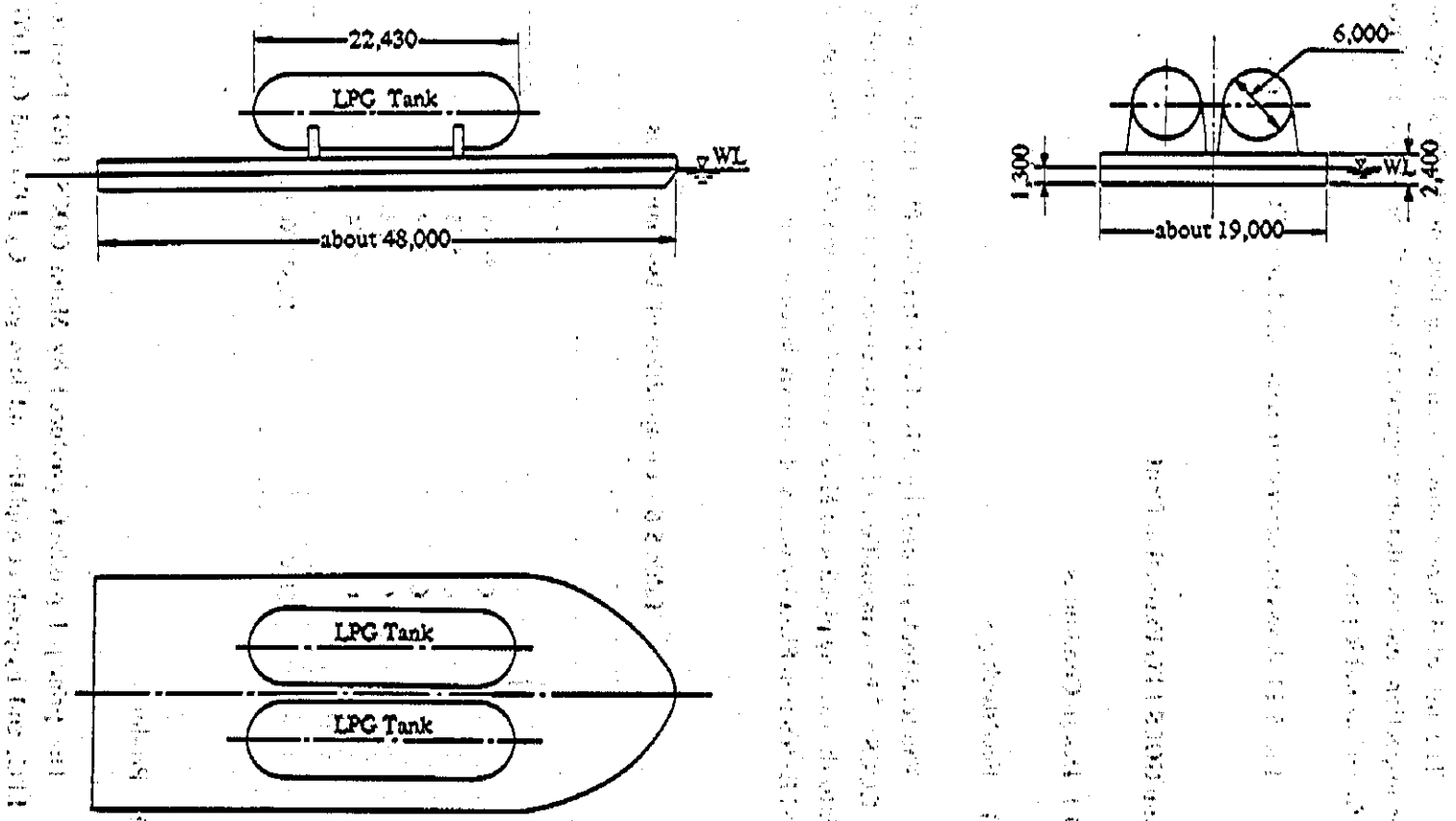
Table 5-6. Composition of Associated Gas

	mol.%
C_1	86.34
C_2	5.85
C_3	3.49
C_4	3.58
C_5	0.74
LHV	10,317 Kcal/Nm^3

2) Products

The principal products produced by Mann GOCS LPG Extraction Plant are C_3 LPG, C_4 LPG, and by-product naphtha and lean gas. C_3 LPG and C_4 LPG are transported separately by pipeline to Mann Terminal, while by-product naphtha is sent from this Extrac-

Fig. 5-11. General Arrangement of LPG River Barge



tion Plant to Mann Refinery by tank lorries for use as motor spirit material. Meanwhile, lean gas is transferred by means of the LPG Extraction Plant's newly layed pipeline to the existing pipeline of MOC.

3) Site conditions

(a) Soil conditions

The site lies to the south of the Mann oil fields and is situated on a plateau. Although a definite soil profile of the site is unknown since soil survey boring has not been conducted, the geological features of the site may be regarded as being the same as those in the region about Mann Refinery roughly 34 km south of the site. Pipe laying work was being advanced in the oil fields, and examination of the soil there indicated it was hardly different from that in Mann Refinery region.

Mann Refinery structures are all erected directly on a spread foundation without use of foundation piles, so adoption of the same method is judged appropriate for the Mann GOCS LPG Extraction Plant.

Regarding bearing capacity, the Burmese side assumed a bearing capacity of 15 tons/m^2, which is considered appropriate. However, it will naturally be necessary to confirm this by soil survey boring at the site prior to drafting the plant's design.

(b) Natural conditions

As for design conditions such as earthquake, rainfall, wind, lightning and sandstorm, they may be regarded as being the same as those of Mann Terminal since the site lies near this Terminal.

5.4.2 Design Policy

1) Stream factor

The annual number of days of operation of the Mann GOCS LPG Extraction Plant is 330 days.

2) Process

The associated gas used as feedstock gas by this LPG Extraction Plant contains C_5+ (naphtha distillate), so the Naphtha LPG Extraction Process utilizing the naphtha distillate for LPG extraction is adopted as the plant's LPG extraction process. This process has the advantage that sponge oil for LPG extraction need not be relied on external means. Since C_3 LPG and C_4 LPG are produced separately by this process C_3 LPG and C_4 LPG are produced separately by this process, a de-propanizer is provided for separation of these LPG fractions.

The processing system and equipment were designed by applying related JIS Specifications, Laws Governing Pressurized Gases and Fire Prevention Laws.

3) LPG tanks

There is no need to erect LPG tanks since product LPG is transported directly to the Terminal. However, off-specifications tanks are provided for system startup and shutdown needs.

4) Shipping facilities

C_3 LPG and C_4 LPG are transported to Mann Terminal at a flow rate of 3–5 m^3/hr by pipeline, by using separate shipping pumps. Loading pumps are also provided in the plant for tnafer of Naphtha products to tank lorries, while lean gas is transferred from plant to existing associated gas line under self-pressure by a newly layed pipeline.

5) Utility facilities

Utilities required by the LPG Extraction Plant are supplied from Mann GOCS whereever possible, and new facilities are to be installed for other required utilities.

(a) Electricity

Two 6-MW gas turbine generators are in operation in the Mann region today, and another of same capacity is to be installed there soon. These gas turbine generators are operated by Electric Power Corporation (EPC). The volume of electricity presently being consumed in this region is 5 MWh, so there is an ample electric power supply capacity in this Mann region. Therefore, the provision of a power receiving/distributon system is all that is needed with this plant.

(b) Water

The water supply capacity in the Mann region is presently 400 tons/hr, and the volume of water consumed is 300 tons/hr. Accordingly, since water supply within this range (100 tons/hr) is possible, the provision of water supply facilities inside the plant is all that is necessary.

(c) Fuel

Since by-product lean gas is utilized as fuel for this LPG Extraction Plant, the provision of a fuel gas line is all that is needed with this plant.

(d) Instrument air

Supply of instrument air from Mann GOCS being impossible, a new instrument air generation facility is to be installed.

(e) Nitrogen

Nitrogen gas (N_2) necessary at time of system startup and shutdown cannot be supplied from Mann GOCS at the present stage, so a new N_2 generation facility is to be installed.

(f) Waste water treatment facility

This is to be newly isntalled.

6) Fire prevention and fire-fighting facilities

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

7) Blowdown facility

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

8) Operation management

(a) Plant operation is achieved by a 4-team, 3-shift system of shift workers, and day workers. Maintenance work during normal operations is achieved by plant workers, but full-scale, regular isnpection and repairs are accomplished with the aid of workers from the Mann Oil Refinery.

(b) An Instrument Room is provided in the LPG Extraction Plant and its operation managed by Plant personnel, but the management organization is to be put under the supervision of Mann Refinery.

9) Spare parts

In response to a request from the Burmese side, spare parts necessary for two years of operation are supplied.

5.4.3 Description of Facilities

1) Process flow

Fig. 5-12 shows the process flow of Mann GOCS LPG Extraction Plant as designed on the basis of the conditions described in Section 4.2.4 and 5.4.2. The plant's processing capacity is 24 x 10^6 SCFD, and Table 5-7 shows the plant's output by products.

The process flow of the plant is described hereunder in accordance with Fig. 5-12.

(a) Compression section

The associated gas received from MOC at the plant's battery limits is pressurized from 2.1 kg/cm^{2}G to a pressure of 38 kg/cm^{2}G necessary for the following LPG recovery process by means of a 3-stage compressor. This compressor is driven by the gas turbine that is fired with by-product lean gas.

(b) Dehydration section

The pressurized associated 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 absorption of moisture and regeneration of absorbent.

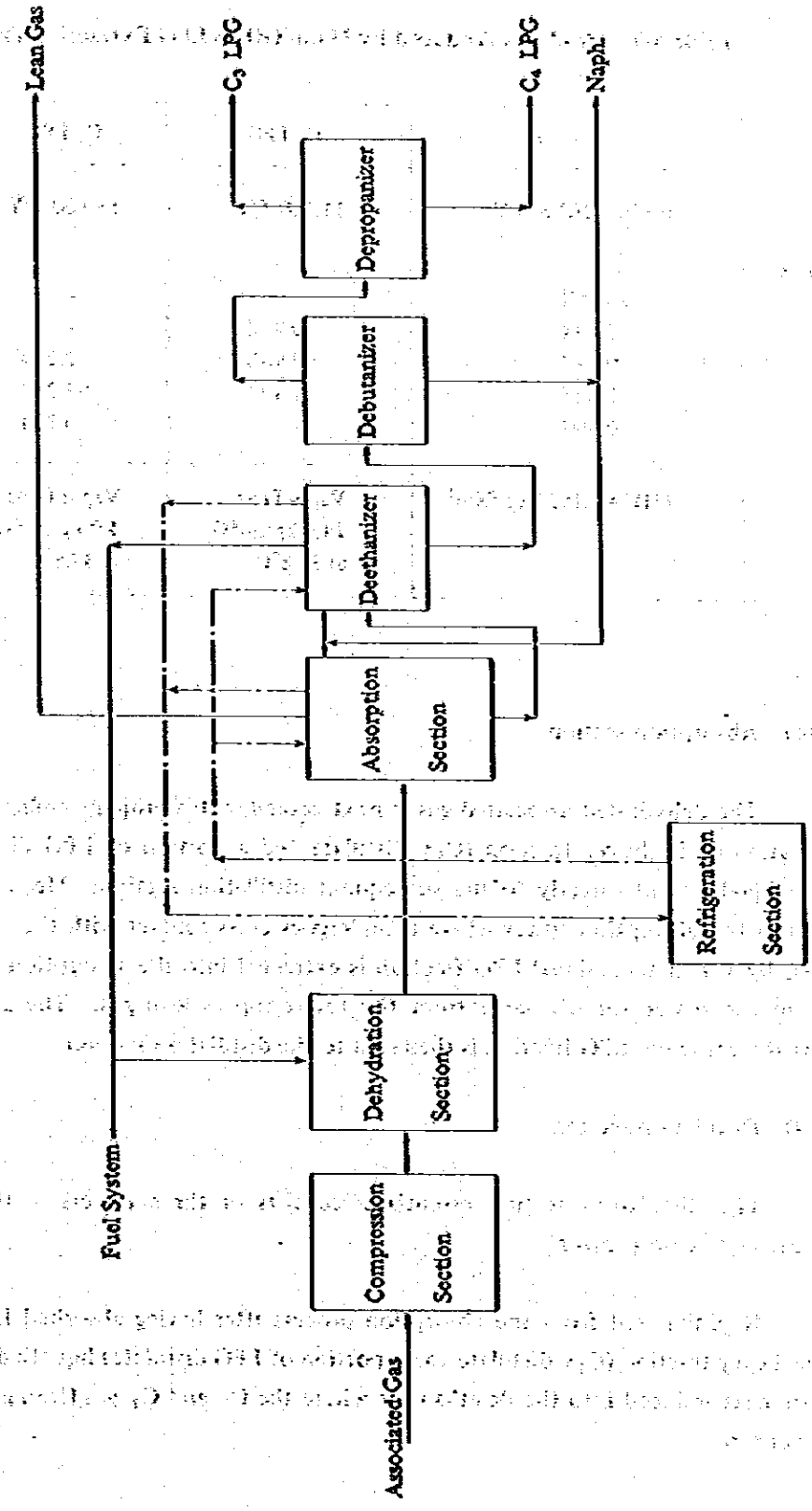


Fig. 5-12. : Block Diagram of Process Flow

Table 5-7. Products Produced by Mann GOCS LPG Extraction Plant

	Lean Gas	C_3 LPG	C_4 LPG	Naphtha
Output	6,850 x 10^6 SCFY	11,200 T/Y	18,800 T/Y	2,900 T/Y
Composition				
C_1	93.06%	-	-	-
C_2	5.63%	0.71%	-	-
C_3	0.97%	97.90%	2.27%	-
C_4	0.04%	1.39%	97.03%	0.59%
C_5	0.30%	-	0.70%	99.41%
Others	LHV = 9,152 Kcal/Nm^3	Vapor Press. 14.6 kg/cm^2G at 37.8°C	Vapor Press. 4.9 kg/cm^2G at 37.8°C	

(c) Absorption section

The dehydrated associated gas is next cooled with a propane chiller for liquefaction and separation of its heavy fraction (C_5+ distillate and a portion of LPG distillate), and the separated liquid is sent directly to the subsequent distillation section. Meanwhile, 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 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 essentially consists of three towers – the de-ethanizer, de-butanizer and de-propanizer.

Naphtha sent from the absorption process after having absorbed LPG distillate, as well as the heavy fraction (C_5+ distillate and a portion of LPG distillate) liquefied by the propane Chiller, are next induced into the de-ethanizer where the C_1 and C_2 gas (lean gas) are separated at the tower top.

Meanwhile, the tower bottom liquid is sent to the debutanizer where LPG is generated at the tower top and naphtha at the tower bottom. A portion of the naphtha collecting at the tower bottom is recovered as product while a portion of it, after being cooled by heat exchanger, is returned to the absorption tower and de-ethanizer tower top.

The LPG distillate generated at the de-butanizer tower top is then sent to the depropanizer for separation into products such as C_3 LPG and C_4 LPG. Meanwhile, 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 compressor, cooled with water, liquefied, then recycled to the chiller and condensers in a closed circulation system.

(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.

(g) Products

The products manufactured by this LPG Extraction Plant, as well as their respective outputs and composition, are shown in Table 5-7.

2) Utility facilities

(a) Consumption of utilities and subsidiary material requirement

The rates of consumption of various kinds of utilities, as well as the volumes of subsidiary materials required by Mann GOCS LPG Extraction Plant, are shown below.

Assumed mean consumption rate

(1) Utilities

Electricity	1,824 kW/hr
Water (for cooling tower)	45 tons/hr
Fuel gas	1,900 NM^3/hr
Instrument air	280 NM^3/hr

(2) Subsidiary material requirement

Naphtha (initial charge)	10 tons
Gas oil (initial charge)	10 tons
C_3 LPG (initial charge)	5 tons
(loss supplementation)	4 tons/yr.
Cooling tower chemicals	
Inhibitor	8 tons/yr
Biocide	2.5 tons/yr
Chlorination	2.9 tons/yr
pH control (98% H_2SO_4)	9 tons/yr

(b) Description of utility facilities

(1) Power receiving/Distribution facilities (2,280 kVA)

Electricity is to be received from the EPC power station in the Mann region, for which a substation is to be constructed alongside the Control Room for power receiving and distribution in the plant.

The principal substation design standards are as follows:

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

For power	Under 150 kW, 400 V, 3-phase, 50 Hz
	Over 150 kW, 3,300 V, 3-phase, 50 Hz

For illumination	Mercury-arc lamp 230 V, single-phase, 50 Hz
	White incandescent lamp and Fluorescent lamp 230 V, single-phase, 50 Hz
For instruments	100 V, single-phase, 50 Hz

- To cope with inadvertent power interruption, an alkali battery system capable of 30-min backup is provided as backup power source for instruments.

(2) Cooling water facilities (1,700 tons/hr)

Water is to be supplied from Mann GOCS which has a water supply capacity of 100 tons/hr.

The cooling water facilities of this plant are designed as a circulation system consisting of a water cooling tower having a capacity of 1,700 tons/hr, three units (including one spare unit) of cooling water circulation pumps each having a capacity of 850 tons/hr, and ancillary pipings. The cooling tower has an assumed water feed rate of 45 tons/hr.

(3) Fuel gas facility (1,900 NM^3/hr)

Since by-product lean gas generated by this LPG Extraction Plant is utilized, this facility only consists of the Fuel Gas Header.

(4) Instrument-air facilities (350 NM^3/hr)

This system consists of two isntrument-air compressors each having a capacity of 350 NM^3/hr, a dryer having a treatment capacity of 350 NM^3/hr, and ancillary pipings. The compressors are also used for supplying air to the nitrogen generator.

(5) N_2 generation facility (100 NM^3/hr)

An adsorption type nitrogen generator capable of generating 100 NM^3/hr of nitrogen is provided. An adsorption type N_2 generator is more economical than a cryogenic process when generating nitrogen in small volumes.

(6) Emergency Power Generator (2,400 kVA)

A diesel engine driven emergency power generator having a capacity of 2,400 kVA is provided as a safety measure to cope with inadvertent power interruption. The generator is designed for automatic startup by receiving voltage drop signals, and is capable of attaining its rated voltage within one minute. The emergency generator gives backup to the following equipment:

a) Motors in the LPG Extraction Plant
b) Instrument-air compressors
c) Air dryer
d) Instrument power source
e) Emergency illumination system
f) Cooling water circulation pumps

3) Off-site facilities and auxiliary facilities

The following facilities are to be provided as ancillary facilities for this LPG Extraction Plant in addition to the facilities described above:

(1) Tank

A spherical tank having a storage capacity of 550 m^3 is to be provided for the collection of off-specifications LPG generated at time of system startup and shutdown.

(2) Shipping facilities

C_3 LPG and C_4 LPG are shipped out from the plant's product receiving tanks by pipeline by means of shipping pumps provided for the respective products. Therefore, shipping facilities essentially consist of the shipping pumps and pipings up to Mann Terminal.
Meanwhile, by-product naphtha is filled directly into tank lorries from the plant's naphtha receiving tank, then shipped to Mann Refinery.
Accordingly, facilities for by-product naphtha are the lorry loading pumps and ancillary pipings. As for lean gas, it is transferred from plant to existing associated gas line by pipes under self-pressure.

(3) Waste water treatment facility

The waste water discharged by this LPG Extraction Plant being comparatively clean, its treatment with a gravity type oil/water separation tank will be sufficient.

(4) Fire prevention and fire-fighting facilities

Planned for installation are a fire hydrant system for pumping water to all parts of the plant compounds from a water storage tank by means of an exclusive-purpose piping system. The water pond (length 15 m, width 5 m, depth 1.5 m) is designed with a capacity of providing an ample volume of water usable by the hydrants for 30 minutes.

(5) Telecommunications facilities

An inter-compound paging system is to be provided.

5.4.4 Plant Plot Plan

Fig. 5-13 shows the plot plan of Mann GOCS LPG Extraction Plant. The following points were given due consideration when drafting the plot plan:

- Division of the plant compounds into the process region and utility facilities region, with each region encircled by roads.
- Arrangement of Control Room alongside the substation in the utility facilities region.
- The heating furnace was arranged in the utility facilities region as a safety measure.
- The process region was enclosed on all four sides with roads for ease of fire-fighting operations.

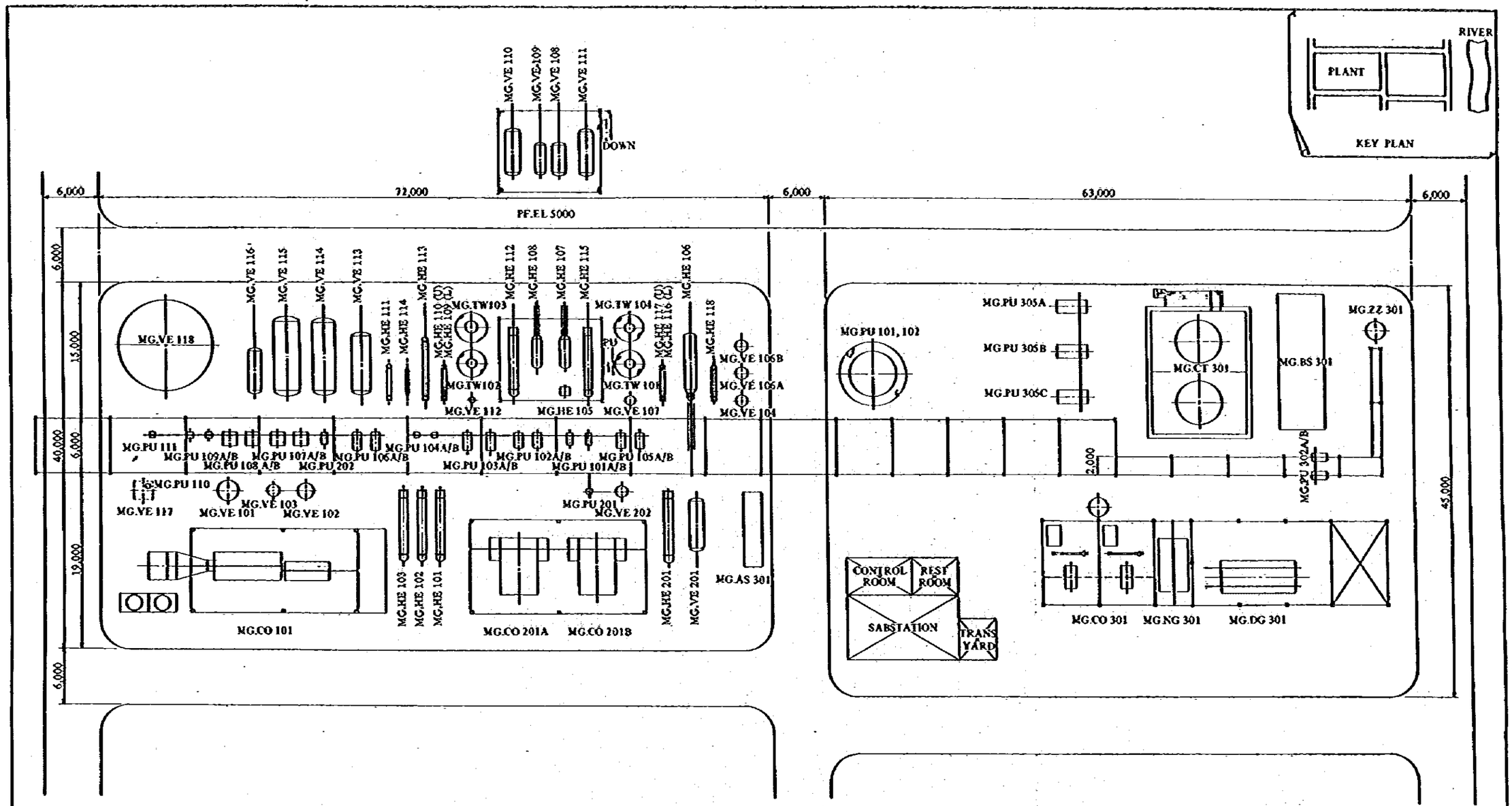
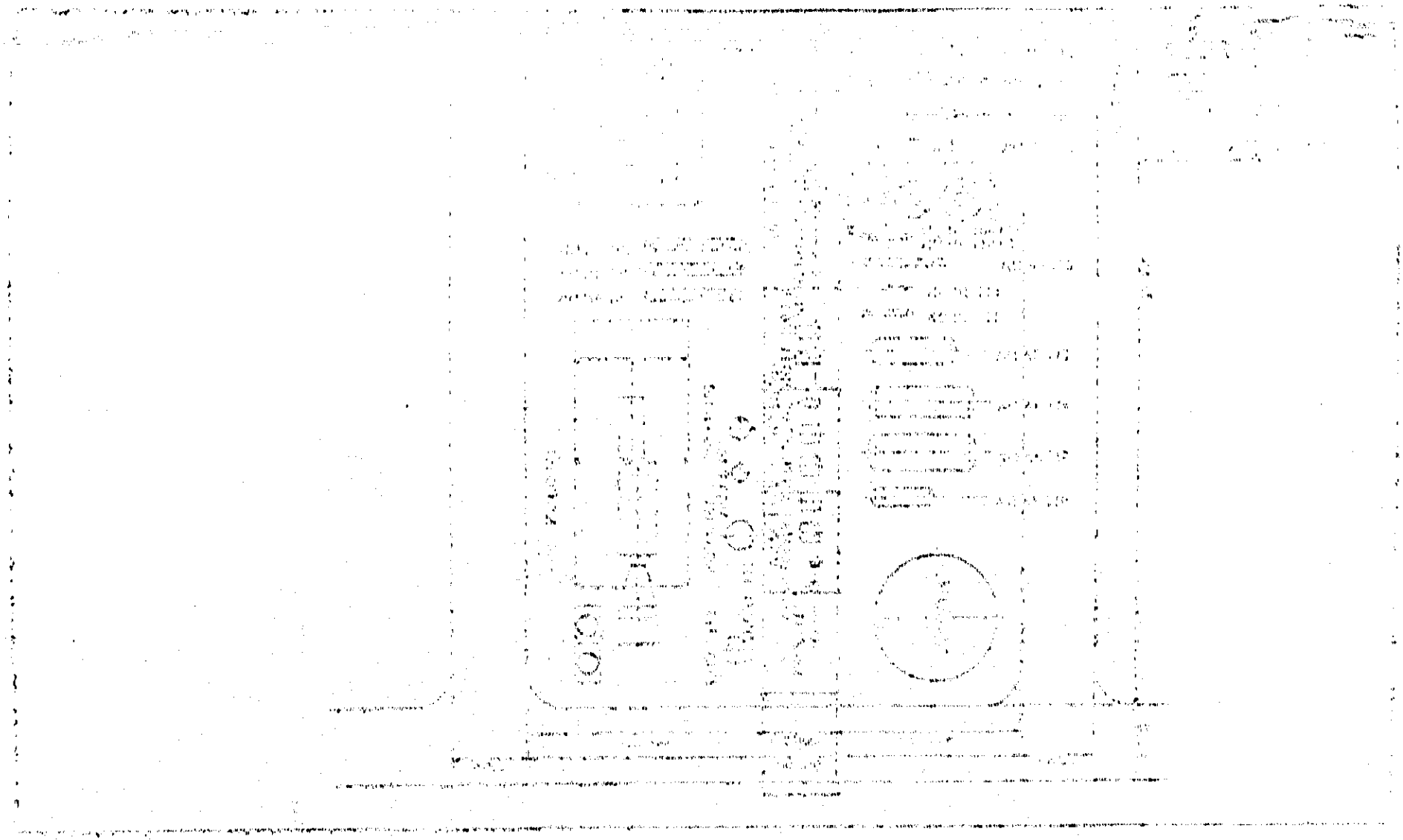


Fig. 5-13. Plot Plan for Associated Gas Utilization (Mann GOCS)



5.4.5 Infrastructures

(a) Traffic

The plant is located in the Mann oil fields about 34 km north of the Mann Oil Refinery. Therefore, the traffic situation is the same as that of the Mann Terminal.

(b) Housing

Assuming that the 64 employees for the plant are recruited from the towns of Minbu and Sagu, which are within commutable distances, there will be no need to construct any new housing facilities for employees.

(c) Water

The existing water supply system in the Mann oil fields can be utilized.

(d) Electricity

A gas turbine power generator station possessed by EPC exists in the Mann oil fields, where two 6,000-kW turbine generators are presently in operation. Another unit is to be installed soon to raise the power station's ultimate capacity to 18,000 kW. The present scale has a surplus capacity of transmitting electricity to the Mann Oil Refinery, from where electricity can be received by the LPG Extraction Plant.

(e) Telecommunications

A radio communications system (VHF) is to be installed between Mann Terminal and Mann GOCS LPG Extraction Plant.

Chapter 6.

CONSTRUCTION OF LPG RECOVERY FACILITIES

Chapter 6. CONSTRUCTION OF LPG RECOVERY FACILITIES

6.1 Syriam Terminal

6.1.1 Survey of Site

Survey of construction site, not only for Syriam Terminal but as well for Mann Terminal and Mann GOCS LPG Extraction Plant, must be completed before conclusion of contract with the contractor in order to have the findings of the survey amply reflected in the designing of plant and facilities.

1) Land surveying

- o Leveling

  Leveling is to be conducted from the nearest standard bench mark to next bench mark.

  A bench mark is to be established near the site.

  Its relationship with Rangoon chart datum level is to be established.

- o Topographic survey – 1

Range:	Terminal site and environs
Purpose:	For land adjustment and layout of facilities
Scale:	1/100 – 1/200
Conter pitch:	0.5 m

- o Topographic survey – 2

Range:	Terminal site, and No. 1, No. 2, No. 3 and No. 4 jetties
Purpose:	For piping plan (Conducted newly since existing survey map is old)
Scale:	1/1,000

- o Profile leveling

Target:	Roads up to Nos. 1 and 4 jetties and site
Purpose:	For piping plan
Scale:	Height 1/100, Distance 1/1,000

2) Soil survey

Soil survey is to be conducted for estimation of settlement due to consolidation by banking and for design of foundation.

Site: Four soil survey boring holes

Test items:

- o Dpeth: To below 5 m of bearing stratum having N-value of 40–50 (roughly 30 m)
- o N-value: Standard penetration test to be conducted every 1.0 m
- o Physical property test: Mechanical analysis of soil (moisture content, density) to be conducted with each change of stratum.
- o Thin wall sampling test: Uniaxial compression test, consolidation test to be conducted with respect to clayey soil. About 5 places with each soil survey boring.

3) Survey for borrowing pit

Since the site lies in a paddy field region, the ground has to be prepared by banking, for which sandy soil has to be used. Therefore, the surrounding region is to be surveyed in order to discover a region of suitable sandy soil. An area of comparatively high level in the environs of Syriam Refinery appears promising, so mechanical analysis of soil, moisture content test and compaction test are to be conducted to ascertain the suitability of the soil for use as banking soil. If no suitable sandy soil can be found in this region, the use of soil mixed with Rangoon River dredging sand is conceivable.

4) Concrete mixing test

Concrete mixing tests are to be conducted by using locally procurable aggregate. The design of concrete mix is as follows:

Reinforced concrete:

Civil engineering works:

Maximum aggregate size 25 mm, 4-week strength 240 kg/cm², slump 10 cm

Building works:

Maximum aggregate size 25 mm, 4-week strength 240 kg/cm², slump 20 cm

Plain concrete:

Civil engineering works:

Maximum aggregate size 40 mm, 4-week strength 210 kg/cm², slump 6–8 cm

Building works:

Maximum aggregate size 25 mm, 4-week strength 210 kg/cm², slump 18 cm

6.1.2 Transportation

The site being isolated from Rangoon by Rangoon River and not connected directly to the city by land roads, plant machinery and equipment as well as steel structures and prestressed concrete piles procured from abroad will have to be unloaded from oceangoing ships onto river barges for transportation to Syriam.

The equipment and materials required for constructing the Syriam Terminal are the roughly 2,200 tons of machinery, equipment and steel materials as well as roughly 3,800 tons of prestressed concrete piles procured from abroad, also 2,100 tons of cement as well as civil engineering works materials such as hume pipes which are procured locally.

The unit weight of these equipment and materials are not so heavy, so they are transported by river barges to the existing Cargo Jetty at Syriam Refinery where they are unloaded. They are then transported via Refinery to the construction site over existing roads by means of trucks or trailers.

Rangoon Port, which is capable of accommodating oceangoing vessels, is an estuary port about 35 km upstream of the river's estuary, the outline of which is shown in Fig. 6-1. The Sule (740 m) and Brooking (270 m) wharfs having a water depth of 7.0 m are available for handling general cargo. At the inlet of the port is a sand bar that obstructs the navigation of large ships, which are therefore required to enter the port by utilizing high tides. The tidal difference in mean spring range is 5.13 m, and the largest ships normally entering the port are of 5,000 DWT classification.

6.1.3 Construction Plan

1) Temporary works

- o Water and electricity
  There is no water or electricity facilities at the site presently, but since these utilities can be supplied by Syriam Refinery, it is assumed that these utilities would be made available by the Burmese side by the time of commencement of construction at the site.

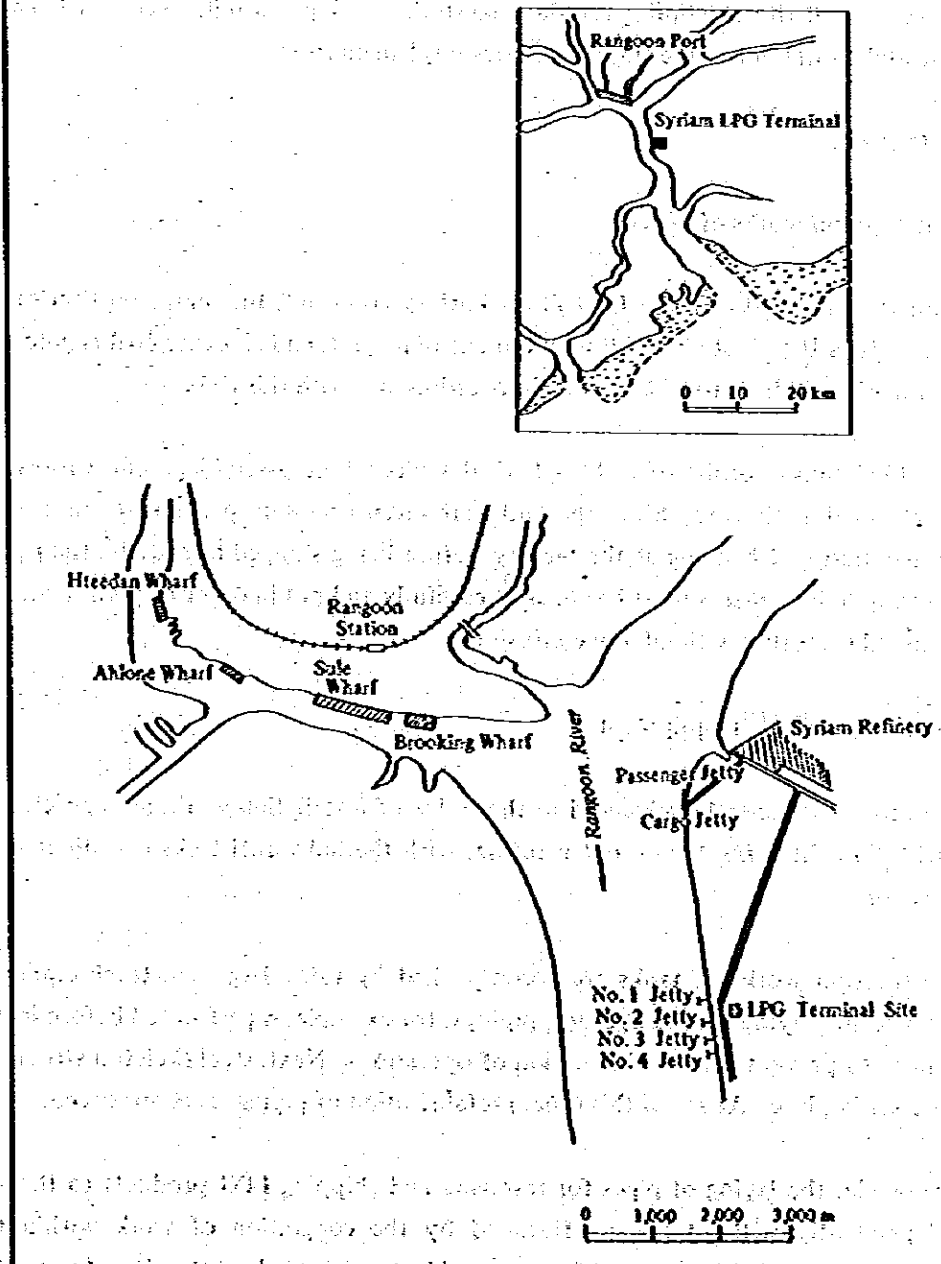
- o Concrete plant
  A motor-driven batcher plant having a capacity of about 0.75 m^3 is to be provided.

- o Temporary structures
  The following temporary structures are to be provided by the Burmese side before commencement of construction for use throughout the construction project:
  - Cement storehouse
  - Field office
  - Laborers' center
  - Warehouse for materials and supplies
  - Workshop for electrical work, insturments, heat insulation, painting, etc.

2) Civil engineering and construction works

Civil engineering and construction works involve a wide range of works relating to the construction of access roads, land adjustment, construction of tank and equipment foundations, provision of water supply and drainage systems for buildings, and reapir and construction

Fig. 6-1. Rangoon Port



of LPG receiving and shipping jetties. These civil engineering and construction works will have to be advanced most systematically in order to prevent mutual obstruction.

The proposed construction site is presently being used as paddy field, so prestressed concrete piles will have to be driven into the soft ground before laying the foundation. Details will have to be confirmed through boring test data, so studies in depth will be necessary between the Burmese side and contractor at the stage of project implementation.

3) Installation

(a) Construction works of tanks

Construction works of the LPG tanks battery comprises the major portion of the installation works. It is the most ciritcal task in the entire project, and all other civil engineering and construction works will have to be advanced in coordination with this task.

The LPG tanks consist of eight spherical tanks whose assemblage constitutes the bulk of work performed at the site. Since the tanks are given necessary preliminary machining such as edge preparation and bending at the factory before being shipped to the site, their parts serial numbers and matching marks must be checked carefully and put in order to permit components to be assembled smoothly without any confusion.

(b) Installation of other equipment

The project is generally advanced in the order of installation work, pipings, electric wiring, instrumentation, heat insulation and painting, with the individual tasks coordinated by the general supervisor.

Construction works of tanks are accomplished by using large-size truck cranes or crawler cranes, while the laying of underground pipings, for example, is performed before installation of equipment to prevent mutual obstruction of operations. Next, steel skeleton structures and pipe racks are set in place. At about this time, prefabrication of pipings is commenced.

Meanwhile, the laying of pipes for receiving and shipping LPG products to the site is advanced independently without being influenced by the congestion of work within the battery limits. Pipes are welded by means of engine welders owing to the difficulty of acquiring electric power at the welding sites.

Electric wiring and painting works are then undertaken, and when the tanks and other structures generally take shape, flushing of piping systems and independent test running of rotary machines are started.

The utility facilities for supplying electricity, water and other utilities necessary for advancing these civil engineering and construction works will naturally have to be erected in time to permit opportune utilization of these utilities.

4) Local manufacture of construction materials

It would be the most advantageous to advance the construction project by using locally manufactured construction materials wherever possible. Therefore, the following materials are to be manufactured locally:

- o Platform and ladders
- o Pipe racks, steel skeleton structures
- o Small atmospheric tanks

However, it would be meaningless unless these materials are supplied opportunely, matched in timing with construction schedules. Therefore, deliberations on details such as on the volumes of work to be accomplished by factoreis, delivry schedules and other elements will be necessary at a later date between the Burmese side and contractor.

6.2 Mann Terminal

6.2.1 Survey of Site

Since the Mann Terminal is to be erected adjacent to the Oil Products Terminal of Mann Refinery presently under construction, no particular problem is anticipated in the unloading and transportation of various construction equipment and materilas as well as in construction works. The surveys required at this site are land surveying and soil survey. The same concrete mixing design adopted at time of construction of Mann Refinery is to be adopted in this construction project.

1) Land surveying

The same standard bench mark used in the construction of the Oil Products Terminal of Mann Refinery is to be utilized.

Topographic survey

Range:	Environs of LPG Terminal site
Purpose:	For land adjustment and layout of facilities
Scale:	1/100 – 1/200
Conter pitch:	0.5 m

2) Soil survey

The construction site lies close to Mann Oil Products Terminal and is therefore assumed to have soil of similar properties, but soil survey boring is to be performed as a safety measure for designing of foundation.

Site:	Two soil survey boring holes
Test items:	
Depth:	10 m
Physical property test:	Mechanical analysis of soil (moisture content, density) to be conducted with each change of stratum
N-value:	Standard penetration test to be conducted every 1.0 m.

6.2.2 Transportation

Roughly 1,300 tons of equipment and steel materials procured from abroad, and roughly 1,500 tons of hume pipes and other civil engineering and construction materials procured locally, are required for constructing Mann Terminal.

Equipment and materials procured from abroad are unloaded at Rangoon Port from oceangoing ships onto river barges, then transported via Twante Canal and upstream of the Irrawaddy River to Mann. At Mann, the cargo is unloaded at the Cargo Jetty earlier used in the construction of Mann Refinery, then transported to the construction site by truck or trailer.

Rapid transportation from Rangoon to site is also possible by truck. That is, an asphalt-paved road about 5 m wide is available from Rangoon via Prome to the opposite bank at Malun, a distance traversed in about 12–13 hours. Here, the truck is loaded on a Z-Craft oeprated by HIC for reaching the other side of the bank at Malun. From here, a gravel road about 5 m wide along th west bank of the Irrawaddy River is used to reach the construction site.

However, since the volume of cargo handled by land transportation will be limited, plant construction equipment and materials should be transported over the Irrawaddy River by barges.

6.2.3 Construction Plan

1) Temporary works

- o Water and electricity
  Since this Terminal is to be constructed near the existing Mann Oil Products Terminal, existing water and electricity facilities are to be utilized.

- o Concrete plant
  A motor-driven batcher plant having a capacity of about 0.75 m^3 is to be provided.

- o Temporary structures
  The following temporary structures are to be provided by the Burmese side before commencement of construction for use throughout the construction project:
  Cement storehouse
  Field office
  Laborers' center
  Warehouse for materials and supplies
  Workshop for electrical work, instruments, heat insulation, painting, etc.

2) Civil engineering and construction works

Civil engineering and construction works involve a wide range of works relating to construction of access roads, land adjustment, construction of tank and equipment foundations, provision of water supply and drainage systems for buildings, and repair and construction of LPG receiving and shipping jetties. These civil engineering and construction works will have to be advanced most systematically in order to prevent mutual obstruction.

Spread foundation will be sufficient for this construction site since pile driving is unnecessary.

3) Installation

(a) Construction works of tanks

The construction works of four spherical storage tanks is the major portion of the installation works to be accomplished here.

Since the tanks are to be assembled at the site, they are given necessary preliminary machining such as edge preparation and bending at the factory before being shipped to the site. Therefore, their parts serial numbers and matching marks must be checked carefully and put in order to permit components to be assembled smoothly without any confusion.

(b) Installation of other equipment

The project is generally advanced in the order of installation work, pipings, electric wiring, instrumentation, heat insulation and painting, with the individual tasks coordinated by the general supervisor.

Construction works of tanks are accomplished by using large-size truck cranes or crawler cranes, while the laying of underground pipings, for example, is performed before installation of equipment to prevent mutual obstruction of operations. Next, steel skeleton structures and pipe racks are set in place. At about this time, prefabrication of pipings is commenced.

Meanwhile, the laying of pipes for receiving and shipping LPG products to the site is advanced independently with out being influenced by the congestion of work within the battery limits. Pipes are welded by means of engine welders owing to the difficulty of acquiring electric power at the welding sites.

However, the pipeline for LPG transportation from Mann GOCS to Mann Terminal is to be layed simultaneous with the construction of Mann GOCS LPG Extraction Plant, and is therefore included in the Phase II portion of the project.

Electric wiring and instrumentation works are then undertaken, and when the tanks and other structures generally take shape, flushing of piping systems and independent test running of rotary machines are started.

The utility facilities for supplying electricity, water and other utilities necessary for advancing these civil engineering and construction works will naturally have to be erected in time to permit opportune utilization of these utilities.

4) Local manufacture of construction materials

The following materials are to be manufactured locally, but exhaustive deliberations will be necessary between the Burmese side and contractor on delivery schedules, quality and other elements:

Platform and ladders
Pipe racks, steel skeleton structures
Small atmospheric tanks

6.3 River Barges for LPG Transportation

6.3.1 Construction Plan

A construction period of about 15 months, including the time required for designing, will be sufficient, so their construction should be advanced by studying existing market situations and building the barges during the idle time of shipbuilders.

6.4 Mann GOCS LPG Extraction Plant

6.4.1 Survey of Site

The surveys required at this construction site are land surveying, soil survey and concrete mix testing.

1) Land surveying

- o Leveling

  A bench mark is to be established hear the construction site by referring to the nearest standard bench mark.

- o Topographic survey

Range:	Environs of Plant site
Purpose:	For land adjustment and layout of facilities
Scale:	1/100 – 1/200
Conter pitch:	0.5 m

2) Soil survey

Site: For soil survey boring holes

Test items:

Depth:	10 m
Physical property test:	Mechanical analysis of soil (moisture content, density) to be conducted with each change of stratum.
N-value:	Standard penetration test to be conducted every 1.0 m.

3) Concrete mixing test

Concrete mixing tests are to be conducted by using locally procurable aggregate. The concrete mixing design is the same as that of Syriam Terminal.

6.4.2 Transportation

Roughly 4,100 tons of equipment and steel materials procured from abroad, and roughly 1,700 tons of cement as well as hume pipes and other civil engineering and construction materials to be procured locally, are required for constructing Mann GOCS LPG Extraction plant.

Equipment and materials procured from abroad are to be unloaded at Rangoon Port from oceangoing ships onto Irrawaddy River barges for transportation to Minbu. The cargo is unloaded here and transported to the construction site by means of trucks or trailers by utilizing existing land roads. The distance between Minbu and the construction site is roughly 5 km, and a gravel road having an effective width of about 5 m is available between these two points.

6.4.3 Construction Plan

1) Temporary works

- o Water and electricity
  Water is to be piped from the Mann GOCS water facility, and electricity supplied by EPC.
  The construction of facilities for the supply of these utilities is assumed to be completed by the Burmese side before commencement of the project in order to prevent obstruction of civil engineering and construction works at the site.

- o Concrete plant
  A motor-driven batcher plant having a capacity of about 0.75 m^3 is to be provided to maintain work schedules.

- o Temporary structures
  The following temporary structures are to be provided by the Burmese side before commencement of construction for use throughout the construction project:
  - Cement storehouse
  - Field office
  - Laborers' center
  - Warehouse for materials and supplies
  - Workshop for electrical work, instruments, heat insulation, painting, etc.

2) Civil engineering and construction works

Civil engineering and construction works involve a wide range of works relating to construction of access roads, land adjustment, and provision of water supply and drainage systems for buildings. These works will have to be advanced most systematically in order to prevent mutual obstruction. Driving of foundation piles for structures is regarded unnecessary for this site.

3) Installation

The installation works at this site may be generally classified into the works for the installation of tanks, process equipment, equipment in general, and the pipeline to Mann Terminal.

- Construction works of tanks

The construction works of spherical off-specifications tanks is the only installation work to be accomplished at this site. Since the tanks are to be assembled at the site, they are given necessary preliminary machining such as edge preparation and bending at the factory before being shipped to the assembling site. Therefore, their parts serial numbers and matching marks must be checked carefully and put in order to permit components to be assembled smoothly without any confusion.

- Installation of process equipment and other equipment in general

The installation work here is generally advanced in the order of tank construction works pipings, electric wiring, instrumentation, heat insulation and painting, with the individual tasks coordinated by the general supervisor.

Since massive towers, for example, cannot be transported in assembled state, they are dismembered into components for the convenience of transportation. At the plant site, these components are welded together on specially installed turning rollers, then assembled into the finished product. The largest of these towers is the de-butanizer, which has a length of 24 m, diameter of 1.2 m/ 1.35 m and weight of 27.6 tons.

These towers and other equipment of massive proportions are installed at the site by means of large-size truck cranes or crawler cranes. Related underground piping systems and other peripheral ancillary equipment are installed prior to the installation of equipment such as towers, heat exchangers and vessels, in order to prevent mutual obstruction among installation operations. Also, systems and equipment such as furnaces, the primary work of which is assemblage, are worked on as soon as possible.

Next, steel skeleton structures and pipe racks are installed, and prefabrication of pipings is commenced at about the same time. The installation of pipings within the battery limits is started from those of largest diameter and uppermost pipe racks, gradually installing branched pipings of smaller diameter.

Meanwhile, the laying of pipeline for LPG product transportation to Mann Terminal is advanced independently without being influenced by the congestion of work within the battery limits. Pipes are welded by means of engine welders owing to the difficulty of acquiring electric power at the welding sites.

Electric wiring and instrumentation works are then undertaken, and when the tanks and other structures generally take shape, operations such as flushing of piping systems, independent test running of rotary machines and curing of furnaces are commenced in preparation of plant startup.

The utility facilities for supplying electricity, water and other utilities necessary for advancing these operations will naturally have to be erected in time to permit opportune utilization of these utilities.

6.5 Construction Schedule

Phase I – Part 2 and Phase II of this project are to be advanced under the following schedule:

Project Implementation Schedule:

Phase I – Part 2	Oct. 1, 1982	Signing of contract
	Jan. 1, 1983	Effectuation of contract
		Construction period (24 months)
	Jan. 1, 1985	Start up operation
Phase II	Oct. 1, 1983	Signing of contract
	Jan. 1, 1984	Effectuation of contract
		Construction period (24 months)
	Jan. 1, 1986	Start up operation

Fig. 6-2 indicates the details of the construction schedule based on the effectuation schedule outlined above.

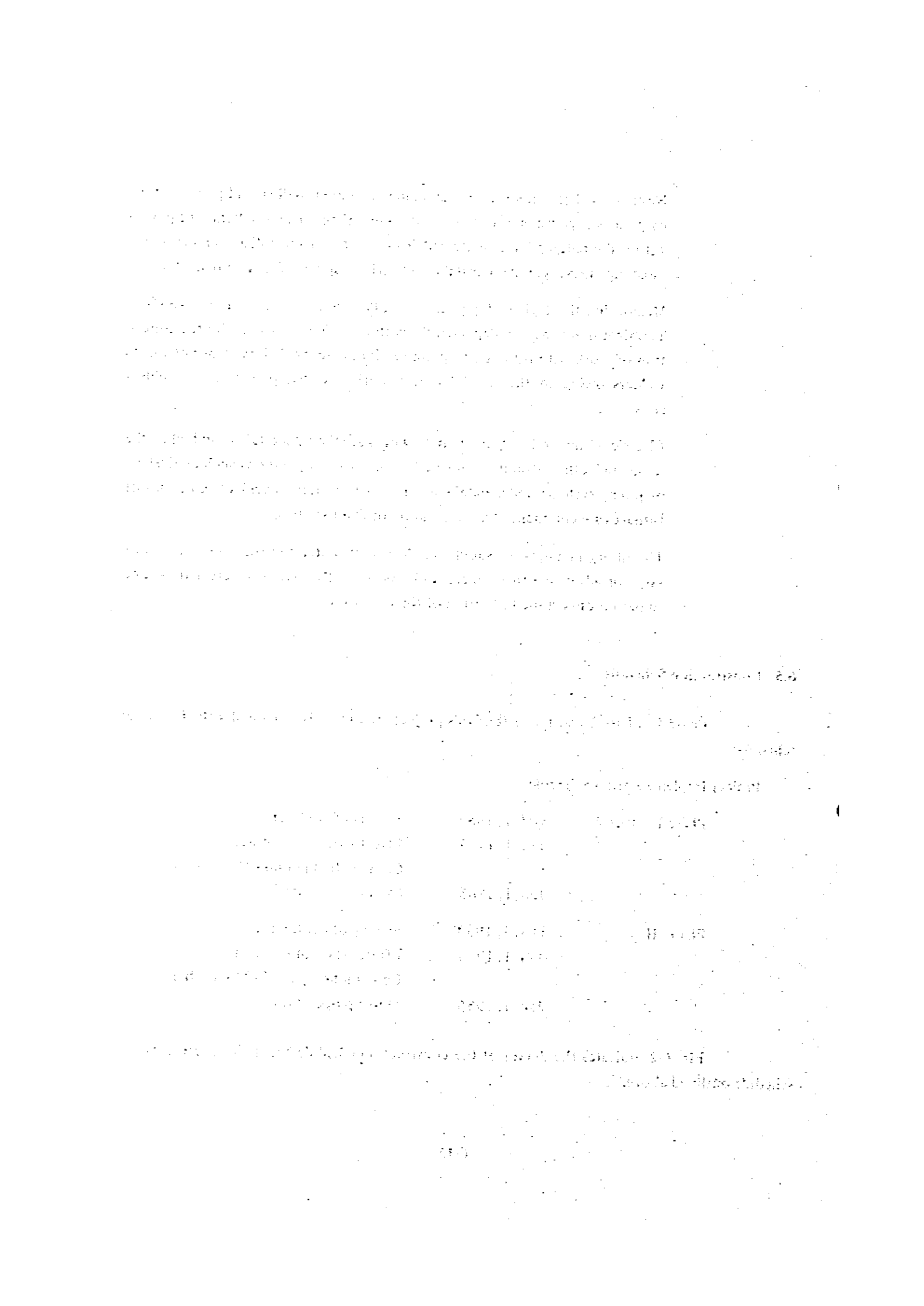
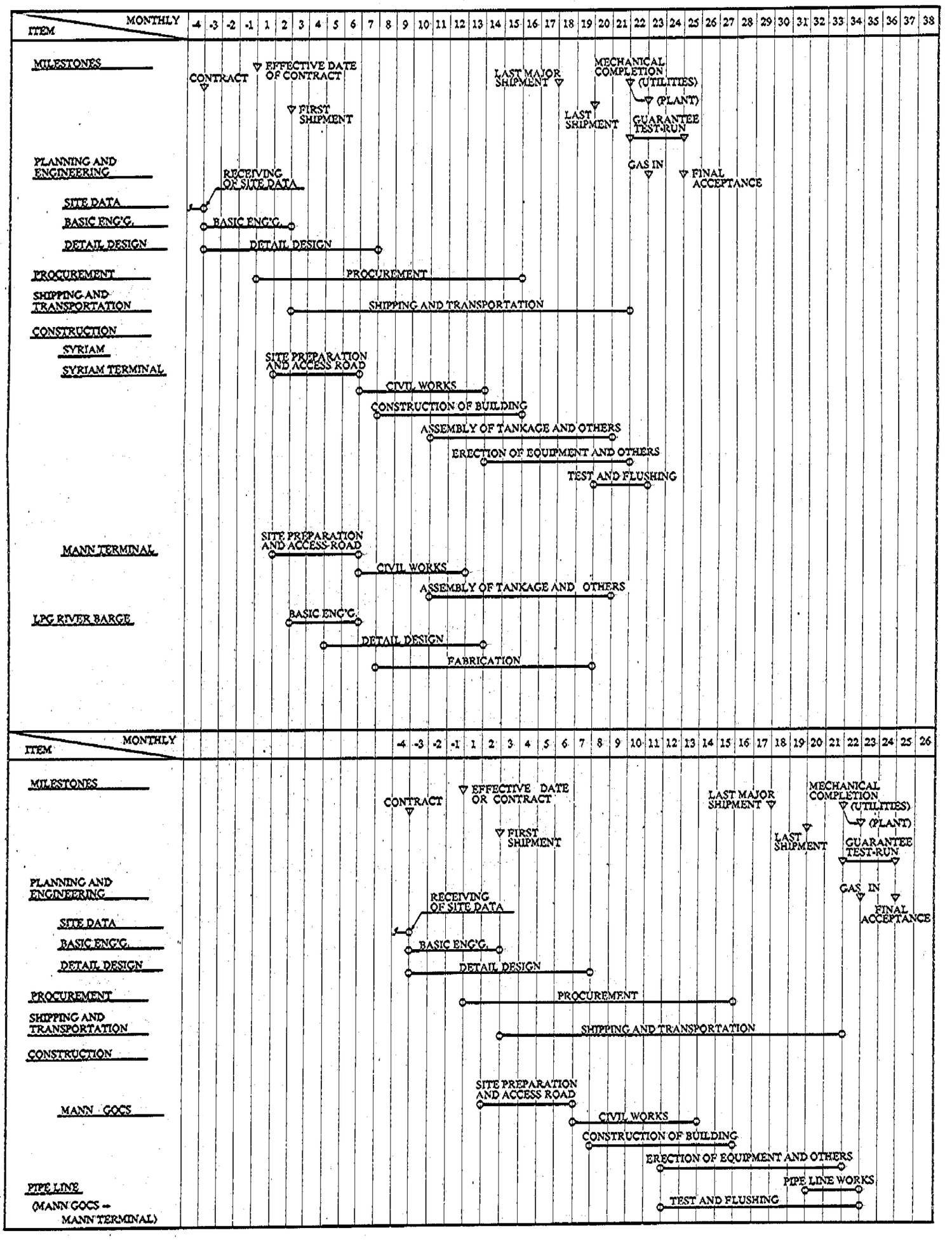
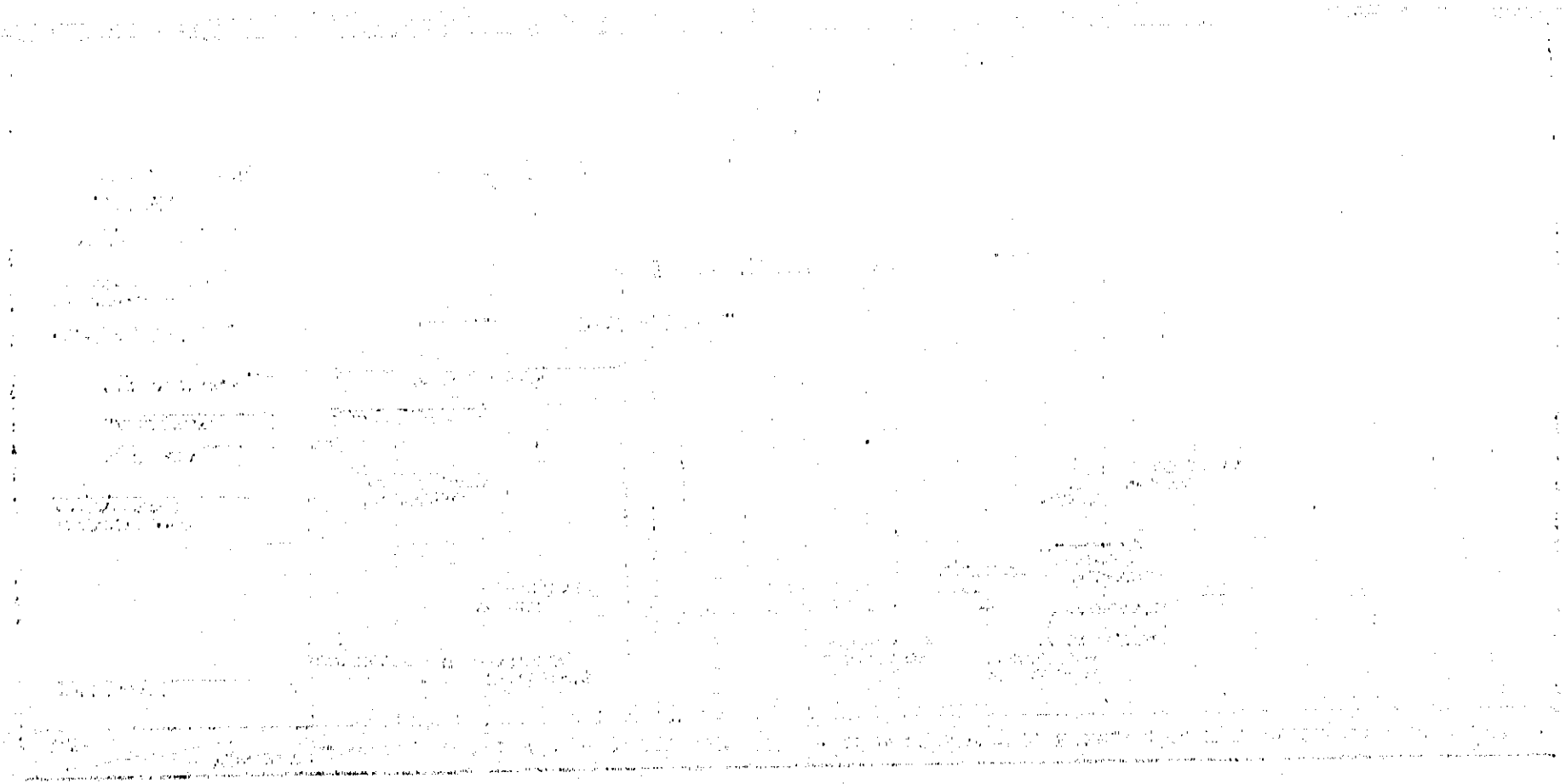


Fig. 6-2. Project Execution Schedule





6.6 Construction Machinery and Materials Plan

6.6.1 Construction Machinery

Burma possesses some construction machinery which have been acquired through the construction of Mann Refinery and other industrial plants, but the number is insufficient and additional machinery is being procured whenever a new plant is to be constructed.

Table 6-1 shows the kinds and quantities of construction machinery required for the Integrated LPG Recovery Project, Table 6-2 the construction machinery presently possessed by the Burmese side, and Table 6-3 the construction machinery which the contractor has to supply in order to carry out this project, based on Tables 6-1 and 6-2.

The following conditions were assumed in compilling these tables:

- The Burmese side construction machinery which were regarded usable by this feasibility study are assumed to be maintained in proper condition for use in the project.

- Since the construction works of Mann Terminal and Syriam Terminal are advanced in the parallel, these construction machinery cannot be diverted for use in both construction works. On the other hand, the period of construction of Mann GOCS LPG Extraction Plant does not coincide with those of the Mann and Syriam Terminals, so diverted use of machinery is possible. However, a portion of these machinery is supplemented in view of wear-out.

Table 6-1. List of Required Construction Machinery

Construction Machinery	Specification	Required Quantity				Remarks
		Phase I – Part 2			Phase II	
		Main Terminal	System Terminal	Total	Main GOCS	
1. Truck Crane	35 ton	2	3	5	2	
2. Truck Crane	20 ton	-	1	1	1	
3. Dump Truck	8 ton	3	3	6	2	
4. Truck	10 ton, keg body	2	1	3	2	
5. Truck	8 ton	2	2	4	2	
6. Truck	4 ton with 2 ton crane	1	2	3	1	
7. Truck	2 ton		2	2	2	
8. Bulldozer	D7, D155A	1	1	2	1	
9. Bulldozer	D4	1	1	2	1	
10. Back Hoe	0.8 m³/Bucket	1	2	3	2	
11. Back Hoe	0.4 m³/Bucket	1	1	2	1	
12. Tractor Shovel	0.8 m³/Bucket	2	2	4	2	
13. Agitator Car	3 m³	2	3	5	3	
14. Piling Machine	Capacity 3.5 ton	-	1	1	-	
15. Pile Cutter	ϕ350	-	1	1	-	
16. Batcher Plant	0.75 m³/Batch	1	1	2	1	
17. Pot Mixer	0.5 m³/Batch	1	1	2	1	
18. Pot Mixer	0.35 m³/Batch	1	1	2	1	
19. Concrete Pump Car	20 m³/H	1	1	2	1	
20. Bar Bending Machine	D40	1	1	2	1	
21. Bar Cutting Machine	D40	1	1	2	1	
22. Vibrator	Elec. L = 6 m	2	5	7	5	
23. Vibrator	Engine L = 6 m	2	5	7	5	
24. Concrete Breaker		2	2	4	2	
25. Belt Conveyor	Engine 300 width	2	3	5	3	
26. Sump Pump	Engine 30 m³/H	3	3	6	3	
27. Sump Pump	Motor 60 m³/H	1	2	3	2	
28. Rammer		1	2	3	2	
29. Hopper	1 m³	2	1	3	2	
30. AC Arc Welder	500 Amp.	16	32	48	16	
31. AC Arc Welder	300 Amp.	15	5	20	23	
32. DC Arc Welder	500 Amp.	1	8	9	4	
33. TIG Welder	300 Amp.	2	3	5	3	
34. Engine Welder	300 Amp.	2	1	3	3	
35. Air Compressor	Motor 7 kg/cm²G	4	8	12	5	
36. Air Compressor	Motor 30 kg/cm²G	1	2	3	1	
37. X Ray Photographic Equipment	250 KVA	1	2	3	1	

Table 6-2. List of Locally Available Machinery

Construction Machinery	Specification	Quantity	Remarks
1. Gine Pole	100 ton	1	
2. Truck Crane	136 ton	1	
3. Truck Crane	20 ton	1	
4. Wheel Crane	35 ton	4	
5. Trailer	100 ton	1	
6. Dump Truck	8 ton	3	
7. Truck	35 ton	1	
8. Truck	8 ton	2	
9. Bulldozer	D-7	4	
10. Power Shovel	0.8 m^3	2	
11. Back Hoe Attachment	0.4 m^3	1	
12. Back Hoe	0.4 m^3	1	
13. Tractor Shovel	0.8 m^3	3	
14. Mixing Car	3 m^3	3	
15. Batcher Plant	0.75 m^3/Batch	1	
16. Air Compressor	Engine 5 m^3/min, 7 kg/cm^2	2	
17. Welder	300 Amp.	3	
18. Welder	AC or DC 300 Amp.	12	
19. Welder	Engine	2	
20. Road Roller	6 ton	1	
21. Asphalt Mixing Plant		1	

Table 6-3. Supply List of Construction Machinery

Construction Machinery	Specification	Contractor Supply				Remarks
		Phase I – Part 2			Phase II	
		Main Terminal	System Terminal	Total	Main CCCS	
1. Truck Crane	35 ton	1	-	1	-	
2. Truck Crane	20 ton	-	-	-	-	
3. Dump Truck	8 ton	3	-	3	-	
4. Truck	10 ton, long body	2	1	3	-	
5. Truck	8 ton	2	-	2	2	
6. Truck	4 ton with 2 ton crane	1	2	3	-	
7. Truck	2 ton	-	2	2	-	
8. Bulldozer	D7, D155A	-	1	1	-	
9. Bulldozer	D4	1	1	2	-	
10. Back Hoe	0.8 m^3/Bucket	1	2	3	1	
11. Back Hoe	0.4 m^3/Bucket	1	-	1	1	
12. Tractor Shovel	0.8 m^3/Bucket	1	-	1	-	
13. Agitator Car	3 m^3	2	-	2	-	
14. Piling Machine	Capacity 3.5 ton	-	1	1	-	
15. Pile Cutter	ϕ350	-	1	1	-	
16. Batcher Plant	0.75 m^3/Batch	1	-	1	1	
17. Pot Mixer	0.5 m^3/Batch	1	1	2	1	
18. Pot Mixer	0.38 m^3/Batch	1	1	2	1	
19. Concrete Pump Car	20 m^3/H	1	1	2	-	
20. Bar Bending Machine	D40	1	1	2	1	
21. Bar Cutting Machine	D40	1	1	2	1	
22. Vibrator	Elec. L = 6 m	2	5	7	2	
23. Vibrator	Engine L = 6 m	2	5	7	-	
24. Concrete Breaker		2	2	4	-	
25. Belt Conveyor	Engine 300 m/m	2	3	5	-	
26. Sump Pump	Engine 30 m^3/H	3	3	6	1	
27. Sump Pump	Motor 60 m^3/H	1	2	3	1	
28. Rammer		1	2	3	1	
29. Hopper	1 m^3	2	1	3	-	
30. AC Arc Welder	500 Amp.	16	32	48	-	
31. AC Arc Welder	300 Amp.	15	2	17	-	
32. TIG Welder	300 Amp.	2	3	5	2	
33. Engine Welder	300 Amp.	2	1	3	3	
34. DC Arc Welder	500 Amp.	1	8	9	-	
35. Air Compressor	Motor 7 kg/cm^2G	4	6	10	-	
36. Air Compressor	Motor 30 kg/cm^2G	1	2	3	-	
37. X Ray Photographic Equipment	250 KVA	1	2	3	-	

6.6.2 Construction Materials

Construction materials may be classified into materials for civil engineering works and consumable materials for installation works.

Most of these construction materials are procurable locally, with the exception of steel materials and special consumable materials. Special consumable materials used in installation works generally consist of special types and have to be available opportunely in bulk, making their local procurement impossible. Therefore, these materials are to be supplied by the contractor.

By way of reference, Table 6-4 indicates the major civil engineering and architectural materials supplied locally, and Table 6-5 the major consumable materials used in installation works.

Table 6-4. List of Major Materials Locally Supplied for Civil and Architecture

Material Name	Description	Unit	Required Quantity			
			Part I – Part 2			Phase II
			Syriam Terminal	Mann Terminal	Total	Mann GOCS
Cement		ton	2,100	1,500	3,600	1,700
Sand		m^3	3,600	2,700	6,300	2,800
Grabel		m^3	6,100	1,700	7,800	4,600
Timber		ton*	310	120	430	270
Home Pipe	ϕ100 mm	m	350	-	350	-
	ϕ200 mm	m	470	60	530	140
	ϕ300 mm	m		90	90	200
	ϕ400 mm	m		60	60	110
	ϕ500 mm	m		50	50	110
	ϕ600 mm	m		50	50	110
	ϕ900 mm	m		130	130	110
Asbestos	Roof	m^2	150	-	150	1,300
Asbestos	Wall	m^2	220	-	220	1,100
Brick		pcs	138,000	113,000	251,000	77,000
Nail		kg	7,500	2,900	10,400	6,400
Annealed Wire		kg	6,500	2,500	9,000	5,600
Oxygen Gas	7 kg /Cylinder	Nos.	150	100	250	200
Acetylene Gas	7 kg /Cylinder	Nos.	50	30	80	50
Propane Gas	25 kg /Cylinder	Nos.	10	5	15	10

Note: * Wood-ton = 1 ft x 1 ft x 50 ft.

Table 6-5. List of Major Consumable Materials for Installation

Material Name	Description	Unit	Required Quantity			
			Phase I – Part 2			Phase II
			Syriam Terminal	Mann Terminal	Total	
1. Electrical Welding Rods		ton	30	20	50	30
2. TIG Welding Rods		kg	200	100	300	200
3. Carbon Arc Gausing Rods		kg	100	50	150	100
4. X-Ray Film		Sheet	1,000	500	1,500	1,000
5. Developer for X-Ray Film	10 l/can	Cans	50	50	100	100
6. Colour Check Reagent	450 cc/can	Cans	50	50	100	100
7. Argon Gas	7 m^3/Cylinder	Nos.	30	30	60	50
8. Other Various Consumable Materials		Set	1	1		

6.7 Schedule for Dispatch of Supervisors

The construction works and intinial start up operation of this project, based on a request from the Burmese side, are to be advanced under the guidance of supervisors dispatched by the contractor.

The number of supervisors to be dispatched for these purposes are Phase I – Part 2: total 240 man-months, 20 supervisors at peak time; and Phase II: total 108 man-months, 9 supervisors at peak time, as shown below.

The range of service offered by these supervisors is in principle limited to guidance only, and does not include actual labor, although labor may be offered spontaneously in special types of work to explain methods or to set examples, in order to offer practical guidance to field workers.

		Phase I – Part 2	Phase II
1)	Construction works		
	Management, general affairs, transportation	52 man-months	30 man-months
	Design	52	28
	Civil engineering and construction	24	12
	Installation	90	14
	Local manufacture	12	12
	Sub-total	230 man-months	96 man-months
2)	Test operation guidance	10	12
	Total	240 man-months	108 man-months

Chapter 7.

CONSTRUCTION COST

Chapter 7. CONSTRUCTION COST

7.1 Estimation Basis of Construction Cost

1) Required machinery, equipment and materials for plant construction supplied by the contractor are calculated by their FOB prices, and construction works as well as trial operation at the site are to be conducted by the Burmese side under the guidance of supervisors dispatched by the contractor.

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

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

4) The foreign exchange rate of US$1.00 = ¥231 or K7.58 which were the mean rate of the month of September, 1981, is to be adopted for cost calculation.

5) The construction costs calculated in foreign currency are based on the assumption that Phase I – Part 2 of the project will be implemented under the conditions of signing of contract on October 1, 1982, and effectuation of contract on January 1, 1983; that Phase II will be implemented under the conditions of signing of contract on October 1, 1983, and effectuation of contract on January 1, 1984; and that the delivery and trial operation of plant and facilities will be completed in 24 months after effectuation of contract, as shown by the construction schedule described in Chapter 6, Section 5.

6) The construction costs calcualted in local currency are based on the following assumptions:

Labor Cost:

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

Civil Engineering and Construction Works Cost:

The price supplied by the Burmese side were used for calculating the prices of equipment and materials procured locally, such as cement, sand, gravel, timber and fuel. The rental fees and administrative expenses supplied by the Burmese side were adopted for calculating the costs of principal construction machinery supplied by the Burmese side. Costs were estimated for construction machinery whose unit fees and costs were not specified by the Burmese side.

Incidentally, rental fees are not calculated for machinery supplied by the contractor.

Installation Cost:

The prices supplied by the Burmese side were used for calculating the costs of locally procured materials such as fuel.

The rental fees and administrative expenses supplied by the Burmese side were adopted for calculating the costs of principal construction machinery supplied by the Burmese side. Costs were estimated for construction machinery whose unit fees and costs were not specified by the Burmese side.

Incidentally, rental fees are not calculated for machinery supplied by the contractor.

7.2 Construction Cost

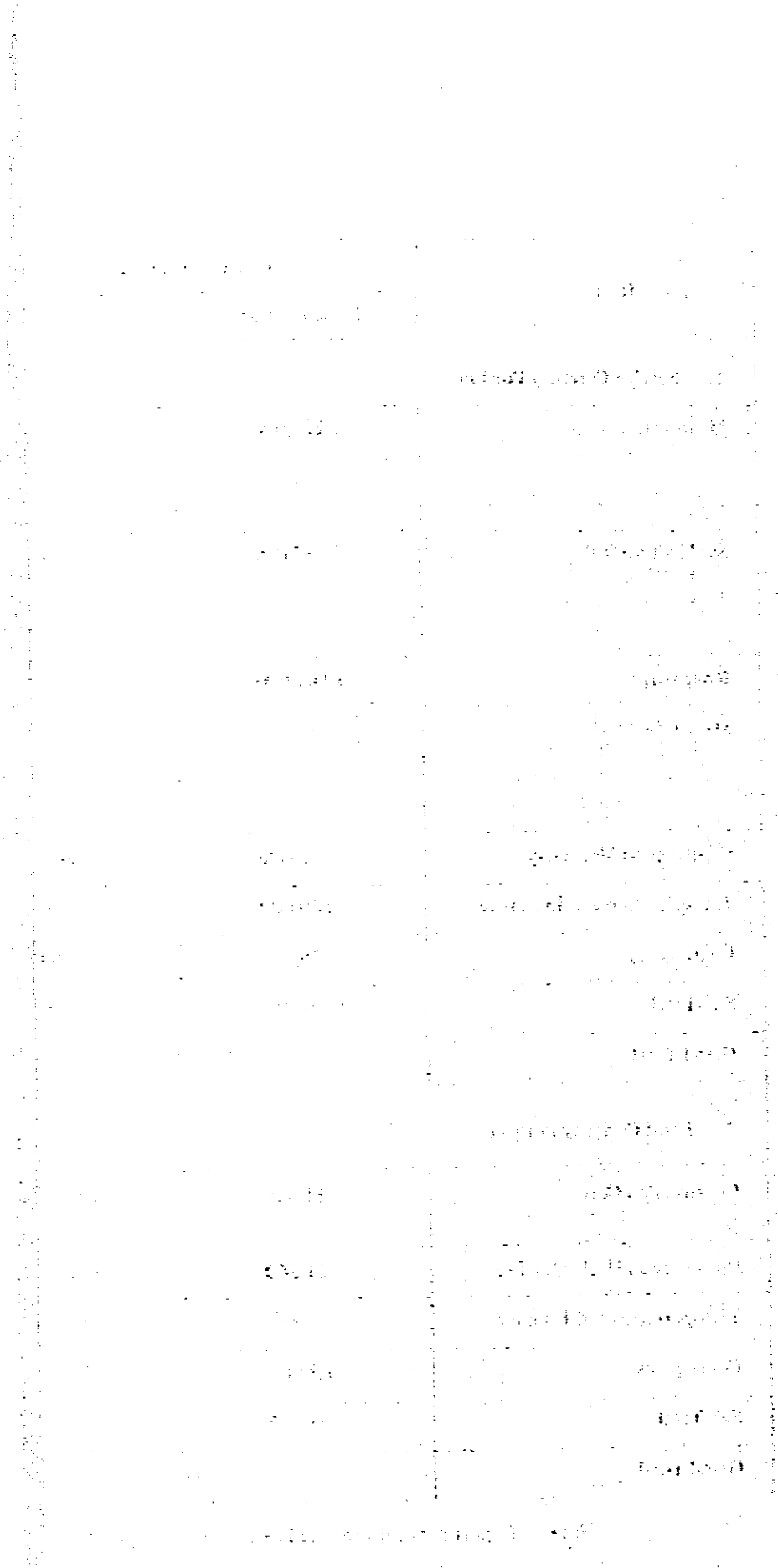
The construction cost of Phase I – Part 2 and Phase II, based on the 7.1, are estimated as follows:

Construction Cost

(Unit: ¥1,000)

Item	Construction Cost		Remarks
	Phase I – Part 2	Phase II	
1. Foreign Currency Portion			
Mann Terminal	1,220,000	-	Tank facilities, LPG shipping facilities, fire-fighting facilities, telecommunication facilities, power receiving/distribution facilities, flare facilities, pipeline, subsidiary materials, temporary works equipment and materials, maintenance equipment and tools, analysis equipment, safety and protective equipment, first-aid supplies, and spare parts for two years. Engineering fee, cost for dispatch of field supervisors.
Syriam Terminal	2,985,000	-	Tank facilities, LPG shipping facilities, fire-fighting facilities, telecommunication facilities, power receiving/distribution facilities, flare facilities, pipeline, subsidiary materials, temporary works equipment and materials, maintenance equipment and tools, analysis equipment, safety and protective equipment, first-aid supplies, and spare parts for two years. Engineering fee, cost for dispatch of field supervisors.
River Barge	1,800,000	-	4 barges
Mann GOCS	-	5,940,000	LPG recovery facilities, refrigeration facilities, tank facilities, filling facilities (gasoline material), pipeline, telecommunications facilities, subsidiary materials, temporary works equipment and materials, maintenance equipment and tools, analysis equipment, safety and protective equipment, first-aid supplies, and spare parts for two years. Engineering fee, cost for dispatch of field supervisors.
Construction Machinery	760,000	235,000	
Transportation and Insurance	560,000	275,000	
Contingency	336,250	322,500	
Sub-Total	7,691,250	6,772,500	
Grand Total	14,463,750		
2. Local Currency Portion			
Construction Cost	11,686	10,100	Field survey, civil engineering works, architectural and installation works, local manufacture of equipment, subsidiary material and supplies costs.
Construction Machinery Fee	21,560	17,530	
Transportation and Insurance	3,889	3,769	
Contingency	1,857	1,570	
Sub-Total	38,992	32,969	
Grand Total	71,961		

Note: Import duties for required machinery and equipment for plant construction are excluded as a result of deliberations with the Burmese side.



Chapter 8.

OPERATING PLAN

Chapter 8. OPERATING PLAN

8.1 Operating Plan

In drafting the operating plan for the Syriam Terminal, Mann Terminal and Mann Terminal and Mann GOCS LPG Extraction Plant, the following factors were taken into consideration:

1) LPG production plan

2) LPG export plan and domestic consumption plan

3) Plan for LPG transportation from Mann Terminal to Syriam Terminal by river barges

4) Relationship between new organizations to be established for the operation of receiving, shipping, storage and production of LPG with existing organizations of Syriam and Mann Refineries.

5) The fact that the project under survey is a part of integrated project consisting of three phases.

Table 8-1 indicates the LPG production plan, transportation plan and domestic consumption plan.

Mann Refinery is scheduled to commence commercial operation in 1982 and anticipated to produce 18,000 tons/yr of LPG. Accordingly, until Mann Terminal, Syriam Terminal and LPG river barges are completed under Phase I – Part 2 of this project, the entire volume of LPG manufactured will apparently be consumed domestically through a slight volume of domestic consumption and inter-refinery consumption (utilization as refinery fuel and combustion through flarestack). LPG for domestic consumption is to be sold locally by filling the volume of LPG equivalent to the local demand into cylinders by an LPG filling system equipped in Mann Refinery.

The completion of Phase I – Part 2 is scheduled for the end of 1984, and in 1985 that is the initial fiscal year, 13,100 tons/yr of LPG, the portion derived from subtracting 3,000

tons/yr for domestic consumption from the output of 16,100 tons/yr of LPG from Mann Refinery (Table 2-1), is to be transported to Mann Terminal by pipeline for further transportation to Syriam Terminal by LPG river barges. In 1986 and 1987 onward, the handling volume will be 14,600 tons/yr and 15,000 tons/yr respectively.

Meanwhile, as Phase I – Part 1 of the project, the Burmese side is presently advancing a project to construct a Coker Complex Plant in the compounds of Syriam Refinery with its completion scheduled for the end of 1984, from where 8,000 tons/yr of LPG are to be produced for transportation to Syriam Terminal by means of a newly installed exclusive-purpose pipeline. Therefore, the volume of LPG handled by Syriam Terminal in its initial year of operation will be 21,100 tons/yr.

Phase II of the project is designed for the production of 30,000 tons/yr of LPG from Mann GOCS LPG Extraction Plant, which are to be transported to Mann Terminal by means of newly installed exclusive-purpose pipelines, then further transported to Syriam Terminal by LPG river barges. Phase II is scheduled for completion in late 1985, so the volume of LPG handled by Syriam Terminal in 1986 will run up to 52,600 tons/yr.

As for the estimated volume of domestic consumption of LPG, the Burmese side plans to increase the volume to 3,000 tons/yr by 1985 and to increase it further in the years ahead. However, since there is still no definite plans, the volume of domestic consumption of LPG was limited to 3,000 tons/yr for this feasibility study, following deliberation with the Burmese side.

Regarding the detailed schedules of the plan to transport LPG by river barges over Irrawaddy River, please refer to Chapter 4.

As for relationships with existing organizations, Syriam Terminal is to be put under Syriam Refinery supervision as an affiliate plant, while Mann Terminal and Mann GOCS LPG Extraction Plant are to be placed under Mann Refinery supervision as affiliate plants.

Accordingly, when drafting the organizational and personnel setups for Mann Terminal, Syriam Terminal and Mann GOCS LPG Extraction Plant, it is assumed that existing organizations as well as existing personnel and facilities (maintenance and repair workers maintenance shop, experiment room, etc.) can be utilized. It was also assumed that the Managing Directors and Deputy Managing Directors of Mann and Syriam Refineries would serve concurrently as the Managing Directors and Deputy Managing Directors of their respective affiliate plants.

Regarding LPG river barges, it was assumed that Crude Movement Indirectly (PIC affiliate), which has hitherto been transporting crude oil by oil river barges, would undertake this task by capitalizing on its expertise, until completion of the crude oil pipeline between Mann Oil Fields to Syriam Terminal.

Table 8-1. LPG Handling Volume by Plants

(Unit: T/Y)

Year	Mann Refinery	Syriam Refinery	Mann GOCS	Domestic Consumption	Export
1982	1,000	-	-	1,000	-
1983	2,000	-	-	2,000	-
1984	3,000	-	-	3,000	-
1985	16,100	8,000	-	3,000	21,000
1986	17,600	8,000	30,000	3,000	52,600
1987	18,000	8,000	30,000	3,000	53,000
1988	18,000	8,000	30,000	3,000	53,000
1989	18,000	8,000	30,000	3,000	53,000

8.2 Organization and Personnel

8.2.1 Basic Drafting Conditions

When drafting the organizational and personnel setups for the respective facilites, it will be necessary to give due consideration to the following factors:

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

In view of the unique situation that the facilities under this study are to be placed under the supervision of Syriam Refinery and Mann Refinery, respectively, the organizational setup as well as personnel setup were drafted on the assumption that the Managing Directors,

Deputy Managing Directors as well as administrative departments including general affairs, accounting and personnel departments of the existing orgnizations, would serve concurrently in the same capacities in the newly established facilities. It was also assumed that personnel belonging to the quality control, maintenance and repair, maintenance shop and other departments of existing organizations, as well as facilities, can be utilized whenever necessary.

The required number of operators was determined on the following basic conception.

1) Number of working days

- o Shift workers 365 days/yr
- o Day workers 298 days/yr

The 298 days/yr was calculated on the basis of 52 Sundays and 15 national holidays annually.

2) Working hours

- o Shift workers 4-team, 3-shift system
- o Day workers 9 hours (actual work 8 hours)

8.2.2 Syriam Terminal

In drafting the organizational and personnel setups for Syriam Terminal, the basic drafting conditions described in Section 8.2.1 and the following factors were taken into account:

1) Syriam Terminal is to be placed under the supervision of Syriam Refinery organization, but it is located only about 3 km from the Refinery.

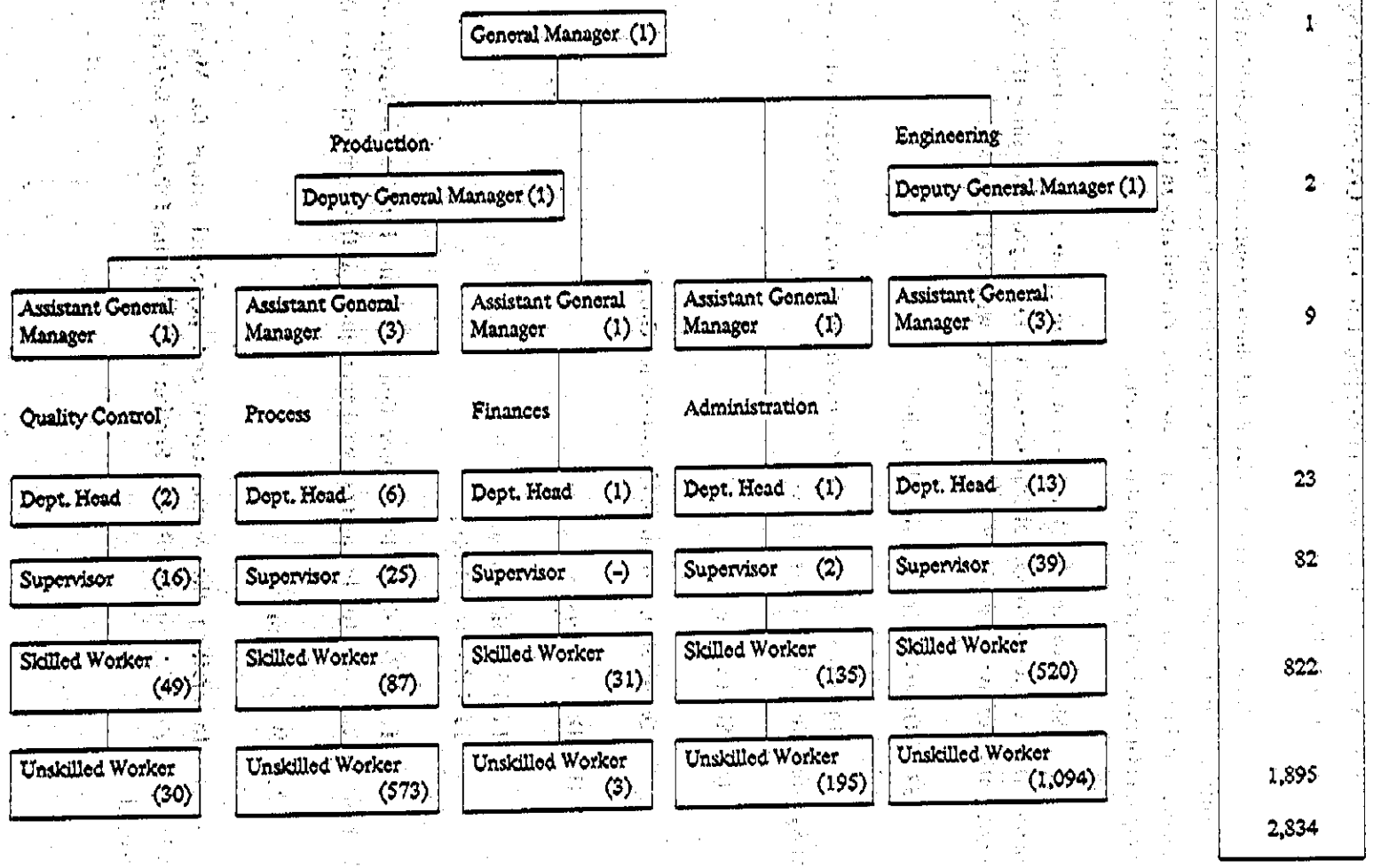
Regarding the organization of Syriam Refinery, please refer to Table 8-2.

2) Characteristics of Syriam Terminal

(a) As a terminal for export of LPG, it serves as a shipping center for LPG ocean tankers.

(b) It serves as a receiving terminal for LPG river barges coming from the Mann region.

Table 8-2. Organization of Syriam Refinery



(c) It serves as a receiving and shipping terminal for LPG piped from Syriam Refinery's Coking Plant.

Regarding the LPG receiving and shipping operations described in Items (a) and (b), in particular, these operations are in principal to be conducted only in the daytime, and may be carried out in parallel. Therefore, operators were divided into an LPG Receiving Group and LPG Shipping Group, both made up of day workers.

Shift workers, on the other hand, are asssumed to be put only to operation and maintenance duties. No special Maintenance Group is provided, since the aid of the existing organization of Syriam Refinery is to be requested whenever necessary.

3) Organization of Syriam Terminal

In view of the considerations described above, the grouping of operation personnel at Syriam Terminal will be as follows:

(a) Shift workers

Terminal Operation and Maintenance Group

(b) Day workers

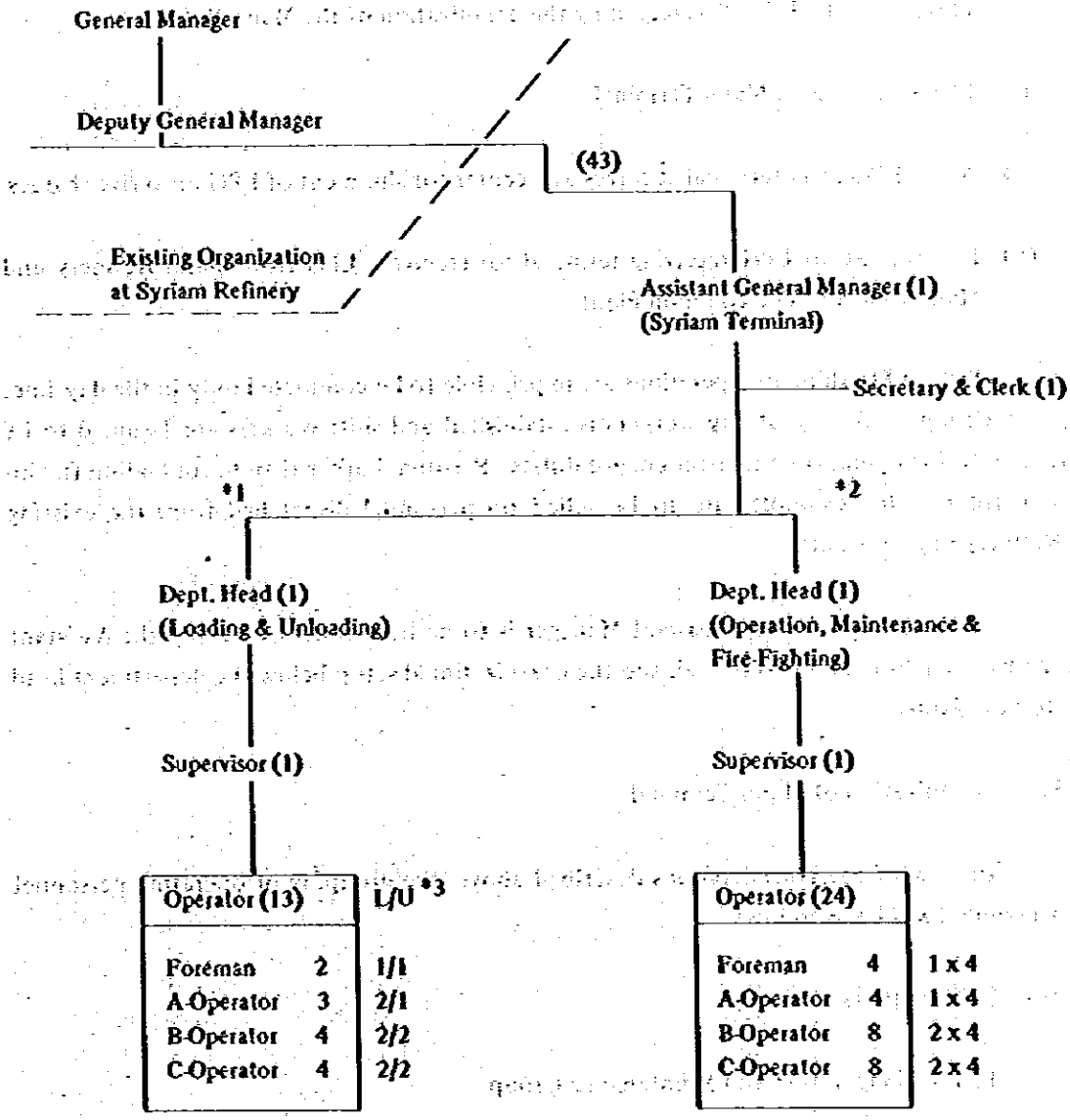
LPG Shipping Group
LPG Receiving Group

Table 8-3 shows the organization of Syriam Terminal as drafted on the basis of the basic policies. The total number of workers required at this Terminal is 43 workers.

8.2.3 Mann Terminal

In drafting the organizational and personnel setups for Mann Terminal, the basic drafting conditions described in Section 8.2.1 and the following factors were taken into account:

Table 8-3. Organization of Syriam Terminal



*1 Full-time worker

*2 Shift worker

*3 Loading & Unloading

1) Mann Terminal is to be constructed in the compounds of Mann Refinery and placed under its supervision.

Please refer to Table 8-4, regarding the organization of the Mann Refiner.

2) Characteristics of Mann Terminal

(a) As an LPG relay terminal, it serves as a center for shipment of LPG onto river barges.

(b) It serves as an LPG receiving terminal for receiving LPG from Mann Refinery and Mann GOCS LPG Extraction Plant.

Since LPG shipping operations are in principle to be conducted only in the daytime, a Shipping Group consisting of day workers is established and shift workers are assumed to be employed only for operation and maintenance duties. Personnel other than for operation (maintenance personnel, for example) are to be relied on personnel dispatched from the existing Mann Refinery organization.

Also, the position of Assistant Manager is to be held concurrently by the Assistant Manager of the existing Mann Terminal, and the organizational setup below the department head level is to be organized.

3) Organization of Mann Terminal

In view of the considerations described above, the grouping of operating personnel at Mann Terminal will be as follows:

(a) Shift workers

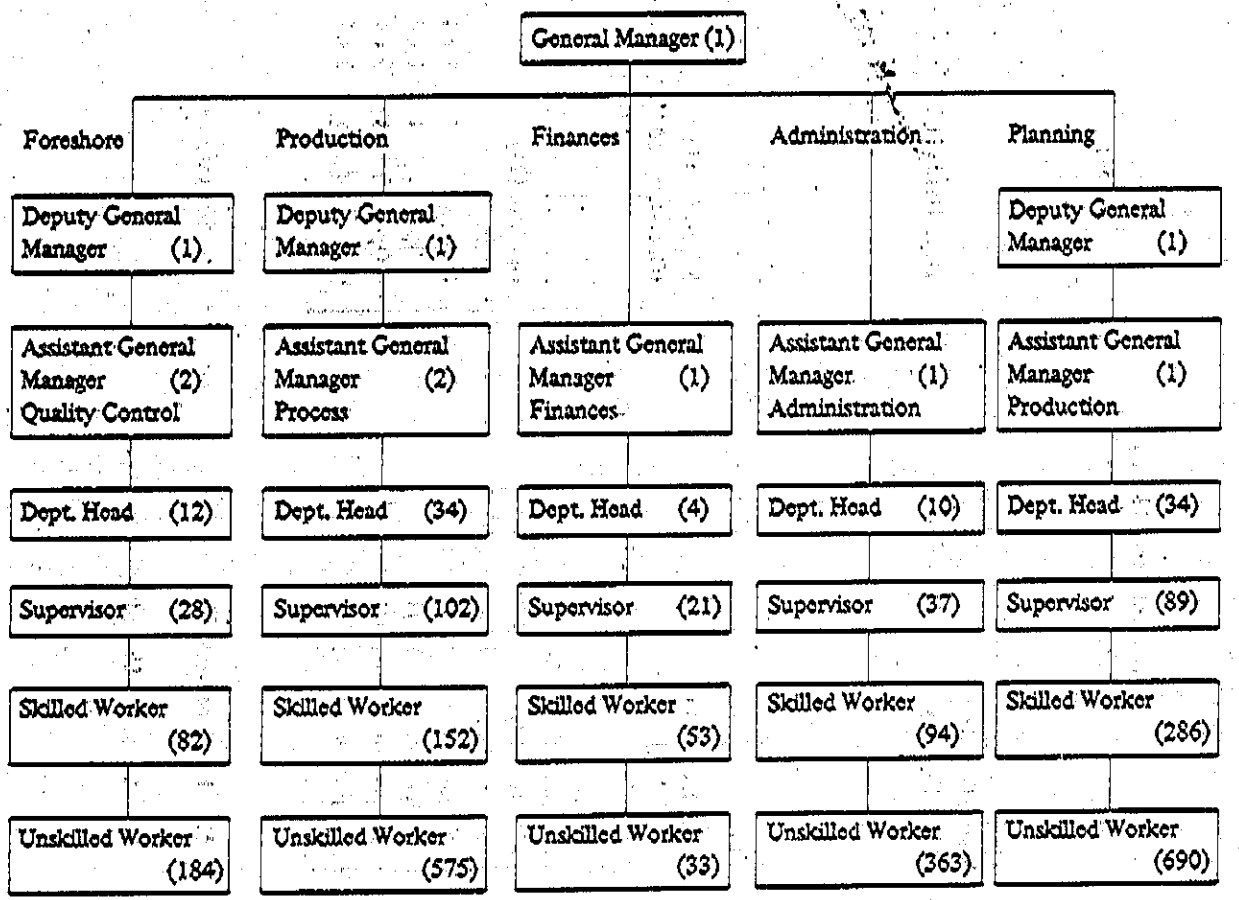
Terminal Operation and Maintenance Group

(b) Day workers

LPG Shipping Group

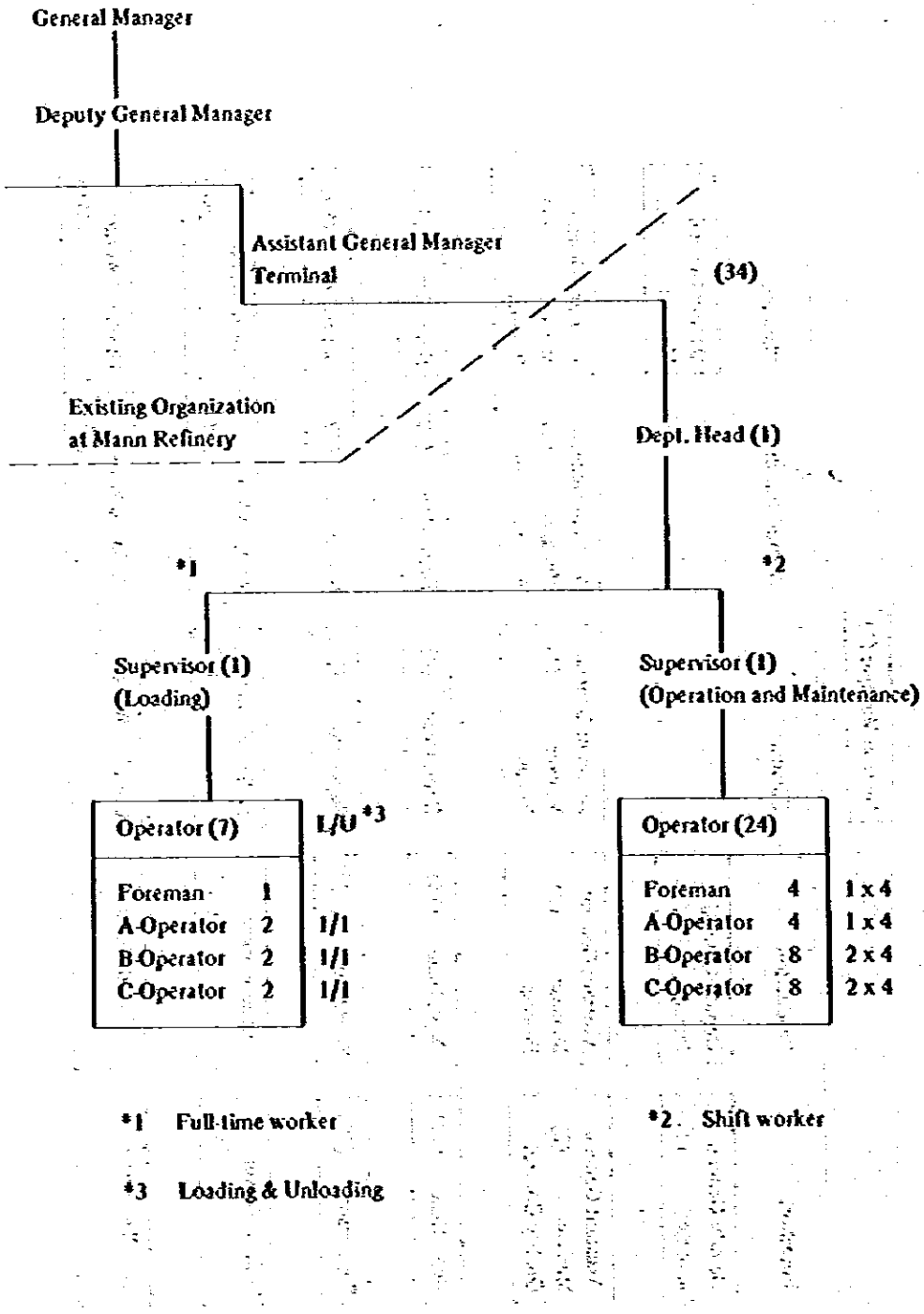
Table 8-5 shows the organization of Mann Terminal as drafted on the basis of the basic policies described above. The total number of workers required at this Terminal is 34 workers.

Table 8-4. Organization of Mann Refinery



Man Power
1
3
7
94
277
667
1,845
2,894

Table 8-5. Organization of Mann Terminal



8.2.4 Mann GOCS LPG Extraction Plant

In drafting the organizational and personnel setups for Mann GOCS LPG Extraction Plant, the basic drafting conditions described in Section 8.2.1 and the following factors were taken into consideration:

1) Mann GOCS LPG Extraction Plant is to be put under the supervision of Mann Refinery organization, but the Plant is only about 33 km away from Mann Refinery.

Please refer to Table 8-4 for Mann Refinery's existing organization.

2) Characteristics of Mann GOCS LPG Extraction Plant

(a) This is the only LPG producing facility among the facilities to be constructed by this project.

(b) Its facilities are related to the existing oil producing facilities of Mann GOCS.

(c) LPG is shopped to Mann Terminal by means of a newly installed pipeline.

(d) It is equipped with a rotary shipping facility for shipment of gasoline material. . . . . .

Since this plant is an LPG producing facility, the Operating Group will be the central group at this plant, and since LPG is to be shipped out continuously, this Group will also be in charge of shipping operations.

Regarding items (b) and (d), a Coordination Department is to be established. As for maintenance personnel, the plan is drafted with day workers comprising most of the members, and aid is to be requested to Mann Refinery's existing organization whenever necessary.

3) Organization of Mann GOCS LPG Extraction Plant

In view of the considerations described above, the grouping of operating personnel at Mann GOCS LPG Extraction Plant will be as follows:

(a) Shift workers

Process Operation Group

Utilities Operation Group

(b) Day workers

Maintenance Group
Coordination Department

Table 8-6 shows the organization of the Mann GOCS LPG Extraction Plant as drafted on the basis of the basic policies described above. The total number of workers required at this Plant is 64 workers.

8.3 Operation Guidance and Training Plan

8.3.1 Basic Drafting Conditions

In drafting the guidance and training plans for operation of the respective LPG facilities, the following factors are taken into consideration:

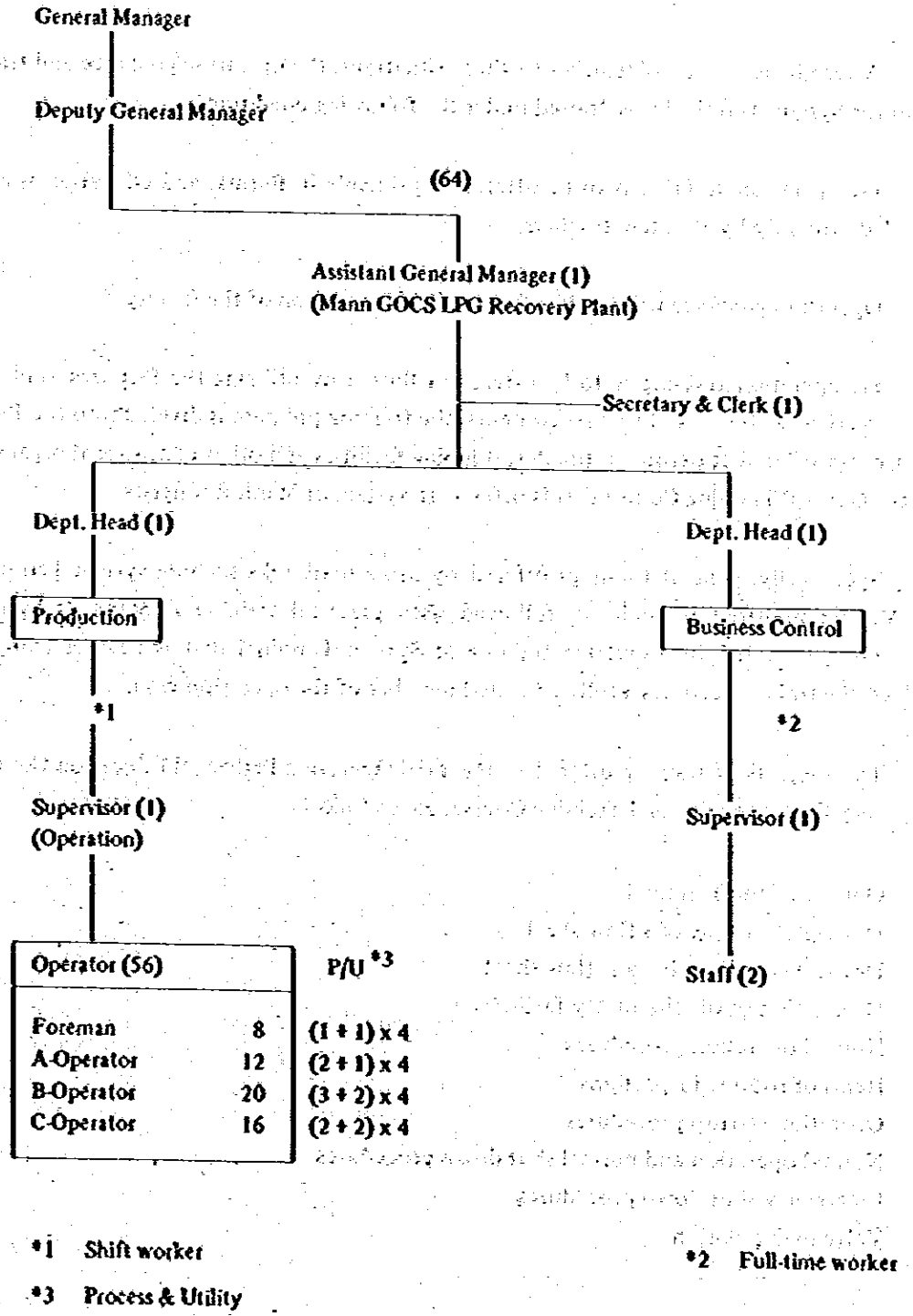
1) The contents and scale of the facility.
2) Relative difficulty of operation of the facility.
3) Whether new types of machinery are used.
4) Special features of the facility.
5) Whether there are similar facilities.
6) Conditions relating to quality and expertise of operating personnel.
7) Related local conditions.

8.3.2 Syriam Terminal

Studying Syriam Terminal on the basis of the basic drafting conditions described in Section 8.3.1 gives us the following picture:

Regarding the contents and scale of Syriam Terminal, there are only storage and shipping facilities here, or eight spherical tanks as well as shipping pumps and several utility facilities. Observing this terminal from its contents and scale, its operation, consisting primarily of LPG receiving and shipping operations, cannot be regarded as being so difficult. Also, as observed from the Burmese side, there are no machinery or equipment of specially new type. Regarding special features of this terminal, the only conspicuous point is that the terminal serves as a special type of LPG export terminal for shipping LPG to LPG ocean tankers, but even

Table 8-6. Organization of Mann GOCS LPG Receiving Plant



*1 Shift worker

*2 Full-time worker

*3 Process & Utility

this is in itself nothing basically different compared with unloading crude oil, so simply offering workers safety education, training and guidance will be sufficient through preoperation training. Furthermore, as similar facility, there is a spherical LPG tank at Mann Refienry, so training can be offered within Burma if necessary.

After giving due consideration to these situations, the operation guidance and training program for Syriam Terminal was drafted under the following conditions:

1) Pre-operation training is to be offered in principle in Burma, and education is also to be extended primarily by Burmese teachers.

2) Operation guidance will not be offered after completion of the facility.

Pre-operation training is to be offered in Burma by utilizing the facilities available at Mann and Syriam Refineries. From its contents, the training program is divided into the Basic Education Course offered at existing refineries, shipping facilities and other educational organizations, and the General Training Course that is offered at Syriam or Mann Refineries.

Specifically, general trainings offered by using textbooks such as Syriam Terminal Operation Manual prepared beforehand, followed with practical training at Mann or Syriam Refineries, and culminated by simulated training at Syriam Terminal that is nearing completion, by which the trainee becomes a fully educated member of the operation team.

The subjects of training offered in the Trial Operation Personnel Education Course, the primary objective of the General Training Course, are as follows:

1) Outline of the Terminal
2) Description of process flow sheet
3) Description of mechanical flow sheet
4) Description of off-site utility facilities
5) Normal operation procedures
6) Items of routine inspections
7) Operation startup procedures
8) Normal operation and normal shut down procedures
9) Emergency shut down procedures
10) Valve mainpulation

11) Pump manipulation
12) Handling of instruments
13) Handling of chemicals
14) Safety precautions
15) Method of reporting on and transfer of operation duties
16) Others

8.3.3 Mann Terminal

Studying Mann Terminal on the basis of the basic drafting conditions described in Section 8.3.1 gives us the following picture:

The contents and scale of Mann Terminal, are only storage and shipping facilities, or four spherical tanks and some shipping pumps. Therefore, as observed from the aspects of the Terminal's contents and scale, its operation, consisting primarily of shipping operations, cannot be regarded as being difficult. Also, as observed from the Burmese side, there are no machinery or equipment of specially new type, and since the Terminal is constructed in the compounds of Mann Refinery, it may simply be regarded as an extension of the routine LPG shipping operations of Mann Refinery, making it possible to offer the necessary operation training within Mann Refienery.

In view of the situation described above, the operation guidance and training program for Mann Terminal was drafted under the following conditions:

1) Pre-operation training is to be offered in principle by utilizing the facilities of Mann Refinery, and education is to be extended primarily by Burmese teachers.

2) Operation guidance will not be offered after completion of the facility.

Pre-operation training is to be offered by utilizing the facilities available at Mann Refinery, and from its contents, the training program is divided into the Basic Training Course and General Training Course. Specifically, general training is offered by using textbooks such as the Mann Terminal Operation Manual prepared beforehand, followed with practical training at Mann Refinery, and culminated by simulated training at Mann Terminal that is nearing completion, by which the trainee becomes a fully educated member of the operation team.

The subjects of training offered in the Trial Operation Personnel Education Course, the primary objective of the General Training Course, are essentially the same as those offered in the Syriam Terminal training course.

8.3.4 Mann GOCS LPG Extraction Plant

Studying Mann GOCS LPG Extraction Plant on the basis of the basic drafting conditions described in Section 8.3.1 gives us the following picture of the Plant:

Regarding the contents and scale of the LPG Extraction Plant, we see that the principal facilities here essentially consist of the LPG extraction facilities and off-site utility facilities. While some experience will be necessary for the handling of heating furnaces and compressors, the Plant's operation will not be so difficult as judged from the experience gained in the operation of Mann Refinery and other facilities.

In view of the situation described above, the operation guidance and training program for Mann GOCS LPG Extraction Plant was drafted under the following conditions:

1) Pre-operation training is to be conducted in principle in Burma, and education is to be extended by Burmese teachers primarily on the handling of heating furnaces and compressors by utilizing the facilities of Mann Refinery.

2) No special operation guidance will be offered after completion of the facility. Instead, equivalent operation guidance is to be offered in the form of plant operation and supervision through the warranty running operations conducted during the two months of plant running for performance warranty.

Specifically, pre-operation training is to be offered by utilizing the facilities available at Mann Refinery, and from its contents, the training program is divided into the Basic Education Course normally extended at Mann Refinery and General Training Course. General training is offered by using textbooks such as Mann GOCS LPG Extraction Plant Operation Manual prepared beforehand, followed with practical training at Mann Refinery, and culminated by simulated training at Mann GOCS LPG Extraction Plant that is nearing completion, by which the trainee becomes a fully educated member of the operation team.

The subjects of training offered in the Trial Operation Personnel Education Course,

which is the primary objective of the General Training Course, are as follows:

1) Outline of the Plant
2) Description of process flow sheet
3) Description of mechanical flow sheet
4) Description of off-site utility facilities
5) Normal operation procedures
6) Items of routine inspections
7) Operation startup procedures
8) Normal operation and normal shut down procedures
9) Emergency shut down procedures
10) Operation of heating furnaces
11) Operation of pumps and compressors
12) Valve manipulation
13) Handling of instruments
14) Handling of chemicals
15) Safety precautions
16) Method of reporting on and transfer of operation duties
17) Others

8.4 River Barges for LPG Transportation

In drafting the organizational and personnel setups for the LPG river barges, the following points were given due consideration:

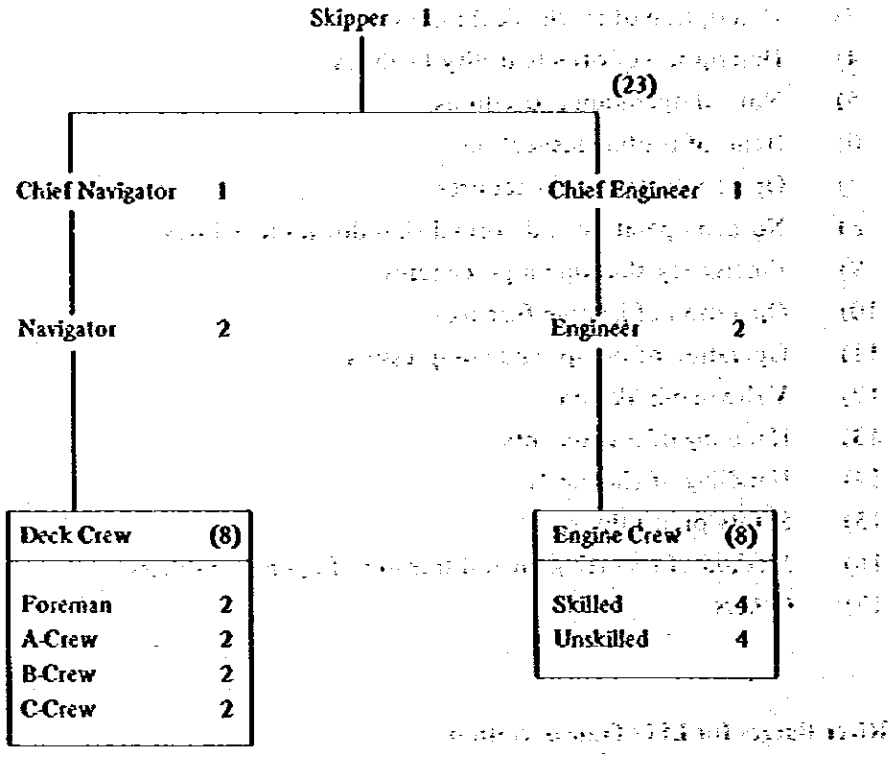
1) Since the river barges for LPG transportation are to be placed under the supervision of Crude Movement Indirectory, an affiliate of PIC, only the skipper and his crew need be taken into account.

2) The engineering crew members are to concurrently surve as fire-fighting and maintenance personnel during navigation.

3) Crew members other than the skipper, chief navigator and chief engineer are to work under a double (day and night) shift system.

Table 8-7 shows the organizational setup for the river barges as drafted on the basis

Table 8-7. Organization of LPG River Barge



of the basic policies described above. Since a river barge is to be manned by a crew of 23 members, a total of 92 crew members will be required for the four barges.

8.5 Running Cost

8.5.1 Basic Conditions for Calculation of Running Cost

The running costs of Syriam Terminal, Mann Terminal and Mann GOCS LPG Extraction Plant are claculated on the basis of the following assumptions:

1) Unit costs and prices supplied by the Burmese side are to be adopted.

2) Electricity, water and chemicals are included as utility items.

3) With respect to LPG transportation cost, the unit transportation cost supplied by the Burmese side is adopted.

4) The maintenance and repair cost is assumed to be equivalent to 2.8% of the total cost of machinery and equipment.

5) The number of working days per year is assumed to be 330 days.

The unit costs adopted for calculating the running cost are as follows:

o Electricity	0.15 kyat/kWh
o Make-up water	0.5 kyat/1,000 I.G
o LPG transportation	0.2 kyat/ton.mile
o Gasoline material transportation	0.5 kyat/ton.mile
o Labor	Please refer to Table 8-8, 8-9 and 8-10
o Maintenance and reapir	Total machinery and equipment cost x 2.8%

8.5.2 Syriam Terminal

By calculating the running cost of Syriam Terminal on the basis of the basic conditions described in Section 8.5.1, we get the following:

1) Utilities		
o Electricity	227 kW/hr	270,000 kyat/Y
o Make-up water	15 tons/hr	270,000 kyat/Y
o Chemicals (for water treatment)		67,000 kyat/Y
2) Labor	43 workers	262,000 kyat/Y
3) Maintenance and repair		1,510,000 kyat/Y
Total		2,379,000 kyat/Y

8.5.3 Mann Terminal

By calculating the running cost of Mann Terminal on the basis of the basic conditions described in Section 8.5.1, we get the following:

1)	Utilities		
	o Electricity	118 kW/hr	140,000 kyat/Y
	o Make-up water	6 tons/hr	108,000 kyat/Y
2)	LPG transportation	45,000 tons/Y	3,375,000 kyat/Y
3)	Labor	34 workers	196,000 kyat/Y
4)	Maintenance and repair (including river barges and tugboats)		2,238,000 kyat/Y
	Total		6,057,000 kyat/Y

8.5.4 Mann GOCS LPG Extraction Plant

By calculating the running cost of the Mann GOCS LPG Extraction Plant on the basis of the basic conditions described in Section 8.5.1, we get the following:

1)	Utilities		
	o Electricity	1,824 kW/hr	2,167,000 kyat/Y
	o Make-up water	45 tons/hr	809,000 kyat/Y
	o Chemicals (for cooling tower)		467,000 kyat/Y
2)	Gasoline material transportation	2,900 tons/Y	30,000 kyat/Y
3)	Labor	64 workers	369,000 kyat/Y
4)	Maintenance and repair		3,708,000 kyat/Y
	Total		7,550,000 kyat/Y

Table 8-8. Salary Structure at Syriam Terminal

Class	Position	People	Wage, K/Month	Total Payment, K/Month
1	General Manager	-	1,400	-
2	Deputy Manager	-	1,300	-
3	Assistant General Manager	1	1,300	1,300
4	Department Head	2	1,200	2,400
5	Supervisor	2	800	1,600
6	Staff	-	500	-
7	Secretary & Clerk	1	400	400
	Sub-Total	6		5,700
8	Foreman	6	700	4,200
9	A-Operator	7	500	3,500
10	B-Operator	12	400	4,800
11	C-Operator	12	300	3,600
	Sub-Total	37		16,100
	Total	43		21,800

Table 8-9. Salary Structure at Mann Terminal

Class	Position	People	Wage, K/Month	Total Payment, K/Month
1	General Manager	-	1,400	-
2	Deputy Manager	-	1,300	-
3	Assistant General Manager	-	1,300	-
4	Department Head	1	1,200	1,200
5	Supervisor	2	800	1,600
6	Staff	-	500	-
7	Secretary & Clerk	-	400	-
	Sub-Total	3		2,800
8	Foreman	5	700	3,500
9	A-Operator	6	500	3,000
10	B-Operator	10	400	4,000
11	C-Operator	10	300	3,000
	Sub-Total	31		13,500
	Total	34		16,300

Table 8-10. Salary Structure at Mann GOCS LPG Recovery Plant

Class	Position	People	Wage, K/Month	Total Payment, K/Month
1	General Manager	-	1,400	-
2	Deputy Manager	-	1,300	-
3	Assistant General Manager	1	1,300	1,300
4	Department Head	1	1,200	1,200
5	Supervisor	3	800	2,400
6	Staff	2	500	1,000
7	Secretary & Clerk	1	400	400
	Sub-Total	8		6,300
8	Foreman	8	700	5,600
9	A-Operator	12	500	6,000
10	B-Operator	20	400	8,000
11	C-Operator	16	300	4,800
	Sub-Total	56		24,400
	Total	64		30,700

Table 8-11. Salary Structure of LPG River Barge

Class	Position	People	Wage, K/Month	Total Payment, K/Month
1	Skipper	1	1,200	1,200
2	Chief Navigator	1	800	800
3	Chief Engineer	1	800	800
4	Navigator	2	500	1,000
5	Engineer	2	500	1,000
	Sub-Total	7		4,800
6	Foreman	2	700	1,400
7	A-Operator	2	500	1,000
8	B-Operator	2	400	800
9	C-Operator	2	300	600
10	Skilled Worker	4	300	1,200
11	Unskilled Worker	4	300	1,200
	Sub-Total	16		6,600
	Total	23		11,400