purposes of this study.

Consumption figures used for the study are given in Table IV-4, and, as an example, a description of ammonia and urea manufacturing processes which were referred to for this study is given as Appendix IV-3. It should be noted, however, that these figures were utilized solely for purposes of this study, and they should not be taken as suggesting any particular process or process evaluation which is to be made by the Project sponsor in the implementation phase of the Project.

(2) Steam system

In the Ammonia and Urea Complex, steam is to be consumed for the following uses:

a. As process steam, to provide a source of hydrogen to be generated for ammonia synthesis in the ammonia plant

b. To heat process fluids in heat exchangers in each plant

c. To drive turbines for rotating machinery in each plant (e.g., for the centrifugal compressors in the ammonia synthesis section)

In an ammonia plant of 1,000 t/d scale such as is planned for the Complex, it is the general engineering practice that steam is to be generated by utilizing waste heat and is to be used for driving turbines, thus reducing electricity requirements.

To reduce electric power consumption, a similar steam-driving system is applicable to the rotating machines in urea plants and utilities plants as well, but the volume of steam available from an ammonia plant will not be sufficient for all possible applications of this nature in a urea plant and utilities plants. Thus several steam systems are alternatively conceivable in order to work out an integral steam balance for the whole Complex, and electric power consumption will be different in the case of each system.

For the purposes of this study, the steam system is designed on the basis of the following design criteria.

a. From the viewpoint of production economics, to the greatest extent possible rotating machines are to be driven by steam, thereby minimizing electric power consumption.

b. From the viewpoint of ease of plant operation, the ammonia plant is designed on the basis of a self-balanced steam system within the loop.

c. Steam for the urea plant and utilities will be provided from a boiler to be installed for that express purpose.

d. The major pieces of rotating machines to be driven by steam turbines are as follows:

Ammonia plant:	Ammonia synthesis compressor
	Air compressor
	Refrigerating unit
	Pump for feeding chemical for CO_2 removal
	Boiler feed water pump
	Reformer draft fan
Urea plant:	Carbon dioxide compressor
	Ammonia pump
	Carbamate pump
Utilities:	Cooling water circulation pump
	Cooling water supply pump
	Boiler feed water pump
	Demineralized water pump

The above system should be further examined for the final determination of design criteria to be used to prepare tender specifications. Regarding design criteria it is recommended that, in such examinations, full consideration should be given to the two points used for the present study, namely, (a) consumption of electric power should be kept at a minimum, and (b) the steam balance should be kept as simple as possible, from the viewpoint of ease of plant operation.

(3) Materials and utilities requirements

On the basis of the above criteria, the material and utility balance for the Complex was developed. There it is presumed that the Complex will use electric power supplied by SESCO and potable water supplied by the Public Works Department. The projected balance of materials and utilities is shown in Fig. IV-1.

The quantities of feedstock and utilities which must be supplied to the battery limits of the Complex are as follows:

Natural gas:	1,822 MMBTU/h (about 46.4 MMSCFD)
Electric power:	6,920 KWH/h
Water:	985 m^3/h (about 5.2 million gallons per day)

(4) Definition and scope of facilities and related work for the Complex

Facilities to be built for the Complex are broadly divided into the following three groups:

1. Process plants
2. Utilities facilities
3. Offsite facilities
   - Product storage and shipping facilities
   - Auxiliary facilities (common service facilities)

The scale and concept of facilities in each of the above groups are defined in the subsequent sections of this chapter. Plans for site preparation and for plant layout for the Complex are also presented in this chapter.

5-2 Process Plants

The process plants in the Complex consist of:

(1) Ammonia plant: 1,000 t/d

(2) Urea plant: 1,500 t/d
(Surplus ammonia: 130 t/d)

It is presumed that PETRONAS - Upstream Division, as supplier of the gas, will install a gas measuring device at the point at which gas is supplied to the Complex. Nevertheless, it is planned here that the Complex operator will simultaneously install a meter at the battery limit of the Complex in order to measure the received gas there. The pressure of gas supplied (see Table IV-2), at the Complex's battery limit, will be 830 psia (or 815 psig). All the currently available ammonia processes require the gas to be fed to the primary reformer with pressure of about 400 psig.

Taking into consideration pressure loss which takes place in the pretreatment section, the pressure of the supplied gas is sufficient to preclude the need for installing a booster compressor within the Complex. Hence the gas receiving facilities planned for the Complex comprise the above-mentioned gas metering system and gas pipeline within the Complex. Further, units for carbon dioxide removal as well as desulphurization will be installed for pretreatment of gas to be fed to the primary reformer. It is planned that the carbon dioxide removal unit adopts a wet process using a certain liquid chemical, and the desulphurization unit adopts a dry process using a certain oxidized metallic catalyst. For the purpose of capital cost estimates, however, these units are deemed as being part of the ammonia plant.

5-3 Utilities Facilities

The utilities facilities comprise all facilities required for the supply of utilities for the Complex, including those listed below:

1. Power receiving and distribution facilities
2. Emergency power generator
3. Water treatment system
4. Cooling water system
5. Steam generation unit
6. Air separation unit
7. Instrument air and plant air unit

These are described in detail in the following paragraphs.

(1) Electric power receiving and distribution facilities

All electric power used within the Complex, except emergency power, is to be supplied by SESCO to the primary transformer station (see Chapter 4, Section 4-2, of this Part). The Complex will have receiving facilities for 8.5 MW (10,625 KVA), and corresponding distribution facilities to supply electric power, after voltage and other currency characteristics are regulated, to the utilities facilities, process plants, product storage and shipping facilities and auxiliary facilities in the Complex.

(2) Emergency power generator

The Complex will have a 750 KW diesel power generator for emergency use to provide electric power to enable operations to be gradually shut down, and for safety operation in the event that electric power supply from SESCO is stopped.

(3) Water treatment system

The Complex will use potable water supplied by the PWD to the battery limit of the Complex. The supplied water will not require any primary treatment such as clarification and filtration, so that the supplied water may be used without such treatment except those for process water and boiler feed water. The water to be used for process water and boiler feed water will be treated in a demineralizer having 200 m^3/h capacity and a polisher having 350 m^3/h capacity which will be installed within the Complex.

Steam condensate from process steam will be circulated to the demineralizer, while the steam used for driving turbines will be circulated to the polisher through a condensate filter, so that most of the steam condensate is to be re-used as boiler feed water.

(4) Cooling water system

Soft water used for cooling will be returned to the cooling towers for cooling the used water by counter-flow of air. Water cooled in the cooling towers will be circulated to the process plants. As a part of the used water is bled out of the system, make-up water is fed to cover such discharges. Thus, the Complex will have a circulating cooling water system of 25,000 m^3/h which consists of cooling

towers and cooling water circulating facilities.

(5) Steam generation unit

As is noted in 5-1 (2) of this chapter, all of the steam required in the ammonia plant will be generated within the ammonia plant. The boiler installed in the Complex will generate steam needed for the urea plant and utilities plants. The Complex will have a boiler which is capable to generate 130 t/h of steam (pressure, 105 kg/cm^2G; temperature, 490°C).

(6) Air separation unit

Nitrogen, as the inert gas required for plant shut-down and start-up, is to be provided by a 600 Nm^3/h (as nitrogen gas) air separation unit to be installed in the Complex. Hydrogen required for start-up of the ammonia plant is to be obtained by means of cracking ammonia.

(7) Instrument air and plant air facilities

To provide instrument air and plant air, an instrument air and plant air unit having the capacity of 1,400 Nm^3/h is to be installed.

5-4 Offsite Facilities

5-4-1 Product storage and shipping facilities

The products to be produced by the Complex are ammonia and urea. A major portion of the ammonia will be used in the manufacture of urea within the Complex, and a small portion of it is to be shipped in the form of liquid ammonia. The urea is to be shipped in bulk form. The storage and shipping facilities which the Complex should have are as described below.

(1) Ammonia storage facilities

A cryogenic, atmospheric-pressure (-33°C, 400 mm H_2O G) tank of 10,000 tons capacity will be installed at the Complex for storage of ammonia. In addition to storing ammonia prior to shipping, this tank will also be used to store ammonia in

order that (1) when the urea plant is shut down, the ammonia plant can be operated, or (2), when the ammonia synthesis section is stopped, the urea plant is operated. The tank is to be equipped with a refrigerating unit to re-liquefy gaseous ammonia which has vaporized during storage, and to maintain the required low temperature.

(2) Ammonia load facilities

It is assumed that liquid ammonia will be transported to market by cryogenic type (3 - 4°C, 7 kg/m²G) tankers. Therefore ammonia which has been stored at low temperature and at atmospheric pressure in the storage tank will be heated to 3 - 4°C within the Complex and transferred by pipeline to the loading unit installed on the Bulk Cargo Pier in Bintulu Deepwater Port, for loading aboard tankers. The pipeline will be a double-pipe, 1,820 m line along the mounting for the conveyor which will transport bulk urea from the Complex to the same pier. One pipe (8″) will be for liquid ammonia, and the other (5″) will be for return gaseous ammonia which has been formed by vaporization during loading. The loader for loading ammonia to the tanker will consist of a flexible pipe which can be manually controlled, as the frequency of shipment and quantity of each shipment are not so great as to require that a mechanized loading arm be installed. Loading capacity of the unit should be 100 t/h. The flow for the above-described ammonia loading system is shown as Fig. IV-7.

(3) Urea storage facilities

As noted in Part II, it is assumed that all urea will be shipped in bulk, and bagged at the point of arrival. Therefore, at the Complex it will be necessary to have a facility for bulk storage of urea, which should have the capacity of 75,000 tons (50 stream days production). This facility should be in the form of a steel-reinforced concrete, air-tight type warehouse, and should be equipped with both a dehumidifying unit and a reclaimer for the loading of urea onto a conveyor for transport to the pier. Another belt conveyor will be installed to transport the urea from the urea plant to the bulk urea storage.

(4) Urea loading facilities

Using a 600 t/h reclaimer installed in the bulk urea storage, stored prilled urea will be loaded onto a bulk conveyor for transport over the distance of 1,820 m to the

Bulk Cargo Pier. Right of way for the conveyor will follow the Tg. Kidurong road, keeping ample distance from the road so as not to interfere with future expansion of the road's width (by 30 m), and so as to minimize earthwork which might be needed for installation of the conveyor way. The conveyor, as shown in Fig. IV-6, will cross the road at one point, where the conveyor will be kept at the height of 8 m. To prevent urea from rain or moisture, the conveyor will be provided with a cover, and will be equipped with a humidity control device. On the pier a movable loader with a loading capacity of 600 t/h will be installed. In carrying out the plans for this Project, it will be necessary to give full attention to the need for allowing for expansion of the existing road, and for obtaining easements so that the conveyor and pipeline route may travel over the land and cross the road as required in accordance with plans which give the most economical route for the conveyor and pipeline. It will also be essential to insure that the loader erected on the pier will have the required durability.

5-4-2 Auxiliary facilities

In addition to the various facilities enumerated and discussed from 5-2 to 5-4-1 above, the following facilities should be installed to insure stable operation of the Complex.

(1) Maintenance shops

In order to carry out periodic inspection and maintenance of the Complex facilities, and also to undertake spot checks and small repair work while the plants are in operation, maintenance shops equipped with machines and tools needed for maintenance of machinery, equipment, instruments and electrical equipment will be installed. The maintenance shops will be designed on the presumption that repair of large machines and equipment will be done by vendors or other qualified fabricators, and the maintenance shops in the Complex will function to undertake repairs only of small and medium size equipment and machinery.

Equipment and machine tools to be furnished in the maintenance shops will include welding equipment and other tools for mechanical repair work; coil winders and other equipment for electrical repairs; as well as calibrators and other testers for instrument repair.

(2) Pollution control facilities

In Malaysia, Environmental Quality Act of 1974 and Environmental Quality Regulation of 1978 set the limits of industrial plant effluents. The following is an example given in those regulations of limits for liquid effluent:

Temperature	40°C
pH	6.0 ~ 9.0
BOD at 20°C	20 mg/ℓ
COD	50 mg/ℓ
Suspended solids	50 mg/ℓ

The effluent treatment facilities of the Complex should be equipped in the following concept:

(a) Gaseous effluent:

As only minute quantities of sulphur are present in the natural gas, there will be no emission of sulphur oxides, and hence no need for gas removal or treatment equipment.

(b) Liquid effluent:

Possible sources of pollution are waste cooling water (containing heavy metal ions and oil), filter washing water from the urea plant, and the like; for each of these waste water sources, adequate treatment devices are to be installed.

(c) Solid effluent:

Urea dust from the prilling tower will be collected by installing a device to reduce particulate concentration to about 50 mg/m^3 at the tower outlet.

(3) Administration office and other buildings, and other structures

Within the Complex there will be need for the provision of an administration office, an analysis laboratory, cafeteria, garage, guard's shed, and other miscellaneous buildings and structures. An outline of these buildings and structures is given in Table

IV-5. In addition to these, there will be need for a fire-fighting system and telecommunication system within the Complex.

5-5 Site Preparation, Access Road and Complex Layout

(1) Site preparation for the Complex

Because the proposed site is strongly undulating, it is likely that site preparation includes much work, depending upon the site development plans. Further, if the finished grade of the site is high, when the time comes to move in plant equipment weighing as much as 300 tons, it will be impossible to use trailers to move the equipment. Therefore the site preparation plan must be prepared on the basis of the two underlying objectives that (1) earthmoving must be kept at a minimum, and (2) the finished grade of the site must be at such an elevation that it is possible to transport heavy equipment to the site (the inclination of the road may be no more than 5% for trailer trucks to be used). The site development plan proposed for the Complex (see Fig. IV-8) is as follows:

Site area:	40 ha
Area to be developed:	18 ha
Finished grade:	30 m (33 m in part)
Excavation:	1,063,000 m^3
Filling & compaction:	994,000 m^3

General information on the site is stated in Section 2-2 of Chapter 2, in this Part IV and the results of a study of the site preparation plan are provided in Appendix IV-4.

(2) Access road

As may be seen from Fig. IV-8, the access road from Tg. Kidurong road (12 m in elevation) to the Complex site will approach the site from the southwest. The major reason for this is the need to minimize the inclination of the access road, as mentioned above. The road width is to be 12 m, and it would be 400 m long. Equipment and materials would be landed at the temporary construction jetty now being planned primarily for use for port construction, carried across the road, and

then transported by means of the access road to the Complex site.

(3) Site layout

A general layout plan of the Complex is furnished as Fig. IV-9.

CHAPTER 6 PROJECT IMPLEMENTATION AND COMPLEX OPERATION

6-1 Organization for Implementation of this Project

The company which will implement the Project and operate the Complex will be established in the near future as a Malaysian company with the equity provided jointly by the ASEAN countries, and at the present time preparations are being made for the Project by the PETRONAS Project Team which has been designated as the executing agency by the Malaysian Government.

For the purpose of implementing this Project, PETRONAS has formed the project team consisting mainly of staff in the Processing and Manufacturing Division. The PETRONAS Project Team intends to engage an internationally-experienced consultant, and with assistance provided by the consultant, will proceed with detailed examination and planning of various technical aspects as well as preparation work for implementation of the Project.

Although the new joint venture, once established, will of course assume the responsibility for carrying out the required work, in order to obtain maximum assurance of success, the Evaluation Study Team emphasizes that it is necessary to further strengthen the present project team so that when the Project enters the implementation stage the basis for project management will already have been established. It is essential, further, that engineers who will later transfer to work for the joint venture, and will have assignments during the construction of the Complex as well as operation and maintenance assignments after the start of Complex operation, be assigned to the project team, so that they will continuously execute their tasks for successful implementation of the Project even after the joint venture company has been established. This will be the first instance of construction of an ammonia and urea complex of a large-scale in Malaysia. In view of the various tasks which must be accomplished by the project executing entity during the stage up to completion of construction (see Section 6-2-2 of this Part for details of such tasks), it is recommended that to the greatest extent possible engineers possessing experience in similar projects be engaged, and that key staff members be trained in similar projects overseas which are now in progress, in order to acquire engineers who have field experience.

6-2 Construction Plan of the Ammonia and Urea Complex

6-2-1 Method of procurement and construction of facilities

The machinery and equipment which will be included in the Complex are exceedingly diverse in nature, and in many cases are technologically sophisticated. Only a few are presently being made in Malaysia, and therefore it will be necessary to rely on imports for the most of the machinery and equipment for the Complex. In addition, the construction of the Complex involves a far-ranging and complex assortment of tasks, such as design and engineering of various facilities including process design of ammonia and urea plants which are the main part of the Cmplex; procurement, shipping and forwarding to the site of equipment, supplies and materials; civil work; erection and installation work; inspection and other relevant activities needed for the completion of the Complex.

In view of the characteristics and complexity of the Project, the PETRONAS Project Team will undoubtedly elect to use a turn-key lump-sum arrangement for construction, in accordance with general practice in Malaysia for large industrial projects, and have the work performed by a qualified, internationally-experienced contractor. Contractor selection will be by means of cmpetitive bidding. Under such form of arrangement, the contract would require the contractor, in a fixed project budget, to perform the design and engineering, procure and supply equipment, supplies and materials, complete the civil, erection and construction work, train operators and other key personnel of the Complex operator, and to provide assistance for and supervision of start-up and commissioning of the plants. Further, the contractor should guarantee to complete this work so as to enable the facilities to be taken over by the Project sponsor after successful completion, within a specified period, of test runs which prove guaranteed performance of plants and facilities.

This manner of constructing the Complex is believed to be the safest and most realistic which can be used in instances of constructing projects as large as this Ammonia and Urea Complex, because it provides assurance of the extent of the total construction cost at the time of signing of the contract, and also because the contractor assumes total responsibility, including the responsibility for completing his work according to a schedule previously approved by the Project sponsor. Therefore, the subsequent discussions are made on the assumption that construction will be done by an internationally-experienced contractor in the above manner.

Nevertheless, in the event that this method is used, there is the possibility that problems will arise, such as the following:

(1) Because the contractor undertakes to do all of the work including procurement of equipment and materials, in order to avoid the risk of fluctuations in prices of equipment and materials after the contract award, or of increases in cost due to design changes, the contractors are to be expected to submit bids which are higher than those would be made if the cost-plus type contract was selected, because of the need to include a considerable contingency fee and safety factor for protection against those risks.

(2) Because the selection of equipment and subcontractors is done by the contractor, it is difficult for the Project's sponsor to give detailed instructions concerning the type and specifications of them after the award of the contract, so that unless there are close checks performed prior to the contract award, and unless there are, at the time of the award, coordination procedures agreed between the Project sponsor and the contractor which would enable the Project sponsor to monitor the contractor's performance and to instruct the contractor regarding any necessary changes even after the contract award, it is possible that a large number of minor problems will emerge at the time operation is begun.

Therefore, in view of these potential problems, it is of vital importance that measures be adopted to prevent these problems from arising, in the course of preparations described in the following clause, including preparation of tender specifications, as well as selection of the contractor, contract negotiations, and project management following the award.

6-2-2 Major tasks which must be performed by the Project sponsor up to the time of completion of construction

On the assumption that procurement and construction of the Ammonia and Urea Complex, as described above, will be performed by a foreign contractor on a turn-key lump-sum basis, the major tasks which the Project sponsor must accomplish up to the time of completion of construction, and the manner in which the sponsor should proceed, are as described below.

(1) Necessary tasks to be performed by the Project sponsor

The following are the major preparations which must be made by the Project sponsor prior to issuance of the Invitation to Bid for the engineering and construction contract for the Complex:

- Completion of soil and subsoil investigations, and final decision on use of the selected site
- Detailed examination of the design criteria
- Preparation of general terms and conditions of contract with regard to the design, engineering, procurement and construction of the Complex
- Preparation of tender specifications for contractor's bids
- Pre-qualification and short-listing of bidders to be invited for the contractor's bids
- Pre-qualification and short-listing of bidders to be invited for the contractor's bids

These are described in further detail in the following paragraphs:

(A) Completion of soil and subsoil investigations, and final decision on use of the selected site

It is of urgent necessity that full rights to use of the site be obtained as early as possible, in order that subsequent steps may be taken without undue hindrance. Then, a further detailed survey of the site conditions must be made, so that the site plans can be drawn. It is advised that as soon as the boring tests and soil investigations are completed, decision on use of the proposed site be made and then design bases be developed.

(B) Detailed examination of the design criteria

It is necessary that based on the concept of plants and facilities which have

already been defined in the feasibility study and also on site conditions which have been clarified as the result of the above-mentioned detailed site survey, conceptual design of the plants and facilities be more precisely made in order to finalize the design criteria. Of course, it is not possible at this stage to precisely define the specifications of equipment involved in process plants, because the processes to be employed can be decided only after the contractor is selected through bidding. However, design criteria for plants and facilities should be determined by the Project sponsor, to the most detailed extent possible, to enable all bidders to design such plants and facilities on an identical concept, with their budget estimations to be made on the basis of proposed manufacturing processes. Further, at the same time the engineering standards to be followed by the contractor for design and engineering should be identified.

(C) Preparation of general terms and conditions for contract

It is required for the Project sponsor to prepare general terms and conditions of contract with regard to design, engineering, procurement and construction of plants and facilities, and to furnish them, as the standard contract form, to bidders as a part of the tender documents. For this purpose it will be necessary for the Project sponsor to study realistic, implementable conditions which satisfy the requirement of financing agencies.

(D) Preparation of tender specifications

The contractor will be selected by competitive bidding by the pre-qualified firms. The services and supplies to be performed or provided by the contractor broadly comprise the following items:

- Preparation, and then management, of the overall construction program for the Project (the detailed construction schedule, and the detailed construction budget; coordination and reporting procedures)

- Procurement, inspection and forwarding to the site (including arrangements for transportation, custom clearance and landing) of equipment, supplies and materials for the Project

– Construction and erection work

– Training of operation and maintenance personnel

– Assistance and supervision for start-up and test-run

To the most detailed extent possible, on the basis of (B) and (C) above, there must be determination and preparation of the scope of work to be required of the contractor, his responsibilities, items to be guaranteed (such as plant performance, mechanical performance, construction workmanship, material standards, completion time, etc.), design bases, design criteria, costing and cost estimate form and items of information which bidders are requested to submit with their bids, etc.

(E) Pre-qualification and short-listing of firms to be invited for bids

It is required for the Project sponsor to carry out pre-qualification and short-listing of firms to be invited for contractor's bids.

(F) Establishment of bid evaluation criteria

In order to conduct fair evaluation of bids, the bid evaluation criteria must be established in advance.

(2) Contractor selection

After the above-described preparations for the tender are completed, an invitation to bid is issued to the qualified contractors, and the technical proposal and commercial proposal submitted by each contractor are compared and evaluated according to the predetermined evaluation criteria and, following technical clarifications which may be necessary, a successful bidder is selected. After negotiations with the successful bidder, the contract is executed.

(3) Tasks to be performed by the Project sponsor after the award of contract

Once the contractor has been employed as has been stated above, responsibility for almost all aspects of construction is borne by the contractor. Nevertheless the

Project sponsor may need to review the critical part of the basic design and detailed design prepared by the contractor, and the major pieces of critical equipment selected by the contractor, in order to insure that the plants will meet the requirements of the Project sponsor and satisfy its desire. It is essential for the Project sponsor to establish coordination procedures with the contractor and also to organize a project management team so that the Project sponsor can carry out these tasks in efficient manner.

Further, in order to be assured that after the completion of construction, there will be a smooth start-up of the plant and facilities, it is important for the Project sponsor, during the construction period, to plan, recruit, organize and train engineers and operators. Another task to be performed by the Project sponsor will be the contracting and supervision for work outside the scope of the contractor's responsibility; securing of the supply of feedstock, auxiliary materials, utilities and supplies; coordination with relevant authorities or institutions; project budget and schedule control and other necessary overall project management.

6-2-3 Implemention schedule

The construction schedule was reviewed through referring to actual achievement in similar projects and taking the site conditions into consideration. As the result, it is projected that from the time that the main contract becomes effective to the time of mechanical completion of the Complex, 33 months will be required, and from start-up to acceptance of the Complex by the Project sponsor an additional 5 months will be required so that in all 38 months are needed (see Fig. IV-2). Therefore, assuming that the contract becomes effective in early January, 1981, it is expected that commercial operation could be begun in March, 1984.

6-3 Organization for Complex Operation and for Administrative Work

6-3-1 Organization for Complex operation, and manpower planning

The organization for management and operation of the Complex was studied in consideration of the scale of the Complex and inherent features of the region of the site. The thus-formulated organization and manpower plan is shown in Table IV-6. It is proposed that the head office of the joint venture company will be set up in Kuala Lumpur, where a staff of 34 persons will be needed. For operation, management and

maintenance of the production facilities and loading of product for shipment, in Bintulu, 611 persons will be required. Because a marketing company would be established independently from the joint venture company, and the product would be sold by FOB Bintulu Deepwater Port contracts, no provision is made for persons who would be directly in charge of product sales.

Operation of the Complex after the completion of construction will be the responsibility of the joint venture company, as owner, but because it is believed that in Malaysia it will be extremely difficult to recruit engineers and technicians who are experienced in operating a large ammonia and urea plant such as this one, it is of particularly high importance to insure that all goes well in the training activities undertaken during the time that the plant is being constructed, and in the necessary on-the-job training to be carried out during the initial stages of Complex operation. The number of employees presently contemplated is somewhat more than those directly needed, but in view of the above conditions the Evaluation Study Team believes that this number is necessary in order for the joint venture company to maintain required levels of technical personnel even if there are some resignations after start-up.

With regard to the organization of the joint venture company, there would be six departments under a board of directors: Finance and Accounting, General Affairs, Personnel, Marketing, Operations and Complex departments. The Complex Manager, at Bintulu, would be in charge of Production, Plant Engineering and Product Storage/Shipping as the direct departments, and General Affairs and Technical Control and Engineering Services as the indirect departments. The total number of employees of the joint venture company, including five executives, would thus be 650.

6-3-2 Technical assistance services required to be provided by foreign firms

It is observed that in connection with implementation of this Project the Project sponsor may need to retain technical assistance services by internationally-experienced consultants with regard to preparation of tenders for contractors as well as the following aspects:

(1) Necessary technical assistance service at the stage of construction

As is stated earlier, there are very many tasks which must be accomplished as part of the work of project management during the construction phase. It will be most

effective to contract for the services of an internationally-experienced consulting firm for supply of technical assistance services, to assist PETRONAS Project Team and the joint venture company in areas where they need additional experience and expertise. The services which would be required are as follows:

a. Review and checking of the basic and detailed designs submitted by the contractor for owner's approval, and provision of instruction to the contractor in regard to any revision of the designs.

b. Participation in inspection of major pieces of equipment, which will primarily be made by the contractor's inspectors.

c. Assistance to the owner's engineers at times of inspections at the site in the course of erection, installation and piping work.

d. Assistance to the owner in preparation and implementation of training programs (for training other than provided by the contractor).

e. Assistance to the owner's engineers in establishing systems for procurement and inventory control of spare parts and plant supplies.

f. Assistance to the owner in establishing an organization for the start-up and for subsequent operation and maintenance system.

g. Assistance to the owner regarding monitoring and controlling the progress of work and the total project budget, and assistance in reporting to financial institutions and stockholders.

(2) Technical assistance service required to be provided after test-runs and during the initial stage of commercial operation

In order to establish an operation system for the Complex and undertake on-the-job training of employees, in parallel with the transition from test to commercial operation, it will be highly efficacious to obtain the systematically organized technical assistance services of an internationally-experienced firm. By means of forming teams of foreign experts and Malaysian counterparts, and carrying out a thorough on-the-job training program for two to three years, it will be possible to

firmly establish a sound Complex management organization and method of functioning. The major services which would be required are as follows:

a. Operational assistance at the time of start-up

b. Assistance in establishing a routine operation and maintenance system

c. Assistance in determining job descriptions and arrangements for assignment of responsibility, as well as in establishing standard operating procedures

d. Implementation of routine tasks through on-the-job training

e. Assistance for routine plant operation, and periodic and maintenance inspections

f. Assistance in emergency shut-down, start-up, and trouble-shooting

g. Assistance in establishing and implementing production control systems

6-3-3 Human resources development

As stated above, one of the keys to success for this Project lies in the recruiting and then intensive training of personnel during the construction stage. Training provided by the contractor is that which is limited to matters related to the licensed process, and moreover is limited in terms of the number of persons trained and the training period, as well as the content of the training. It is therefore necessary, as noted in the above paragraph, to plan and carry out a comprehensive training program. Need therefore exists to make budgetary provisions for such training, in addition to provision for technical assistance services to be rendered by foreign firms during the construction stage and the initial operation stage.

In Indonesia PUSRI (P.T. Pupuk Sriwidjaja) has recently completed a Training Center, and has begun to train ammonia and urea plant operators there, for work for PUSRI and also for others. The content of the training program is, in outline, as follows.

a. Basic chemistry

b. Basic chemical engineering

c. Basic aspects of chemical plants (especially ammonia and urea plants)

d. Ammonia and urea plant operation (through use of simulation)

e. Practice operation at an ammonia or urea plant now functioning

It will be effective if arrangements are made for the PUSRI Training Center to be used to train operators for work at the Complex.

Table IV-1 SPECIFICATION OF PRODUCTS

Ammonia		
	Ammonia	99.5 wt. % (Min.)
	Water	0.25 wt. % (Max.)
	Oil	10 ppm (Max.)
Carbon Dioxide		
	Carbon Dioxide	98.5 mol. % (Min.)
	Inerts	1.5 mol. % (Max.) (Dry Basis)
Urea		
	Nitrogen	46.0 wt. % (Min.)
	Moisture	0.3 wt. % (Max.)
	Biuret	0.5 wt. % (Max.)
	Free Ammonia	Trace
	Iron	Trace
	Ash	Trace

Table IV-2 NATURAL GAS SUPPLY CONDITIONS TO THE ASEAN UREA PROJECT (MALAYSIA)

	Richest		Leanest
– Composition (in mol percent):			
C_1	89.07		87.11
C_2	4.39		2.34
C_3	2.79		1.24
iC_4	0.60		0.27
nC_4	0.64		0.26
iC_5	0.23		0.11
nC_5	0.13		0.07
C_6	0.12		0.11
C_7+	0.02		0.03
Sub-total	97.99		91.54
H_2S (ppm)	7		14
N_2		max. 1.8	
CO_2		max. 8.0	
– Heating Value (BTU/SCF):			
Gross Heating Value	1,114		987
Low Heating Value	1,002		888
– Temperature:		86°F	
– Pressure:		830 psia	

Table IV-3 SAMPLES OF WATER SPECIFICATION AT BINTULU WATER STATION

(ppm)

Sampling Date	26 July 1979		13 July 1979	
	(A)	(B)	(A)	(B)
Ammoniacal Nitrogen (as N):	absent	absent	-	-
Albuminoid Nitrogen (as N):	absent	absent	-	-
Nitrates (as N).	absent	absent	absent	absent
Free Carbon Dioxide (as CO_2):	3.0	1.4	6.0	4.0
Total Alkalinity (as $CaCO_3$):	12	30	16	24
PH (Hydrogen-ion Concentration):	6.4	7.3	6.3	7.3
Chlorides (as Cℓ):	4	9	3	7
Residual Chlorine (as $C\ell_2$) on receipt:	-	0.10	-	0.30
Residual Alum (as Aℓ):	-	absent	-	absent
Soluble Iron (as Fe):	0.60	absent	0.50	absent
Total Iron (as Fe):	-	-	-	-
Fluoride (as F):	-	0.70	-	0.30
Oxygen absorbed from $KMnO_4$ in 4 hrs:	4.60	0.50	-	-
Colour (Hazen Units).	120	5	125	5
Turbidity:	72.0	0	100	1.5

Notes: (A) Raw Water Inlet Tunnel
(B) Outlet of Clear Water Well

Table IV-4 TYPICAL RAW MATERIAL AND UTILITIES CONSUMPTION

1. Ammonia Plant[1)]

	(per ton of Ammonia)
Natural Gas[2)]	8.66 MMKcal (LHV)
Electric Power	12 KWH
Cooling Water[3)]	360 Ton
Boiler Feed Water	5.3 Ton
Condensate Return (Export)	3.4 Ton

2. Urea Plant

	(per ton of Urea)
Ammonia	0.58 Ton
Carbon Dioxide	0.76 Ton
Electric Power	35 KWH
Steam (at 100 kg/cm^2)	1.20 Ton
Cooling Water[3)]	105 Ton
Condensate Return (Export)	0.90 Ton

Notes:
1) includes natural gas pre-treatment
2) 8.66 MMKcal = 34.37 MMBTU
3) in circulation, $\Delta t = 10^{\circ}C$

Table IV-5 FACILITIES INCLUDED IN THE PROJECT SCOPE

	Facilities	Rated Capacity
1.	Process Plants	
1)	Ammonia plant	1,000 t/d
2)	Urea plant	1,500 t/d (excess ammonia 130 t/d)
2.	Utilities Plants	
1)	Demineralizer	200 m^3/h
2)	Polisher	350 m^3/h
3)	Main sub-station	8,500 KW (10,625 KVA)
4)	Cooling towers	25,000 m^3/h
5)	Steam generation	130 t/h (105 kg/cm^2G, 490°C)
6)	Instrument and plant air	1,400 Nm^3/h
7)	Air separation (Nitrogen generation)	600 Nm^3/h
8)	Emergency diesel	750 KW
9)	Effluent treatment	one set
10)	Utilities distribution	one set
3.	Offsites Facilities	
3-1	Products storage & loading	
1)	Ammonia storage	10,000 ton (-33°C, atm.)
2)	Ammonia loading facilities	100 t/h
3)	Urea bulk storage (Reclaimer 600 t/h)	75,000 ton
4)	Bulk urea handling & loading	600 t/h
5)	Conveyor way for bulk urea shipping	1,820 mL
6)	Pipeline for ammonia shipping	1,820 mL (8B x 1, 5B x 1)

Table IV-5 FACILITIES INCLUDED IN THE PROJECT SCOPE (Cont'd.)

Facilities	
3-2 Common facilities	
1) Equipment & machines for maintenance and work shops	
2) Equipment for laboratories	
3) Drinking water & fire-fighting system	
4) Intercommunication system	
5) Lighting and lightening system	
6) Miscellaneous equipment & machines for common facilities	
3-3 Offsite buildings & structures	
	Total Floor Area
1) Maintenance shop	1,680 m^2
2) Laboratory	360 m^2
3) Local laboratories	30 m^2 x 5
4) Gate houses	50 m^2 x 2
5) Carport	150 m^2
6) Administration office	1,250 m^2
7) Cafeteria & locker room	1,400 m^2
8) Warehouses	1,400 m^2 x 2
9) Work shop	2,000 m^2
10) First aid house	200 m^2
11) Maintenance & engineering office	1,000 m^2
12) Fencing	one complete
13) Access road	12 mW x 400 mL
3-4 Housing and utility during construction	

Table IV-6 ORGANIZATION CHART OF ASEAN UREA PROJECT (MALAYSIA)

	Number of Personnel					
	Director, General Manager	Manager	Supervisor	Foreman	Worker	Total
Company Total	(7)	(37)	(87)	(168)	(351)	(650)
Board of Directors	(5)	–	–	–	–	(5)
Head Office, Kuala Lumpur	(1)	(6)	(8)	(11)	(8)	(34)
– General Manager Office	1	1	1	1	1	5
– General Affairs Department	–	1	1	2	1	5
– Finance/Accounting Department	–	1	2	2	2	7
– Personal Department	–	1	1	2	1	5
– Procurement Department	–	1	1	2	1	5
– Sales Department	–	1	2	2	2	7
Factory, Bintulu, Sarawak	(1)	(31)	(79)	(157)	(343)	(611)
– Factory Manager Office	1	1	2	2	2	8
– Production Department	(0)	(4)	(8)	(24)	(122)	(158)
Ammonia Process Plant	–	1	2	4	32	39
Urea Process Plant	–	1	2	4	24	31
Utility Facilities	–	1	3	12	60	76
Waste Treatment	–	1	1	4	6	12
– Maintenance and Inventory Control Department	(0)	(6)	(18)	(46)	(92)	(162)
Maintenance	–	4	12	36	72	124
Inventory Control	–	2	6	10	20	38
– Technical Control and Engineering Services Department	(0)	(6)	(24)	(41)	(22)	(93)
Production Management	–	2	10	15	5	32
Engineering Services	–	2	10	10	5	27
Analytical Laboratory	–	2	4	16	12	34
– Products Storage and Shipping Department	(0)	(4)	(8)	(8)	(16)	(36)
Products Storage	–	2	4	4	8	18
Products Shipping	–	2	4	4	8	18
– General Affairs Department	(0)	(10)	(19)	(36)	(89)	(154)
General Affairs	–	1	2	4	4	11
Personnel	–	1	2	4	4	11
Payroll	–	1	3	3	2	9
Accounting	–	1	2	2	2	7
Community Relations	–	1	3	3	1	8
Security, Safety and Fire-fighting	–	3	3	12	48	66
Clinic	–	1	2	4	8	15
Canteens	–	1	2	4	20	27

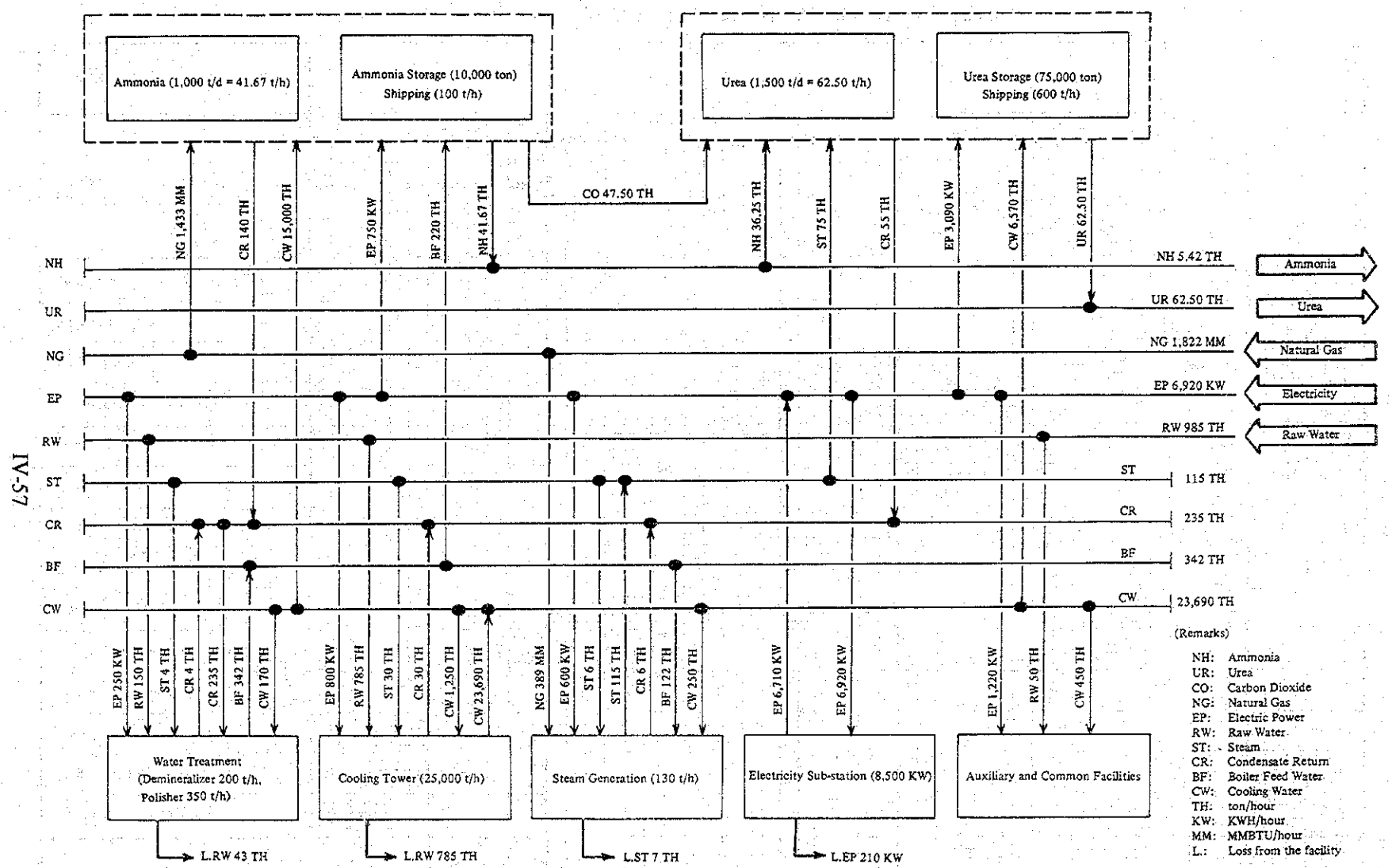


Fig. IV-1 TYPICAL RAW MATERIAL AND UTILITY BALANCE (100% Operation)

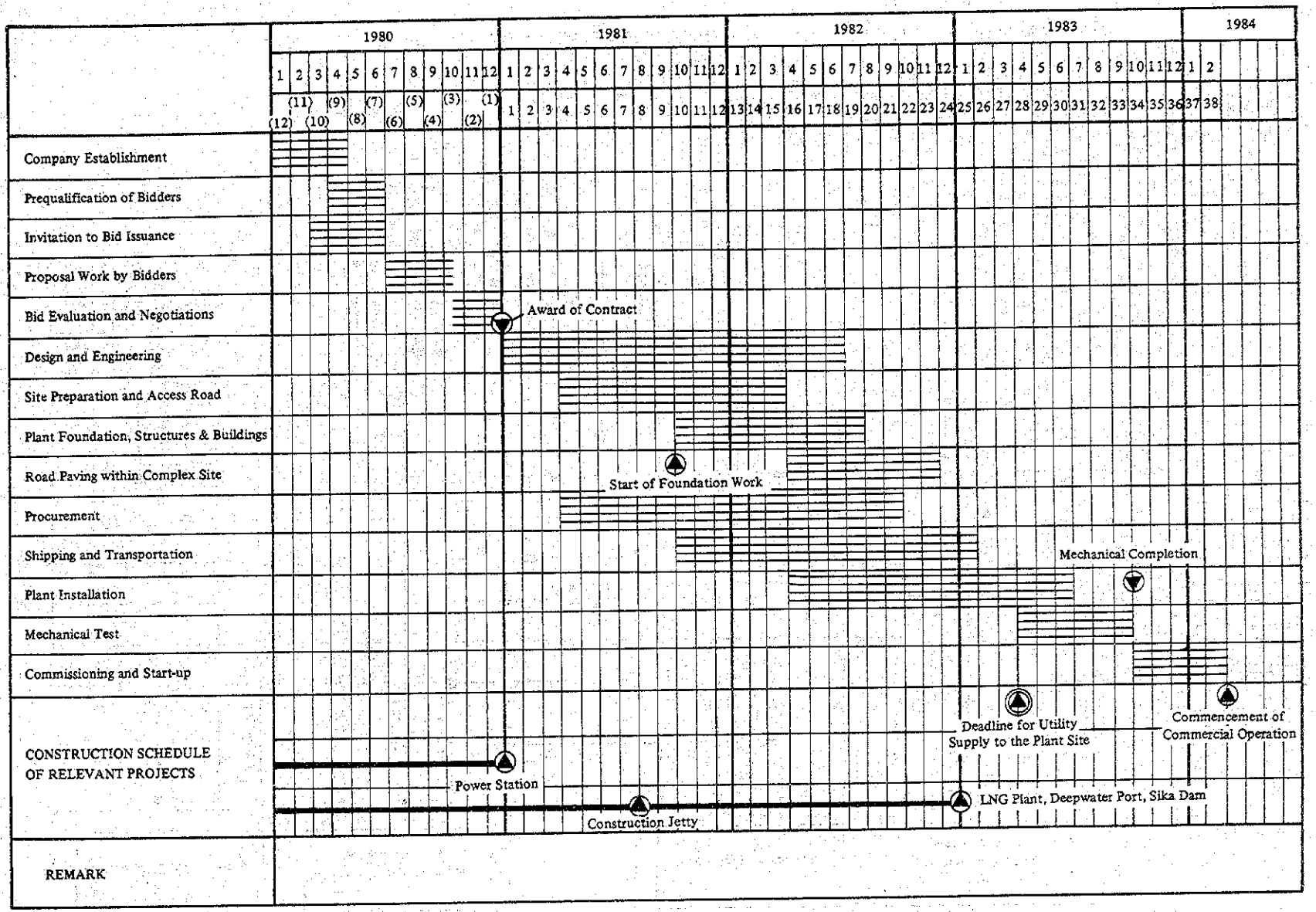
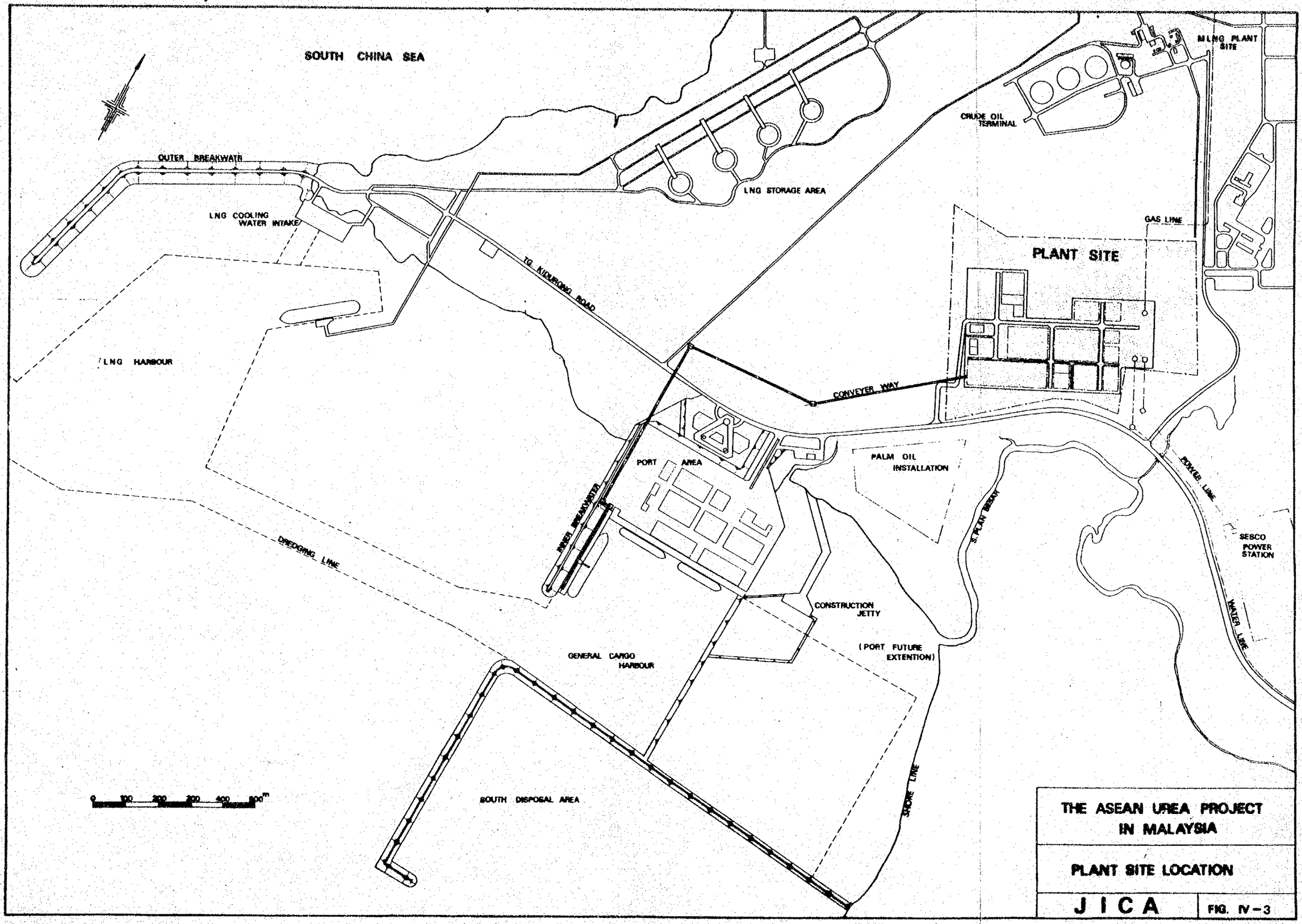
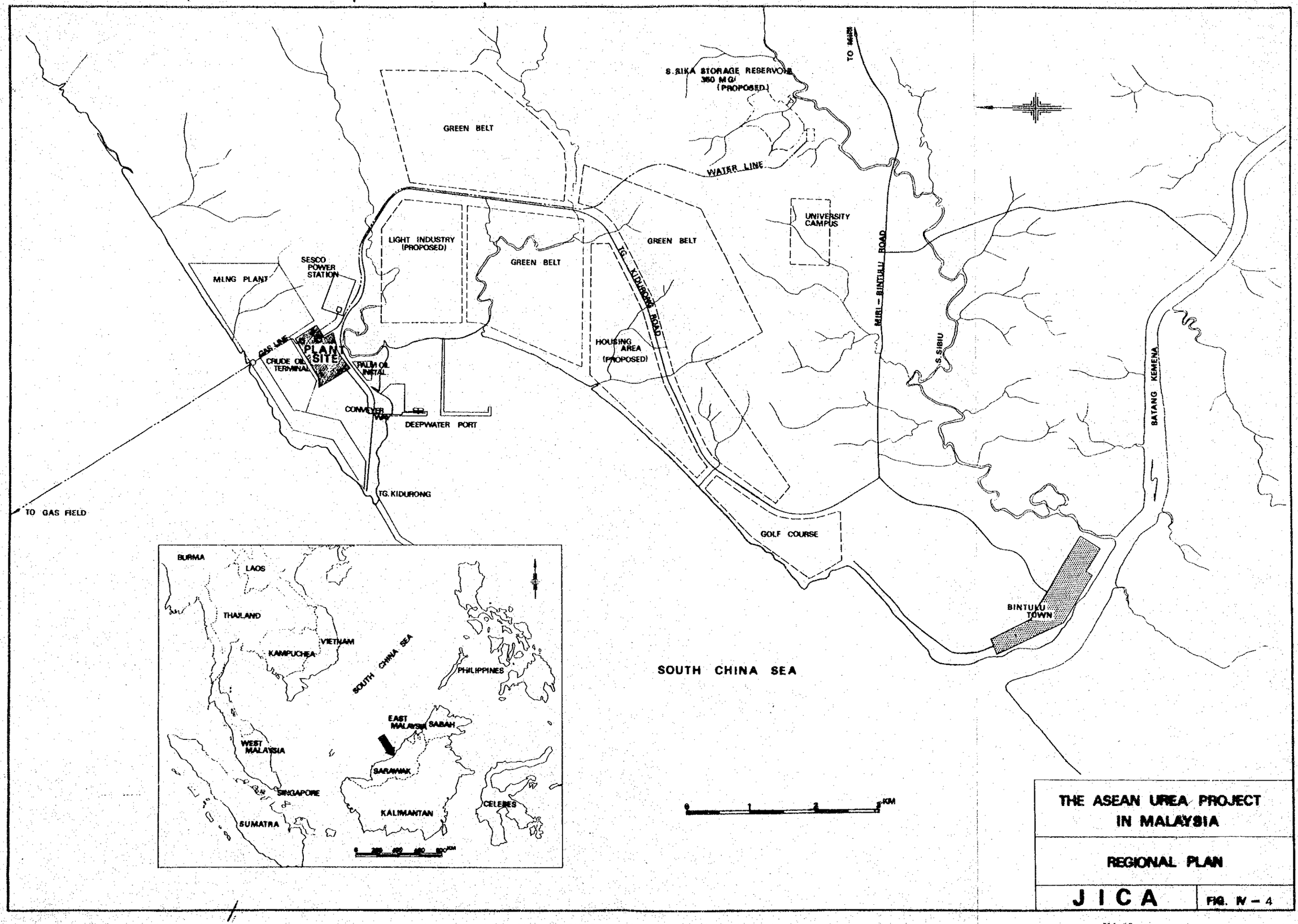


Fig. IV-2 PROJECT IMPLEMENTATION SCHEDULE


SOUTH CHINA SEA
OUTER BREAKWATER
LNG COOLING WATER INTAKE
LNG HARBOUR
DREDGING LINE
TG. KIDURONG ROAD
LNG STORAGE AREA
CRUDE OIL TERMINAL
M LNG PLANT SITE
GAS LINE
PLANT SITE
CONVEYER WAY
PORT AREA
INNER BREAKWATER
PALM OIL INSTALLATION
S. PLANT BERTH
POWER LINE
SESCO POWER STATION
WATER LINE
CONSTRUCTION JETTY
(PORT FUTURE EXTENTION)
GENERAL CARGO HARBOUR
SOUTH DISPOSAL AREA
STONE LINE
0 100 200 300 400 800m
THE ASEAN UREA PROJECT IN MALAYSIA
PLANT SITE LOCATION
JICA
FIG. IV-3


S.SIKA STORAGE RESERVOIR
360 M.G.
(PROPOSED)
TO MIRI
GREEN BELT
WATER LINE
UNIVERSITY CAMPUS
LIGHT INDUSTRY (PROPOSED)
GREEN BELT
GREEN BELT
TG. KIDURONG ROAD
MIRI - BINTULU ROAD
S.SIBIU
BATANG KEMENA
SESCO POWER STATION
MLNG PLANT
GAS LINE
PLANT SITE
CRUDE OIL TERMINAL
PALM OIL INSTAL
HOUSING AREA (PROPOSED)
CONVEYOR
DEEPWATER PORT
TG. KIDURONG
TO GAS FIELD
GOLF COURSE
BINTULU TOWN
SOUTH CHINA SEA
BURMA
LAOS
THAILAND
VIETNAM
KAMPUCHEA
SOUTH CHINA SEA
PHILIPPINES
EAST MALAYSIA
SABAH
WEST MALAYSIA
SARAWAK
SINGAPORE
KALIMANTAN
CELEBES
SUMATRA
KM
THE ASEAN UREA PROJECT IN MALAYSIA
REGIONAL PLAN
JICA
FIG. IV - 4

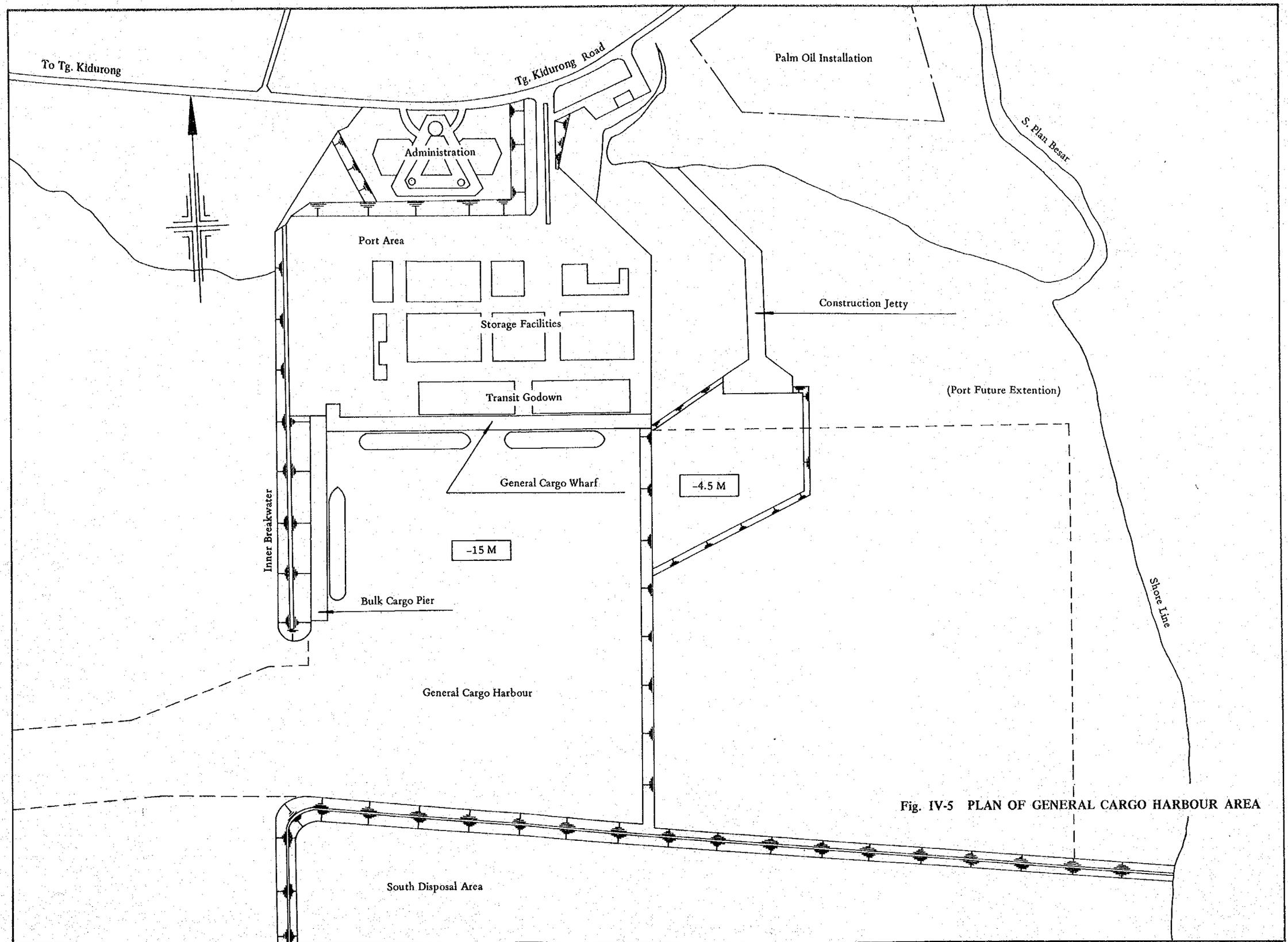
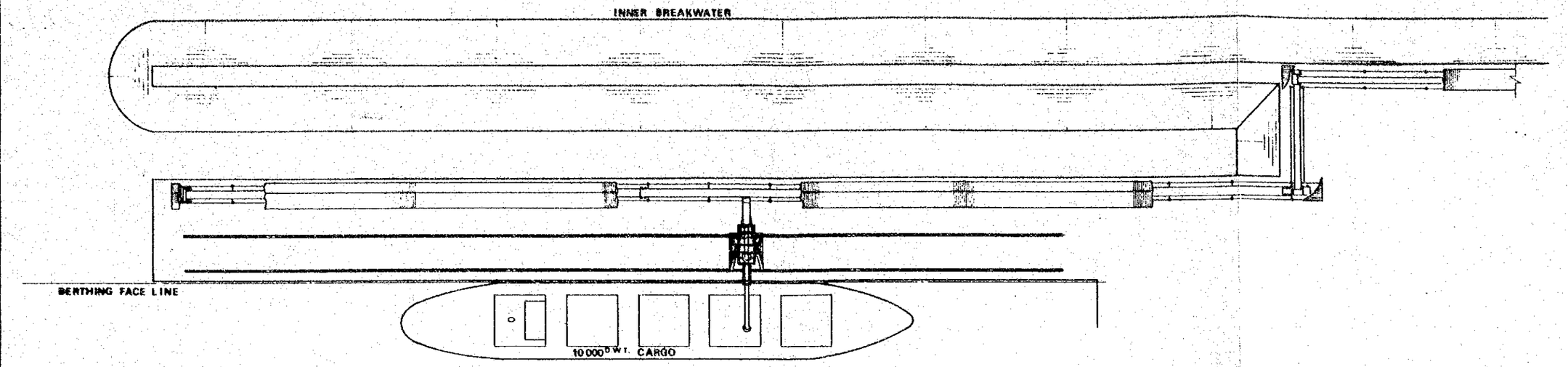
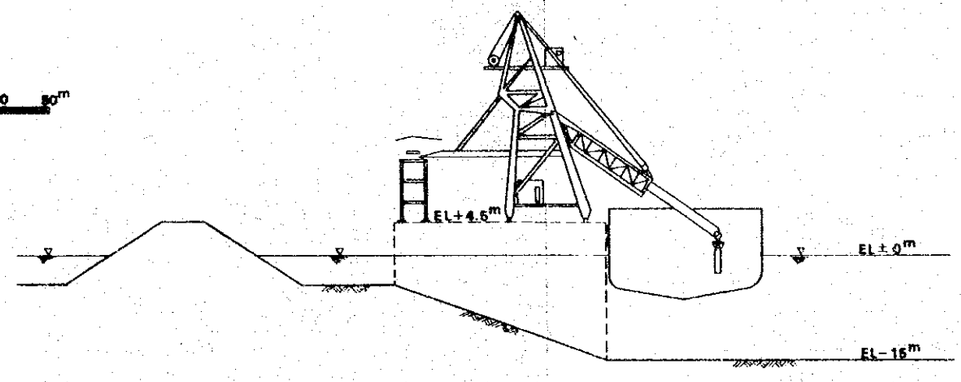


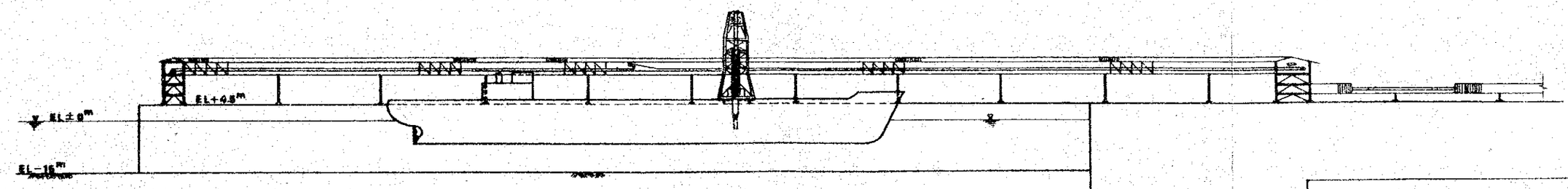
Fig. IV-5 PLAN OF GENERAL CARGO HARBOUR AREA



PLAN 0 10 20 30 40 50m



SIDE VIEW 0 10 20 30m



FRONT VIEW 0 10 20 30 40 50m

THE ASEAN UREA PROJECT IN MALAYSIA

LOADING PIER

JICA FIG. IV – 6

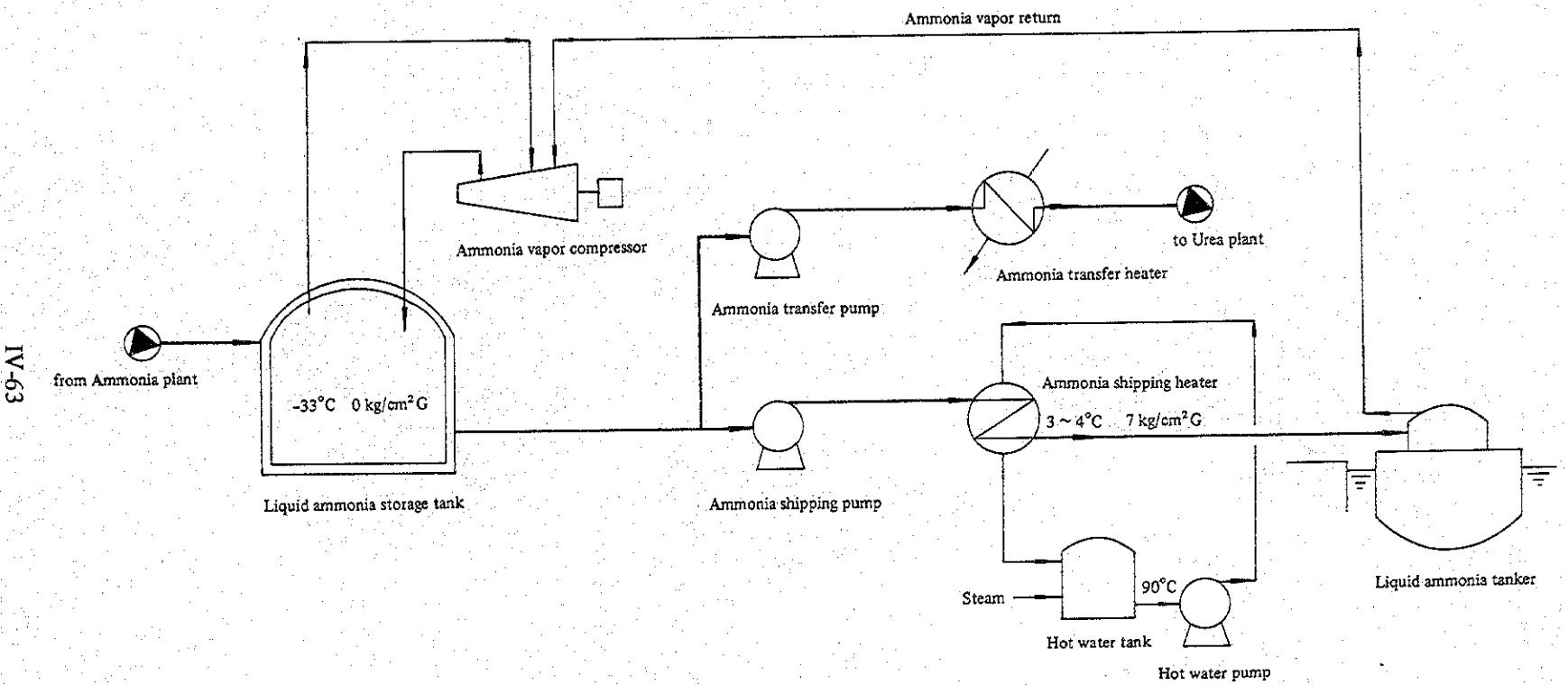
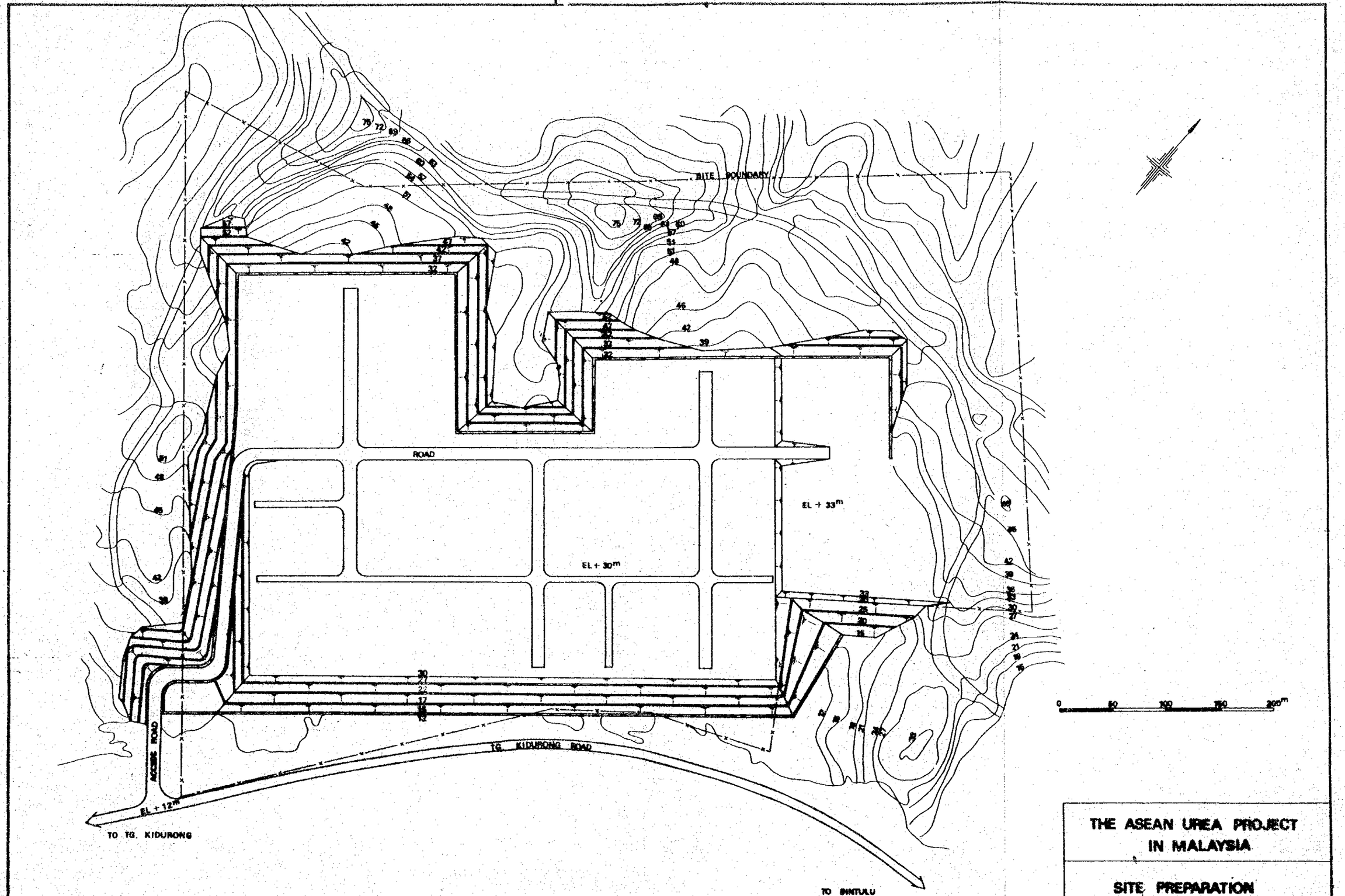


Fig. IV-7 AMMONIA STORAGE AND SHIPPING FACILITIES

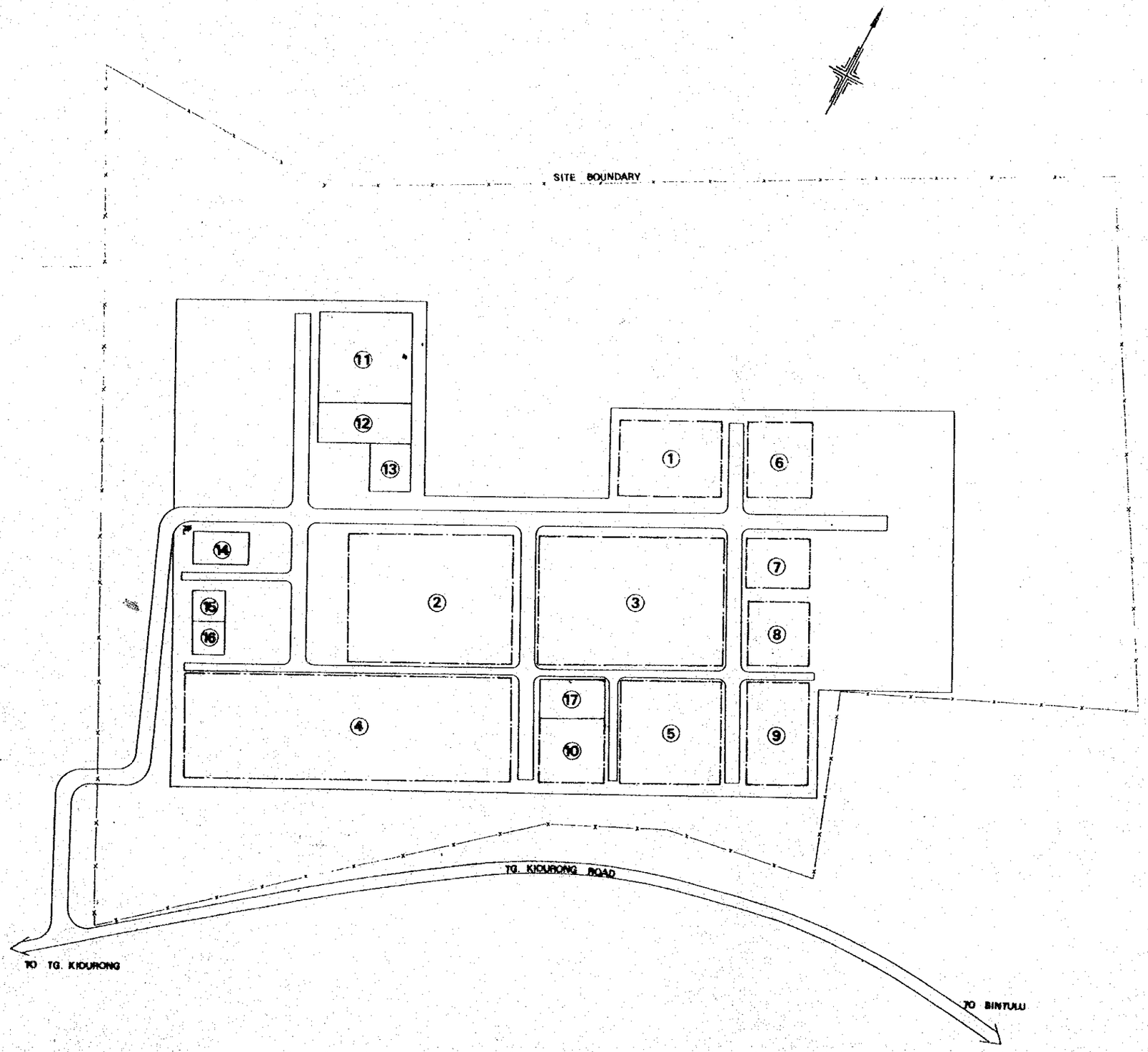


THE ASEAN UREA PROJECT IN MALAYSIA

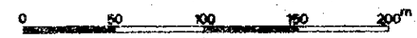
SITE PREPARATION

JICA

FIG. IV - 8



NO	DESCRIPTION
1	COOLING TOWERS
2	UREA PLANT
3	AMMONIA PLANT
4	UREA BULK STORAGE & BAGGING FACILITY
5	AMMONIA STORAGE
6	GAS RECEIVING & BURN PIT
7	MAIN SUB-STATION
8	AIR SEPARATION
9	WASTE WATER TREATMENT
10	BOILER
11	WAREHOUSE
12	MAINTENANCE SHOP
13	LABORATORY
14	ADMINISTRATION BUILDING
15	FIRST AID & FIRE FIGHTING
16	CANTEEN
17	CONTROL ROOM



THE ASEAN UREA PROJECT IN MALAYSIA

PLANT LAYOUT

JICA

FIG. IV – 9

P A R T V

CAPITAL REQUIREMENTS, AND FINANCING PLAN

PART V CAPITAL REQUIREMENTS AND FINANCING PLAN

CHAPTER 1 CAPITAL REQUIREMENTS

1-1 Introduction

On the basis of technical requirements, conceptual design of facilities and implementation plan for this Project which were stated in Part IV, the total capital requirements for the Project was estimated. The thus-projected capital requirements are shown in Table V-1.

Because the source of financing for the Project is not yet determined, some of the basic conditions for estimation of capital requirements are unknown yet. Nevertheless, the following conditions have been assumed as the bases for the estimation, on the basis of past conditions in Malaysia and other relevant matters:

(1) Type of contract:

Turn-key, lump-sum contract, with a single responsibility of the contractor.

(2) Procedure for the award of contract:

Presumed to be by competitive bidding.

(3) Basis for prices:

By application of suitable escalation rates to 1979 base prices, up to the time of expenditure for each item.

(4) Escalation:

For the foreign exchange portion, 9% p.a.; for the portion to be procured within Malaysia, 7% p.a.

(5) Exchange rates for cost estimation:

Local currency portion is calculated in Malaysian dollars, and converted to U.S. dollars at the rate of US$1 = M$2.2. The foreign exchange portion is calculated in U.S. dollars and Japanese yen, and the yen portion is converted to dollars at the rate of US$1 = ¥230.

(6) Import duty:

Assumed to be exempted.

1-2 Project Capital Requirements

The breakdown of the projected total capital requirements is shown in Table V-1. Because the source of financing is not determined at the present time, the interest rate is not known but for present purposes it is presumed that the interest rate will be 6 - 4% p.a. Using these rates, and including interest during construction, the capital requirements for the Project would be as follows:

Total Capital Requirements

('000 U.S. dollars)

	Foreign currency portion	Malaysian currency portion	Total capital requirements
Interest: 6% p.a.	242,690	61,270	303,960
	(79.8%)	(20.2%)	(100%)
Interest: 5% p.a.	239,070	61,270	300,340
	(79.6%)	(20.4%)	(100%)
Interest: 4% p.a.	235,530	61,270	296,800
	(79.4%)	(20.6%)	(100%)

1-3 Increment in Capital Requirements Due to Delay in Commencement of Construction

According to the Complex construction schedule indicated in Fig. IV-2, it is assumed that operation of the Complex is to be begun in March, 1984. It is anticipated that in the

event of a delay in the commencement of construction, whatever the cause, there will be need for increased capital expenditure due to the influence of inflation.

It is herein presumed that the escalation of the foreign exchange cost will be 9% p.a., and that of the Malaysian currency cost will be 7% p.a., and moreover that the capital requirement is approximately US$300 millions, which may be taken as being composed of 80% foreign exchange component and 20% Malaysian currency component. Under such circumstances, the following increment in the total capital requirements is to be expected in the event of a delay in the commencement of construction:

6 months delay:	approximately US$13 million increase (4.3%)
12 months delay:	approximately US$26 million increase (8.6%)

1-4 Assumptions Taken for Capital Cost Estimate of Each Component

The breakdown of the projected capital requirements is given in Tables V-1 and V-2, and the bases of estimation of each cost component shown in those tables are provided as the Attachment to Table V-1. Explained below are major assumptions taken for the estimation. (Reference is made to each item of cost component shown in those tables.)

(1) Site preparation cost

The following are the major assumptions taken for the estimation of site preparation cost:

a. Site preparation work would be commissioned to local contractors in accordance with a site preparation plan drawn by a foreign contractor, and the local contractors undertaking this job would perform contracted work under the supervision of foreign supervisors.

b. The scope of site preparation work to be contracted to the local contractors would be limited to such an extent that they can proceed with execution of work prior to the basic design and engineering (especially the layout of facilities) of the Ammonia and Urea Complex which should be furnished by the general contractor undertaking the design and construction of the entire Complex.

In short, the work included for the estimation of site preparation cost consists

of excavation, filling and compacting, grading, the protection of slopes, and forming a drainage ditch around the Complex site. Construction of roads and drainage ditch located inside the boundary of the Complex site is excluded from this work.

It must be noted, however, that in the event that the site preparation work, as is assumed above, is performed by local contractors, the schedule of their work should be controlled by the general contractor in order to insure the completion of the Complex as scheduled, because of the importance of the timing of the completion of the site preparation work, and the starting date of other construction activities.

(2) Plant direct cost

i) Plant equipment and materials

Included in this cost component is the equipment and materials except civil and building materials for plant facilities. It is presumed that all of this equipment and materials be met by imports.

ii) Spare parts

It is assumed that an initial stock of spare parts needed for operation for two years will be procured at the same time as the plant equipment. On the basis of this assumption, the cost for spare parts to be procured initially is estimated at 6% of the cost of i) above.

iii) Catalyst and chemicals

It is assumed that catalyst will be initially procured in the quantity of requirements for two charges, one charge to be used for the initial charge and another charge to be stored as spare. As to chemicals (including lubricants), an assumption is made that these materials will initially be procured in the quantity of requirements for operation for one year.

iv) Civil materials

Items of materials for local procurement are listed in the Attachment to Table V-1. It must be noted here that requirements for reinforcing bars and precast concrete piles are presumed to be met by imports. The reasons why such assumptions were made are as follows:

a) Reinforcing bars

Although some reinforcing bars are locally available in Malaysia, their availability seems to be not sufficient to supply all of the bars needed in accordance with the specifications, and further, there is no assurance regarding the supply of quantities needed at the times required. In view of this, it is assumed that all reinforcing bars will be procured in foreign countries and will be imported into Malaysia. Nevertheless, there may be a possibility that a portion of the bars will be procured from domestic sources at the time of construction of the Complex.

b) Precast concrete piles

The type of concrete piles which are used for improving soil bearing capacity is either the precast concrete (PC) pile or the reinforced concrete (RC) pile. A square-section, no-core type PC pile is locally available in West Malaysia. RC pile can be manufactured at the site if this is the type to be used.

Nevertheless, for estimation of the cost, an assumption was made that imported PC pile (a round, central-core type) would be used, because the domestic-made PC pile is more costly than the imported one and, moreover, local PC pile makers seem to lack in capacity to supply the quantity needed at the time required.

It is recommended that, in the stage of implementation of this Project, detailed study be made of the possibilities of using either locally-made PC pile or RC pile, and that specifications of piles to be used be finally determined on the basis of that study.

If a decision is made that requirements for the above two materials are to be met by local products, the projected capital requirements for this cost compo-

nent (i.e., civil materials) given in Table V-2 should be revised by transferring 10-12% of the cost in the foreign exchange portion to the local currency portion. It must be noted, however, that in such a case there would be some increase in total cost, and somewhat greater danger regarding delays in delivery.

v) Construction labor

The costs of this component include those only for local labor. The costs for foreign supervisors are included in the cost component given as item F-(b), "Expatriates and Supervision" in Table V-2.

Work volume of local construction workers, including equipment operators, is estimated at 843,750 man-days (at 8 working-hour per day) in total, and their costs are estimated at the average rate of US$21.5 per man-day (M$47.2 per man-day), including provisions for overtime pay, meals, transportation between work camp and site, lodgings, severance pay, bonus, etc.

(3) Construction equipment

It is assumed that the construction equipment will be mobilized in the following three ways, namely, (i) the contractors will bring to the site some prior-owned equipment, and also (ii) will acquire through lease or purchase other equipment for this particular Project, in addition to which (iii) the Complex owner will provide some equipment which has been purchased by the contractor on behalf of the Complex owner.

When the contractors mobilize prior-owned equipment, the Complex owner will have to pay the contractors for the use of that equipment, the charges being based on such factors as type of equipment, duration of use for this Project, and so on.

When the contractors lease equipment, the lease charge and related costs are to be passed on to the Complex owner.

When the contractors purchase new construction equipment for use in the execution of construction work, they will sell them to other construction contractors or equipment leasing firms after completion of the construction of the Complex. In

this case, the Complex owner should compensate the contractors for any monetary loss incurred by the general contractor after selling the used construction equipment.

As for construction equipment which the Complex owner will use for repair and maintenance work after completion of the Complex, it is assumed that this equipment will be purchased by the contractors on behalf of the Complex owner, in the same manner as plant equipment is purchased. It is further assumed that this equipment will be made available for the contractors to use to construct the Complex, at no charge.

A list of construction equipment needed for construction of the Complex is given in item C of the Attachment to Table V-1, where the equipment to be costed in the foreign currency portion is distinguished from those to be costed in the local currency portion.

The construction equipment costed in the local currency portion consists mainly of those to be used for civil work. Some of this equipment is to be locally fabricated in Malaysia, so that they can be procured with local currency. As for the equipment which are not available in Malaysia, it is assumed that the local contractors who undertake the civil work for this Project would possibly purchase imported equipment, and, after completion of the construction work, would either use the equipment for other projects or otherwise would sell it as used construction equipment to other local contractors, because there exists large demand for such equipment in Malaysia. On this presumption it is assumed that the Complex owner would pay in local currency to the local contractors lease or rental charges for use of such equipment. Therefore, for either case, it may be possible to assume that the cost of this component is disbursed in local currency.

The construction equipment of which the cost for use is appropriated in the foreign exchange portion, consists of the equipment needed for inland transportation to the site and erection of heavy equipment. This construction equipment is not fabricated in Malaysia. Nor could this equipment be expected to be owned by local contractors, because the cost of the equipment seems to be beyond the financial capacity of local contractors for purchasing and, moreover, it is unlikely that there exists demand for it in Malaysia so that local contractors can not justify the cost of owing such construction equipment. As a consequence, it is assumed that supply of

such equipment will be arranged by the general contractor or foreign subcontractors, so that payments for the use of the equipment should be made in foreign currency.

The cost for use of construction equipment which was appropriated in the local currency portion, was estimated by subtracting the anticipated resale price (obtained by selling the equipment after use) from the price of new equipment in Malaysia. The resale price must be determined separately for each piece of equipment, because the depreciation and charges for use may vary from one to another, depending on the life of equipment and period of their actual use. However, as an average, the cost for using the construction equipment to be paid by the Complex owner was estimated at about 35% of the price of new equipment. For the cost for use of construction equipment which was appropriated in the foreign exchange portion, the estimation of cost to be paid by the Complex owner was made in the same manner as the above, but for this case the freight and other charges to be incurred by the foreign contractors in bringing the equipment back to their countries after use was regarded as the resale price to be subtracted.

(4) Ocean freight, marine insurance, and local handling costs
(which are hereinafter given in end-1979 price)

i) Ocean freight

The weight of the plant equipment and materials needed to build this Complex is estimated at 134,000 freight tons in total, and that includes many pieces of heavy equipment. In view of this fact, for the estimation of freight charges, it is assumed that chartered vessels having heavy-duty derrick cranes will be used for sea transportation of the equipment and materials. Components of plant facilities (such as equipment, machinery and pipes) as well as construction equipment which are to be imported, include, in a large portion, those which are subject to the payment of extra rates of ocean freight charges applicable to heavy or long-measure items. On the other hand, imported civil materials (such as steel pipes, reinforcing bars and piles) include in a less portion, those which are subject to the payment of extra charges. Therefore, two sets of tariff rates were applied to the estimation of ocean freight cost. One rate is set at US$105 per freight ton which is to be applied to the former items, and another rate is set at US$66.5 per freight ton which is to be applied to the latter items. As the weighted average, thus-estimated ocean freight cost

results in US$97.25 per freight ton.

ii) Barging charge

It is presumed that the equipment and materials for construction of the Ammonia and Urea Complex will be landed using the temporary construction jetty to be built in Bintulu Deepwater Port and to be completed by July, 1981. Offloading of equipment and materials for the Complex would be begun during the latter half of 1981, which would be in time to use the jetty. However, it does not seem that ships carrying the equipment and materials can be moored along the jetty, because according to present plans dredging of an access channel will not be completed by that time (completion is scheduled to be 1982), and further, the draught along the jetty will be 4.5 m. For that reason, it is assumed that the equipment and materials will be transhipped to barges from ocean-going vessels by using derrick cranes of the vessels at the outer area of the ports, and will be transported to the jetty by barges.

For this barging, it is estimated that there will be need for one 1,000-ton barge, three 500-ton barges, two 500 HP tugboats and three 350 HP tugboats, all of which are assumed to be chartered from foreign sources, during the period of this operation.

The total cost of barging, including pay for the crew, fuel, etc., is estimated as US$1,000,000, which results in the average of US$7.5 per freight ton.

iii) Landing and inland transportation

The cost of machines and vehicles to be used for landing and inland transportation of equipment and materials is included in the cost itemized as construction equipment, and direct costs for landing and inland transportation (such as costs for operators, labor, fuel, etc.) are included in the costs itemized as construction laborers and indirect field expenses.

Costs included in this component are landing charges (charges for wharfage, stevedoring, and potable water supply) and customs clearance fees. As the Bintulu Deepwater Port is still under construction, there is so far no schedule

of those charges applicable to this port. Therefore, the estimation of those charges to be paid for the landing of equipment and materials at the port was made by applying the rates of those charges prevailing at other ports, which are landing charges of US$5 per freight ton and customs clearance fee of US$3 per freight ton.

iv) Marine insurance

It is assumed that the general contractor will purchase marine insurance to cover all imported equipment and materials for the Complex, and the premium paid for that insurance will be reimbursed by the Complex owner.

The cost of marine insurance premium is estimated at the rate of 0.44% of C&F cost for imported equipment and materials, and is appropriated in the foreign exchange portion.

(5) Contingencies

For the rates used for estimation of the cost contingency, refer to items I and J of the Attachment to Table V-1.

i) Physical contingency

The physical contingency is provided in order to cover any costs which may occur in excess of those estimated here; this additional cost, which is unforeseeable at present, may arise from such factors as the degree of precision of the conceptual design, meteorological conditions in the site area, soil conditions and other matters encountered at the time of construction. The contingency rates were estimated individually for each cost item. The physical contingency thus estimated by means of applying the contingency rates, as is shown in Table V-1, is the equivalent of 7.0% of the Base Project Cost in the foreign exchange portion, 11.7% of the Base Project Cost in the local currency portion, and 7.9% of the total amount of Base Project Cost.

ii) Price contingency

Increased costs due to inflation is anticipated in the future. (A) The rate of

escalation is estimated at 9% per annum for the costs of the foreign exchange portion and 7% per annum for the costs of the local currency portion, which are annual compound rates (the basis for this estimation is given in Part VI), and (B) the period from the time of estimation of the Base Project Cost (as of the end of 1979) up to the time of disbursement was projected on each cost component. The amount of price contingency is estimated by accumulating the amount of escalation on each cost component which is calculated by applying the formula of (A) x (B) in compound. The thus-estimated price contingency, as is shown in Table V-1, is the equivalent of 20.3% of the Base Project Cost in the foreign exchange portion, 21.0% of the Base Project Cost in the local currency portion, and 20.4% of the Base Project Cost in total.

(6) Interest during construction

Interest during construction is estimated on the following assumptions: (a) 70% of the total capital requirements will be financed through loans, (b) disbursement of loans will be made at 30% of the total loan amount in 1981, 40% in 1982, 20% in 1983 and 10% in 1984, and (c) the interest rate (not yet determined) is 6-4% per annum. The table showing projected disbursement of loans and interest payments is given as item L in the Attachment to Table V-1.

(7) Other expenses

The breakdown of the estimated indirect field expenses, services charges, project management costs, pre-operation expenses, and initial working capital is given in the Attachment to Table V-1.

CHAPTER 2 FINANCING PLAN

As was agreed at the ASEAN Economic Ministers Meeting, of the capital requirements for the Project, 30% would be financed from the equity capital of the joint venture company which is to be established and the remaining 70% would be financed through long-term loans. It has already been decided that the ownership of the company would be in the following ratios, and that the company's shares would be paid up in U.S. dollars:

Malaysia	60%
Indonesia	13%
Philippines	13%
Singapore	1%
Thailand	13%

About 80% of the capital requirements is projected for foreign exchange requirements and the remaining portion is projected for local currency requirements. Therefore, it is anticipated that loans would not be sufficient to cover the requirements of foreign exchange funds, so that the equivalent of about one-third of the equity capital (about 10% of the total capital requirements) would be appropriated for foreign exchange requirements.

At the present time, since the source of financing for this Project has not yet been determined, the terms and conditions necessarily are not known. When Malaysia obtained the approval of the ASEAN Economic Ministers for this Project, the terms and conditions used as the basis of financial planning were the interest rate on loans of 5% p.a., and repayment in 15 years (including a four-year grace period). The same terms and conditions were used in the study made by the Evaluation Study Team, with the additional use of interest rates of 6% p.a. and 4% p.a. The results with regard to financing planning are shown in TableV-3. Also, a repayment schedule is provided with Table V-4.

The schedule for disbursement, as mentioned in the item on interest during construction in the preceding chapter of this Part, has been assumed to be as follows:

1981	30%
1982	40%
1983	20%
1984	10%
Total	100%

Table V-1 ESTIMATED CAPITAL REQUIREMENTS

(US$ '000)

		Foreign	Local	Total
A.	Site Preparation	770	6,320	7,090
B.	Plant Direct Cost	100,070	22,080	122,150
C.	Construction Equipment	7,530	1,390	8,920
D.	Ocean Freight, Insurance & Local Hand'g	14,630	1,070	15,700
E.	Indirect Field Expenses	1,990	1,420	3,410
F.	Services	37,740	3,630	41,370
G.	Project Management	6,960	1,360	8,320
H.	Pre-Operation Expenses	2,070	5,090	7,160
	Base Project Cost (B/C) (in End-1979 Prices)	171,760	42,360	214,120
I.	Physical Contingency (% of B/C)	12,040 (7.0 %)	4,960 (11.7 %)	17,000 (7.9 %)
J.	Price Contingency (% of B/C)	34,840 (20.3 %)	8,900 (21.0 %)	43,740 (20.4 %)
K.	Initial Working Capital (in Beg. 1984 Prices)	3,520	5,050	8,570
	Total Project Cost	222,160	61,270	283,430
L.	Interest During Construction			
	Interest Rate: 6 %	20,530	0	20,530
	5 %	16,910	0	16,910
	4 %	13,370	0	13,370
	Total Financing Required			
	Interest Rate: 6 %	242,690 (79.8 %)	61,270 (20.2 %)	303,960 (100 %)
	5 %	293,070 (79.6 %)	61,270 (20.4 %)	300,340 (100 %)
	4 %	235,530 (79.4 %)	61,270 (20.6 %)	296,800 (100 %)

Table V-2 ESCALATED CAPITAL COST ESTIMATE

	1979 – End (US$ '000)			Combined Contingency (%)		1984 – Beginning (US$ '000)		
	(Foreign)	(Local)	(Total)	(Foreign)	(Local)	(Foreign)	(Local)	(Total)
A. Site Preparation	770	6,320	7,090	19.6	24.0	920	7,840	8,760
B. Plant Direct Cost								
(a) Plant Equipment & Materials								
– Ammonia Plant	35,580	0	35,580	27.7	–	45,440	0	45,440
– Urea Plant	15,970	0	15,970	27.7	–	20,390	0	20,390
– Utilities Facilities	17,290	0	17,290	27.7	–	22,080	0	22,080
– Offsite Facilities	12,610	0	12,610	27.7	–	16,100	0	16,100
(a) Sub-total	81,450	0	81,450			104,010	0	104,010
(b) Spare Parts	4,890	0	4,890	27.7	–	6,250	0	6,250
(c) Catalyst and Chemicals	3,540	0	3,540	27.7	–	4,520	0	4,520
(d) Civil Materials	10,190	3,980	14,170	27.7	23.1	13,010	4,900	17,910
(e) Construction Labour	0	18,100	18,100	–	40.9	0	25,500	25,500
B. Plant Direct Cost Total	100,070	22,080	122,150			127,790	30,400	158,190
C. Construction Equipment	7,530	1,390	8,920	19.8	17.0	9,020	1,630	10,650
D. Ocean Freight, Insurance & Local Hand'g	14,630	1,070	15,700	26.0	21.7	18,430	1,300	19,730
E. Indirect Field Expenses	1,990	1,420	3,410	22.6	25.2	2,440	1,780	4,220
F. Services								
(a) General Contractor's Fee	25,500	0	25,500	24.8	–	31,820	0	31,820
(b) Expatriates & Supervision	12,240	3,630	15,870	24.8	20.2	15,280	4,360	19,640
F. Services Total	37,740	3,630	41,370			47,100	4,360	51,460
G. Project Management								
(a) Technical Advisor	2,240	440	2,680	33.5	27.4	2,990	560	3,550
(b) Operation Advisor	4,720	920	5,640	45.5	36.3	6,870	1,250	8,120
G. Project Management Total	6,960	1,360	8,320			9,860	1,810	11,670
H. Pre-operation Expenses	2,070	5,090	7,160	48.9	39.5	3,080	7,100	10,180
K. Initial Working Capital						3,520	5,050	8,570
Total Project Cost						222,160	61,270	283,430

Note: On the combined contingency and each cost item, refer to the 'EXPLANATORY NOTES ON THE CAPITAL ESTIMATE' attached hereinafter.

Table V-3 TENTATIVE FINANCING PLAN

(US$ '000)

		Case B-6	Case B-5	Case B-4
Interest Rate		6 % per year	5 % per year	4 % per year
Total Financing Required		303,960	300,340	296,800
Equity	(30 %)	91,188	90,102	89,040
Debt	(70 %)	212,772	210,238	207,760
Equity Share				
Malaysia	(60 %)	54,714	54,062	53,425
Indonesia	(13 %)	11,854	11,713	11,575
Philippines	(13 %)	11,854	11,713	11,575
Singapore	(1 %)	912	901	890
Thailand	(13 %)	11,854	11,713	11,575
Equity		91,188	90,102	89,040
Loan Disbursement				
1981	(30 %)	63,832	63,071	62,328
1982	(40 %)	85,109	84,095	83,104
1983	(20 %)	42,554	42,048	41,552
1984	(10 %)	21,277	21,024	20,776
Debt		212,772	210,238	207,760

Table V-4 TENTATIVE LOAN REPAYMENT SCHEDULE

	Case B-6	Case B-5	Case B-4
Total Debt:	US$212.772 million	US$210.238 million	US$207.760 million
Interest Rate:	6 % per annum	5 % per annum	4 % per annum
Grace Period:	4 years	4 years	4 years
Repayment:	11 year-equal-installment-repayment after the grace period	11 year-equal-installment-repayment after the grace period	11 year-equal-installment-repayment after the grace period

(US$ '000)

Year	Case B-6 Principal	Interest	Debt Service	Balance after Payment	Case B-5 Principal	Interest	Debt Service	Balance after Payment	Case B-4 Principal	Interest	Debt Service	Balance after Payment
1981	0	1,915	1,915	63,832	0	1,578	1,578	63,071	0	1,247	1,247	62,328
1982	0	6,383	6,383	148,941	0	5,257	5,257	147,166	0	4,157	4,157	145,432
1983	0	10,212	10,212	191,495	0	8,411	8,411	189,214	0	6,650	6,650	186,984
1984	0	12,659	12,659	212,772	0	10,424	10,424	210,238	0	8,241	8,241	207,760
1985	19,343	12,766	32,109	193,429	19,113	10,512	29,624	191,125	18,887	8,310	27,198	188,873
1986	19,343	11,606	30,949	174,086	19,113	9,556	28,669	172,013	18,887	7,555	26,442	169,985
1987	19,343	10,445	29,788	154,743	19,113	8,601	27,713	152,900	18,887	6,799	25,687	151,098
1988	19,343	9,285	28,627	135,400	19,113	7,645	26,758	133,788	18,887	6,044	24,931	132,211
1989	19,343	8,124	27,467	116,057	19,113	6,689	25,802	114,675	18,887	5,288	24,176	113,323
1990	19,343	6,963	26,306	96,714	19,113	5,734	24,846	95,563	18,887	4,533	23,420	94,436
1991	19,343	5,803	25,146	77,371	19,113	4,778	23,891	76,450	18,887	3,777	22,665	75,549
1992	19,343	4,642	23,985	58,028	19,113	3,822	22,935	57,337	18,887	3,022	21,909	56,661
1993	19,343	3,482	22,825	38,686	19,113	2,867	21,979	38,225	18,887	2,266	21,154	37,774
1994	19,343	2,321	21,664	19,343	19,113	1,911	21,024	19,112	18,887	1,511	20,398	18,887
1995	19,343	1,161	20,503	0	19,112	956	20,068	0	18,887	755	19,642	0
Total	212,772	107,766	320,538		210,238	88,741	298,979		207,760	70,158	277,918	

EXPLANATORY NOTES ON

THE CAPITAL COST ESTIMATE

A. SITE PREPARATION

1. Design Basis

(1)	Plant site area:	40 ha
(2)	Area to be improved:	18 ha
(3)	Finished grade:	30 m above Mean Sea Level (Partially 33 m)
(4)	Soil Excavation:	1,063 x 10^3 m^3
(5)	Soil Filling and Compaction:	994 x 10^3 m^3
(6)	Soil Disposal:	69 x 10^3 m^3
(7)	Gradient of access road:	5% max.

2. Scope of the Site Preparation Works

– Plant site
  (1) Clearing and grubbing
  (2) Soil excavation
  (3) Soil filling and compaction
  (4) Slope protection
  (5) Drainage on the slope

– Access road to the plant site
  (6) Excavation
  (7) Asphalt pavement

3. Estimated Construction Cost

(End-1979 price: US$ '000)

		Components	
		Foreign	Local
a)	Civil materials	61	529
b)	Construction labor[1)]	0	724
c)	Construction equipment[6)]	21	3,107
d)	Field expenses		
	d-1 Temporary works & expenses	0	872[2)]
	d-2 Fuel & oil for equipment	0	390

e)	Services			
	e-1	Survey, design & fee	235	562[3]
	e-2	Expatriates[4]	450	88
	e-3	Local supervisors[5]	0	45
		Total	767	6,317
			(770)	(6,320)

Notes:

1) Laborers: 29,000 man-days
   Operators: 10,300 man-days
2) 20% of Local portion of a) through c)
3) 10% of Local portion of a) through d)
4) 50 man-months: US$9,000/m-m for the foreign currency portion and US$1,750/m-m for the local currency portion
5) 18 man-months at the unit rate of US$2,500/m-m
6) See Section C, Construction Equipment, below.

B. PLANT DIRECT COST

(a) Plant Equipment and Materials

For the scope of the facilities, refer to Table IV-5, Facilities Included in the Project Scope.

Plant Equipment includes the following items;

Furnaces, heat exchangers, reactors, towers, drums & tanks, pumps with drivers, compressors with drivers, special equipment & machines, utility equipment, transportation & conveying, fire & safety equipment

Plant Materials include following items;

Piping, electrical, instruments, insulation, painting

(b) Spare Parts

6% of the Plant Equipment and Materials Cost is allowed for two years supply of spare parts.

(c) Catalyst & Chemicals

– Catalyst for the ammonia process

Desulfurization:	Zinc oxide
Primary reformer:	Nickel
Secondary reformer:	Chromia, Nickel
High temperature shift converter:	Iron-Chromia
Low temperature shift converter:	Copper-Zinc-Alumina
Methanator:	Nickel
Ammonia synthesis converter:	Iron

– Chemicals and supplies for processes and water treatment;

CO_2 removal from the natural gas and the reformed gas, water clarification, antiformer, anticorrosion, inhibiter, lubricant oil and others

Chemicals (examples):

K_2CO_3, DEA, NaOH, $Al_2(SO_4)_3$, H_2SO_4, CaClO, $Na_5P_3O_{10}$, $Na_2Cr_2O_7$, $Na_3PO_4 \cdot 12H_2O$, etc.

– Cost of the catalyst & chemicals (US$'000 in end-1979 prices)

Initial charge of catalyst (1 set)	1,230
Spare catalyst (1 set)	1,230
Chemicals and supplies (for 1 year consumption)	1,080
	3,540

(d) Civil Materials include materials for:

Piling, site improvement, road pavement, foundations, drainages, concrete structures, steel structures, architectural buildings

Main items to be locally procured:

Cement, river sand, aggregate, crusher run, crushed stone, asphalt, primer, timber, brick, plywood, precast concrete pipe, earthenware pipe, rubble stone, gasoline, fuel oil, kerosene

(e) Construction Labor

– Unit Labor Cost comprises the basic salary, overtime, leave, and allowances (meal, medical, retirement pay, etc.) at the end of 1979 in the Bintulu area.

Grade[1)]	M$/day[2)]	US$/day
A	51.7	23.5
B	43.1	19.6
C	56.5	25.7
D	44.9	20.4
E	31.5	14.3
F	56.5	25.7
G	51.7	23.5
H	40.3	18.3
I	33.4	15.2
J	29.7	13.5
K	22.9	10.4

Notes:

1) A: Foreman, welder, piping worker (skilled), brick mason (skilled)
B: Mason, carpenter, rigger, scaffold, steel worker, plasterer, painter
C: Scaffold foreman
D: Ducting worker, electrical, fitter, piling worker (semi-skilled)
E: Concrete worker
F: Land surveyor (skilled), piling worker (skilled)
G: Equipment operator, piping worker (semi-skilled), mechanist, insulator
H: Truck driver
I: Land surveyor (semi-skilled)
J: Laborer (male)
K: Laborer (female), watchman

2) As 8 hours per working day

– Man-hours requirements

(See item A, as to man-hours required for the site preparation work.)

	Man-day	Man-hours
Civil works	416,250	3.33 million
Erection works	427,500	3.42 million
Total	843,750	6.75 million

– Average labor wage (End-1979)

US$18,100,000/843,750 man-days = US$21.45/man-day (= M$47.2/man-day)

C. CONSTRUCTION EQUIPMENT[1)]

(a) Main Construction Equipment List

(Imported from overseas)[2)]

Civil Works[4)]

Gantry crane (10 ton)	2
Pile driver (P & H80P)	4
Leader	4
Diesel hammer	5
Pile cap	5
Clamshell attachment	1
Batcher plant	1
Concrete buckets	6
Crawler crane (35 ton)	1
Crawler crane loom	5
Truck crane (15 ton)	3

Erection & Transportation[5)]

Gin poles (400 ton)	2
Truck crane (20 - 127 ton)	7
Crawler crane (35 ton)	1
Dolly (300 ton)	2

Trailer (300 ton)	1
Trailer and tractor (40 - 60 ton)	2

(Locally available)[3]

Civil Works[4]

Bulldozer (D7, D8)	9
Shovel dozer	6
Wheel loader	1
Grader	2
Crawler drill	4
Rollers	7
Vibrators	15
Trailer truck (25 ton)	1
Trucks (4 - 18 ton)	22
Asphalt spreader	1
Tank lorry	4
Backhoe	2
Soil compactor	9
Truck mixer (3.5 m^3)	5
Fork lift (2 ton)	1
Mortar mixers	2

Erection & Transportation[5]

Truck with crane (4 ton)	2
Trucks (2 - 10 ton)	14
Fork lifts (3 - 5 ton)	2

(b) Common and Miscellaneous Use[6]

Welders (300A - 500A)	120
Annealing machine (180 KV)	1
Compressor (7 - 60 $kg/cm^2 G$)	13
Pump	23
Bar bender	2
Bar cutter	2
Belt conveyors	10

Generators	2
Tools for repairing	1 set
Miscellaneous equipment and machines	1 set

Notes: Assumptions and bases used for the cost estimate;

1) All the equipment is estimated on a rental or lease basis.
2) Shall be re-exported to overseas after the completion of erection.
3) Shall be removed by local contractors or equipment suppliers after the completion of erection.
4) Includes equipment for the site preparation use (item A) and for the plant civil works. Most of the site preparation works shall be undertaken using locally available equipment.
5) A part of the equipment shall be kept in the Complex for the plant maintenance even after the completion of erection.
6) Assumed that a 40% of total equipment shall be locally available as cost.

D. OCEAN FREIGHT, INSURANCE & LOCAL HANDLING

(in end-1979 prices)

		Freight[1] Ton (FT)	Ocean[2] Freight (US$'000)	Local[3] Handling (US$'000)
(a)	Ammonia Plant	43,460	4,890	350
(b)	Urea Plant	15,730	1,770	125
(c)	Utilities Facilities	20,980	2,370	165
(d)	Off-Site Facilities	20,920	2,360	170
(e)	Plant Civil Materials	20,320	1,510	160
(f)	Construction Equipment	6,150	690	50
(g)	Materials for Temporary Works	6,700	500	50
	Sub-total	134,260	14,090	1,070
(h)	Marine Insurance[4]	-	540	-
	Total	134,260	14,630	1,070

Notes:

1) Includes spare parts
2) – US$112.5/FT for the plant equipment and materials applicable to item (a), (b), (c), (d) and (f)
   – US$74.0/FT for item (c) and (g)
   – Both of the above estimated unit costs include barging charge from heavy derrick vessels to the construction jetty in the Deepwater Port at a cost of US$7.5/FT.
3) Allows US$8/FT (US$5/FT for the wharfage, the stevedorage and the fresh water, and US$3/FT for custom clearance charges)
4) 0.44% of C&F price

E. INDIRECT FIELD EXPENSES[1)]

(a) Temporary field buildings[2)]
(b) Temporary houses for expatriates
(c) Temporary houses for local laborers
(d) Utilities supply facilities for the camps[3)]
(e) Construction supplies[4)]
(f) Field office expenses
(g) Insurance[5)] and miscellaneous

Notes:

1) Expenses incurred during the plant construction period at the construction site.
   Expenses for the site preparation work are separately estimated in item A of this attachment.
2) Administration offices and workshops
3) Includes drinking water & power supply facilities.
4) Fuel & lubricant oil for the construction equipment, tools for safety and miscellaneous consumables
5) Insurances on construction works

F. SERVICES

(a) General Contractor's Fee
   – License and know-how fee
   – Basic design fee

- Detail engineering fee
- Procurement services
- Inspection
- Documentation services
- Provision for bonus

(b) Expatriates and Supervision

Man-months required

General contractor's expatriates (construction & start-up)	1,200 m-m
Vendor's servicemen	160 m-m
Local staff supervision	500 m-m

Man-months rate (end-1979)

Expatriates (1,360 m-m):

US$9,000/m-m in foreign exchanges including international air fare,

US$1,750/m-m in the local currency including out-of-pocket expenses

Local supervision (500 m-m):

US$2,500/m-m in the local currency including out-of-pocket expenses

G. PROJECT MANAGEMENT

Man-months required

Technical advisor (Implementation stage):	250 m-m
Management contractor (Operation advisor):	500 m-m
Marketing advisor:	24 m-m
	774 m-m

Man-months rate

The same as that of the general contractor's expatriates described above.

H. PRE-OPERATION EXPENSES

(US$'000 in beginning-1984 prices)

		Foreign	Local
1.	Training costs and fees for the permanent staff	1,800	1,000
2.	Labor cost before the commencement of commercial operation (6 months equivalent)	0	2,724
3.	Land Rent during the Complex construction (38 months)	0	228
4.	Losses during test operation		
	i) Natural gas (2 months consumption)	0	2,152
	ii) Electricity (2 months consumption)	0	476
	iii) Raw water (2 months consumption)	0	306
	iv) Catalyst and chemicals (3 months consumption)	405	0
	v) Spare parts (3 months consumption)	781	0
5.	Miscellaneous (3% of above)	90	210
	Total	3,076	7,096
		(3,080)	(7,100)
	Conversion to the end of 1979 price	(2,070)	(5,090)

I, J. CONTINGENCY SCHEDULE (PHYSICAL & PRICE)

(%)

		Physical Contingency		Price Contingency to Beg. - 1984			Combined Contingency	
		(Foreign)	(Local)	Months to Expend Date	(Foreign)	(Local)	(Foreign)	(Local)
A.	SITE PREPARATION	5	12	(18)	13.9	10.7	19.6	24.0
B.	PLANT DIRECT COST							
	(a) Plant Equipment & Materials	7.5	-	(24)	18.8	-	27.7	-
	(b) Catalyst & Spares	7.5	-	(24)	18.8	-	27.7	-
	(c) Civil Materials	7.5	7.5	(24)	18.8	14.5	27.7	23.1
	(d) Direct Labour & Overhead	-	15	(36)	-	22.5	-	40.9
C.	CONSTRUCTION & EQUIPMENT	7.5	7.5	(15)	11.5	8.9	19.8	17.0
D.	OCEAN FREIGHT, INSURANCE & LOCAL HAND'G	7.5	7.5	(22)	17.2	13.2	26.0	21.7
E.	INDIRECT FIELD EXPENSES	10	15	(15)	11.5	8.9	22.6	25.2
F.	SERVICES	5	5	(24)	18.8	14.5	24.8	20.2
G.	PROJECT MANAGEMENT							
	(a) Project Implementation	7.5	7.5	(30)	24.2	18.5	33.5	27.4
	(b) Operational & Marketing Advisor	7.5	7.5	(42)	35.3	26.8	45.5	36.3
H.	PRE-OPERATION EXPENSES	10	10	(42)	35.3	26.8	48.9	39.5

Notes: Price Contingency (Escalation in compound rate)

- Foreign exchange: 9% per annum
- Local currency: 7% per annum

K. INITIAL WORKING CAPITAL

(US$'000 in beginning-1984 prices)

		Foreign	Local
(a)	Products inventory (on month value[2] of direct production cost[1])	1,461	2,608
(b)	Accounts receivable (1.5 months[2] value of direct production cost[1])	2,192	3,912
(c)	Accounts payable (less) (one month[2] value of variable cost)	(135)	(1,467)
	INITIAL WORKING CAPITAL	3,518	5,053
		(3,520)	(5,050)
(d)	Working capital included in Base Project Cost		
	– Spare parts	0	6,250
	– Catalyst and chemicals	0	4,520
	TOTAL WORKING CAPITAL	3,520	15,820

Notes: 1) Direct production cost = Total production cost – Depreciation

2) 1/12 (or 1.5/12) x Annual cost at 90% capacity utilization

L. DISBURSEMENT AND INTEREST DURING CONSTRUCTION

(US$'000)

	Case B-6	Case B-5	Case B-4
Total Financing Required:	303,960	300,340	296,800
Debt (70%)	212,772	210,238	207,760
Equity (30%)	91,188	90,102	89,040
Interest Rate:	6% per year	5% per year	4% per year
Disbursement (assumed):			
1981 30 %	63,832	63,071	62,328
1982 40 %	85,109	84,095	83,104
1983 20 %	42,554	42,048	41,552
1984 2 months 10 %	21,277	21,024	20,776
	212,772	210,238	207,760

Interest during Construction:

at End of Year:	Case B-6 (1st)	Case B-6 (2nd)	Case B-6 (3rd)	Case B-6 (4th)	Case B-5 (1st)	Case B-5 (2nd)	Case B-5 (3rd)	Case B-5 (4th)	Case B-4 (1st)	Case B-4 (2nd)	Case B-4 (3rd)	Case B-4 (4th)
a. Already drawn	0	63,832	148,941	191,495	0	63,071	147,166	189,214	0	62,328	145,432	186,984
b. Previous year's interest	0	0	0	0	0	0	0	0	0	0	0	0
c. Opening debt (a + b)	0	63,832	148,941	191,495	0	63,071	147,166	189,214	0	62,328	145,432	186,984
d. Interest on opening debt (c x interest rate)	0	3,830	8,936	1,915	0	3,154	7,358	1,577	0	2,493	5,817	1,247
e. Drawing during year	63,832	85,109	42,554	21,277	63,071	84,095	42,048	21,024	62,328	83,104	41,552	20,776
f. Interest on current drawings (e x 1/2 x interest rate)	1,915	2,553	1,277	106	1,577	2,103	1,051	88	1,247	1,662	831	69
g. Total interest for year (d + f)	1,915	6,383	10,213	2,021	1,577	5,257	8,409	1,665	1,247	4,155	6,648	1,316

Interest during Construction:	20,532 ≒ 20,530	16,908 ≒ 16,910	13,366 ≒ 13,370

PART VI

FINANCIAL ANALYSIS

PART VI FINANCIAL ANALYSIS

CHAPTER 1 GENERAL

In this Part VI the Evaluation Study Team gives its estimates of ammonia and urea manufacturing costs, financial projections and analysis as well as the assessment of financial viability of the Project.

The manufacturing cost esimates as well as the financial projections presented and explained in this report are based on the presumption that commercial operation of the Complex is started in March, 1984, and the Complex has an economic life-span of 15 years after the commencement of commercial operation.*1)

These estimates and projections are given in terms of 1984 constant price.*2) For the estimates of manufacturing costs (in terms of 1984 constant price), each cost component is estimated on the basis of the presently prevailing prices with provisions for price escalation up to early 1984. The applied escalation rates are 9% per annum for foreign exchange components and 7% per annum for local currency components.*3)

(Notes) *1) The economic life-span of this type of project, in general, is considered to be 12 to 15 years. As the Malaysian Government has made its financial assessment on the basis of an economic life-span of 15 years in its feasibility study for this Project which has been submitted to the ASEAN Economic Ministers Meeting, the Evaluation Study Team has used this period for its evaluation study.

*2) The "1984 constant price" denotes the prices set at a level which is projected as though being prevailing in 1984 and which is deemed to be constant over the project life.

*3) A current index of chemical plant costs is given in Fig. VI-1. After the so-called "oil crisis" in 1973, these costs showed a sharp increase up to 1975, and thereafter showed a constant increase at an average rate of 7% p.a. It is likely that the future costs will tend to have increases much greater than the past. Hence provisions are made for escalation of 9% p.a. regarding the costs for equipment, materials and services to be procured from abroad.

Consumer price index and wage and salary index in Malaysia are given in the above figure. These indexes show stable trends compared to those in other countries. Nevertheless, reflecting world-wide inflation which is expected to be escalated, the domestic price seems to rise at a rate higher than the past. Therefore, provisions are made for escalation of 7% p.a. for local cost items.

CHAPTER 2 MAJOR ASSUMPTIONS TAKEN FOR PREPARING ESTIMATES OF MANUFACTURING COST AND FINANCIAL PROJECTIONS

2-1 Projection of Production and Sales of Products

The manufacturing facilities of the Project consist of a 1,000 t/d ammonia plant and a 1,500 t/d urea plant. The ammonia plant has an excess capacity of 130 t/d of ammonia on balance with the capacity of the urea plant, because ammonia requirements for the manufacture of urea are rated at 870 tons per on-stream day, provided that the urea plant is operated at full capacity utilization. An annual capacity of urea and ammonia, as products for sale, is rated at 495,000 tons and 42,900 tons (excess ammonia) respectively on the basis of 330 stream days a year.

In view of past records of operation in ammonia and urea complexes in various countries, the average rate of annual capacity utilization is in general as high as 90% of annual rated capacity. Operation of the large ammonia and urea complex which is being planned will be a new experience for Malaysia. Nevertheless, in consideration of technical management assistance that shall be rendered by experienced foreign firms during the initial two to three years of operation, as is conceived for the Project, it is reasonable to assume from technical point of view that the rate of capacity utilization will be 70% for the first year, 80% for the second year and 90% for the third year onwards. The projection of production schedule has been developed on this basis.

Based on the foregoing criteria for projection of the production schedule and also on the prospect of projected sales discussed in Chapter 5, Part II, three alternative projections are assumed for the production and sales of urea and ammonia as a basis for financial projections of the Project. These projections are given as Cases A, B and C respectively in Tables VI-1 to VI-3.

Assumptions taken for the development of these projections are described in the subsequent paragraphs. In all cases, it is assumed that the Complex will have an in-plant inventory of the products at an amount equivalent to one month production.

A. Projection of production and sales - Case A

A-1) Urea

The production and sales of urea are projected on the assumption that the produced urea shall be sold only in the Malaysian domestic market as well as other ASEAN markets where the quantity of sold urea is assumed to be equivalent to all the projected Malaysian demands for urea and half of the projected urea imports into other ASEAN markets (except Indonesia). No export outside ASEAN markets is assumed for the projection.

A-2) Ammonia

The sales projection of ammonia is made on the assumption that ammonia shall be sold only in Malaysian domestic markets to meet any demand for ammonia which cannot be met from the existing ammonia plant in the country. No export of ammonia is assumed. The production schedule of ammonia is projected so as to meet ammonia requirements for the projected production of urea plus the projected sales of ammonia.

B. Projection of production and sales - Case B

B-1) Urea

For this case annual production of urea is projected so as to attain the projected rates of capacity utilization (70% in the first year, 80% in the second year, and 90% in the third year onward). Sales of the produced urea are projected on the assumption that all the projected Malaysian demands for urea, and half of the projected urea imports into other ASEAN markets (except Indonesia), as is projected for Case A, shall be met by supply from the Project and any surplus remaining after the supply to these markets shall be exported outside the ASEAN markets. (There is still a possibility that all the produced urea can be absorbed by sales within ASEAN region if the domestic demands in Malaysia is larger than the projected quantity.)

B-2) Ammonia

For this case the sales projection of ammonia is made on the same basis as Case A. The production schedule for ammonia is projected so as to meet ammonia requirements for the projected production of urea plus the projected sales of ammonia.

C. Projection of production and sales - Case C

C-1) Urea

The production and sales of urea in this case is projected on the same basis as Case B.

C-2) Ammonia

Annual production of ammonia is projected so as to attain the projected rates of capacity utilization (70% in the first year, 80% in the second year, and 90% in the third year onward). Sales of any excess ammonia remaining after supply is provided for the manufacture of urea are projected on the assumption that all the excess ammonia shall be absorbed by sales to the Malaysian domestic market. (There is a possibility that the domestic demands for ammonia may exist so as to absorb all the projected production.)

2-2 Sales Prices of the Products

As stated in the preceding section, the main product for sale is urea, but also ammonia marketed through in a relatively small quantity. The projected sales prices of these products, which are used for the financial projections and analysis, are described below.

A. Urea

The produced urea will be marketed primarily to the Malaysian domestic markets as well as other ASEAN available markets*1) according to the agreement made by the ASEAN member states for the Project.

The sales price of urea will be set once every year in accordance with the agreed principle on the pricing formula which is to set the price at FOB at international market prices between floor and ceiling prices.*2)