it is necessary that its gradients and curves are fully taken into consideration both in planning and to construction of the road.
In order to build the Refinery on such a field as proposed Site, a series of surveys must be carried out thoroughly.
Furthermore, as there is absolutely neither electric power nor water in the field, it is necessary for smooth implementation of construction works to establish a delibelate plan of temporaly works which will begin at the start of land adjustment works and continue till the commencement of regular construction works opend by the erection of tanks.

It is advisable to fabricate the equipment capable of being done by factories in the Country in the construction of the Refinery. It is considered that this would bring about some activity in the industry of the Country and assist in the elevation of its technical level.

7.1 Site Survey

The scope of this survey covers a wide area and its contents are diverse since the construction of the Refinery includes even those of incidental facilities such as a crude oil pipeline from the M/F Tank Farm to the Refinery, product pipelines extending from the Refinery Site to the bank of the Irrawaddy River, and shipping jetties at the river shore.
It is necessary that the survey shall be completed for the most part before contracting with a contractor in order that the results of it can be fully reflected in the plans.

7.1.1 Survey

1) Leveling

From the nearest Bench-Mark (BM), the leveling will be carried out in regard to the following points.

- Decision of zero-point true height of the water gauge of the Irrawaddy River at Minbu.
- Establishment of a BM near the starting point of the crude oil pipeline.
- Establishment of a BM in the Refinery Site.
  Establishment of a BM in the Terminal Site.

2) Topographic Survey

(a) Aero-Photo Maping

- Scale : 1/5,000
- Contour line space : 2.0m
- Extent : The area covering M/F Tank Farm, crude oil pipeline route, Refinery Site, Terminal Site, shipping jetties, residential area, and Minbu Town.
- Service : To design the master plan

(b) Topographic Survey

- Scale : 1/500 ~ 1/1,000
- Contour line space : 0.5 ~ 1.0m
- Extent : Respective ranges of Refinery Site, Terminal Site, product shipping jetties, access road, pipeline routes of crude oil and products, and residential area.
- Service : To design each facility.

3) Sounding Survey

- Scale : 1/500 ~ 1/1,000
- Contour line space : 0.5 ~ 1.0m

- Extent : The area bounded by a length of river shore between the confluence section of Sebwet Chaung and of Kyau Chaung to the Irrawaddy River, and by a width of 200m offshore.
- Service : To select shore points suitable for setting up unloading place, water intake facilities, and shipping jetties, and also, to design said facilities.

4) Current Measuring

- Extent : Same as that of sounding survey.
- Service : For selection of shore point suitable for setting up shipping jetties and for design of their structure.

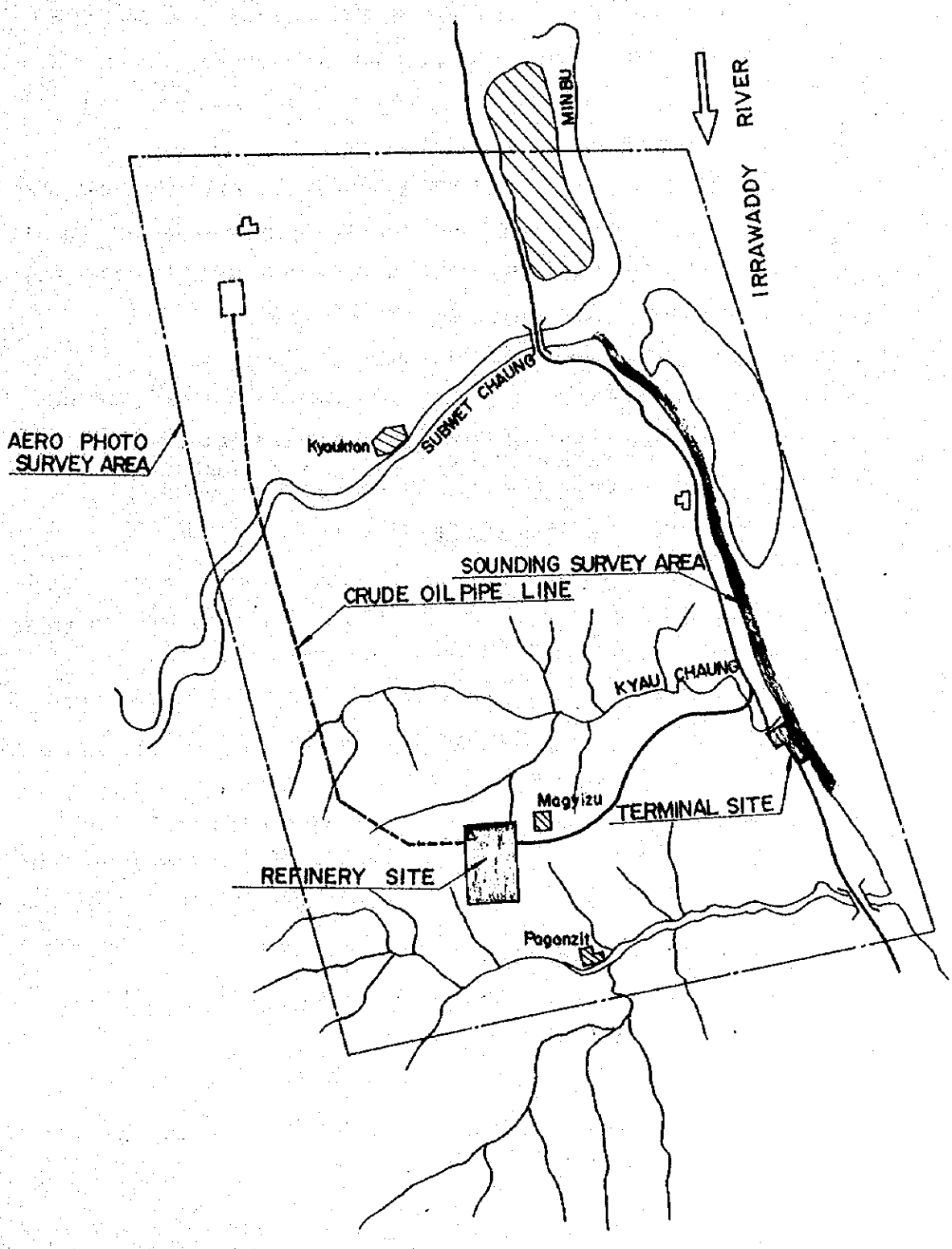
It is necessary to construct the product shipping jetties in a place where the current is gentle and will allow barges to be brought alongside or to leave the jetties with stability. During the rainy season where the current speed becomes faster, the river conditions such as current, current direction and eddy conditions will be observed and measured for selecting such a location as previously mentioned.

5) Profile and Cross Leveling

- Extent : Respective ranges of Refinery Site, Terminal Site, shipping jetties, access road, pipeline routes of crude oil and products.
- Service : For calculation of cut and fill volume, and for detailed design of said facilities.

FIG. 7-1 SURVEY AREA

SCALE 1" = 1 mile



7.1.2 Soil Survey

1) Preliminary Survey

Several numbers of boring will be done respectively at the proposed points in the Refinery Site and the Terminal Site in order to decide the concrete positions of both site.

2) Primary Survey

When plot plan of the Refinery and the Terminal will have been made, the necessary number of boring will be carried out for designing the foundation. Soil survey items to be performed are listed below for your reference.

(a) Preliminary Survey

- Refinery Site : 4 borings (for the plateau)
- Terminal Site (including jetty area) : 6 borings (for 2 points taken for tentative)
- Details of Test

N value	:	About 1 time every 2m drill
Soil test (to be carried out every change of stratum)	:	About 1 time every 2 borings
Unconfined compression test	:	Refinery Site - 2, Terminal Site - 3, carried out to soil suitable for foundation. Consolidation test to be done if the soil has compressibility.

(b) Primary survey

- Refinery Site : 12 borings
- Terminal Site : 6 "
- Jetties : 12 "
- Details of test
  N valve

- Soil test (to be carried out every change of stratum) : About 1 time every 2 borings

7.1.3 Other Surveys

1) Survey of Deposits of Gravel and Sand

As it is estimated so in great quantities that 46,600m^3 of gravel and 23,300m^3 of sand will be used for concrete aggregate, 82,000m^3 of gravel for paving of roads, and 42,000m^3 of sand for foundation of tanks, the investigation shall be carried out previously to find out the places where there will be gravel or sand deposits enough for said uses, and to estimate their available amount as accurately as possible.

Further, it will be necessary to have decided whether or not they are suitable for use as construction materials, conducting grading analysis and hardness test of them.

2) Concrete Proportion Test

It is necessary to conduct a concrete proportion test of the concrete which consists of cement and aggregate to be actually used, and to have defined the moderate proportion between the cement and the aggregate.

The concrete properties used design are as shown below:

(a) Reinforced Concrete

- Civil use

Maximum size of aggregate	: 25 mm
4 - week strength	: 240 kg/cm^2
Slump	: 7 ~ 10 cm

- Building use

Maximum size of aggregate	: 25 mm
4 - week strength	: 240 kg/cm^2

Slump : 20 cm

(b) Plain Concrete

- Civil use

  Maximum size of aggregate : 40 mm

  4 - week strength : 210 kg/cm^2

  Slump : 6 ~ 8 cm

- Building use

  Maximum size of aggregate : 25 mm

  4 - week strength : 210 kg/cm^2

  Slump : 18 cm

7.2 Transportation

Regarding the transportation route(s) from the Rangoon Port to the Site, two major routes have been considered, one being river transportation through the Irrawaddy River, and the other being overland transportation by roads or railways.

For the construction of the Refinery, it is necessary to transport heavy and bulky pieces of equipment, and a large amount of steel materials, to be used for this. Materials and equipment cannot be transported overland directly from Rangoon to the Site located on the west bank of the river without crossing the river between Magwe and Minbu.

In addition to this, if a thought is given to the possibility of troubles in traffic during the rainy season, the overland transportation cannot possibly become the main means of transportation.

Consequently, the greater part of the materials and equipment for construction shall be transported up the Irrawaddy River. However, it was considered in this plan that every materials and equipment would be transported through the river due to the convenience of

making a plan of shipping schedule.

Namely, the said materials and equipment brought from abroad during construction period is expected to be a sum of 35,000 tons in weight. Also, it is foreseen that the heaviest one will be about 80 tons in weight, and the maximum size of bulky one will be 3.8m in diameter and 18m in length.
These would all be transported up the Irrawaddy River from the Rangoon Port to the Site.

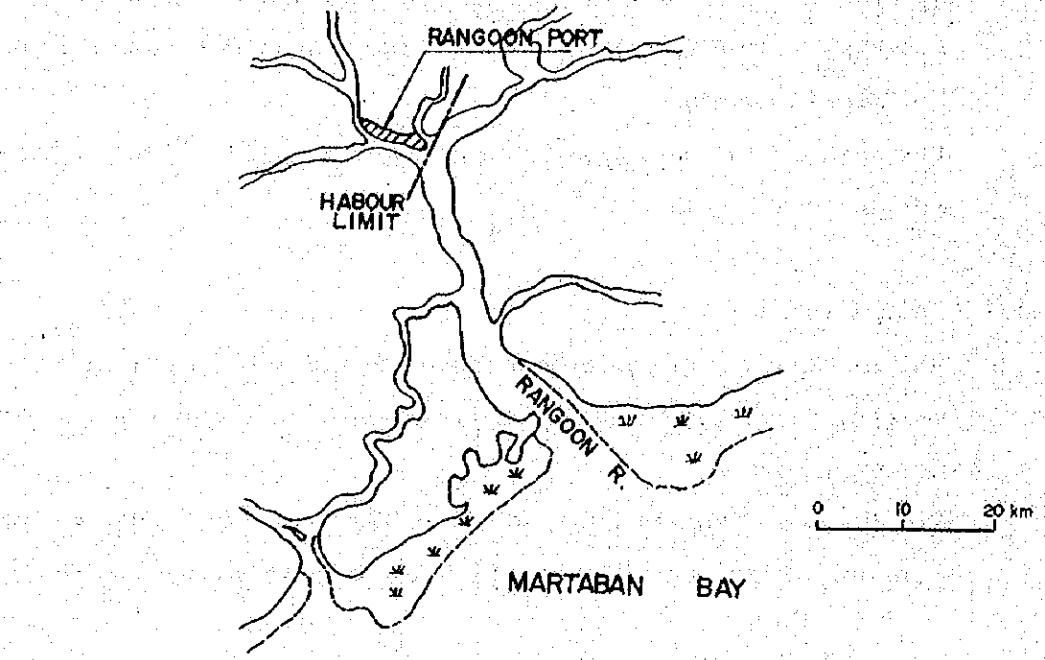
7.2.1 Rangoon Port

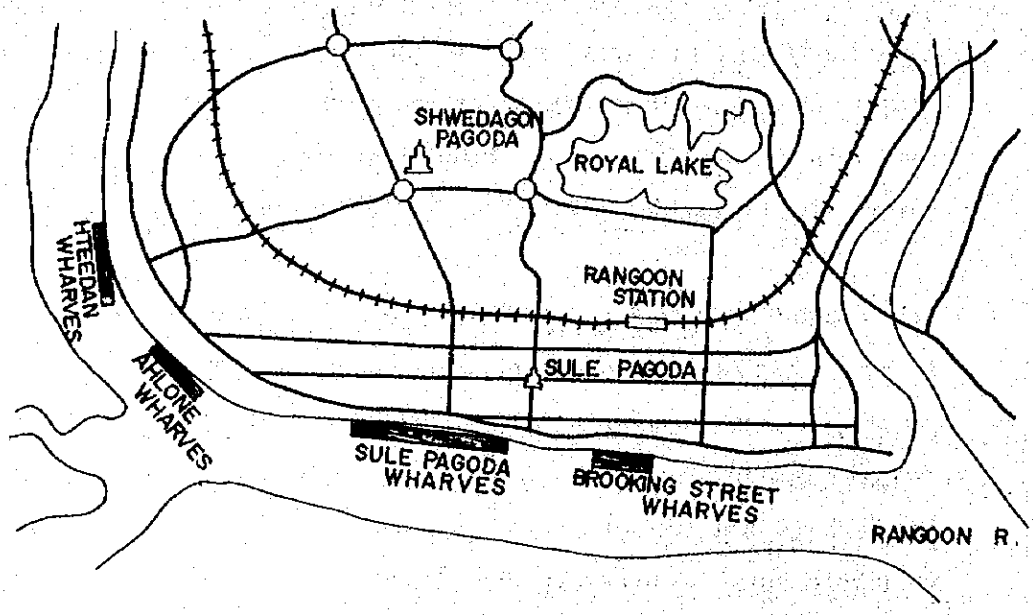
The materials and equipment from abroad will be transferred from sea-going vessels to carriers for inland river transport at the Rangoon Port.
The Rangoon Port is situated about 35 km up the mouth of the Rangoon River, and its general feature is as shown in Fig. 7 - 2.

The depth of the port is maintained at a maximum DL-9m, and ships of 10,000 DWT can enter the port and arrive alongside of wharves. However, there are several sand banks at the mouth of the port which hinder passage of ships, so that, in fact, only ships of maximum 5,000 DWT or around can enter the port at all times. Ships larger than this must anchor in the roadstead or the port until high tide (maximum high tide difference: 4.8m) to come in or out the port.

Sule Pagoda wharf and Brooking wharf can be used for general cargo. In both wharves, respectively, there is the apron having a width of 20 to 30m and warehouses in the rear, which seems to give unloaded cargo a space necessary for temporary storage. The crane of Brooking wharf can unload cargo up to 40 tons, however, cargoes heavier than this must be directly transferred onto other ships by the sea-going vessels own derricks.

FIG. 7-2 RANGOON PORT





7.2.2 Irrawaddy River Transport

Carriers of inland river transport enter the Irrawaddy River through the Twante Canal from the Rangoon Port, which is 150m in width, DL-4.5m in depth, and 34 km in length. There is a difference of 10m - 15m in the water level of the Irrawaddy River between the rainy season and the dry season. In the dry season, the river becomes so shallow that only ships with draft of 1.8m or less can proceed as far as Minbu.

From the viewpoint of loading and unloading, the Z-craft is convenient for the transportation of heavy materials and equipment, and such a carrier is planned to be used. The transport limitation of the Z-craft is 18m in length, 7.5m in width and 150 tons in weight. It is 560 km from the Rangoon Port to Minbu and the round trip navigation, including loading and unloading works, is planned at 15 days.

7.2.3 Unloading Work at Minbu

After selecting a stable place along the river shore, and giving it a gentle slope by gravel paving, a temporary landing stage will be built. A Z-craft loaded with a heavy equipment will land its bow directly onto the stage and bring its ramp down. The heavy equipment will be loaded onto a trailer by a 127-ton truck crane after being hauled out from the Z-craft by bulldozer or winch.

As the heavy equipment will be hauled out the loading point, it will be employed, to make this easier, either it will be draged by arranging steel rollers on wooden blocks that will have been layed on the stage to a route, or it will be conveyed by carts which will have been attached to it and can move on the railway extended on wooden blocks.

Unloading work of heavy equipment is favourable to do during the rainy season when the water level is higher and the lift of equipment becomes shoter. Meanwhile, relatively light equipment will be taken off the Z-craft brought alongside the stage by a truck crane and be loaded directly onto a truck without hauling.

Since the transportation of heavy equipment as well as its unloading work at the Site hold an important place in construction of the Refinery, it is advisable to have the guidance of an experienced professional.

7.2.4 Transportation Plan

A detailed and careful transport plan and its execution is required for smooth and efficient proceeding of the construction work.

In making plan of shipping schedule, it was discussed to extend a shipping period as long as possible considering the progress of the construction, and to make a monthly load of shipment as uniform as possible every month, in order to minimize the required number of ships for the transport and to put them good uses. For this discussion, it was intended to maintain a monthly load of shipment below 2,000 tons.

This result is shown in Fig. 7 - 3 and Fig. 7 - 4.

The required number of ships was preliminarily calculated according to the following conditions:

- The all of materials and equipment would be transported by the river transportation through the Irrawaddy River.
- It was tentatively decided to use only 150 ton Z-craft to transport.
- The Z-craft transport cycle was considered two round trips per month without regard to the rainy or dry seasons.

- The loading capacity per Z-craft was calculated at 240m^3 or 100 tons considering the volumetric efficiency.

7.3 Construction Plan

7.3.1 Provisional Plan

There is currently neither water nor electric power for use at the Site, and these must be newly prepared.

The provisional plan was divided into two stages, a primary provisional installation and a secondary provisional installation, because it would be of a large scale and it would be difficult, in terms of the time needed for the arrangement of materials, to make all the preparations prior to the beginning of the construction work.

It was designed so that the primary provisional installation was concerned with the civil works such as land adjustment, tank foundation, etc., which were at the first stage in the construction schedule, and the secondary provisional installation was concerned with the regular construction that followed the civil works.
The lay-out plan for the main temporary facilities contemplated in above plan is shown in Fig. 7 - 5.

FIG. 7-3 SHIPPING SCHEDULE

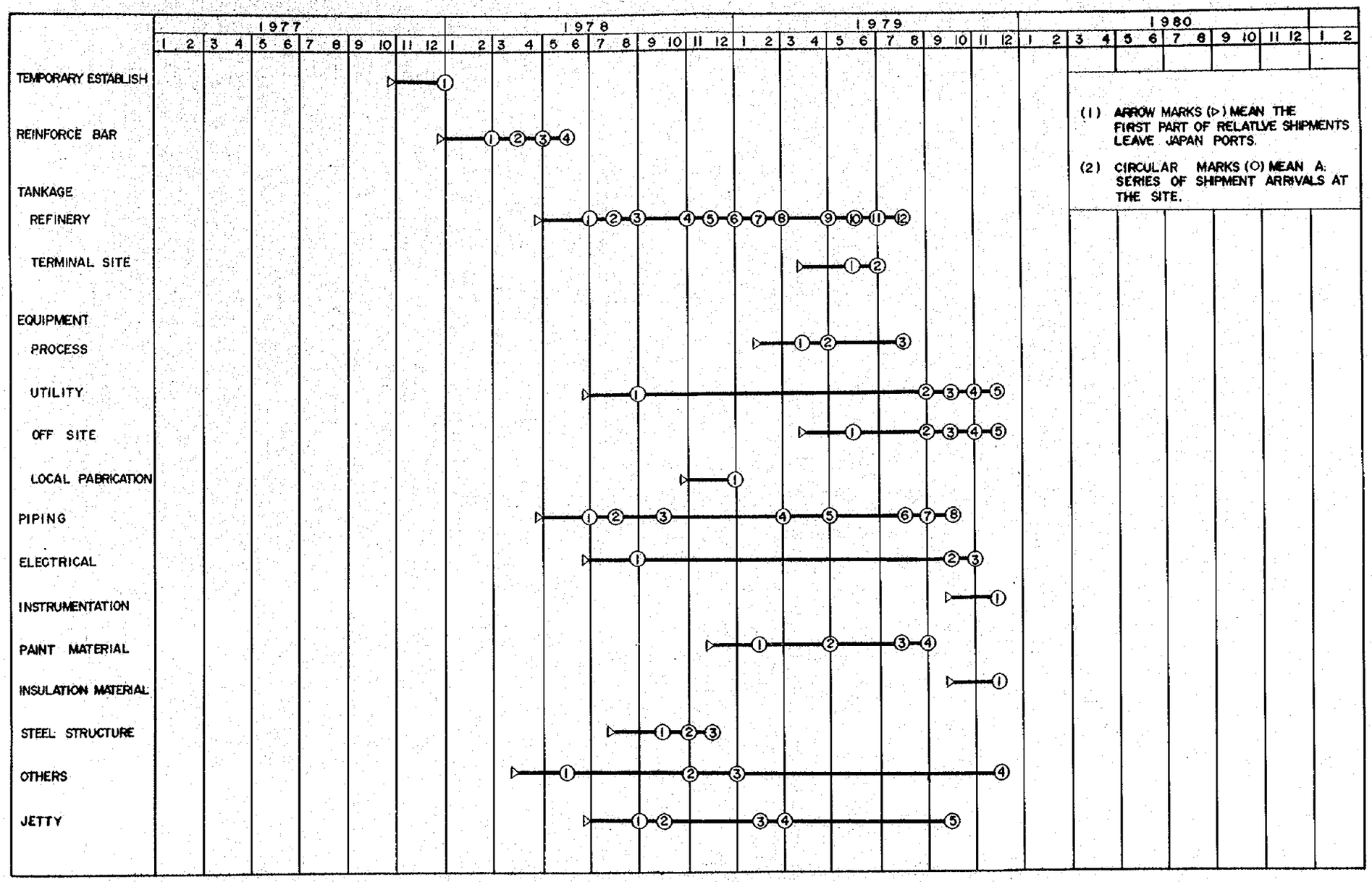
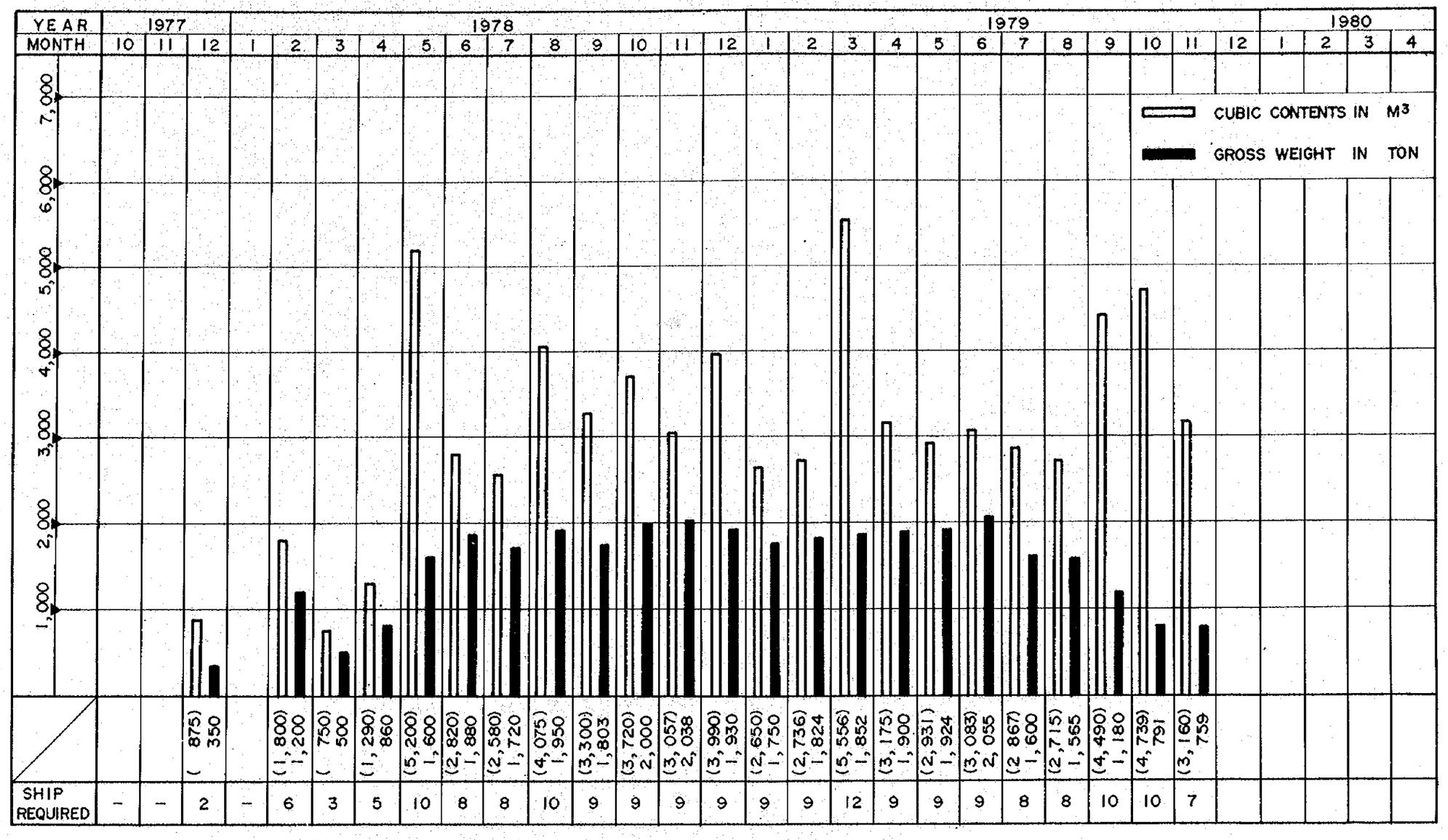


FIG. 7 - 4 DISTRIBUTION PATTERN OF SHIPMENT



YEAR	1977			1978												1979												1980			
MONTH	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
			(875) 350		(1,800) 1,200	(750) 500	(1,290) 860	(5,200) 1,600	(2,820) 1,880	(2,580) 1,720	(4,075) 1,950	(3,300) 1,803	(3,720) 2,000	(3,057) 2,038	(3,990) 1,930	(2,650) 1,750	(2,736) 1,824	(5,556) 1,852	(3,175) 1,900	(2,931) 1,924	(3,083) 2,055	(2 867) 1,600	(2,715) 1,565	(4,490) 1,180	(4,739) 791	(3,160) 759						
SHIP REQUIRED	–	–	2	–	6	3	5	10	8	8	10	9	9	9	9	9	9	12	9	9	9	8	8	10	10	7					

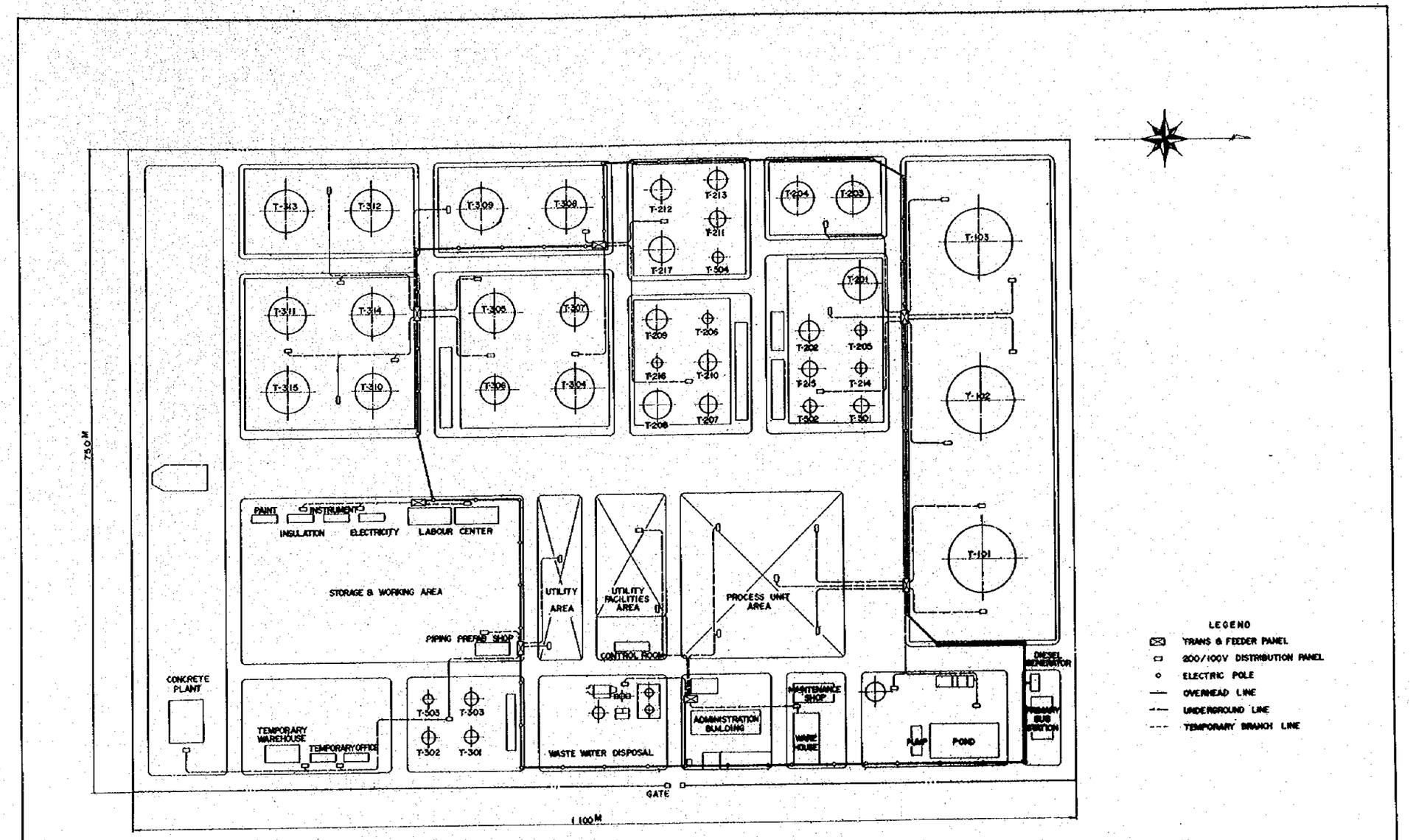


FIG. 7-5
TEMPORARY
ESTABLISH PLAN

1) Water

In the primary provisional installation, a small diesel engine powered pump (about 0.3m^3/min) will be set up on the shore of the Irrawaddy River, and a temporary pipeline will be laid to the Refinery Site to supply water. The water supply point will be close to the concrete plant. And living water for supervisors will be supplied by a temporary water treatment apparatus.

In the secondary provisional installation the regular facilities of water intake and treatment together with a water supply pipeline will have been built for use till January, 1979 when the initial tank water test will begin. The main water supply pipeline will be equipped with one raised branch point closed by a stop valve at each working area, and whenever it will be necessary, a temporary pipeline can be connected with the valve and be extended to objective points to supply water.

2) Electric Power

As the primary provisional installation is concerned with the civil works such as land adjustment, tank foundation, etc., there will not be very much the consumption of electric power. Consequently, a diesel engine ganerator of 50 KVA or around, will be provided.

Because there will be, on a large scale, a lot of welding works, for tanks, piping, etc. during the secondary provisional installation, it is estimated so much that approximately 1,200 KW will need to be supplied at the peak.
The two emergency diesel engine generators (750 KW each) designed for the purpose of emergency operation of the Refinery will be temporarily used for the power source for this provisional installation.

The generator will have been installed till July, 1978 when the assembly of tanks will begin.

Such temporary electric facilities as the main lines, transformers and switch gears, which are shown in Fig. 7 - 5, will be stationarily installed, but a branch line and distribution panel (shown by a dotted line) can be moved from place to place according to the progress of the works and used, in sequence, for the most economical use.

3) Concrete Plant

The primary provisional installation will use an engine powered mixer.

In secondary provisional installation, a batcher plant powered by an electric motor with 1.0m^3 level capacity will be installed in the field.

4) Building

The following temporary building will be constructed at the beginning of the construction schedule, and used through the entire working period.

° Cement storehouse	$10^m \times 12^m \times 1$
° Laboratory for concrete test	$7^m \times 12^m \times 1$
° Field offices	$10^m \times 30^m \times 2$
° Labour centers	$20^m \times 50^m \times 2$
° Warehouse	$20^m \times 40^m \times 1$
° Piping prefabrication shop	$15^m \times 40^m \times 1$
° Shops for electrical, instrument, insulation and painting works	$10^m \times 30^m \times 4$

7, 3, 2 Civil and Architecture

The work of civil and architecture is composed of various works such as access road, land adjustment, tank foundations, machinery foundations, buildings, water supply and sewer, shipping jetties. The construction work for the these must be carried out in good order so that there are no conflicts in the installation of equipment and machinery.

Construction work will begin at access road, and proceed to land adjustment, and to tank foundations. Some of these will be carried out in a series and other will be done in parallel.

In view of the soil bearing force of $2t/ft^2$, it was considered that the foundations for facilities at the Site would be able to be laid directly on the ground without driving of piles. However, there may be changes in design of the foundation according to the actual results of soil survey of the Site.

Construction volume for major civil works is roughly estimated in Table 7 - 1.

Table 7 - 1 CONSTRUCTION VOLUME FOR MAJOR CIVIL WORKS

Item	Refinery Site	Terminal Site	Total
Excavation	178,000^{m3}	19,700^{m3}	197,700^{m3}
Concrete	34,600m^3	12,900m^3	47,500m^3
Form	166,600m^2	18,300m^2	184,900m^2
Paving gravel	56,000m^3	26,000m^3	82,000m^3
Sand for tank foundation	37,900m^3	4,100m^3	42,000m^3
Concrete pile	(350mmsq. L=6~12m)	1,080pcs	1,080pcs

In order to carry out this work within the short period, for each moving work, it will be made full use of such construction machinery as scrapers, bulldozers, shovels, dump trucks, cranes, etc., and for concrete work, it will be necessary to increase the work efficiency by using a batcher plant, truck mixers, and concrete pumps.
It is expected that approximately 100m^3 of concrete will be used per day on the average.

Important critical points of this progress are, from the conclusion of the contract, start of tank assembly at the 13th month, beginning of water supply and drainage at the 19th month, and beginning of process equipment installation at the 23rd month. The foundation work for the facilities must be performed to meet these critical points.

1) Refinery Site

(a) Access Road

The access road is expected to extend to approximately 8 km, it will be constructed from the bank of the Irrawaddy River to the Site on top of the plateau. In order to haul the great amount of materials and equipment smoothly, the road will be paved with asphalt (paving surface about 60,000 m^2). It is thought that the construction work of the access road should begin before the conclusion of the contract because it should complete till the start of gravel paving in the Site, which will be at 6th month after the conclusion of the contract.

(b) Land Adjustment

The land adjustment area is expected to be 750m x 1,100 where the amount of earth to be moved will be not so much because it is an almost flat level land.

The commencement of the work is scheduled to be three months after the contract: the same time as when the lay-out plan of the Refinery will have been decided.
The amount of earth to be moved is estimated to be around 250,000m^3 with the major part of the work done by the scrapers.

(c) Road Construction inside the Site
When the land adjustment will be about half finished, paving the roads with gravel will begin so that they will be used as temporary roads for use in construction of tank foundations and machinery foundations.
Finished concrete paving of the roads will be done when the construction of the Refinery will be almost completed. It is estimated that 23,000 m^3 of gravel will be needed for the initial work, which will mean an average of 160 m^3 of gravel per day will need to be hauled, laid and compacted if a six month working period be necessary.

(d) Tank Foundation Work
Because assembly work of the tanks is scheduled to begin at the 13th month, the construction of their foundations must be completed in time.
The surface soil is taken away, and sand is laid and compacted for making the foundations. As much as 38,000 m^3 of sand is estimated to be needed for the foundations, which will mean an average of 280 m^3 of sand per day will need to be laid if a six month working period be necessary.
The commencement is scheduled for the 9th month.

(e) Machinery Foundation and Basin Work
This will require about 7,000 m^3 of concrete. This shall

be completed during about 8 months so that the installation of machinery can begin in time and progress favourably.

(f) Water Supply and Sewer Work

The tank water filling test is scheduled for the 19th month. By that time, the water intake facilities at the Irrawaddy River and water pipeline shall be completed for use of the test, as well as the necessary sections of the water loop line of the fire fighting system in the Refinery Site.

It is desired that the supply water is clarified, so the water treatment facilities at the Terminal Site should also be completed.

Because the water will be drained from the tanks to the rain water sewer after completion of the test, the necessary sections of the rain water system shall be completed.

(g) Building Work

The building for the emergency generator shall be built at first so that the generator will be able to be installed in time. The construction of other buildings will begin at their foundation in parallel with the machinery foundation and it shall be carried out in such a correct order as conflicts to erection and installation of the equipment can be avoided.

(h) Fire Dike

The construction of fire dikes will be carried out in parallel with assembly of tanks. But final closing works of dikes will be respectively done after water filling tests of the relative tanks.

2) Terminal Site

The works of access road and land adjustment will be undertaken in the Terminal Site in the wake of completion of the relative works at the Refinery Site. Also, the foundations for the tanks and equipment in the Terminal Site can be undertaken in the wake of completion of the tank foundations at the Refinery Site because there will be such a leading time as assembly of tanks of the Terminal Site is scheduled to begin at the stage where assembly of some tanks will have completed at the Refinery Site.

3) Shipping Jetties

A total of nine jetties will be needed: 2 for the bulk shipping, 6 for the drum shipping, 1 for the petroleum coke.
Because the bulk shipping jetty will be a fixed type, the most of its construction will be on the pilings and assembly of steel structure as an upper part of it.
As the drum and petroleum coke jetties will be pontoon-swing bridge types, their works will be on pilings for mooring, assembly of steel bridges, and setting of pontoons.

The construction of shipping jetties shall be primarily carried out during the two dry seasons, and the work shall proceed as quickly as possible. For that purpose, it was considered that the pilings as foundation of the bulk shipping jetty would be carried out in parallel with assembly of steel structure on land, and then the structure assembled would be installed on the pile foundations.

7.3.3 Erection and Installation

The erection and installation work is classified into three main groups: construction of tanks, installation of process units and installation of the other facilities.

1) Construction of Tanks

The number of tanks is as many as a total of 48 including those at the Terminal Site.

As assembly of the tanks will all be done at the field, construction works of tanks will account for largest part of the entire construction work of the Refinery.

The tanks were divided into the following 5 blocks in order to permit to begin assembly works of respective blocks in a row. It is because it is very useful for putting skilled workers to good uses and for obtaining the best working average during the time period.

- Crude oil tank farm
- Product tank farm
- Semi product tank farm
- Spherical tank farm
- Terminal Site tank farm

Furthermore, the workers to be engaged were allocated to the following three groups:

- Group A : Product tank farm → Semi product tank farm
- Group B : Crude oil tank farm → Terminal Site tank farm
- Group C : Spherical tank farm

After Group A will complete the construction of product tank farm, they, in order, will move to undertake that of semi product tank farm. Shortly after Group A, Group B will begin the construction of crude oil tank farm, and, in order,

move to that of Terminal Site tank farm with completion of crude oil tank farm. But spherical tank farm will be built independently by Group C.

After all steel plates for tank shells, in shops, will have finished in their edge preparation and rolled in their prescribed radii, they will be shipped to the Site. Therefore the full attention shall be paid on their arrangement and storage by means of careful checks of Item Nos and Matchmarks on them in order to avoid conflicts to be caused at their assembly.

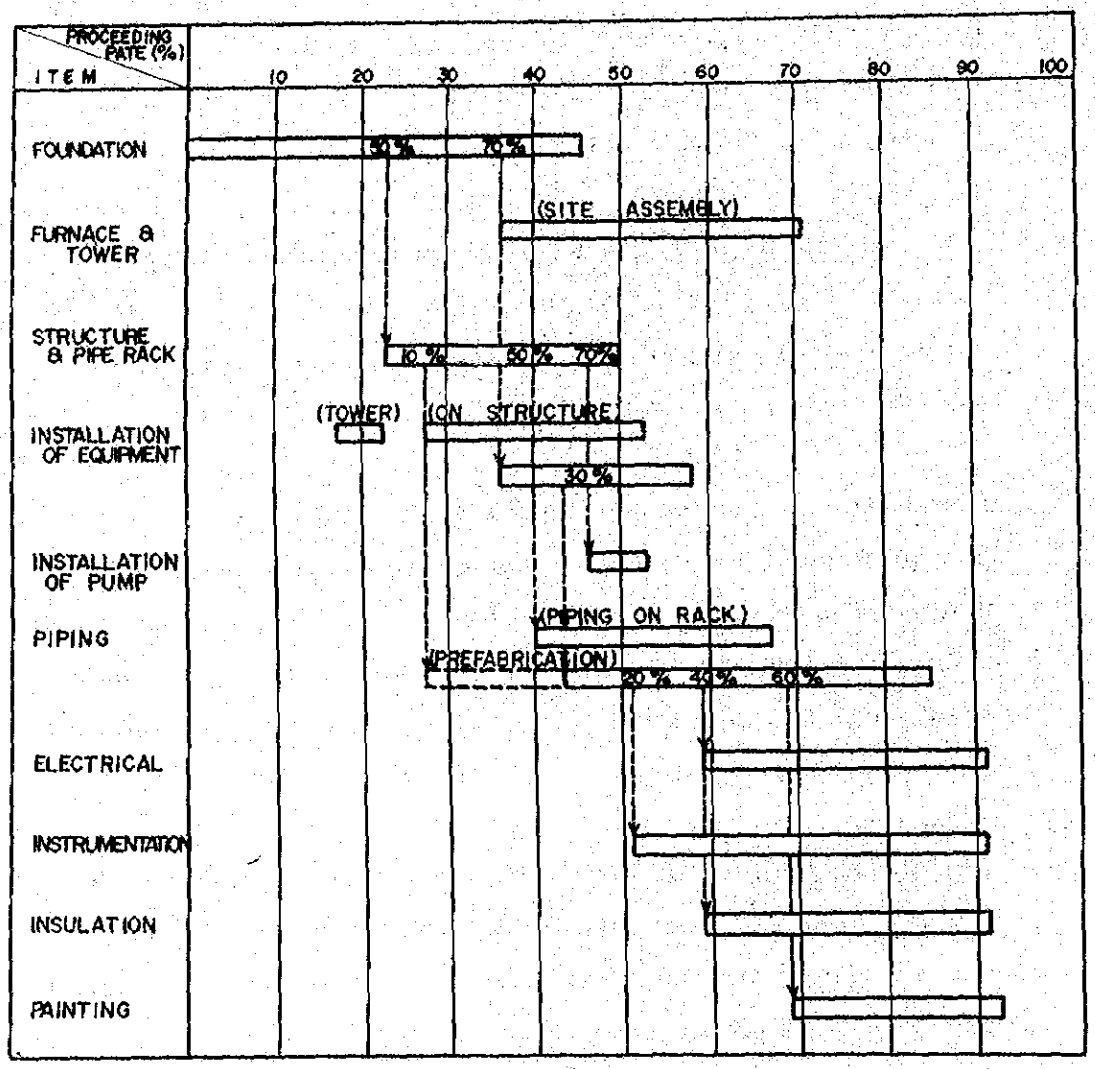
A use of automatic welding equipment is being considered for works on larger tanks. In this case, it is necessary that the welders will go abroad to be trained in the complete use of the equipment, and then go back to the work at the Site.

2) Installation of Process Units and Other Facilities

The procedure for work development is shown in Fig. 7 - 6. The construction work of the Refinery, following this pattern, will proceed with the respective works of installation of equipment and machinery, piping electrical, instrument, insulation and painting.

The starting points of respective works will be controlled and fixed by a supervisor in the field. The before-mentioned starting points and the points marked, in Fig. 7 - 7 : Progress Schedule, with power supply, water supply, utility test run and plant test run become critical points in the progress of the refinery construction work.

FIG. 7-6 CONSTRUCTION PROGRESS PATTERN



The tall columns exceeding the length limitation for transportation will be divided into some pieces within the limitation and sent to the Site. These pieces will be assembled by welding on the turning roller set in the Site to a complete one, and then it will be set up.

A largest one is the main fractionator for the Topping Unit:
3.8m in diameter, 45m in length, 95 tons in weight.
A 100 ton ginpole will be provided and used for its installation.
A large-sized truck crane or crawler cranes will be used for installation of the others.
The works of under ground piping around columns shall be completed prior to their installations to avoid complications.
Also, the assembly works of such facilities which require a longer field work as cooling tower, etc. and of such equipment of knock-down equipment as furnaces shall begin at early stage of the progress when foundation work will allow.

Next, assembly works of steel structure and pipe racks will begin at their established positions.
Prefabrication of piping will also begin at this time. It will have a large influence on the time needed to complete the refinery construction how smoothly piping work can progress. A shop will be built at the Site and prefabrication of piping will be carried out there in accordance with the spool drawings.

The installation of piping, at the Refinery Site, will begin with laying of main lines consisting of large size pipes and pipes on pipe racks, then continue to that of branch lines consisting of small size pipes.
In piping work, a special consideration shall be paid for protecting the insides of pipes from sand and mud.

A crude oil pipeline and the product pipelines can be carried out independent of the installation work at the Refinery Site. The welding work for these will be done by engine welders in view of a saving of temporary electric facilities.

As the installation work, in order, will develop to electrical work and instrumentation work, a whole shape of the Refinery will gradually be appearing, and then cleaning of the piping, trial runs of the rotary machinery, and curing of the furnaces will begin in preparation for the plant operation.
It is necessary at this time that such utilities as electric power, water, steam, shall be stably supplied for those jobs.

7. 3. 4 Local Fabrication

It is desired to utilize the factories in the Country fully for fabrication of equipment.
From a result of the investigation, those articles shown in Table 7 - 2 were favourably considered to be fabricated in the Country according to the following reasons.

- Platforms and ladders can easily damaged to deformation during their transportation.
- Pontoon and non-pressurized vessels incur expenses during their transportation due to their bulky shapes.
- The facilities and working level of existing factories in the Country is equal to the job.

The following factories are advisable for the job in view of their facilities, working level and experiences:

- Sinmalaik Dockyard

- Maintenance Shop of Syriam Refinery
- Maintenance Shop of Chauk Refinery

Products manufactured at a local factory must be delivered to the Site in time in accordance with the time schedule required for the construction work. Also, it is important that a close correspondence must be maintained between a factory and the Site while production is going on.

On this point, the Maintenance Shop Chauk Refinery is especially suitable because of its close proximity. However, because the total weight amounts to 2,270 tons as shown in Table 7 - 2, there remains the question of whether one shop can capably do all the work or not. The Burmese side and a contractor must discuss the details of this point at a later date.

TABLE 7 - 2 LIST OF LOCAL FABRICATION

	Name of Equipment	Q'ty	Weight
1.	Pontoons	8	750 tons
2.	Non-pressurized small vessels	26	20 tons
3.	Platforms and ladders	1 set	100 tons
4.	Pipe racks	1 set	1,000 tons
5.	Steel structure	1 set	400 tons
	Total		2,270 tons

7.4 Construction Schedule

The progress of the Refinery construction is shown in Fig. 7 - 7.

According to this progress schedule, the project contract is scheduled to come into force on July 1, 1977 and the end of the plant test run is expected to be at the end of December, 1980; 42 months after. While it was thought initially that the test run could be completed in 33 months, but unfortunately this seems to be unfeasible according to the following reasons as a result of the detailed study.

- A long period is necessary for procurement and supply of the great amount of locally available materials.
- Most of the construction works of shipping jetties must be carried out during the dry seasons.
- The peak in number of workers must be kept moderate.

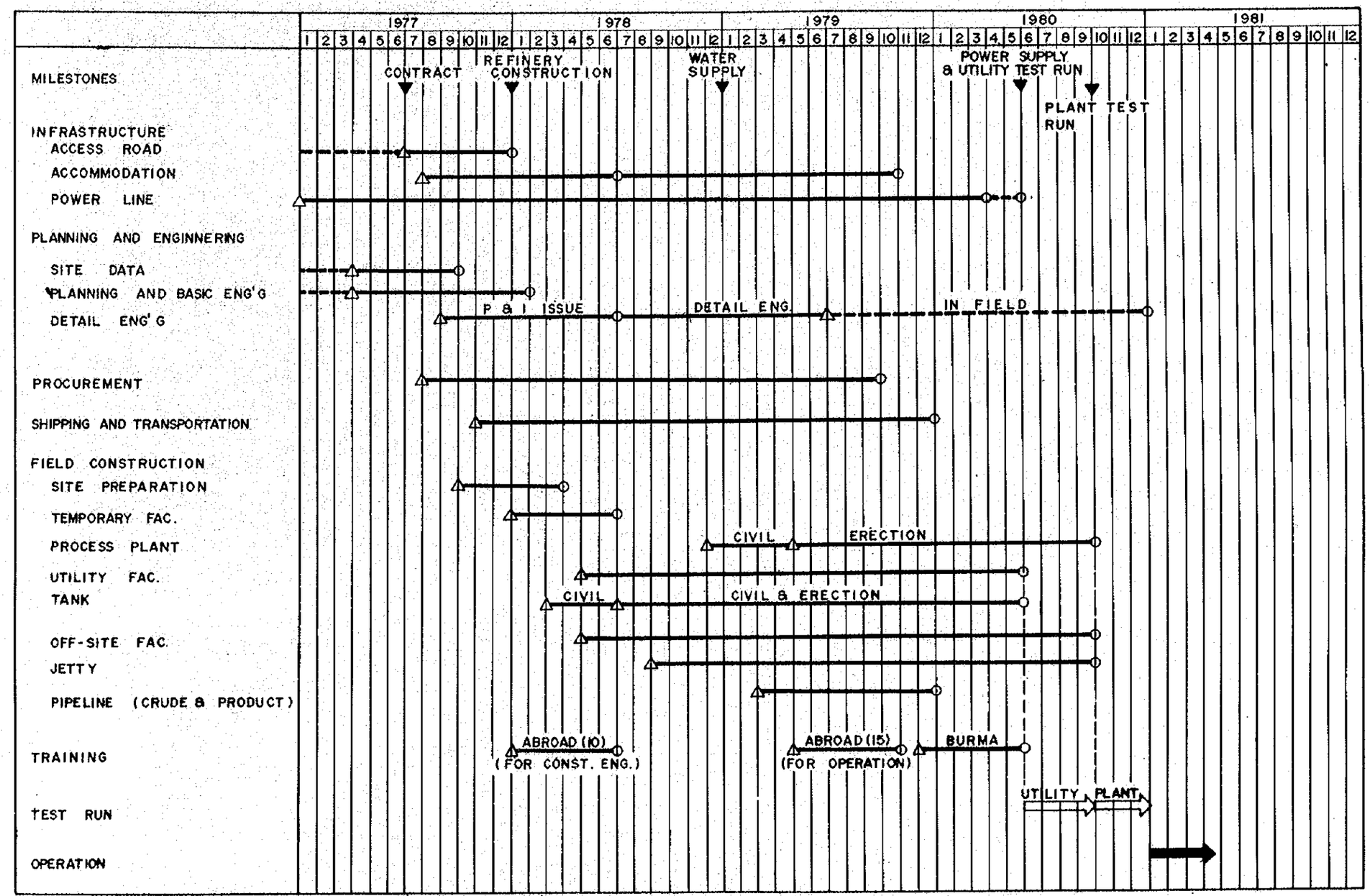
In the construction schedule, it was designed that major jobs should be carried out according to the following plans.

- The surveys about the Site should be started at the earliest and the all including boring test for machinery foundations should be completed, at the latest, by the end of September, 1977.
- The construction of access road should be begun at the earliest and be completed by the end of December, 1977, that is, before gravel paving work at the Refinery Site will begin.
- The primary provisional installation is scheduled to begin at the beginning of January, 1978. The secondary provisional installation is to begin at the beginning of May, 1978.
- Power necessary for tank tests shall be available by beginning of January, 1979, which will be supplied from Malun power

station. For the start-up operations, Kyunchaung power transmission line shall be completed by March 1980.

- Construction of tanks is scheduled to begin at the beginning of July, 1978 and is expected to be completed at the end of April, 1980.
- Installation of process units is scheduled to begin at the beginning of May, 1979. Installation of piping is expected to begin at the beginning of August, 1979: three months after, when large equipment will have been almost installed. Then electric and instrumentation works will follow that of piping.
- Introduction of crude oil into the crude oil tanks is expected to begin at the beginning of May, 1980. This crude oil shall be used as fuel oil for the boilers till home fuel will become available.
- Oil-in to the units shall begin at the beginning of October, 1980 and the plant test run will finish during the successive three months.

FIG. 7-7 PROGRESS SCHEDULE



7.5 Construction Machinery and Materials Plan

7.5.1 Construction Machinery Plan

The major construction machinery predicted to be necessary for the construction of the Refinery has been gathered into a table and shown in Table 7 - 3.

The following points were especially considered during its preparation.

- In regard to the construction work of civil and architecture, there is a necessity to plan the mechanization of concrete work from the standpoint of ensuring its successful completion within the established time. For this purpose, a batcher plant, mixer trucks, and a concrete pump were listed.
- A 127 ton truck crane was included for smooth unloading works at the river shore.
- A 80 ton trailer was included to haul unloaded materials and equipment smoothly to the Site.
- As for the quantity and type of welder, engine welders in moderate quantity were included in the plan taking into consideration the construction schedule and the plan of electric power source for temporary facilities.
- Because the main fractionator for the Topping Unit can be hardly erected by the 127 ton truck crane, it was designed to be erected by a ginpole.
- It was expected that such heavy-duty construction machinery for civil work as shovel, bulldozer etc., could be supplied in the Country.
- It was considered that the contractor should supply heavy-duty cranes because they were big in size, and to ensure smooth construction work would require them to be maintained fully.

TABLE 7 - 3 LIST OF MAJOR CONSTRUCTION MACHINERY

	Machine Name	Description	No. Req'd	Allocation to Burmer	Allocation to Contractor
1.	<u>For Civil Work</u>				
(1)	Power Shovels	0.6 m^3	2	2	-
(2)	Scrapers	9 m^3	8	8	-
(3)	Bulldozers	23 tons	2	2	-
(4)	Bulldozers	19 tons	10	10	-
(5)	Bulldozers	13 tons	2	2	-
(6)	Tractor Shovels	1.4 m^3	3	3	-
(7)	Tractor Shovels	0.5 m^3	2	2	-
(8)	Motor Graders	blade 3.0m	2	2	-
(9)	Back Hoes	0.3 m^3	5	5	-
(10)	Dump Trucks	6 ton	32	32	-
(11)	Trucks	6 ton	10	10	-
(12)	Truck Cranes	10 ton	4	4	-
(13)	Truck Cranes	30 ton	2	1	1
(14)	Pile Drivers	D-18-22 hammer	2	2	-
(15)	Welders (engine)	300A	4	4	-
(16)	Batcher Plant	1 m^3	1	-	1
(17)	Truck Mixers	3 m^3	6	-	6
(18)	Concrete Pump	15 m^3/h	1	-	1
(19)	Tampers	80 kg	4	-	4
(20)	Tire Rollers	15 ton	3	3	-
(21)	Road Rollers	15 ton	2	2	-
(22)	Asphalt Plant	30 t/h	1	1	-
(23)	Asphalt Finisher	L=2400mm	1	1	-
(24)	Compressor (engine)	50 Hp	1	1	-
(25)	Drainage Pumps	2B	5	5	-

	Machine Name	Description	No. Req'd	Allocation to Burmer	Allocation to Contractor
2.	For Installation				
2.1	Heavy-Duty Machinery				
(1)	Truck Crane	127 ton	1	-	1
(2)	Truck Crane	35 ton	1	-	1
(3)	Truck Cranes	30 ton	2	-	2
(4)	Crawler Cranes	30 ton	3	-	3
(5)	Trailer	80 ton cap.	1	-	1
(6)	Trucks	10 ton	2	2	-
(7)	Trucks	8 ton	3	3	-
(8)	Trucks	2 ton	5	5	-
(9)	Wrecker Cars	w/8t pole	3	3	-
(10)	Fork Lift Trucks	2 ton	2	-	2
(11)	Gin Pole with Accessories	100 ton	1 set	-	1 set
2.2	Welding				
(1)	Engine Welders	300 A	20	-	20
(2)	Argon Welders	500 A	3	-	3
(3)	Electric Welders	300 A	90	-	90
(4)	Automatic Welders	600 A - 1000A	4	-	4
(5)	Welding Rod Dryers	For 200 kg	4	-	4
(6)	Portable Dryers	For 10 kg	50	-	50
(7)	Carbon Arc Gauging Units	D.C. 600A	5	-	5
(8)	Annealing Machine	180 KV (30KV x 6P)	1 set	-	1 set
2.3	Inspection				
(1)	Air Compressors	7 kg/cm^3	4	-	4

	Machine Name	Description	No. Req'd	Allocation to Burmer	Allocation to Contractor
(2)	Air Compressors	60 kg/cm^2	1	-	1
(3)	Water Pressure Pump	150 kg/cm^2 30 l/min	1	-	1
(4)	X-Ray Photographic Equipment	200 KVP	2	-	2
(5)	Magnaflax Test Units	3600 AT-AC	3	-	3
(6)	Vacuum Test Pumps	0.01 mmHg	4	-	4
2.4	General Use				
(1)	Turning Rollers	30 ton cap. 4,000 ϕ	3 sets	-	3 sets
(2)	Impact Wrenches	1' 1/4" x 3"	2 sets	-	2 sets
(3)	Tube Expander	w/control regulator	1 set	-	1 set
(4)	Pipe Screw Cutting Machines	1" - 6"	2	-	2
(5)	High Speed Pipe Cutters	2" - 10"	2	-	2
(6)	Pipe Benders	Max. 6"	2	-	2
(7)	Oil Jacks	50 ton	3	-	3
(8)	Oil Jacks	20 ton	3	-	3
(9)	Chain Blocks	5 ton	2	-	2
(10)	Chain Blocks	3 ton	3	-	3
2.5	Other Small Tool				
(1)	Grinders	1 set	-	-	1 set
	Air Rotary Grinder	1 set	-	-	1 set
	Air Angle Grinder	1 set	-	-	1 set
	Electric Grinder	1 set	-	-	1 set

	Machine Name	Description	No. Req'd	Allocation to Burmer	Allocation to Contractor
(2)	Electric Drills		1 set	-	1 set
(3)	Pipe Vice		1 set	-	1 set
(4)	Pipe Bevelling Machine		1 set	-	1 set
(5)	Gas Welders and Cutting Equipment		1 set	-	1 set
	Acetylene hose		1 set	-	1 set
	Torch regulator		1 set	-	1 set
	Oxygen hose		1 set	-	1 set
(6)	Cabtyre Cord		1 set	-	1 set
(7)	Distribution Boards, Projector		1 set	-	1 set
(8)	Transit, Y level, etc.		1 set	-	1 set
2.6	Transportation & Stationary				
(1)	Jeeps		3	-	3
(2)	Micro-Buses		2	-	2
(3)	Motorcycles		5	-	5
(4)	Light Vans		2	-	2
(5)	Room Coolers		50	-	50
(6)	Refrigerators		15	-	15
(7)	Desk Calculators		2	-	2
(8)	Xerox		1	-	1
(9)	Receiver Sets		1 set	-	1 set
(10)	Simple Water Filters		5 sets 2 sets	- -	5 sets 2 sets

7.5.2 Construction Materials Plan

The construction materials consist of the materials used as structures of civil and architecture, and the consumable materials in installation works.

With regard to the former, it is expected that the materials, excluding steel or special materials can be procured in the Country. However, in regard to the latter, it was planned that these should be supplied by the contractor, because it seems difficult to procure in the Country within a short period because these consist of many special kinds.

For your reference, the major materials locally supplied for civil and architecture are shown in Table 7 - 4, and the consumable materials supplied by contractor for installation work are shown in Table 7 - 5.

TABLE 7 - 4 LIST OF MAJOR MATERIALS LOCALLY SUPPLIED FOR CIVIL AND ARCHITECTURE

	Material Name	Description	Q'ty Req'd
(1)	Cement		15,600 tons
(2)	Sand		23,300 m^3
(3)	Gravel		46,600 m^3
(4)	Timbers		3,000 m^3
(5)	Concrete Piles	14" x 14" x 6.0 mL	100 pcs
(6)	ditto	14" x 14" x 12.0 mL	450 pcs
(7)	ditto	14" x 14" x 10.0 mL	530 pcs
(8)	Hume Pipes	ϕ 300 mm	2,350 m
(9)	ditto	ϕ 600 mm	2,400 m
(10)	ditto	ϕ 750 mm	350 m

	Material Name	Description	Q'ty Req'd
(11)	ditto	ϕ 900 mm	460 m
(12)	ditto	ϕ 1,200 mm	450 m
(13)	Slates	for roof	6,730 m^2
(14)	ditto	for wall	3,800 m^2
(15)	Rubbles		10,500 m^3
(16)	Paving Gravel		82,000 m^3
(17)	Sand for Tank Foundation		42,000 m^3
(18)	Reinforce Bars	to be used for buildings left in the scope of Burmese Side	190 tons
(19)	Steel Frames		80 tons
(20)	Fuel & Lubricating Oil		1,300 Kℓ

TABLE 7 - 5 LIST OF MAJOR CONSUMABLE MATERIALS FOR INSTALLATION

	Material Name	Description	Q'ty Req'd
(1)	Electric Welding Rods		200 tons
(2)	TIG Welding Rods		1,500 kg
(3)	Carbon Arc Gauging Rods		1,000 kg
(4)	X-Ray Films		1,500 sheets
(5)	Developer for X-Ray Film	10 ℓ/can	200 cans
(6)	Colour Check Reagent	450 cc/can	500 cans
(7)	Oxygen	7 kg/cylinder	1,500 cylinders
(8)	Acetylene	7 m^3/cylinder	500 cylinders
(9)	Argon Gas	ditto	200 cylinders
(10)	Propane Gas	5 kg/cylinder	100 cylinders
(11)	Other various consumable stores		1 set

7.6 Construction Manpower Plan

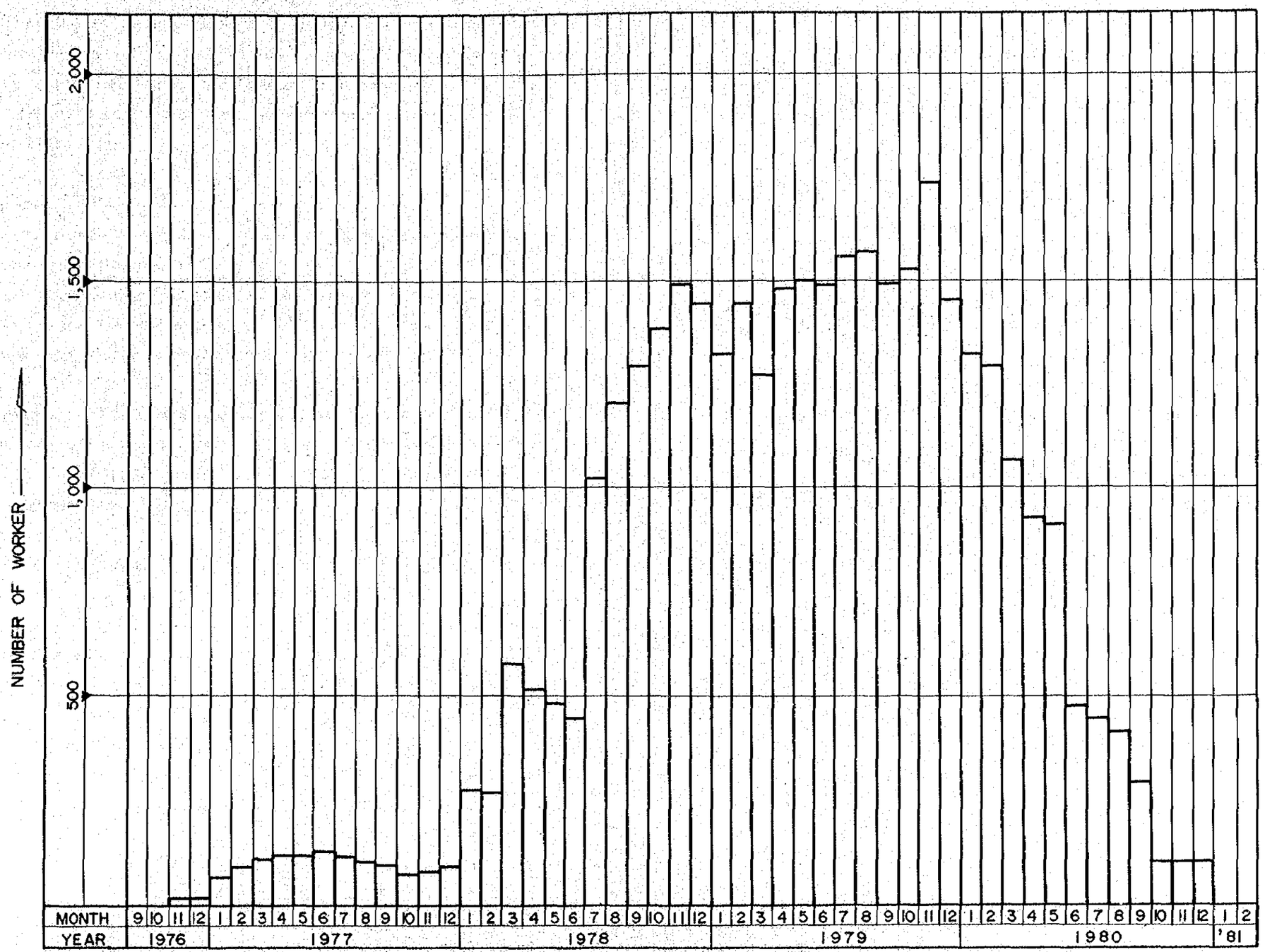
For reference, the estimated manpower required for the construction of the Refinery is shown below by kinds of jobs.

Job Name	Manpower Required (man-day)
Survey	7,600
Land adjustment	7,600
Access road	19,700
Provisional Installation	18,700
Unloading-hauling	15,800
Civil	304,200
Architecture	80,700
Shipping jetty	50,500
Tankage	125,500
Installation	47,900
Piping	116,300
Electricity	56,500
Instrumentation	32,000
Insulation	19,000
Painting	14,400
Assist for plant test run	7,500
Total	923,900 man-day

The numbers of workers required in every month are shown in Fig. 7 - 8.

It can be seen from this that the maximum of worker is appriximately 1,800 men per day. It is required that 30% of this, at least, shall be skilled workers.

FIG. 7-8 MAN POWER ALLOCATION



It seems necessary that 10 persons will receive a series of training in abroad so that, in the field during the construction, they can conduct the workers engaged in such jobs requiring a high level of technology as welding, installation and maintenance of rotary machinery, instrumentation. It is advisable that the details of this shall be discussed and settled later between the Burmese side and the contractor.

7.7 Supervisor Plan

The construction works as well as the test operation shall be conducted by the Burmese side under the guidance of supervisors dispatched from the contractor. As a result of estimation, the total of them is expected to be 1,012 man-months as mentioned below, and there, at peak point, will be 42 men at the Site.

In principle, the services of supervisors shall be for advising, however, if necessary, they will make demonstrations on the jobs which require special technique, and also be engaged in training of workers in the field.

1)	Construction - - - - - - - - - -	895 man-months
	Field administration	(160)
	Transportation	(44)
	Design	(56)
	Civil & architecture	(63)
	Installation	(558)
	Local fabrication	(14)
2)	Plant Test Run - - - - - - - - -	105 man-months
3)	Commercial Operation - - - - - for one year	12 man-months
	Total	1,012 man-months

Chapter 8.

CONSTRUCTION COST

Chapter 8

CONSTRUCTION COST

8.1 Estimation Basis

1) The contractor shall supply materials and equipment on the basis of FOB Japan, and the construction work of the Refinery is to be carried out by the Burmese side together with the plant test run with cooperation of supervisors dispatched by the contractor.
As for the necessary surveys previously mentioned in 7.1 - Site Survey, whole items of it are to be conducted by the Burmese side without any guidances of the supervisors in the field.

2) The locally available materials are to be provided and supplied by Burmese side in compliance with the request prepared by the contractor.

3) It is a principle that the materials and equipment to be supplied by the contractor shall be procured in Japan. However, if there are special goods unavailable in Japan, these, for example, special testing apparatuses, etc., will be procured by the contractor in other countries.

4) The foreign exchange rate for currency should stand at ¥300 per US $1 or K 6.60 per US $1.

5) The foreign currency portion of construction cost is estimated on the understanding that the contract will come into force in July, 1977, and that the plant test run will be completed within 42 months after the contract.

6) The local currency portion of construction cost is estimated based on the following conditions;

°	Labor cost:	K300/month per capita in average as suggested by Burmese side. With assuming that working days would 25 days per month, the man-day cost of labor is taken as K12/day.
°	Civil work cost:	Costs of materials to be procured locally such as sand, gravel, timber, fuel, etc. are taken as those informed by Burmese side. Lease fees of machinery and equipment and required manpower are assumed based on those derived from experiences in Japan with the local conditions taken into consideration.
°	Installation:	Costs of locally procured materials such as fuel are those informed by Burmese side. Lease fees of machinery and equipment are not reckoned in on the assumption that they are supplied by Contractor. Required manpower are estimated in the same manner as in the civil work cost.
°	Overhead expense:	5% of direct construction cost is taken, as suggested by Burmese side.

8.2 Scope of the Project

The scope of the new refinery project shall be defined as follows;

1) Site survey
2) Land adjustment
3) Civil work
4) Refinery facilities

5) Facilities outside Refinery

- Crude oil pipeline
- Shipping jetty
- Access road
- Living compound
- Power transmission line
- Inter-refinery communication facilities
- Public transportation

However, the last four items of facilities outside Refinery (Living compound to Public transportation) are not included in the construction cost of the proposed project since they are to be constructed on other funds.

8.3 Construction Cost

1) Foreign currency portion

(Unit: thousand yen)

Item	Capital Investments	Description
(1) Process units	7,281,000	Topping Unit with Stabilizer & Splitter, Naphtha HDS Unit, Reforming Unit, SPI Unit, Coking Unit, LPG Recovery Unit, Naphtha Merox Unit
(2) Utility facilities	4,973,000	Water Intake and Water Treating Fac. Cooling Water fac., Boiler and Steam fac., Electricity Receiving and Distribution fac., Air fac., Home Fuel fac., N_2 Generator
(3) Off-site facilities	8,725,000	Waste Water Treating fac., Blow Down and Flare fac., Tank yard, Filling and Shipping fac., Fire-fighting fac., Communication fac., Building, Jetty, Pipeline

Item	Capital Investments	Description
(4) Other materials	3,737,000	Construction machinery, Auxiliary materials, Temporary fac., Internal Transportation fac., Maintenance Equipment and Tools, Laboratory equipment, protective appliances, First-aid appliances, Catalysts (two charges) and Chemicals (two years supply), Spare parts (two years supply)
(5) Freight and Insurance	1,924,000	Ocean freight, Marine insurance and Other insurances
(6) Engineering and Supervision	3,116,000	Engineering fees, Supervisor's fees for construction and operation
(7) Training	194,000	Fees for training abroad
Total	29,950,000	

2) Local currency portion

(Unit: thousand Kyat)

Item	Capital Investment	Description
(1) Survey	2,200	Project study, Site survey, Data gathering
(2) Civil work	33,945	Access road, Land adjustment, Fence and roads, Tank foundation, Foundation for equipment, Sewer, Pond, Water Intake fac., Temporary fac.
(3) Building	9,871	Factory building, Administration building
(4) Jetty	8,168	Shipping jetties (Bulk, Drum, Coke)
(5) Installation	9,790	Works of installation, piping, electricity, instrumentation, insulation, painting
(6) Local fabrication	669	Local fabrication of such equipment as small atmospheric tanks, pontoons, platforms, ladders, pipe racks, structures

Item	Capital Investment	Description
(7) Import duty	92,346	17% of FOB prices of materials and equipment
(8) Inland transportation	2,625	Transportation cost of materials and equipment supplied on the FOB basis, from Rangoon Port to the site
(9) Other supplies	440	
Total	160,054	

Chapter 9.

OPERATION OF REFINERY

Chapter 9

OPERATION OF REFINERY

9.1 Operation Plan

In the operation plans for Syriam, Chauk, and Mann refinery, the following factors are taken into consideration;

- Production and supply conditions of crude oil.
- Transportation and distribution of the crude oil and products.
- Service factor of existing refineries, which is taken with due consideration for superannuation of their facilities.

Of those items, as the production and supply of crude oil has already been discussed in Chapter 2, crude oil will be produced at the oil fields in central Burma including Mann oil field as the core. And crude oil to the Mann Refinery will be supplied by pipeline, while that to the Syriam and Chauk Refineries will be made by oil barges. (It is said that the Government of Burma has a installation plan of cross-country crude pipeline which will run from the Mann oil field to the Syriam Refinery, and installation has partly started, while its completion target is unconfirmed.)

Therefore, from the point of view of crude transportation, the supply to the Mann Refinery is the most convenient, however, on the other hand, when we consider transportation and distribution of the products, it is requested for each refinery to process the crude oil in such quantities to correspond with the demand in each of their respective territories which will decrease the cost of product distribution.

Further, it is informed that the Chauk Refinery will, in future, begin to decrease their production rate on account of superannuation of his facilities. In fact, when the Mann Refinery is completed, Chauk Refinery will play an important part as a base for product distribution by reason of its location and the condition of facilities.

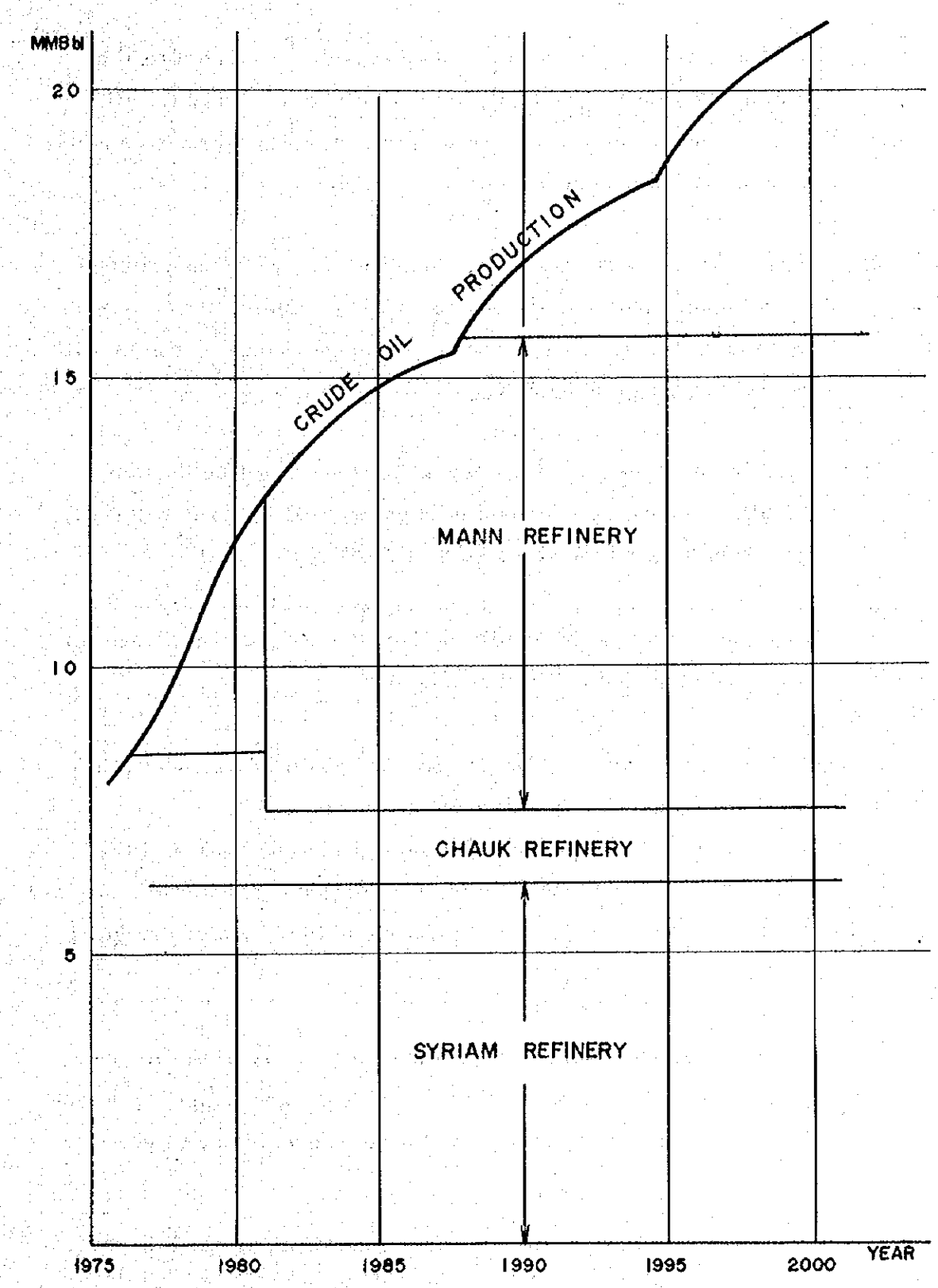
Hereinafter, operation plan of these refineries which contemplated based on the above mentioned basic plan is explained brieftly.

In Table 9 - 1 and Fig. 9 - 1, the production plan and the supply plan of crude oil for three refineries are shown respectively.

Table 9 - 1 PRODUCTION AND ALLOCATION OF CRUDE OIL (1,000 Bbl)

	Crude Oil Production	Crude Oil Allocation			Surplus
		Syriam	Chauk	Mann	
1977	8,821	6,205	2,299	-	317
1978	9,858	"	"	-	1,354
1979	11,130	"	"	-	2,626
1980	12,147	"	"	-	3,643
1981	12,961	"	1,278	5,478	-
1982	13,612	"	"	6,129	-
1983	14,133	"	"	6,650	-
1984	14,550	"	"	7,067	-
1985	14,883	"	"	7,400	-
1986	15,150	"	"	7,667	-
1987	15,363	"	"	7,880	-
1988	15,829	"	"	8,213	133
1989	16,495	"	"	"	799
1990	17,029	"	"	"	1,333

FIG.9-1 CRUDE OIL ALLOCATION



The basic idea of establishing these plans is explained in more detail as follows;

1) Although the Syriam Refinery has a problem related to the transportation of crude oil, it will be able to continue full operation with actual record of service factor without consideration for superannuation of its facilities.

2) The refining facilities at the Chauk Refinery are considered to be superannuated, therefore, after the Mann Refinery has been completed, the service factor of the Chauk Refinery will be decreased to about 50%.

3) The design capacity of the Mann Refinery shall be 25,000 BPSD. The crude processing capacity will be 23,750 BPCD, based on 95% of service factor of the Topping Unit.

4) At each refinery, crude oil shall be processed at the rate for minimizing product distribution cost.

In Table 9 - 2, the crude oil processing program is listed in the order of years at each respective refinery. In Table 9 - 3 and 9 - 4, the production quantity at each refinery is listed by year and the kinds of products shown. In Table 9 - 5, the total production quantity of the three refineries are listed by year and the kinds of products shown.

Based upon the above-mentioned production quantity of the products and the demand forecast, the balance of demand and supply is summarized in Table 9 - 6 in the order of kind of products and year.

TABLE 9-2 CRUDE THRUPUT OF EACH REFINERY

Year	Mann	Syriam	Chauk
1981	15,008 BPCD	17,000 BPCD	3,500 BPCD
1982	16,792 "	"	"
1983	18,219 "	"	"
1984	19,362 "	"	"
1985	20,274 "	"	"
1986	21,005 "	"	"
1987	21,589 "	"	"
1988 -	22,500 "	"	"

TABLE 9-3 PRODUCTION OF MANN REFINERY (1,000 Bbl)

Year	Crude Refined Thruput	Production			
		Gasoline	Kerosene	Diesel Oil	Fuel Oil
1981	5,478	1,071.0	931.2	1,722.8	931.2
1982	6,129	1,198.2	1,041.9	1,927.6	1,041.9
1983	6,650	1,300.0	1,130.5	2,091.4	1,130.5
1984	7,067	1,381.6	1,201.4	2,222.6	1,201.4
1985	7,400	1,446.7	1,258.0	2,327.3	1,258.0
1986	7,667	1,498.9	1,303.4	2,411.3	1,303.4
1987	7,880	1,540.5	1,339.6	2,478.3	1,339.6
1988	8,213	1,605.6	1,396.2	2,583.0	1,396.2

Notes: Gasoline includes naphtha
Yield 85.0%
Production rate : Gasoline 23%, Korosene 20%
Diesel Oil 37%, Fuel Oil 20%

TABLE 9-4 PRODUCTION OF SYRIAM AND CHAUK REFINERIES (1,000 Bbl)

Year	Crude Oil Refined	Production			
		Gasoline	Kerosene	Diesel Oil	Fuel Oil
1981 -	7,483	1,399.3	1,653.7	2,035.4	1,272.1

Notes: Gasoline includes naphtha
Yield 85%
Production Rate: Gasoline 22%, Kerosene 26%
Diesel Oil 32%, Fuel Oil 20%

TABLE 9-5 PRODUCT-WISE ANNUAL TOTAL PRODUCTION OF THREE REFINERIES (1,000 Bbl)

Year	Total Production			
	Gasoline	Kerosene	Diesel Oil	Fuel Oil
1981	2,470.3	2,584.9	3,758.2	2,203.3
1982	2,597.5	2,695.6	3,963.0	2,314.0
1983	2,699.3	2,784.2	4,126.8	2,402.6
1984	2,780.9	2,855.1	4,258.0	2,473.5
1985	2,846.0	2,911.7	4,362.7	2,530.1
1986	2,898.2	2,957.1	4,446.7	2,575.5
1987	2,939.8	2,993.3	4,513.7	2,611.7
1988	3,004.9	3,049.9	4,618.4	2,668.3

TABLE 9-6 DEMAND AND SUPPLY PROJECTION

(1,000 Bbl)

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Gasoline																					
Potential Supply	1,399	2,470	2,598	2,700	2,781	2,846	2,898	2,940	3,005	3,005	3,005	3,005	3,005	3,005	3,005	3,005	3,005	3,005	3,005	3,005	3,005
Requirement	1,989	2,020	2,053	2,086	2,119	2,153	2,187	2,222	2,258	2,294	2,331	2,368	2,406	2,444	2,484	2,523	2,563	2,604	2,646	2,688	2,731
Central & Upper Burma	1,193	1,212	1,231	1,252	1,277	1,292	1,312	1,333	1,355	1,377	1,399	1,421	1,444	1,466	1,490	1,514	1,538	1,563	1,588	1,613	1,639
Lower Burma	796	808	822	834	842	861	875	889	903	917	932	947	962	978	994	1,009	1,025	1,041	1,058	1,075	1,092
Surplus(+) or Deficit(-)	-590	+450	+545	+614	+662	+693	+711	+718	+747	+711	+674	+637	+599	+561	+521	+482	+442	+401	+359	+317	+274
Kerosene																					
Potential Supply	1,654	2,585	2,696	2,784	2,855	2,912	2,957	2,993	3,050	3,050	3,050	3,050	3,050	3,050	3,050	3,050	3,050	3,050	3,050	3,050	3,050
Requirement	3,117	3,226	3,339	3,456	3,577	3,702	3,832	3,966	4,105	4,249	4,397	4,651	4,710	4,875	5,046	5,222	5,405	5,594	5,790	5,992	6,202
Central & Upper Burma	1,714	1,774	1,837	1,901	1,967	2,036	2,108	2,181	2,258	2,337	2,418	2,503	2,591	2,681	2,775	2,872	2,972	3,077	3,185	3,296	3,411
Lower Burma	1,403	1,452	1,502	1,555	1,610	1,666	1,724	1,785	1,847	1,912	1,979	2,048	2,119	2,194	2,271	2,350	2,433	2,517	2,605	2,696	2,791
Surplus(+) or Deficit(-)	-1,463	-641	-643	-672	-722	-790	-875	-973	-1,055	-1,199	-1,347	-1,501	-1,660	-1,825	-1,996	-2,172	-2,355	-2,544	-2,740	-2,942	-3,152
Diesel Oil																					
Potential Supply	2,035	3,758	3,963	4,127	4,258	4,363	4,447	4,514	4,618	4,618	4,618	4,618	4,618	4,618	4,618	4,618	4,618	4,618	4,618	4,618	4,618
Requirement	3,356	3,523	3,700	3,885	4,079	4,283	4,497	4,722	4,958	5,206	5,466	5,739	6,026	6,329	6,644	6,976	7,325	7,691	8,076	8,479	8,903
Central & Upper Burma	1,678	1,762	1,850	1,943	2,040	2,142	2,249	2,361	2,479	2,603	2,733	2,870	3,013	3,165	3,322	3,488	3,663	3,846	4,038	4,240	4,452
Lower Burma	1,678	1,761	1,850	1,942	2,039	2,141	2,248	2,361	2,479	2,603	2,733	2,869	3,013	1,164	3,322	3,488	3,662	3,845	4,038	4,239	4,451
Surplus(+) or Deficit(-)	-1,321	+235	+263	+242	+179	+80	-50	-208	-340	-588	-848	-1,121	-1,408	-1,711	-2,026	-2,358	-2,707	-3,073	-3,458	-3,861	-4,285
Fuel Oil																					
Potential Supply	1,271	2,203	2,314	2,403	2,474	2,530	2,576	2,612	2,668	2,668	2,668	2,668	2,668	2,668	2,668	2,668	2,668	2,668	2,668	2,668	2,668
Requirement	1,372	1,411	1,438	1,473	1,515	1,542	1,574	1,600	1,629	1,651	1,676	1,702	1,718	1,734	1,746	1,759	1,767	1,801	1,848	1,891	1,936
Central & Upper Burma	823	847	863	884	909	925	944	960	977	991	1,006	1,021	1,031	1,040	1,048	1,055	1,060	1,081	1,109	1,135	1,161
Lower Burma	549	554	575	589	606	617	630	640	652	660	670	681	687	694	698	704	707	720	739	756	775
Surplus(+) or Deficit(-)	-101	+792	+876	+930	+959	+988	+1,002	+1,012	+1,039	1,017	+992	+966	+950	+934	+922	+909	+901	+867	+820	+777	+732

As can be seen from this Table, the demand of the so-called middle distillates such as kerosene exceeds the supply, while, on the other hand, production of gasoline (including naphtha) and fuel oil are having surplus.

With regard to gasoline fraction, it is considered as a future problem that a plant construction program for a petrochemical industry might be realized in Burma and for which gasoline may be used as its raw material.
For kerosene, most of the demand is for home use such as for lighting, and for cooking purposes. Then, if, in the future, the demand for this product is not substituted in certain areas by electricity, the gap between demand and supply will widen and prove difficult to fulfill.
As for diesel oil, it is recommended for making up shortage of supply that the end users make use of fuel oil instead of diesel oil as best they can.

On the other hand, the selection of production processes at the Mann Refinery has been investigated with due consideration for the above mentioned points, and the smoke point improver and coker units may be employed which, as a result, an increase in kerosene and diesel oil can be expected which can cover the gap between demand and supply to some extent.

However, with the adoption of a coker, the cracked gasoline which is produced thereby has a gummy compound which should be limited to below 15% of contamination into motor gasoline. Therefore, from this point, production increase of the middle distillates shall have a certain limit.

So, at the actual operation it is expected to increase production of

kerosene and diesel oil by saving stockpile in the reason of low demand and by relaxing specification of these products so far as it allowable.

Also, it can be read from the Table that 845,000 barrels per year on an average of fuel oil and gasoline fractions will be exported during 1980 to 1988. (In addition, most of coke production of 50 tons per day maximum at Syriam and 70 tons per day at Mann will also be exported, while it was not mentioned in the Table.)

9.2 Refinery Organization

In general, organization plan of refinery is to be established with consideration for the following items;

- Contents of refining facilities
- Scale of facilities
- Site conditions including relation to other industries in surrounding area.
- Labor conditions
- Regulation and custom related to labor
- Other local conditions

Of those, at the planning of organization of the Mann refinery, considerations were paid for characteristic of the refinery. For example, the Refinery will be equipped with up-to-date facilities which have never been experienced in Burma. At the same time, the plan was investigated with reference to the systems adopted in both the Syriam and the Chauk refineries.

The Organization Charts planned on the above basic considerations are summarized in Fig. 9 - 2 and 9 - 3.

FIG. 9-2 ORGANIZATION CHART OF MANN REFINERY

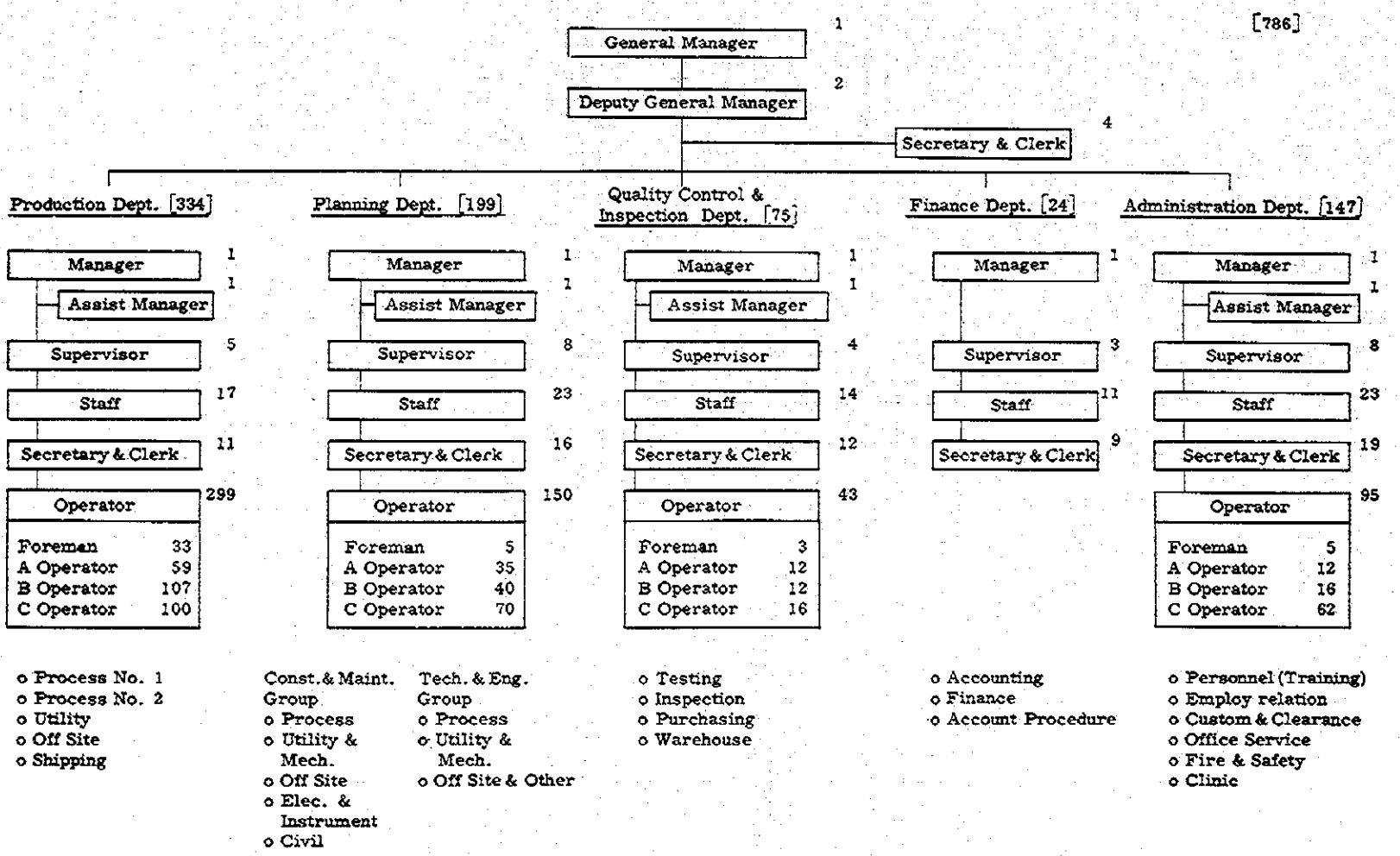
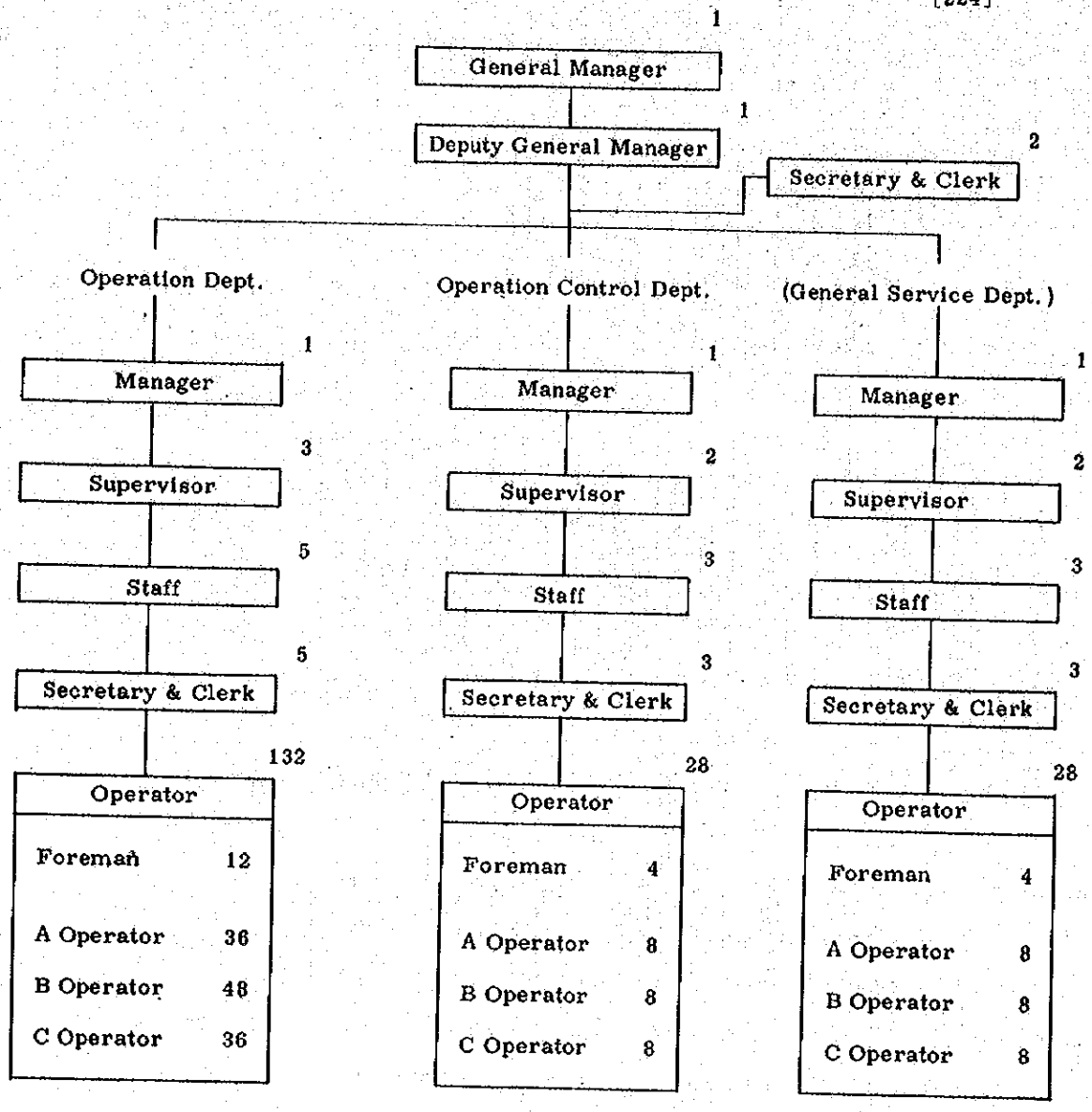


FIG. 9-3 ORGANIZATION CHART OF MIMBU TERMINAL

[224]



The Organization plan of the Terminal was established independently from the Refinery with consideration for the fact that the Refinery will belong to the function or PIC and the Terminal to PSSC.

In the plan of refinery organization, the following departments are provided under the jurisdiction of Refinery General Manager and of Deputy General Manager.

- Production Department
- Planning Department
- Quality Control & Inspection Department
- Finance Department
- Administration Department

Of these departments, each department except for Finance Department include the job field which contain shifts for 24-hours operation.

For shift system of refinery operation, various kinds of it are being adopted in each country and organization. In this plan for the Refinery and also for the Terminal, 4-shift system is applied to each shift operation field in accordance with the system adopted in other refineries in Burma.

Required numbers of employee is described in each organization chart, according to which a total of 786 people and 224 people are accounted for the Refinery and the Terminal respectively. In this plan of number of employee, it was contemplated to establish organization with not so many employee as that of the Syriam and the Chauk refineries.

The reason of the above are;

1) The Mann refinery is equipped with modern facilities.

2) The Mann refinery will start with not so complicated function as those of other refineries that are the core of industries in each area and include a part of function of other industries such as maintenance shop which is at service even for other industries.

Moreover, function of job is classified into ten classes from General Manager to Cooperator and salary structure for each is summarized in Table 9 - 7.

TABLE 9 - 7 SALARY STRUCTURE

* Figures include employees of Mann Refinery & Minbu Terminal

Class	Position	Total People*	Wage K./Month	Total Payment K./Month
1	General Manager	2	1,400	2,800
2	Deputy & Manager	3	1,300	3,900
3	Department Manager	8	1,100	8,800
4	Supervisor	39	900	35,100
5	Staff	99	650	64,350
6	Secretary & Clerk	84	575	48,300
	Sub-total	235		163,250
7	Foreman	66	380	25,080
8	A-Operator	170	270	45,900
9	B-Operator	239	195	46,605
10	C-Operator	300	185	55,500
	Sub-total	775		173,085
	Total	1,010		336,335

9.3 Operation Guidance and Training Program

The operation guidance shall be done for the performance operation after the mechanical completion of the new refinery. It should take the shape of guidance and supervision for which the necessary man-power has been estimated at 105 man-month.

During the course of operation guidance, the following points are stressed;

- Smooth start-up of grass roots refinery.
- Operation guidance for the processing of Naphtha HDS, Reformer, Smoke Point Improver, which, until now, have never been experienced in Burma.
- Guidance for the operation and handling of new type machinery.
- Performance guarantees for processes and machinery.

The training of employees is classified into two programs: one which will be executed outside of Burma and the other will be carried out inside Burma.

The purpose of the training outside of Burma is for obtaining knowledge regarding the handling and operation of new machinery and processes which cannot be done in Burma.

With regard to the scale and content of the facilities for the Mann Refinery, the program of training outside of Burma shall apply for 25 persons for over a period of 6 months at least.

The 25 persons to be trained shall consist of several technical staffs and operators. Further, trainees will be classified into group A and B, and 10 persons who are belonging to group A will be instructed

in the techniques of plant construction, and the remaining 15 persons shall be allocated to "B" Group which will mainly learn plant operation techniques.

Group A will be dispatched for overseas soon after the contract of plant construction, and, as mentioned previously, they will be trained on new construction techniques over a period of 6 months and then return to Burma in order to contribute to the Mann Refinery construction.

The 15 members of group B will get training for the operation and handling of new devices. This training also will be executed overseas and will continue for a period of six months from one year before the completion of the Mann Refinery. During the remaining six months, the 15 persons will be employed as inspectors for construction works, and also serve as assistant instructors for training of refinery employees.

On the other hand, training carried out inside of Burma shall be classified into two categories, one will consist of a basic educational course which will take place at the existing refineries in Burma or school, and the other will be for practical training to be carried out at the Mann Refinery.

Basic training shall be completed until 6 month before the mechanical completion of the Mann Refinery, and successively, further 6 month will be allotted for practical training at the refinery field. Training at the refinery field will consist of practical training with actual facilities, which are nearing completion, using operation manual for each facility prepared by contractor so that the training may be of great help for cultivation of operator's ability.

The curriculums of the training are as follows;

- Explanation on outline of facilities.
- Explanations of the Process Flow Sheet.
- Explanations of the Mechanical Flow Sheet.
- Outline of Off-site Facilities.
- Operation manual for normal operation.
- Daily Inspection Items.
- Operation manual for startup operation.
- Operation manual for shutdown.
- Operation manual for emergency shutdown.
- Valve Operation
- Heater and Furnace Operation.
- Pump, Compressor Operation.
- Instrument Handling.
- Handling of Catalysts.
- Handling of Chemicals.
- Safety Precautions.
- Operation Reports and Messages.
- Others.

Chapter 10.

REQUIRED CAPITAL AND PROCUREMENT

Chapter 10

REQUIRED CAPITAL AND PROCUREMENT

10.1 Constructed Cost

The amount of capital required for plant construction is estimated as shown in Table 10-1.

TABLE 10-1 CONSTRUCTED COST

Item	Foreign Currency Portion (¥1,000)	Local Currency Portion (K 1,000)
Engineering Fee	1,056,000	
Equipment (FOB)	21,989,000	
Spare Parts	600,000	
Construction Equipments and Construction Materials	1,206,000	
Catalysts and Chemicals	893,500	
Ocean Freight	1,572,000	
Marine Insurance	132,000	
Import Duty for Equipment		92,346
Inland Transportation		2,625
Civil Work		33,945
Building		9,871
Erection Work		9,790
Jetty		8,168
Local Fabrication		669
Other Insurances	220,000	
Supervising Fee for Civil and Erection Works	1,792,000	
Other Supplies		440
Total	29,460,500	157,854

Note: Cost for procurement of land is not included in the table shown above.

10.2 Other Cost Items

1) Comissioning Cost

The commissioning cost is calculated on the basis of the following conditions:

(a) Commissioning period is for three months.

(b) Labor cost for three months.

(c) Cost of materials

- Hydrogen gas
- Crude oil, chemicals and electric power for 10 days of operation.

TABLE 10-2 COMMISSIONING COST

Item	Foreign Currency Portion (¥1,000)	Local Currency Portion (K 1,000)
Supervisor's Fee	239,000	
Manpower Cost		1,010
Material and Utility Cost	27,500	7,359
Total	266,500	8,369

2) Pre-operation Cost

The pre-operation cost will be K2,200,000.

3) Training Cost

The training cost will be ¥194,000,000.

4) Operation Guidance Cost

The operation guidance cost for a period of one year will be ¥29,000,000.

10.3 Working Capital

Working capital of K26,400,000 will be required, calculated by subtracting the cost of crude oil from the total manufacturing cost (refer to Chapter 11) for two months of production.

10.4 Total Capital Requirement

TABLE 10-3 TOTAL CAPITAL REQUIREMENT

Item	Foreign Currency Portion (¥1,000)	Local Currency Portion (K 1,000)
Constructed cost	29,460,500	157,854
Commissioning cost	266,500	8,369
Pre-operation cost		2,200
Training cost	194,000	
Operation guidance cost	29,000	
Sub-total	29,950,000	168,423
Working capital		26,400
Total	29,950,000	194,823

10.5 Procurement of Required Capital

1) Foreign Currency Component : ¥29,950,000,000

It is assumed that the amount of foreign currency required would be procured through a long-term government to government loan. And in this report, the following conditions are assumed for the sake of ease of calculation:

Amount of loan: ¥29,950,000,000

Term of loan: Repayment is to be done semi-annually during a period of 25 years after signing the contract, including the grace period of seven years.

Interest: 3% per annum

2) Local Currency Component: K194,823,000

It is assumed that the amount of local currency required would be arranged without interest from some organ of the Burmese government.

10.6 Interest During Plant Construction

In addition to sums described above, a sum of ¥1,697,700,000 will be incurred as interest during the construction of the plant.

10.7 Capital Investment Plan

The plan for investment of required capital is shown in Table 10-4.

TABLE 10-4 CAPITAL INVESTMENT PLAN

(U.S. $1,000)

	First Year*2		Second Year		Third Year		Fourth Year*3	
	F.C.P	L.C.P	F.C.P	L.C.P	F.C.P	L.C.P	F.C.P	L.C.P
Total construction cost	49,100	11,958	39,280	9,567	9,821	2,392		
Commissioning cost					889	1,268		
Preproduction expenses		333						
Training cost	647							
Operation supervision fee							97	
Working capital								4,000
Total	49,747	12,291	39,280	9,567	10,710	3,660	97	4,000

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

*2 The first year includes 18 months at the initial phase of construction

*3 Refinery operation is started in the fourth year

*4 The total construction cost is assumed to be invested by 50% in the first year, 40% in the second, and 10% in the third.

2) Local Currency Component: K194,823,000

It is assumed that the amount of local currency required would be arranged without interest from some organ of the Burmese government.

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	F.C.P	L.C.P	F.C.P	L.C.P	F.C.P	L.C.P	F.C.P	L.C.P
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*2 The first year includes 18 months at the initial phase of construction

*3 Refinery operation is started in the fourth year

*4 The total construction cost is assumed to be invested by 50% in the first year, 40% in the second, and 10% in the third.

Chapter 11

FINANCIAL EVALUATION

11.1 Preconditions for Financial Calculations

When calculating and evaluating the revenue and expenditure of the proposed project, it appears most suitable and, at the same time, necessary, to make financial calculations for the Mann Refinery itself and also for Mann Refinery as seen from the standpoint of Petrochemical Industry Corporation (PIC) which will be in charge of operation of Syriam and Chauk Refinery in addition to the planned Mann Refinery's operation.

The quantitative values, prices and other factors to be employed in these calculations are defined as follows.

11.1.1 Quantities of Products Exportable from Mann Refinery

It is predicted that products turned out by both Chauk and Mann Refinery would be primarily supplied to Central and Upper Burma, while products from Syriam Refinery would be marketed to Lower Burma.

The quantities of products exportable from Mann Refinery are calculated and shown in Table 11-9, which will be described later. These calculations are advanced on the following concept.

Namely, the products manufactured by Mann Refinery would primarily be distributed to satisfy market demands raised in Central and Upper Burma, with the remainder supplied to Lower

Burma to satisfy the demand not fully met by the products turned out by Syriam Refinery.
Whatever products left over after meeting these demands are then to be exported from Mann Refinery.

11.1.2 Estimation of Volume of Export Created by Construction of Mann Refinery

The products from Mann Refinery would mostly be consumed domestically, with the exception of coke. Accordingly, a part of the products turned out by Syriam Refinery, which had been directed for these markets so far, would be freed from domestic consumption and switched to export.

Therefore, in order to know the revenue and expenditure of Petrochemical Industry Corporation, which will be operating Mann Refinery in addition to Syriam and Chauk Refinery, it will be necessary to estimate not the quantities of products sold domestically or exported by the Mann Refinery, but the combined quantities of products sold domestically or exported in connection with all petroleum products turned out by three refineries after the operation of Mann Refinery.

These quantities are shown in Table 9-6.

11.1.3 Crude Oil Purchase Price and Product Sales Price

The following unit prices are used when calculating total expenditure for crude oil and sales revenue of petroleum products.

The reason of using each unit price is as follows:

1) Crude Oil Price

Through discussion with the Burmese side, the crude oil purchase price of K0.83/I.G. (U.S. $4.40/Bbl) was suggested, so this price is used. (This price is generally conceived to reflect actual costs.)

2) Local Sales Prices of Petroleum Products

Since the local sales prices shown in Table 11-1 were submitted during the deliberations with the Burmese side, these prices are used.

TABLE 11-1 LOCAL SALES PRICE OF PETROLEUM PRODUCTS

Product	Ex-Factory Price(K/I.G.)	Tax (K/I.G.)	Balance (K/I.G.)	US$/Bbl
Motor Gasoline	3.05	1.91	1.14	6.04
Kerosene	2.10	0.93	1.17	6.20
Diesel Oil	1.97	0.87	1.10	5.83
Fuel Oil	1.43	0.30	1.13	5.99

3) Export Prices of Petroleum Products

According to the monthly circulation published by the Petroleum Association of Japan (Vol. 21, No. 2), the posted prices of petroleum products in Singapore are indicated as shown in Table 11-2. However, the posted price for fuel oil represents that of Iranian fuel oil.

Prices in Singapore are quoted since Singapore is close to Burma and possesses refineries displaying export capability. The price of Iranian fuel oil is quoted for almost the same reason.

TABLE 11-2 POSTED PRICE OF PETROLEUM PRODUCTS

Product	¢/USG	(US$/Bbl)
Motor Gasoline (Octane Value 90)	41.7	17.52
Kerosene	40.0	16.81
Diesel Oil	36.0	15.38
Fuel Oil		10.80

The transportation costs (kyat/ton-mile) for transporting petroleum products from Mann to Syriam, as submitted by the Burmese side, are shown in Table 11-3. Converting these figures into transportation costs in terms of US$/Bbl, we get Table 11-4.

TABLE 11-3 TRANSPORTATION COST

Material Transported	Starting Place End Place	Method	Cost (Kyat per ton Mile)
Crude Oil	Minbu to Syriam	Oil Barge	0.14
Gasoline	Riverine	Oil Barge	0.22
SK, HSD, FO	Riverine	Oil Barge	0.14
Gasoline	Riverine	Cargo Vessel	0.23
SK, HSD, FO	Riverine	Cargo Vessel	0.15
Gasoline	Railway	Tank Car	0.33
SK, HSD, FO	Railway	In Drum	
Gasoline SK, HSD, FO	Road	Bowser	0.53
Gasoline SK, HSD, FO	Road	In Drum	0.55
Coke		Cargo Vessel	0.10
Coke		Railway	0.20
Coke		Road	0.60

TABLE 11-4 TRANSPORTATION COST OF PETROLEUM PRODUCTS (MANN TO SYRIAM)

Product	US$/Bbl
Motor Gasoline	1.54
Kerosene	1.06
Diesel Oil	1.13
Fuel Oil	1.18

In order to calculate the export prices of petroleum products, the values shown in Table 11-4 are first subtracted from the values shown in Table 11-2, followed with further subtraction of U.S. $0.5 per barrel for each product for the reason of easing exports.

However, since fuel oil produced from Mann crude oil is expected to contain only about 0.15% of sulfur and is of very high quality, U.S. $3.0 as a premium was added to the unit selling price of fuel oil per barrel.

The result is shown in Table 11-5.

TABLE 11-5 UNIT SALES PRICE OF PETROLEUM PRODUCTS FOR EXPORT (US$/Bbl)

Product	Sales Price For Export
Motor Gasoline	15.48
Kerosene	15.25
Diesel Oil	13.75
Fuel Oil	12.12

Furthermore, the unit sales price of coke for export is determined as U. S. $50/ton, from which U. S. $6/ton is subtracted as transportation cost from Mann to Syriam, making the unit sales price of coke produced at Mann Refinery U. S. $44.0/ton.

11.2 Total Manufacturing Cost

11.2.1 Preconditions for Calculation of Manufacturing Cost

A number of preconditions adopted in connection with several special cost items when calculating the total manufacturing cost are as follows:

(a) For power cost, K0.05/kWH, a value presented by the Burmese side, is used and converted into U. S. $ value.

(b) For labour cost, the values indicated in Table 9-7 are used.

(c) For the maintenance cost, 2.5% of the equipment cost (FOB) and building cost are used.

(d) For the insurance cost, 1% of the constructed cost is used.

(e) The administration cost was determined as U. S. $100,000 annually.

(f) The period of depreciation of machinery and equipment is to be 20 years, 10% salvage value; period of depreciation of buildings is to be 50 years and the 10% salvage value. Depreciable investments are as shown in Table 11-6.

(g) Interest of 3% per annum for only foreign currency loan is used.

(h) Other miscellaneous costs are determined as U. S. $2,000,000.

(i) As for credit, the export value of coke was subtracted as credit.

TABLE 11-6 DEPRECIABLE INVESTMENT

	(US$1,000)
Plant	
Engineering Fee	3,520
FOB Cost of Machinery & Equipment	73,297
Spare Parts	2,000
Construction Material	420
Ocean Freight	5,240
Marine Insurance	440
Import Duty for Equipment	13,991
Inland Transportation Cost	398
Civil Work	5,143
Building Work for Plant Machinery	582
Erection Work	1,483
Jetty	1,238
Local Fabrication	101
Other Insurances	733
Supervising Fee for Civil and Erection Works	5,973
Commissioning Cost	2,157
Preoperation Cost	333
Training Cost	647
Guidance Cost	97
Total	117,793
Building	
Building Cost (Excluding building for machinery)	914
Total	914

Note: Construction Machinery will be sold in the first year of operation.

11.2.2 Total Manufacturing Cost

The total manufacturing cost, as calculated according to Paragraph 11.2.1 above, is tabulated into Table 11-7.

TABLE 11-7 TOTAL MANUFACTURING COST

Operation	18,000 BPSD	25,000 BPSD
Annual Production		
Liquid Products	5,026,050 Bbl	6,980,625 Bbl
Coke	19,184 t	26,645 t

Item	Q'ty	Unit Price (US$)	Annual Cost (US$ 1,000)	Q'ty	Unit Price (US$)	Annual Cost (US$ 1,000)
Raw Materials						
Crude Oil	5,913,000	4.40	26,017	8,212,500	4.40	36,135
Chemicals & Catalyst			920			1,150
Utility						
Electric Power	47,304,000	0.0076	359	63,072,000	0.0076	479
Operating Labour			612			612
Maintenance Cost			1,855			1,855
Insurance			1,221			1,221
Administration Cost			100			100
Depreciation			5,317			5,317
Interest			2,995			2,995
Congingency			2,000			2,000
Total			41,396			51,864
	t			t		
Credit (Sales of Coke)	19,184	44.0	(-) 844	26,645	44.0	(-) 1,172
			40,552			50,692
Cost per Bbl of Product		US$	8.07		US$	7.26
Cost per I.G. of Product		US$	0.231		US$	0.208
Cost per I.G. of Product		K	1.52		K	1.37

11.3 Financial Aspects

11.3.1 Loan Repayment Plan

Procured loans are to be repaid according to the conditions prescribed in Paragraph 10.2. Table 11-8 indicates the schedule of repayment and the balance.

11.3.2 Financial Projection

The financial projection of the Mann Refinery Construction Project can be made on the basis of the production or marketing plan, the estimated volumes of domestic sales and exports (see Paragraph 11.1.1) and the loan repayment plan.

In this case, the financial projection can be made from two angles, as described earlier in this Chapter, in connection with the Mann Refinery itself and with total Petrochemical Industry Corporation's activities.

However, in the former case, net loss would be incurred in the projection of revenue and expenditure as indicated in Table 11-10 under the selling prices designated by the Burmese government.

Accordingly, henceforth, financial projection or financial evaluation shall be focussed primarily to the latter. The financial projection for the latter case is shown in Table 11-11.

11.3.3 Internal Rate of Return

As shown in Table 11-11-C, a value of about 2.2% has been obtained when the internal rate of return is calculated, as a criterion for financial evaluation of the project, in connection with PIC.

While this value is low as an internal rate of return, the value would naturally be increased should the domestic selling prices of petroleum products be increased.

This relationship is shown in Fig. 11-1.

FIG. 11-1 RATE OF RAISING LOCAL SELLING PRICE vs. IRR (FINANCIAL)

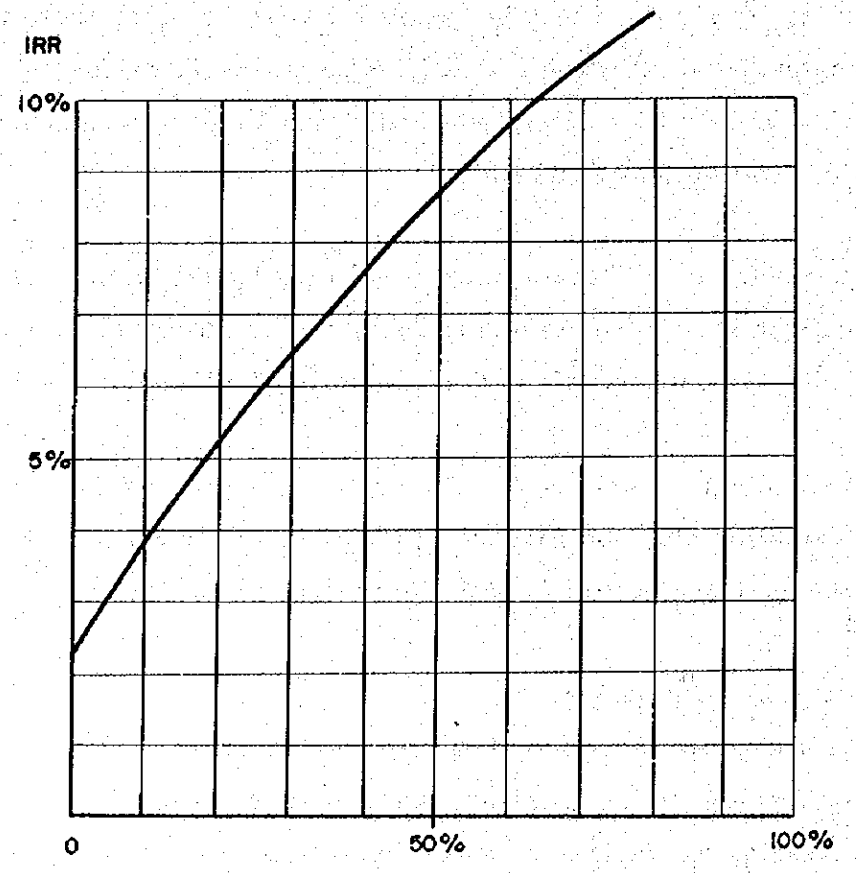

TABLE 11-8 REPAYMENT SCHEDULE OF FOREIGN LOAN

(US$ 1,000)

Year	Loan	Repayment	Balance	Interest
1	49,747		49,747	746
2	39,280		89,027	2,082
3	10,710		99,737	2,831
4	97		99,834	2,994
5			99,834	2,995
6			99,834	2,995
7		2,698	97,136	2,955
8		5,396	91,740	2,874
9		5,397	86,343	2,712
10		5,396	80,947	2,550
11		5,397	75,550	2,388
12		5,396	70,154	2,226
13		5,397	64,757	2,064
14		5,396	59,361	1,903
15		5,397	53,964	1,741
16		5,396	48,568	1,579
17		5,397	43,171	1,417
18		5,396	37,775	1,255
19		5,397	32,378	1,093
20		5,396	26,982	931
21		5,397	21,585	769
22		5,396	16,189	608
23		5,397	10,792	446
24		5,396	5,396	284
25		5,396	0	121

TABLE 11-9 VOLUME OF PRODUCTS EXPORTABLE FROM MANN REFINERY

Year	Demand in Central and Upper Burma			Supply from Chauk Refinery			Quantity to be Supplied from Mann Refinery			Output of Mann Refinery			Surplus of Mann Refinery			Output of Syriam Refinery			Demand in Lower Burma			Deficiency of Supply from Syriam Refinery to Lower Burma			Quantity Exportable from Mann Refinery		
	Gasoline	Diesel Oil	Fuel Oil	Gasoline	Diesel Oil	Fuel Oil	Gasoline	Diesel Oil	Fuel Oil	Gasoline	Diesel Oil	Fuel Oil	Gasoline	Diesel Oil	Fuel Oil	Gasoline	Diesel Oil	Fuel Oil	Gasoline	Diesel Oil	Fuel Oil	Gasoline	Diesel Oil	Fuel Oil	Gasoline	Diesel Oil	Fuel Oil
1981	1,212	1,762	847	239	348	217	973	1,414	631	1,071	1,723	931	98	309	300	1,160	1,687	1,055	808	1,761	554	0	74	0	98	235	300
1982	1,231	1,850	863	239	348	217	992	1,502	646	1,198	1,928	1,042	206	426	396	1,160	1,687	1,055	822	1,850	575	0	163	0	206	263	396
1983	1,251	1,943	884	239	348	217	1,012	1,595	667	1,300	2,091	1,131	288	496	464	1,160	1,687	1,055	834	1,942	589	0	255	0	288	241	464
1984	1,277	2,040	909	239	348	217	1,038	1,692	692	1,382	2,223	1,201	344	531	509	1,160	1,687	1,055	842	2,039	606	0	352	0	344	179	509
1985	1,292	2,142	925	239	348	217	1,053	1,794	708	1,447	2,327	1,258	394	533	550	1,160	1,687	1,055	861	2,141	617	0	454	0	394	80	550
1986	1,312		944	239		217	1,073		727	1,499		1,303	426		576	1,160	1,687	1,055	875	2,248	630	0		0	426	0	576
1987	1,333		960	239		217	1,094		743	1,541		1,340	447		597	1,160	1,687	1,055	889	2,361	640	0		0	447	0	597
1988	1,355		977	239		217	1,116		670	1,606		1,396	490		636	1,160	1,687	1,055	903	2,479	652	0		0	490	0	636
1989	1,377		991	239		217	1,138		774	1,606		1,396	468		622	1,160	1,687	1,055	917	2,603	660	0		0	468	0	622
1990	1,399		1,006	239		217	1,160		789	1,606		1,396	446		607	1,160	1,687	1,055	932	2,733	670	0		0	446	0	607
1991	1,421		1,021	239		217	1,182		804	1,606		1,396	424		592	1,160	1,687	1,055	947	2,869	681	0		0	424	0	592
1992	1,444		1,031	239		217	1,205		814	1,606		1,396	401		582	1,160	1,687	1,055	962	3,013	687	0		0	401	0	582
1993	1,466		1,040	239		217	1,227		823	1,606		1,396	379		573	1,160	1,687	1,055	978	3,164	694	0		0	379	0	573
1994	1,490		1,048	239		217	1,251		831	1,606		1,396	355		565	1,160	1,687	1,055	994	3,322	698	0		0	355	0	565
1995	1,514		1,055	239		217	1,275		838	1,606		1,396	331		558	1,160	1,687	1,055	1,009	3,488	704	0		0	331	0	558
1996	1,538		1,060	239		217	1,299		843	1,606		1,396	307		553	1,160	1,687	1,055	1,025	3,662	707	0		0	307	0	553
1997	1,563		1,081	239		217	1,324		864	1,606		1,396	282		532	1,160	1,687	1,055	1,041	3,845	720	0		0	282	0	532
1998	1,588		1,109	239		217	1,349		892	1,606		1,396	257		504	1,160	1,687	1,055	1,058	4,038	739	0		0	257	0	504
1999	1,613		1,135	239		217	1,374		918	1,606		1,396	232		478	1,160	1,687	1,055	1,075	4,239	756	0		0	232	0	478
2000	1,639		1,161	239		217	1,400		944	1,606		1,396	206		452	1,160	1,687	1,055	1,092	4,451	775	0		0	206	0	452

Note: As is evident from Table 9-6, Diesel oil surplus will be unavailable for export after 1986.
Kerosene surplus is unavailable today and in future for export.

TABLE 11-10-A SALES REVENUE OF MANN REFINERY

				1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Gasoline	Export	Quantity	(1,000 Bbl)	98	206	288	344	394	426	447	490	468	446	424	401	379	355	331	307	282	257	232	206
		Unit Price	(US$)	15.48																			
		Revenue	(US$ 1,000)	1,517	3,189	4,458	5,325	6,099	6,594	6,920	7,585	7,244	6,904	6,563	6,207	5,867	5,495	5,124	4,752	4,365	3,978	3,591	3,189
	Local	Quantity	(1,000 Bbl)	973	992	1,012	1,038	1,053	1,073	1,094	1,126	1,138	1,160	1,182	1,205	1,227	1,251	1,275	1,299	1,324	1,349	1,374	1,400
		Unit Price	(US$)	6.04																			
		Revenue	(US$ 1,000)	5,877	5,992	6,112	6,270	6,360	6,481	6,608	6,801	6,874	7,006	7,139	7,278	7,411	7,556	7,701	7,846	7,997	8,148	8,299	8,456
Kerosene	Export	Quantity	(1,000 Bbl)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Unit Price	(US$)																				
		Revenue	(US$ 1,000)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Local	Quantity	(1,000 Bbl)	931	1,042	1,131	1,201	1,258	1,303	1,340	1,396	1,396	1,396	1,396	1,396	1,396	1,396	1,396	1,396	1,396	1,396	1,396	1,396
		Unit Price	(US$)	6.20																			
		Revenue	(US$ 1,000)	5,772	6,460	7,012	7,446	7,799	8,079	8,308	8,655	8,655	8,655	8,655	8,655	8,655	8,655	8,655	8,655	8,655	8,655	8,655	8,655
Diesel Oil	Export	Quantity	(1,000 Bbl)	235	263	242	179	80	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Unit Price	(US$)	13.75																			
		Revenue	(US$ 1,000)	3,231	3,616	3,327	2,461	1,100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Local	Quantity	(1,000 Bbl)	1,488	1,665	1,849	2,044	2,247	2,411	2,478	2,583	2,583	2,583	2,583	2,583	2,583	2,583	2,583	2,583	2,583	2,583	2,583	2,583
		Unit Price	(US$)	5.83																			
		Revenue	(US$ 1,000)	8,675	9,707	10,780	11,917	13,100	14,056	14,447	15,059	15,059	15,059	15,059	15,059	15,059	15,059	15,059	15,059	15,059	15,059	15,059	15,059
Fuel Oil	Export	Quantity	(1,000 Bbl)	300	396	464	509	550	576	597	636	622	607	592	582	573	565	558	553	532	504	478	452
		Unit Price	(US$)	12.12																			
		Revenue	(US$ 1,000)	3,636	4,800	5,624	6,169	6,666	6,981	7,236	7,708	7,539	7,357	7,175	7,054	6,945	6,848	6,763	6,702	6,448	6,109	5,745	5,478
	Local	Quantity	(1,000 Bbl)	631	646	667	692	708	727	743	760	774	789	804	814	823	831	838	843	864	892	918	944
		Unit Price	(US$)	5.99																			
		Revenue	(US$ 1,000)	3,787	3,870	3,995	4,145	4,241	4,355	4,451	4,552	4,636	4,726	4,816	4,876	4,930	4,978	5,020	5,050	5,175	5,343	5,499	5,655
Coke	Export	Quantity	(T)	16,872	18,877	20,482	21,766	22,792	23,614	24,270	25,296	25,296	25,296	25,296	25,296	25,296	25,296	25,296	25,296	25,296	25,296	25,296	25,296
		Unit Price	(US$)	44.0																			
		Revenue	(US$ 1,000)	742	831	901	958	1,003	1,039	1,068	1,113	1,113	1,113	1,113	1,113	1,113	1,113	1,113	1,113	1,113	1,113	1,113	1,113
		Total Export Sales		9,126	14,436	14,310	14,913	14,868	14,614	15,224	16,406	15,896	15,374	14,851	14,374	19,925	13,456	13,000	12,567	11,926	11,200	10,449	9,780
		Total Local Sales		24,104	16,029	17,899	29,778	31,500	32,971	33,814	35,067	35,224	35,446	35,669	35,868	36,155	36,248	36,435	36,610	36,886	37,205	37,512	37,825
		Grand Total		33,230	38,465	42,209	44,691	46,368	47,585	49,038	51,473	51,120	50,820	50,520	50,242	50,080	49,704	49,435	49,177	48,812	48,405	47,961	47,605

14R

TABLE 11-10-B PRO FORMA INCOME STATEMENT

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Total Revenue				34,670	38,465	42,209	44,691	46,368	47,585	49,038	51,473	51,120	50,820	50,520	50,242	50,080	49,704	49,435	49,177	48,812	48,405	47,961	47,605
Export Sales				9,126																			
Local Sales				24,104																			
Sales of Construction Machinery				1.440																			
Total Cost				36,488	39,399	41,739	43,622	45,137	46,363	47,352	48,871	48,871	48,871	48,871	48,871	48,871	48,871	48,871	48,871	48,871	48,871	48,871	48,871
Raw Materials																							
Crude Oil				24,104	26,968	29,260	31,095	32,560	33,735	34,672	36,137	36,137	36,137	36,137	36,137	36,137	36,137	36,137	36,137	36,137	36,137	36,137	36,137
Chemicals & Catalyst				920	950	981	1,012	1,045	1,079	1,114	1,150	1,150	1,150	1,150	1,150	1,150	1,150	1,150	1,150	1,150	1,150	1,150	1,150
Utility																							
Electric Power				359	376	393	410	427	444	461	479	479	479	479	479	479	479	479	479	479	479	479	479
Operating Labour				612	612	612	612	612	612	612	612	612	612	612	612	612	612	612	612	612	612	612	612
Maintenance Cost				1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855
Insurance				1,221	1,221	1,221	1,221	1,221	1,221	1,221	1,221	1,221	1,221	1,221	1,221	1,221	1,221	1,221	1,221	1,221	1,221	1,221	1,221
Administration Cost				100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Depreciation				5,317	5,317	5,317	5,317	5,317	5,317	5,317	5,317	5,317	5,317	5,317	5,317	5,317	5,317	5,317	5,317	5,317	5,317	5,317	5,317
Other Expense				2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000
Net Income Before Interest Tax				-1,818	-934	470	1,069	1,231	1,222	1,686	2,602	2,249	1,949	1,649	1,371	1,209	833	564	306	-59	-466	-910	-1,266
Interest																							
Net Income Before Tax																							
Income Tax (50%)																							
Net Income After Interest and Tax																							

1-16
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TABLE 11-10-C CASH FLOW (US$ 1,000)

Year	Investment	Net Income Before Interest & Tax	Interest	Net Income After Interest	Tax Payable	Net Income After Interest & Tax	Depreciation	Cash Flow
1	62,038		746					-62,038
2	48,847		2,082					-48,847
3	14,370		2,831					-14,370
4	4,097	-1,818	2,994	- 4,812		-4,812	5,317	- 3,592
5		- 934	2,995	- 3,929		-3,929	5,317	1,388
6		470	2,995	- 2,525		-2,525	5,317	2,792
7		1,069	2,995	- 1,926		-1,926	5,317	3,391
8		1,231	2,874	- 1,643		-1,643	5,317	3,674
9		1,222	2,712	- 1,490		-1,490	5,317	3,827
10		1,686	2,550	- 864		- 864	5,317	4,453
11		2,602	2,388	214	107*	107	5,317	5,424
12		2,249	2,226	23	11	12	5,317	5,329
13		1,949	2,064	- 115		- 115	5,317	5,202
14		1,649	1,903	- 254		- 254	5,317	5,063
15		1,371	1,741	- 370		- 370	5,317	4,947
16		1,209	1,579	- 370		- 370	5,317	4,947
17		833	1,417	- 584		- 584	5,317	4,733
18		564	1,255	- 691		- 691	5,317	4,626
19		306	1,093	- 787		- 787	5,317	4,030
20		- 59	931	- 990		- 990	5,317	4,327
21		- 466	769	- 1,235		-1,235	5,317	4,082
22		- 910	608	- 1,518		-1,518	5,317	3,799
23		-1,266	446	- 1,712		-1,712	5,317	3,605
23	-16,373							16,373
								(-32,835)

* It is assumed that tax will be imposed on the profit and loss of that particular year.

TABLE 11-11-A SALES REVENUE OF PIC BY MANN REFINERY CONSTRUCTION

				1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Gasoline	Export	Quantity	(1,000 Bbl)	450	545	614	662	693	711	718	747	711	674	637	599	561	521	482	442	401	359	317	274
		Unit Price	(US$)	15.48																			
		Revenue	(US$ 1,000)	6,966	8,437	9,505	10,248	10,728	11,006	11,115	11,564	11,006	10,434	9,861	9,273	8,684	8,065	7,461	6,842	6,208	5,557	4,907	4,242
	Local	Quantity	(1,000 Bbl)	621	653	686	720	754	787	822	859	895	932	1,007	1,045	1,085	1,124	1,164	1,205	1,247	1,289	1,332	1,332
		Unit Price	(US$)	6.04																			
		Revenue	(US$ 1,000)	3,751	3,944	4,143	4,349	4,554	4,754	4,965	5,188	5,406	5,629	5,853	6,082	6,312	6,553	6,789	7,031	7,278	7,532	7,786	8,045
Kerosene	Export	Quantity	(1,000 Bbl)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Unit Price	(US$)																				
		Revenue	(US$ 1,000)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Local	Quantity	(1,000 Bbl)	931	1,042	1,131	1,201	1,258	1,303	1,340	1,396	1,396	1,396	1,396	1,396	1,396	1,396	1,396	1,396	1,396	1,396	1,396	1,396
		Unit Price	(US$)	6.20																			
		Revenue	(US$ 1,000)	5,772	6,460	7,012	7,446	7,800	8,079	8,308	8,655	8,655	8,655	8,655	8,655	8,655	8,655	8,655	8,655	8,655	8,655	8,655	8,655
Diesel Oil	Export	Quantity	(1,000 Bbl)	235	263	242	179	80	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Unit Price	(US$)	13.75																			
		Revenue	(US$ 1,000)	3,231	3,616	3,328	2,461	1,100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Local	Quantity	(1,000 Bbl)	1,488	1,665	1,849	2,044	2,247	2,411	1,478	2,583	2,583	2,583	2,583	2,583	2,583	2,583	2,583	2,583	2,583	2,583	2,583	2,583	2,583	2,583
		Unit Price	(US$)	5.83																			
		Revenue	(US$ 1,000)	8,675	9,707	10,780	11,917	13,100	14,056	14,447	15,059	15,059	15,059	15,059	15,059	15,059	15,059	15,059	15,059	15,059	15,059	15,059	15,059	15,059
Fuel Oil	Export	Quantity	(1,000 Bbl)	792	876	930	959	988	1,002	1,012	1,039	1,017	992	966	950	934	922	909	901	867	820	777	732	732	732
		Unit Price	(US$)	12.12																			
		Revenue	(US$ 1,000)	9,599	10,617	11,272	11,623	11,975	12,144	12,265	12,593	12,326	12,023	11,708	11,514	11,320	11,175	11,017	10,920	10,508	9,938	9,417	8,872	8,872	8,872
	Local	Quantity	(1,000 Bbl)	139	166	201	242	270	301	328	357	379	404	430	446	462	474	487	495	529	576	619	664	664	664
		Unit Price	(US$)	5.99																			
		Revenue	(US$ 1,000)	833	994	1,204	1,450	1,617	1,803	1,965	2,138	2,270	2,420	2,576	2,672	2,767	2,839	2,917	2,965	3,169	3,450	3,708	3,977	3,977	3,977
Coke	Export	Quantity	(T)	16,872	18,877	20,482	21,766	22,792	23,614	24,270	25,296	25,296	25,296	25,296	25,296	25,296	25,296	25,296	25,296	25,296	25,296	25,296	25,296	25,296	25,296
		Unit Price	(US$)	44.0																			
		Revenue	(US$ 1,000)	742	831	901	958	1,003	1,039	1,068	1,113	1,113	1,113	1,113	1,113	1,113	1,113	1,113	1,113	1,113	1,113	1,113	1,113	1,113	1,113
		Total Export Sales		25,538	23,501	25,006	25,290	24,806	24,189	24,448	25,270	24,445	23,570	22,682	21,900	21,117	20,353	19,591	18,875	17,829	16,608	15,437	14,227	14,227	14,227
		Total Local Sales		19,031	21,105	23,139	25,162	27,071	28,192	29,685	31,040	31,390	31,763	32,143	32,468	32,793	33,106	33,420	33,710	34,161	34,696	35,208	35,736	35,736	35,736
		Grand Total		39,569	44,606	48,145	50,452	51,877	52,881	54,133	56,310	55,835	55,333	54,825	54,368	53,910	53,459	53,011	52,585	51,990	51,304	50,645	49,963	49,963	49,963

TABLE 11-11-B PRO FORMA INCOME STATEMENT

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Total Revenue				41,009	44,606	48,145	50,452	51,877	52,881	54,133	56,310	55,835	55,333	54,825	54,368	53,910	53,459	53,012	52,585	51,900	51,304	50,645	49,963
Exports Sales				20,538																			
Local Sales				19,031																			
Sales of Construction Machinery				1,440																			
Total Cost				36,488	39,399	41,739	43,622	45,137	46,363	47,352	48,871	48,871	48,871	48,871	48,871	48,871	48,871	48,871	48,871	48,871	48,871	48,871	48,871
Raw Materials																							
Crude Oil				24,104	26,968	29,260	31,095	32,560	33,735	34,672	36,137	36,137	36,137	36,137	36,137	36,137	36,137	36,137	36,137	36,137	36,137	36,137	36,137
Chemicals & Catalyst				920	950	981	1,012	1,045	1,079	1,114	1,150	1,150	1,150	1,150	1,150	1,150	1,150	1,150	1,150	1,150	1,150	1,150	1,150
Utility																							
Electric Power				359	376	393	410	427	444	461	479	479	479	479	479	479	479	479	479	479	479	479	479
Operating Labour				612	612	612	612	612	612	612	612	612	612	612	612	612	612	612	612	612	612	612	612
Maintenance Cost				1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855
Insurance				1,221	1,221	1,221	1,221	1,221	1,221	1,221	1,221	1,221	1,221	1,221	1,221	1,221	1,221	1,221	1,221	1,221	1,221	1,221	1,221
Administration Cost				100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Depreciation				5,317	5,317	5,317	5,317	5,317	5,317	5,317	5,317	5,317	5,317	5,317	5,317	5,317	5,317	5,317	5,317	5,317	5,317	5,317	5,317
Other Expense				2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000
Net Income Before Interest and Tax				4,521	5,207	6,406	6,829	6,739	6,517	6,780	7,439	6,964	6,462	5,953	5,496	5,040	4,589	4,141	3,714	3,119	2,434	1,774	1,092
Interest	746	2,082	2,831	2,994	2,995	2,995	2,995	2,874	2,712	2,550	2,388	2,226	2,064	1,903	1,741	1,579	1,417	1,255	1,093	931	769	608	446
Net Income Before Tax				1,527	2,212	3,411	3,834	3,865	3,805	4,230	5,051	4,738	4,398	4,050	3,755	3,461	3,172	2,886	2,621	2,188	1,665	1,166	646
Income Tax (50%)				764	1,106	1,706	1,917	1,933	1,903	2,115	2,526	2,369	2,199	2,025	1,878	1,731	1,586	1,443	1,311	1,094	833	583	323
Net Income After Interest and Tax				763	1,106	1,705	1,917	1,932	1,902	2,115	2,525	2,369	2,199	2,025	1,877	1,730	1,586	1,443	1,310	1,094	832	583	323
Investment																							
Foreign Currency	49,747	39,280	10,710	97																			- 9,326
Local Currency	12,291	9,567	3,600	4,000																			- 7,047
Repayment							2,698	5,396	5,397	5,396	5,397	5,396	5,397	5,396	5,397	5,396	5,397	5,396	5,397	5,396	5,397	5,396	5,396

TABLE 11-11-C INTERNAL RATE OF RETURN (FINANCIAL)

Year	Investment	Net Income Before Interest & Tax	Tax Payable	Net Income After Tax	Depreciation	Net Cash Inflow	Discount Rate (3%)	Present Value of Net Inflow	Discount Rate (2%)	Present Value of Net Inflow
1	62,038						0.97087	-60,231	0.98039	-60,821
2	48,847						0.94260	-46,043	0.96117	-46,950
3	14,370						0.91514	-13,151	0.94232	-13,541
4	4,097	4,521	2,260	2,260	5,317	3,480	0.88849	3,092	0.92385	3,215
5		5,207	2,604	2,603	5,317	7,920	0.86261	5,832	0.90573	7,173
6		6,406	3,203	3,203	5,317	8,520	0.83748	7,135	0.88797	7,566
7		6,829	3,415	3,414	5,317	8,731	0.81309	7,099	0.87056	7,601
8		6,739	3,370	3,369	5,317	8,686	0.78941	6,857	0.85349	7,413
9		6,517	3,258	3,258	5,317	8,575	0.76642	6,572	0.83676	7,175
10		6,780	3,390	3,390	5,317	8,707	0.74409	6,479	0.82035	7,143
11		7,439	3,720	3,719	5,317	9,036	0.72242	6,528	0.80426	7,267
12		6,964	3,482	3,482	5,317	8,799	0.70138	6,171	0.78849	6,938
13		6,462	3,231	3,231	5,317	8,548	0.68095	5,821	0.77303	6,608
14		5,953	2,977	2,976	5,317	8,293	0.66112	5,483	0.75788	6,285
15		5,496	2,748	2,748	5,317	8,065	0.64186	5,177	0.74301	5,992
16		5,040	2,520	2,520	5,317	7,837	0.62317	4,884	0.72845	5,709
17		4,589	2,295	2,294	5,317	7,611	0.60502	4,605	0.71416	5,435
18		4,141	2,071	2,070	5,317	7,387	0.58739	4,339	0.70016	5,172
19		3,714	1,857	1,857	5,317	7,174	0.57029	4,091	0.68643	4,924
20		3,119	1,560	1,559	5,317	6,876	0.55368	3,807	0.67297	4,627
21		2,434	1,217	1,217	5,317	6,534	0.53755	3,512	0.65978	4,311
22		1,774	887	887	5,317	6,207	0.52189	3,239	0.64684	4,015
23		1,092	546	546	5,317	5,933	0.50669	3,006	0.63416	3,762
23	-16,373						0.50669	-8,296	0.63416	10,383
								(-22,992)		(+7,402)

$$2 + \frac{7,402}{7,402+22,992} = 2.24\ (\%)$$

Chapter 12.

ECONOMIC EVALUATION

Chapter 12

ECONOMIC EVALUATION

The financial aspects of Mann Refinery Project are as described in detail in the preceding chapter. However, for a better confirmation of the nature of the proposed project, it may be advisable to give further study from the basic view points which are not taken up in the foregoing financial evaluation.

These include:

1) Evaluation of the production of petroleum products in Burma.
2) Benefits accrued by the production of diesel oil.
3) Increase of employment influenced by the project.

Namely, it will be clear that the Mann Refinery Project, in the light of above merits, can deserve a higher value than that of its, financial evaluation.

12.1 Evaluation of The Domestic Production of Petroleum Products

As described earlier under Financial Evaluation, the Burmese government designates the figures indicated in Table 11-1 in regard to the local selling prices of petroleum products, so these figures have naturally been employed in the calculation of sales revenues when giving financial evaluation to the project.

This means that the results of financial evaluation would vary according to the price standards which the government may choose to adopt for any of a number of reasons.

In other words, the financial evaluation (or at least the revenue and expenditure) would be largely influenced by the selling

prices to be determined by the government.

Accordingly, it appears quite necessary, in addition to the financial evaluation characterized by such a nature, to carry out in parallel a so-called cost benefit calculation (or so-called economic evaluation), on the basis of the values (benefits) of manufactured goods such as the petroleum products turned out by the planned project, against the values (costs) of all the natural resources including crude oil, which are consumed in the process of manufacturing these goods.

Naturally, an accurate estimate of these benefits and costs would be quite difficult, especially the benefits to be accrued. Therefore, in this report only a rough estimate based on simple assumptions is shown. Nonetheless, the importance of the estimate is not lessen.

Based on the concept outlined above, or from the viewpoint of benefits and costs, the profitability of Mann Refinery Project has been calculated as shown in Table 12-1.

The petroleum products sold on the local markets are thought to have the same values as those for export products. Therefore in the calculation made in Table 12-1 F.O.B. prices are used for the value of both petroleum products sold locally and exported. As for indicating the cost of crude oil, the same cost used for the financial evaluation described earlier is employed for the reason described in Paragraph 11.1.3.

The above concept of calculation is interpreted as follows:

1) Where the sale of Mann Refinery products is concerned, the policy is to first satisfy domestic demand and to export what may be available as surplus. In principle, this means that the amount of benefit gained by meeting the domestic demand is none less than the amount of revenues otherwise accrued by exporting these products.

2) However, according to the values obtained earlier through financial calculations, the production cost per barrel of product lies somewhere about U. S. $7 - 8. Judging from this situation, it may be conjectured that the costs of these products are considerably lower than the F. O. B. prices, or that the F. O. B. prices themselves are overrated.

3) Accordingly, by combining 1) and 2), using F. O. B. price is justified as a standard of economic evaluation of the project.

The result of calculation in terms of internal rate of return is roughly 28% as shown in Table 12-1.

Furthermore there is a slight different viewpoint from the way described above, namely, using F. O. B. price at Mann (export price) for crude oil and C. I. F. prices at Mann (import price for petroleum products on the assumption that crude oil is exportable and petroleum products are importable from international market.

The result of calculation in terms of internal rate of return based on the above is indicated at almost 15% as shown in Table 12-2.

As can be judged from these tables, the internal rate of return of the planned project would deserve a sufficiently large value

in the event the "benefit and cost" concept is adopted.

The high values for internal rate of return indicate the high potencial value of the planned project.

12.2 Benefits accrued by the Production of Diesel Oil

Among the petroleum products manufactured by Mann Refinery, production of diesel oil, in particular, weights much in the light of the existence of the following situations in Burma.

Namely, while diesel engines are popularly employed in Burma today by power plants, various industrial plants as well as by agricultural machinery and large size vehicles, there is a shortage of diesel oil in the country, with the result that many of these engines are inevitably idled away or run at below their full capacities.

When the supply of diesel oil is supplemented through realization of the planned project, the economic effects would be tremendous. These effects would not be limited simply to creating a new supply of diesel oil but would certainly contribute immensely toward increasing the production in the field of agriculture and industries as a whole.

12.3 Influence of The Project on Promotion of Employment

The securing and increasing of employment attending the implementation of this project constitutes a vitally important factor for the stabilization of the Burmese economy as well as standard of living.

Mann Refinery Project represents a rather capital-intensive venture though the employment of roughly 1,000 workers is envisioned, which essentially means that stabilized income will be offered to a population of roughly 5,000 citizens when their families are taken into account.

Accordingly, the planned project should be studied and evaluated not only from a purely commercial standpoint but also by taking into consideration of tremendous contribution for stabilizing the Burmese socioeconomic foundation.

TABLE 12-1-A BENEFIT OF MANN REFINERY

				1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Gasoline	Export	Quantity	(1,000 Bbl)	450	545	614	662	693	711	718	747	711	674	637	599	561	521	482	442	401	359	317	274
		Unit Price	(US$)	15.48																			
		Revenue	(US$ 1,000)	6,966	8,437	9,505	10,248	10.728	11,006	11,115	11,564	11,006	10,434	9,861	9,273	8,684	8,065	7,461	6,842	6,207	5,557	4,907	4,242
	Local	Quantity	(1,000 Bbl)	621	653	686	720	754	787	822	859	895	932	969	1,007	1,045	1,085	1,124	1,164	1,205	1,247	1,289	1,332
		Unit Price	(US$)	15.48																			
		Revenue	(US$ 1,000)	9,613	10,108	10,619	11,146	11,672	12,183	12,725	13,297	13,855	14,427	15,000	15,588	16,177	16,796	17,400	18,019	18,653	19,304	19,954	20,619
Kerosene	Export	Quantity	(1,000 Bbl)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Unit Price	(US$)																				
		Revenue	(US$ 1,000)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Local	Quantity	(1,000 Bbl)	931	1,042	1,131	1,201	1,258	1,303	1,340	1,396	1,396	1,396	1,396	1,396	1,396	1,396	1,396	1,396	1,396	1,396	1,396	1,396
		Unit Price	(US$)	15.25																			
		Revenue	(US$ 1,000)	4,198	15,891	17,248	18,315	19,185	19,871	20,435	21,289	21,289	21,289	21,289	21,289	21,289	21,289	21,289	21,289	21,289	21,289	21,289	21,289
Diesel Oil	Export	Quantity	(1,000 Bbl)	235	263	242	179	80	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Unit Price	(US$)	13.75																			
		Revenue	(US$ 1,000)	3,231	3,616	3,328	2,461	1,100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Local	Quantity	(1,000 Bbl)	1,488	1,665	1,849	2,044	2,247	2,411	2,478	2,583	2,583	2,583	2,583	2,583	2,583	2,583	2,583	2,583	2,583	2,583	2,583	2,583
		Unit Price	(US$)	13.75																			
		Revenue	(US$ 1,000)	20,460	22,894	25,424	28,105	30,896	33,151	34,073	35,516	35,516	35,516	35,516	35,516	35,516	35,516	35,516	35,516	35,516	35,516	35,516	35,516
Fuel Oil	Export	Quantity	(1,000 Bbl)	792	876	930	959	988	1,002	1,012	1,039	1,017	992	966	950	934	922	909	901	867	820	777	732
		Unit Price	(US$)	12.12																			
		Revenue	(US$ 1,000)	9,599	10,617	11,272	11,623	11,975	12,144	12,265	12,593	12,326	12,023	11,708	11,514	11,325	11,175	11,017	10,920	10,508	9,935	9,417	8,372
	Local	Quantity	(1,000 Bbl)	139	166	201	242	270	301	328	357	379	404	430	446	462	474	487	495	529	576	619	664
		Unit Price	(US$)	12.12																			
		Revenue	(US$ 1,000)	1,685	2,012	2,436	2,933	3,272	3,648	3,975	4,327	4,593	4,896	5,212	5,406	5,599	5,745	5,902	5,999	6,411	6,981	7,502	8,048
Coke	Export	Quantity	(T)	16,872	18,877	20,482	21,766	22,792	23,614	24,270	25,296	25,296	25,296	25,296	25,296	25,296	25,296	25,296	25,296	25,296	25,296	25,296	25,296
		Unit Price	(US$)	44.00																			
		Revenue	(US$ 1,000)	742	831	901	958	1,003	1,039	1,068	1,113	1,113	1,113	1,113	1,113	1,113	1,113	1,113	1,113	1,113	1,113	1,113	1,113
		Total Export Sales		20,538	23,501	25,005	25,290	24,805	24,190	24,448	25,269	24,445	23,570	22,681	21,899	21,117	20,353	19,591	18,875	17,829	16,609	15,437	14,226
		Total Local Sales		45,956	50,905	55,727	60,499	65,025	68,853	71,208	74,029	75,253	76,128	77,017	77,799	78,581	79,345	80,107	80,823	81,869	83,089	84,261	85,472
		Grand Total		66,494	74,406	80,732	85,789	89,830	93,043	95,656	99,698	99,698	99,698	99,698	99,698	99,698	99,698	99,698	99,698	99,698	99,698	99,698	99,698

TABLE 12-1-B NET BENEFIT

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Total Revenue				67,934	74,406	80,732	85,789	89,830	93,043	95,656	99,698	99,698	99,698	99,698	99,698	99,698	99,698	99,698	99,698	99,698	99,698	99,698	99,698
Sales of Product				66,494																			
Sales of Construction Machinery				1,440																			
Total Cost				31,170	34,082	36,417	38,305	39,820	41,046	42,035	43,554	43,554	43,554	43,554	43,554	43,554	43,554	43,554	43,554	43,554	43,554	43,554	43,554
Raw Materials																							
Crude Oil (US$ 4.40/Bbl)				24,103	26,968	29,260	31,095	32,560	33,735	34,672	36,137	36,137	36,137	36,137	36,137	36,137	36,137	36,137	36,137	36,137	36,137	36,137	36,137
Chemicals & Catalyst																							
Utility																							
Electric Power																							
Operating Labour																							
Maintenance Cost				7,067	7,114	7,157	7,210	7,260	7,311	7,363	7,417	7,417	7,417	7,417	7,417	7,417	7,417	7,417	7,417	7,417	7,417	7,417	7,417
Insurance																							
Administration Cost																							
Other Expense																							
Net Income Bofore Interest and Tax				36,764	40,324	44,315	47,484	50,010	51,997	53,621	56,144	56,144	56,144	56,144	56,144	56,144	56,144	56,144	56,144	56,144	56,144	56,144	56,144

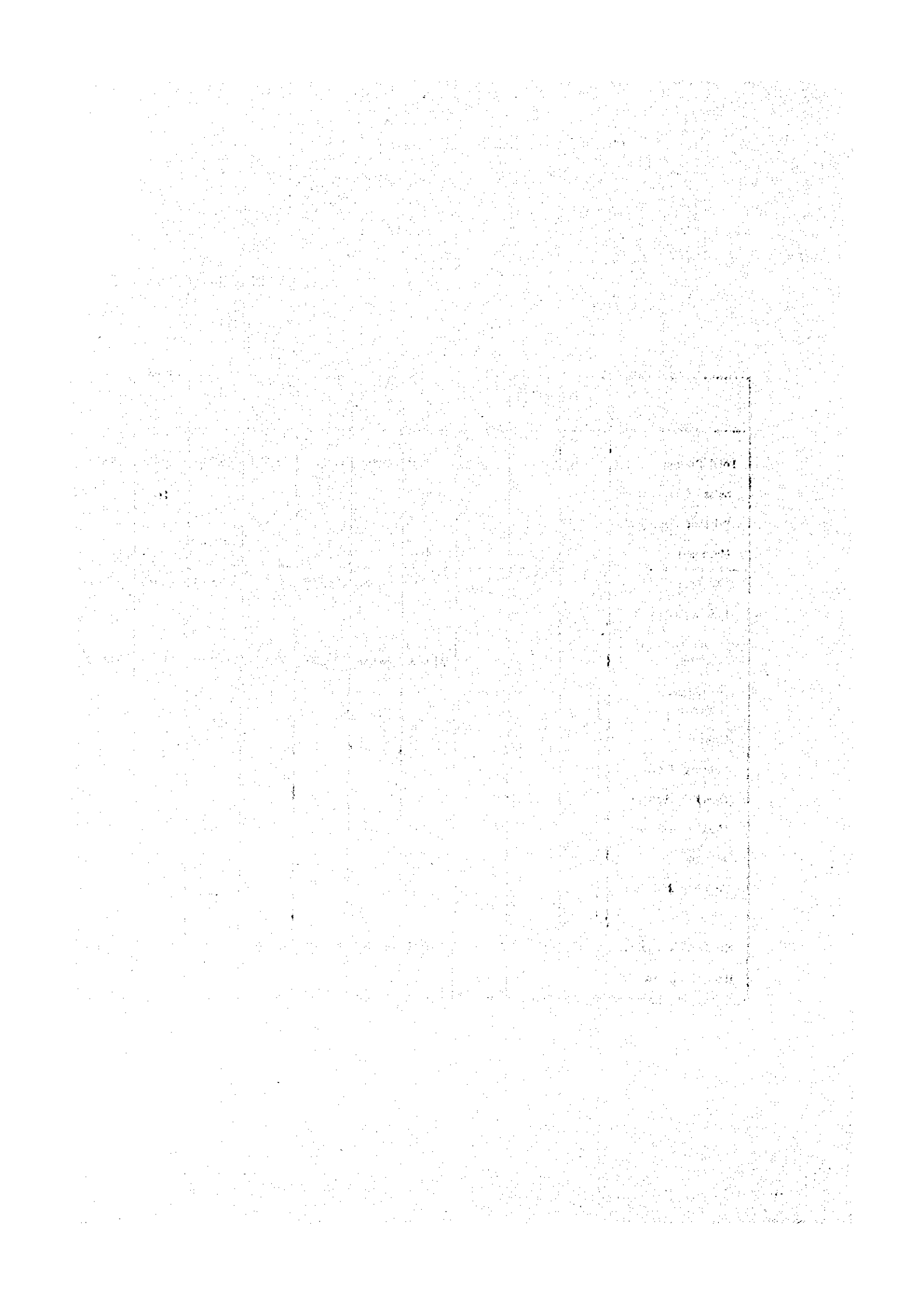

TABLE 12-1-C INTERNAL RATE OF RETURN

Year	Investment	Net Income Before Interest & Tax	Discount Rate (28%)	Present Value	Discount Rate (30%)	Present Value
1	54,664		0.781	-42,684	0.769	-42,029
2	43,251		0.610	-26,383	0.592	-25,604
3	12,971		0.477	- 6,187	0.455	- 5,901
4	4,485	36,764	0.373	12,040	0.350	11,298
5		40,324	0.291	11,734	0.269	10,847
6		44,315	0.227	10,060	0.207	9,173
7		47,484	0.178	8,452	0.159	7,550
8		50,010	0.139	6,951	0.123	6,151
9		51,997	0.108	5,616	0.094	4,888
10		53,621	0.085	4,558	0.073	3,914
11		56,144	0.066	3,706	0.056	3,144
12		56,144	0.052	2,919	0.043	2,414
13		"	0.040	2,246	0.033	1,853
14		"	0.032	1,797	0.025	1,404
15		"	0.025	1,404	0.020	1,123
16		"	0.019	1,067	0.015	842
17		"	0.015	842	0.012	674
18		"	0.012	674	0.009	505
19		"	0.009	505	0.007	393
20		"	0.007	393	0.005	281
21		"	0.006	337	0.004	225
22		"	0.004	225	0.003	168
23		"	0.003	168	0.002	112
23	-14,974		0.003	45	0.002	30
				+ 485		- 6,546

$$28\% + 2 \times \frac{485}{6,546+458} = 28.1$$

TABLE 12-2-A BENEFIT OF MANN REFINERY

				1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Gasoline	Export	Quantity	(1,000 Bbl)	450	545	614	662	693	711	718	747	711	674	637	599	561	521	482	442	401	359	317	274
		Unit Price	(US$)	15.48																			
		Revenue	(US$ 1,000)	6,966	8,437	9,505	10,248	10,728	11,006	11,115	11,564	11,006	10,434	9,861	9,273	8,684	8,065	7,461	6,842	6,207	5,557	4,907	4,242
	Local	Quantity	(1,000 Bbl)	621	653	686	720	754	787	822	859	895	932	969	1,007	1,045	1,085	1,124	1,164	1,205	1,247	1,289	1,332
		Unit Price	(US$)	20.14																			
		Revenue	(US$ 1,000)	12,507	13,151	13,816	14,501	15,186	15,850	16,555	17,300	18,025	18,770	19,516	20,281	21,046	21,852	22,637	23,443	24,269	25,115	25,960	26,826
Kerosene	Export	Quantity	(1,000 Bbl)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Unit Price	(US$)																				
		Revenue	(US$ 1,000)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Local	Quantity	(1,000 Bbl)	931	1,042	1,131	1,201	1,258	1,303	1,340	1,396	1,396	1,396	1,396	1,396	1,396	1,396	1,396	1,396	1,396	1,396	1,396	1,396
		Unit Price	(US$)	19.10																			
		Revenue	(US$ 1,000)	17,782	19,902	21,602	22,939	24,028	24,887	25,594	26,664	26,664	26,664	26,664	26,664	26,664	26,664	26,664	26,664	26,664	26,664	26,664	26,664
Diesel Oil	Export	Quantity	(1,000 Bbl)	235	263	242	179	80	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Unit Price	(US$)	13.75																			
		Revenue	(US$ 1,000)	3,231	3,616	3,328	2,461	1,100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Local	Quantity	(1,000 Bbl)	1,488	1,665	1,849	2,044	2,247	2,411	2,478	2,583	2,583	2,583	2,583	2,583	2,583	2,583	2,583	2,583	2,583	2,583	2,583	2,583
		Unit Price	(US$)	17.78																			
		Revenue	(US$ 1,000)	26,457	29,604	32,875	36,342	39,952	42,868	44,059	45,926	45,926	45,926	45,926	45,926	45,926	45,926	45,926	45,926	45,926	45,926	45,926	45,926
Fuel Oil	Export	Quantity	(1,000 Bbl)	792	876	930	959	988	1,002	1,012	1,039	1,017	992	966	950	934	922	909	901	867	820	777	732
		Unit Price	(US$)	12.12																			
		Revenue	(US$ 1,000)	9,599	10,617	11,272	11,623	11,975	12,144	12,265	12,593	12,326	12,023	11,708	11,514	11,320	11,175	11,017	10,920	10,508	9,938	9,417	8,872
	Local	Quantity	(1,000 Bbl)	139	166	201	242	270	301	328	357	379	404	430	446	462	474	487	495	529	576	619	664
		Unit Price	(US$)	12.89																			
		Revenue	(US$ 1,000)	1,792	2,140	2,591	3,119	3,480	3,880	4,228	4,602	4,885	5,208	5,543	5,749	5,955	6,110	6,277	6,381	6,819	7,425	7,979	8,559
Coke	Export	Quantity	(T)	16,872	18,877	20,482	21,766	22,792	23,614	24,270	25,296	25,296	25,296	25,296	25,296	25,296	25,296	25,296	25,296	25,296	25,296	25,296	25,296
		Unit Price	(US$)	44.00																			
		Revenue	(US$ 1,000)	742	831	901	958	1,003	1,039	1,068	1,113	1,113	1,113	1,113	1,113	1,113	1,113	1,113	1,113	1,113	1,113	1,113	1,113
		Total Export Sales		20,538	23,501	25,006	25,290	24,806	24,189	24,448	25,270	24,445	23,570	22,682	21,900	21,117	20,353	19,591	18,875	17,828	16,608	15,437	14,227
		Total Local Sales		58,538	64,797	70,884	76,901	82,646	87,485	90,436	94,492	95,500	96,568	97,649	98,620	99,591	100,552	101,504	102,413	103,678	105,130	106,529	107,975
		Grand Total		79,076	88,298	95,890	102,191	107,452	111.674	114,884	119,762	119,945	120,138	120,330	120,520	120,708	120,905	121,095	121,288	121,506	121,738	121,966	122,202

TABLE 12-2-B NET BENEFIT

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Total Revenue				80,516	88,298	95,890	102,191	107,452	111,674	114,884	119,762	119,945	120,138	120,330	120,520	120,708	120,905	121,095	121,288	121,506	121,738	121,966	122,202
Sales of Product				79,076																			
Sales of Construction Machinery				1,440																			
Total Cost				65,134	72,081	77,647	82,120	85,700	88,581	90,891	94,475	94,475	94,475	94,475	94,475	94,475	94,475	94,475	94,475	94,475	94,475	94,475	94,475
Raw Materials																							
Crude Oil (US$ 4.40/Bbl)				58,067	64,967	70,490	74,910	78,440	81,270	83,528	87,058	87,058	87,058	87,058	87,058	87,058	87,058	87,058	87,058	87,058	87,058	87,058	87,058
Chemicals & Catalyst																							
Utility																							
Electric Power																							
Operating Labour																							
Maintenance Cost				7,067	7,114	7,157	7,210	7,260	7,311	7,363	7,417	7,417	7,417	7,417	7,417	7,417	7,417	7,417	7,417	7,417	7,417	7,417	7,417
Insurance																							
Administration Cost																							
Other Expense																							
Net Income Before Interest and Tax				15,382	16,217	18,243	20,071	21,752	23,093	23,993	25,287	25,470	25,663	25,855	26,045	26,233	26,430	26,620	26,813	27,031	27,263	27,491	27,727

TABLE 12-2-C INTERNAL RATE OF RETURN (ECONOMIC)

Year	Investment	Net Income Before Interest & Tax	Discount Rate (14%)	Present Value	Discount Rate (15%)	Present Value
1	54,654		0.877	-47,932	0.870	-47,549
2	43,251		0.770	-33,303	0.756	-32,698
3	12,971		0.675	- 8,755	0.658	- 8,535
4	4,485	15,382	0.592	6,451	0.572	6,233
5		16,217	0.519	8,417	0.497	8,060
6		18,243	0.456	8,319	0.432	7,881
7		20,071	0.400	8,028	0.376	7,547
8		21,752	0.351	7,635	0.327	7,113
9		23,092	0.308	7,113	0.284	6,568
10		23,993	0.270	6,478	0.247	5,926
11		25,287	0.237	5,993	0.215	5,437
12		25,470	0.208	5,298	0.187	4,763
13		25,663	0.182	4,671	0.163	4,183
14		25,855	0.160	4,137	0.141	3,646
15		26,045	0.140	3,646	0.123	3,204
16		26,233	0.123	3,227	0.107	2,807
17		26,430	0.108	2,854	0.093	2,458
18		26,620	0.095	2,529	0.081	2,156
19		26,813	0.083	2,225	0.070	1,877
20		27,031	0.073	1,973	0.061	1,649
21		27,263	0.064	1,745	0.053	1,445
22		27,491	0.056	1,539	0.046	1,265
23		27,727	0.049	1,359	0.040	1,109
23	-16,373		0.049	802	0.040	655
				(+4,449)		(-2,800)

$$14 + \frac{4,449}{4,449+2,800} = 14.6\%$$

Chapter 13;

POINT OF ISSUE FOR MATERIALIZATION OF THE PROJECT

Chapter 13

POINT OF ISSUE FOR MATERIALIZATION OF THE PROJECT

For materialization of the Refinery project, there are several sorrounding problems on the outskirts of the project.
If these problems are not solved, it seems difficult to expect smooth implementation of the Project.
Outline of these problems is presented briefly below;

13.1 Crude Oil Exploration Facilities

In Chapter 2, subject concerning the exploration and exploitation of crude oil was fully investigated and crude production plan in future was established from both technical and economic viewpoints.

Based on this production plan, the capacity of the Refinery was defined and the operation plan of each refinery was established accordingly.
Therefore, the execution of the crude production plan is an indispensable condition in the materialization of the Project.

The proposed crude production plan needs 3 more unit of drilling rigs by 1978 for securing necessary amount of crude for the Project.
Consequently, it must be emphasized that necessary moves must be taken at an early stage for procurement of 3 sets of rigs.

13.2 Transportation of Equipment

As mentioned in 7.2.4 - Transportation Plan, it is considered that 8 to 10 Z-crafts would be necessary based on the plan

in which all materials and equipment are assumed to be transported through the Irrawaddy River by Z-crafts. Even if 30% of the cargo would be transported by cargo vessels or by overland transport as packed cargo, a minimum of 6 Z-crafts be still required.

Comments on this problem are described below;

- As shown in Fig. 7 - 3 : Shipping Schedule, these Z-crafts are required to secure exclusively for the Project for two years.

- The required numbers of Z-crafts were estimated on condition that the Z-crafts would be in their full working through two years. If some trouble is caused in loading or unloading work, or their navigations due to their periodic inspections and maintenances, and natural condition such as weather, their two round trips per month will become difficult and their transport capacity shall be reduced.

- Large and heavy equipment will take a long time for their loading and unloading, and it will often appear such inefficient shipping as only one piece of them can be carried in a craft at one time.

- The plan of shipping schedule is based on condition that the cargo having arrived at the Rangoon Port is already shipped on their way up the Irrawaddy River before entering the next sea-going vessel into the port.
  If a freight congestion is caused by, it will not only increase construction cost due to addition of such extra costs as long term holding fees and stevedore charges at the Rangoon Port, but also have the effect of extending the construction period.

13.3 Civil Work

Prior to the commencement of engineering works for the Refinery, collection of the detailed and specific data, as mentioned in 7.1 - Site Survey, is required in regard to geological conditions including soil condition of the Site, and also the river conditions of the Irrawaddy River near the bank where shipping terminal including jetties are planned to be built. With these data, plot plan and design works for the access road, Refinery, Terminal, and shipping jetties can be appropriately worked out.

During construction period, as mentioned in 7.3.2 - Civil and Architecture, it is expected that a large amount of such materials as gravel and sand for use in concrete, gravel for access road, sand for tank foundations, etc., will be required to supply locally. So, investigation will also be necessary not only for the places where they will be available but also for their available amount and for transportation means.

It is desirable that these surveys or investigations are completed before the tender call of the Project because the data will be necessary to prepare the tender documents in Burmese Side.

13.4 Power Transmission Line

The distance from the Kyunchung electric power plant to the Refinery is approximately 140 Km, and the installation of transmission line on the route will require about two years.

It is necessary to start the installation work so early that the Refinery will be able to receive electric power by March, 1980 as scheduled in construction progress.

13.5 Product Transportation

Transportation of products will be one of major problems after the completion of the Mann refinery considering that main route of the transportation is over the Irrawaddy, and that the river condition will be in quite difference by season.

The following are pointed out as a result of investigation on this subject.

- Number of barges and coastal tankers used as main measures of petroleum product transportation is sufficient even after the completion of the Mann refinery when considered the number of those already ordered. Nevertheless, an early completion of cross-country crude pipeline, which is said to be constructed from the oil field in Central Burma to Syriam refinery, would be an efficient means for product transportation.
- In regard to other means of product transportation other than oil barge and coastal tanker, various types of transportation facilities are being used, and potentiality for transportation capacity of these facilities might be considered as very high. However, it seems necessary to reinforce land transportation facilities, such as bowser and rail tank car which are used exclusively for transportation of petroleum product, in accordance with increase of amount of products to be delivered.

Appendix

1. AN EXAMINATION OF SITE SELECTION

Appendix 1

AN EXAMINATION OF SITE SELECTION

In Chapter 5, site selection for the Refinery was discussed in comparison of the Mann area and the Rangoon area.

In this appendix, a comparison will be made between the two sites from the point of view of plant construction costs and products transportation costs.

1) Advantages of the Syriam Site in view of the Decreases in Plant Construction Costs

When a comparison is made between the Mann area and that of Rangoon, it is reasonable to compare both with taking into consideration the connected conditions of each site. For example, in the case of the Mann area, it will be necessary to install long distance electric transmission lines, and in the case of the Rangoon area, many hundreds of miles of crude pipeline will have to be installed or a number of vessels will have to be purchased in order to transport the crude oil to new refinery.

However, in this section, both sites will be compared in a simple way from only the point of view of construction costs of the refinery itself and transportation costs.

In the Rangoon area, the land adjacent to the Syriam Refinery was supposed as the site for refinery, and the cost compared with that of Mann case has been calculated as follows:

- Foreign currency portion of decreased cost — U. S. $ 4,930,000
  - Cost reduction items ; Coke jetty, water intake and water treatment facilities, maintenance equipment, crude oil pipeline, and terminal facilities.
  - Cost increase items ; None
- Local currency portion of decreased cost — U. S. $ 37,000
  - Cost reduction items ; Transportation cost of construction materials, access road,
  - Cost increase item ; foundation

Due to the above-mentioned decrease in construction cost, the annual decrease in cost at the Syriam Refinery is as follows:

	U. S. $
Depreciation	248,000
Interest for Foreign Currency	148,000
Maintenance Costs	123,000
Insurance	49,000
	$ 568,000

2) Advantages of the Mann Site due to the Decrease in Transportation Costs.

All the products from the Mann Refinery will be supplied effectively to Central and Upper Burma except for a small amount which will be for export. On the contrary, if the new refinery were to be built at Syriam, the transportation of crude oil to Syriam and also the transportation of products to Central Burma (to the Mann area) will be necessary, and it will cause the increase of cost. (Refer, Fig. A1 - 1 and A1 - 2).

(a) Cost increase in the case of Syriam

Increase of transportation cost in the case of Syriam is calculated as shown below :

Crude Oil Transportation Cost (From Mann to Syriam)	K. 8.53/Bbℓ-Product
Products Transportation Cost (From Syriam to Mann)	K. 8.81/Bbℓ-Product
Total :	K. 17.34/Bbℓ
	(U. S. $ 2.63/Bbℓ)

(b) Amount of increased cost:

To give an example, in the year 1985, expected production from the Mann Refinery is shown as follows:

Production	6,290,000 Bbℓ
Domestic Sales	5,266,000
Export	1,024,000

Therefore, if the new refinery were built at Syriam, it can be considered that, as rough calculation, the required transportation costs were more than U. S. $13,849,580 (U. S. $2.63 x 5,266,000 = U. S. $13,849,580).

On the other hand, the decrease in the cost of transportation for exported products will be calculated at around U. S. $43,400 [(8.81 - 8.53) x 1,024,000 x 1/6.6] .

Therefore, if the new refinery were built at Syriam, the increase of annual transportation costs would amount to approximately U. S. $13,800,000.

3) Advantages of the Mann Site:

According to the results of the above comparison, it can be said that the Mann site has an advantage over the Syriam site because saving on transportation cost in the case of the Mann site seems considerably higher than saving on construction cost in the case of the Syriam site.