PART IV ANNEX

Annex IV-1 Comparative Study of Type of Harbor

1-1 General

There are a few alternatives for the design and construction of a harbor. Among others, comparative study will be made hereafter on two types of harbor, which are as follows:

a)	Off-shore Berth:	Extension of the jetty towards the ocean
b)	On-shore Berth:	Dredged inner harbor

The following evaluation criteria have been established to carry out a comparison study for the harbor required in the project.

a) Harbor availability

b) Effect of the habor on land preparation of the plant site

c) Effect of the harbor on unloading of machinery, equipment and materials for plant construction

d) Compatibility of the harbor with future industrial and regional development of the plant site area, including expansion of fertilizer plant

1-2 Requirements for the harbor for the project

Harbor facilities for this project must fulfill the following requirements:

a)	Annual shipment of urea:	540,000 T/Y as bulk
b)	Ship size to be accommodated:	Bulk carrier 7,500 to 10,000 DWT
c)	Required draft:	- 10 m

Facilities to be included in the harbor are:

a)	Loader:	Bulk loader (Self-weight approximately 300 T) Rated capacity; 600 T/H Actual capacity; 510 T/H	
b)	Tugboat		
c)	Navigational aids		
d)	Communications system		

Based on the above defined requirements and facilities, the specifications and functions of the harbor facilities are:
(Refer to Annex IV-2 for the design)

a)	Berth:	Length; 150 m Depth; 10 m	
b)	Loading capacity:	510 T/H	
c)	Average cargo load per ship:	8,000 T/ship	
d)	Average period of towing operation:	3H (To be assisted by tugboat and operable day and night)	
e)	Loading time:	$\frac{8,000 \text{ T/ship}}{510 \text{ T/H}} = 15.7 \text{ H/ship}$	
f)	Average unoccupied time:	Unoccupied time between leaving ship and arriving ship is set to be 1 (one) day which is considered to be equivalent to 15H.	
g)	Average occupancy of the harbor per ship:	d) + e) + f) = 3 + 15.7 + 15 (H) = 33.7 (H)	

$$= \frac{33.7}{15} \quad \text{(D)}$$

$$= 2.25 \quad \text{(D)}$$

1-3 Outline of alternative type of harbor

As stated in the foregoing, two alternative types are set for comparative study. The outline of these types will be described here. The two types are;

Case A:	Off-shore Berth
Case B:	In-shore Berth

Although an intermediate type between Case A and B is possible by extending a set of breakwaters towards the ocean in Case A, it is considered included in Case B.

1-3-1 Outline of off-shore berth

In Case A, a jetty will be extended from the shore toward the ocean until the point where a depth of 10 m is available. At the point, a berth will be constructed. In consideration of the bathymetric chart of Kuala Geukeh, the dimensions of the facilities are:

Length of jetty:	350 m
Dimensions of wharf:	150 m long
	20 m wide

A belt conveyor is laid on the jetty for the transportation of bulk urea and a bulk loader of approximately 300 T of self-weight will be installed on the berth.

1-3-2 Outline of in-shore berth

In Case B, a wharf will be constructed in the dredged inner land which is surrounded by a set of breakwaters. This harbor consists of the breakwater, approach channel, turning basin, and berth.

The approach channel will be extended perpendicular to the shoreline and is to be protected by the breakwater, which will function as a protection against siltations and as a preservation of calmness in the harbor. The breakwater will be constructed at a length of about 350 m off the coast where a depth of 10 m is available. And, the structure of the breakwater will be a rubble mound on the shore side and a composite type on the ocean side.

1-4 Harbor availability of each type

1-4-1 General

It is the most important requirement for the harbor of the fertilizer project that availability should be secured to ensure stable shipment of the product urea. Harbor availability becomes a particularly difficult problem when the natural conditions in general, and the oceanographic condition in particular, of the harbor site are taken into consideration. In view of these conditions, a scrutinization of harbor availability shall be made for the types in Case A and Case B.

1-4-2 Critical conditions for tugging, towing, and loading operations

The natural conditions which affect harbor availability are waves, wind, current and rain. The critical conditions of these factors on towing and loading operations shall be established respectively as follows by covering Cases A and B. However, it should be noted here that the current of the site area seldom attains a velocity higher than 1.0 knots, so that no study will be made concerning the current factor, since current problems can be solved by delaying the towing operation as necessary until the current becomes calm.

1) Case A: Off-shore berth

The critical condition will vary depending on the size of the vessel, the direction of external forces (waves and wind) affecting the vessel, and the towing method employed. Here, it is assumed that the ordinary towing system will be employed for the subject vessel ranging from 7,500DWT to 10,000DWT in vessel size. In view of these factors, together with other relative conditions on the operations, the critical conditions will be established as follows:

(1) Critical conditions for the tugging operation

Wind velocity:	20 knots
Wind wave:	$H_{1/3} = 1.2$ m
Swell:	$H_{1/3} = 0.75$ m

(2) Critical conditions for the towing and loading operations

Wind velocity:	20 knots
Wind wave:	$H_{1/3}$ = 1.4 m
Swell:	$H_{1/3}$ = 0.5 m
Rain:	Principally, bulk loading is possible even in the rain; however, the site is facing the ocean so that the rain is usually accompanied by strong wind. In view of these conditions, it is assumed that the operability of loading facilities will be less than 50% of the rated capacity when it is raining.

2) Case B: In-shore berth

In Case B, an in-shore berth (dredged inner harbor) is built so as to ensure calmness inside the harbor to an extent that loading operations can be carried out at any time regardless of the conditions of wind, waves, and current. Therefore, the factors affecting the operation of the harbor adversely are wind, rain, and the critical condition of the tugging operation at the arrival time of the vessels in the harbor. However, in the case of an in-shore berth, the tugging operation is affected by serious oceanographic conditions only until the time when the vessel is drawn into the approach channel of the harbor. Therefore, the critical condition for the tugging operation in Case B is different from that of Case A, which involves the tugging operation up to the berthing of the vessels entirely on the off-shore wharf.

It is assumed here that the breasted towing method will be employed when oceanographic conditions are mild, and the tow line method will be employed at the time of rough weather conditions in order to overcome critical conditions of the tugging operation imposed by weather or waves. On the basis of these assumptions, the critical condition of operations in the in-shore berth shall be established as follows:

(1) The critical conditions for the tugging operation

Wind:	20 knots

(2) Critical conditions for towing and loading operations

Wind:	20 knots
Rain:	Same as for Case A

1-4-3 Harbor closure days

The proposed plant site faces the Andaman Sea in the northwestern part of Sumatra Island. In this area, a southwesterly monsoon prevails under the equatorial air mass during the summer, from May to September, while during the winter a northeasterly monsoon prevails under the tropical air mass. These monsoons attack the harbor site in the form of a swell from the northwest during the summer, and a wind wave in the northwest during the winter. These constitute a major factor affecting the deterioration of harbor availability.

In view of the product urea shipment plan, the major portion is destined for export as described in Part II. Although the export business of fertilizer involves many factors affecting the planned shipping schedule, such as a bagging operation schedule at P.T. PUSRI's bulk depot, and ship assignments, the shipping schedule is assumed to be as follows for the scrutinization of harbor closure days:

a) Average monthly shipment and average ship's call

Average annual shipment:	540,000 T/Y
Average monthly shipment:	45,000 T/M
Average load of ship:	8,000 T/ship
Average monthly call:	$\frac{45{,}000\ T/M}{8{,}0000\ T/ship} = 5.6$ call/M
Harbor occupancy days:	2.25 D/call
Monthly occupancy:	5.6 x 2.25 = 12.7 D/M

b) Maximum monthly shipment and maximum ship's call

The maximum load of harbor facilities is assumed to be 30% more than the average loads described above. Therefore:

Maximum monthly shipment:	67,500 T
Maximum ship's call:	8.4 call/M
Maximum occupancy:	18.9 D/M

These are the maximum loads for the harbor facilities. On the basis of the above assumed maximum loads, harbor availability will be calculated only for the winter season when natural conditions are more severe than the summer season, since in the summer, the southwesterly monsoon season, natural conditions such as wind velocity, wind wave and rainfall are steady.

Tables 2 to 5 show harbor closure days due to wind, wind wave, and rain. Here harbor closure days are defined as days when natural conditions exceed the critical conditions for the operations set in the above Paragraph 1-4-2. The sources of these data are from harbor development plans for the LNG project, etc.

1) Case A: Off-shore berth

Harbor closure days for Case A are shown in Table 1 for the months of December to February.

In this case, the critical conditions for the operations of towing and loading are the predominant factors for the calculation of harbor closure days. Those days are:

December	17.3 D
January	12.5 D
February	9.5 D

In Table 1, the closure days due to wind are included in the closure days caused by wind wave.

2) Case B: In-shore berth

In Case B, the only critical conditions are from wind and rain so that the harbor closure days for this case are calculated to be as follows.

December	7.3 D
January	8.5 D
February	2.5 D

1-4-4 *Evaluation in view of product shipping schedule*

Evaluation among the two alternative cases will be made in view of the product shipping schedule against the harbor closure days.

1) Case A: Off-shore berth

From the shipping schedule, it is calculated that the required availability of the harbor, which is equivalent to the average occupancy rate, is 12.7 D/M, and the maximum harbor availability is required to be 18.9 D/M. Monthly harbor availability for the months December to February is as follows:

December:	31 - 17.3 = 13.7 (D)
January:	31 - 12.5 = 18.5 (D)
February:	28 - 9.5 = 18.5 (D)

It can be noted here that harbor availability for each month is sufficient for the average monthly availability required; however, it is insufficient for the maximum availability required. Especially, this kind of harbor has disadvantages in flexibility against the irregular arrangement of ships, since this harbor availability is less than the maximum availability required for three continuous months.

Moreover, as it is clear from Table 3, it occurs that the wind wave exceeds critical conditions within an average occupancy of 2.25 D while the vessels are on the berth. In this case, the vessels have to deberth waiting for calm weather so that the deberthing and berthing operations lose time. Therefore, harbor availability of 13.7 D will be decreased.

2) Case B: In-shore berth

Harbor closure days in Case B are less than 10 D in the months from December to February, so that no interference with the shipping operation is anticipated.

1-5 Effect of the harbor on land preparation of the plant site

In Case B, it is required to dredge the in-shore land in an amount of approximately 4.2 million m^3. On the basis of available soil data of the plant site at Geukeh, most of the dredged borrow is found to be adequate for sand for the reclamation of the plant site. On the other hand, the envisaged plant site encompasses several fish ponds and faces the ocean, so that it is necessary to prepare the land at a level of more than 4.5 m above I.S.L.W. (Indian Spring Law Water) by reclaiming the existing land at an average level of 2.0 m above I.S.L.W. This reclamation necessitates sand in an amount of approximately 2.7 million m^3. Although the above-mentioned dredged borrow contains some quantity of unsuitable soils for land reclamation, it is possible to secure an ample amount of sand for reclamation of about 2.7 million m^3, in view of the existing data.

If the dredged borrow is not available at all, it will be necessary to secure supply sources of mountain sand for land reclamation. However, the topography of the plant site vicinity shows that no adequate mountains are available from which soils can be supplied economically for reclamation. Therefore, reclamation work must rely on dredged borrow.

In view of the saving of overall investment cost of this project, the possibility of utilizing dredged borrow for the reclamation of the plant site is one of the advantages of constructing an in-shore berth.

1-6 Effects of the harbor on the unloading of machinery, equipment, and materials for the consturction of the plant

In order to construct the envisaged plant, an enormous amount of machinery, equipment, and materials (approximately 150,000 freight tons) must be transported to the site. In view of the present status of the infrastructure in the vicinity of the plant site, it is impossible to transport these necessary items, including equipment with the maximum weight of 350T/item.

As shown by the construction schedule of the project, the shipment of these items will be started 12 months after the effective date with the general contractor. The dredging and wharf construction work will be completed in ten months after the effective date as shown by the construction schedule. Therefore, ocean transportation and unloading of the items become possible upon completion of harbor facilities.

One of the main features of the in-shore berth is its almost complete independence from oceanographic and climatic conditions in carrying out the unloading of machinery, equipment, and materials necessary for plant construction.

On the other hand, in Case A, the construction period is the same as the above in-shore berth, so that the berth for the transportation of these items becomes available with at the same time as that of Case B.

However, the harbor availability in Case A is limited, as discussed in the foregoing.

1-7 Compatibility of the harbor with the future industrial and regional development of the plant site area, including the expansion of the fertilizer plant

The project is to be located in the complex based on the natural gas made available from the Arun gas field. Since the Arun gas field has reserves with the world's highest standards, many projects are being planned based on the abundant gas from the field. This project will be implemented as the second project following the LNG project. There are also possible projects based on other abundant natural resources available in the Aceh region. Moreover, in due course of the development of these possible proejcts, the area will be regionally developed.

A list of possible projects in the vicinity of the project site area includes among others, the following:

i. Expansion of the envisaged fertilizer project
ii. Petrochemical projects
iii. Wood-based industries including pulp and paper

From these projects, products must be shipped to the other parts of Indonesia and to destinations for export. Therefore, realization of these projects inevitably necessitates harbor facilities.

Moreover, in due course of realization of these projects, the population of the area will increase and thus, the import of consumer goods to the area will be increased accordingly.

Under these circumstances, this industrial and regional development surely necessitates harbor facilities for the transportation of possible cargoes such as:

a) Capital goods
b) Products from each possible project
c) Raw materials and utility material for these projects
d) Consumer goods

In view of the future requirements of the harbor facilities in the region, a comparative study will be made between Cases A and B in the flexibility of handling these possible transportation requirements.

In Case A, it is impossible to expand the constructed facilities, so that for further requirements, a completely new unit of the facilities must be designed and constructed.

As for Case B, this type of harbor is flexible enough for any possible expansion, so that, for small-scale expansion requirements, a jetty type berth can be constructed south of the envisaged berth after a small amount of area dredging, and for large-scale expansion, a new unit of facilities in the envisaged harbor can be constructed after dredging the area east of the turning basin of the envisaged harbor.

Either for small- or large-scale expansion, expansion of the breakwater is not required and the berth can be constructed with a less durable structure, thus reducing the investment cost compared with the expanded wharf in Case A.

As an analysis has been done in the foregoing, it is clear that Case B, the in-shore berth system, is more advantageous for the envisaged project.

Annex IV-2 Conceptual Design of the Harbor Facilities

2-1 Design conditions (In-shore berth)

2-1-1 Subject vessels

Bulk carrier (Bulk fertilizer carrier)

a.	Subject vessel capacity:	7,500 to 10,000 DWT
b.	Average ship size:	8,000 DWT
c.	Average loading weight per vessel:	8,000 T
d.	Dimension of vessels	

DWT	Length (m)	Width (m)	Depth (m)	Draft with full cargo (m)
5,000	109	15.3	8.4	6.7
10,000	142	19.0	11.1	8.3
15,000	165	21.6	13.0	9.5

2-1-2 Natural conditions

1) Tide

i.	Highest Astronomical Tide	+ 2.22 m
ii.	Mean Water Spring	+ 1.88 m
iii.	Mean High Water Neap	+ 1.32 m
iv.	Mean Sea Level	+ 1.01 m
v.	Mean Low Water Neap	+ 0.70 m
vi.	Mean Low Water Springs	+ 0.14 m
vii.	Standard Level (I.S.L.W.) (Indian Spring Low Water)	± 0.00 m
viii.	Lowest Astronomical Tide	+ 0.20 m

2) Current

The current in front of the envisaged plant site runs parallel to the coastline in an east/west direction with a maximum velocity of approximately 1.3 knots.

3) Wind

In the area facing the Andaman Sea on the northeastern coast, Sumatra Island is under the influence of the prevailing monsoon, a southwesterly monsoon under an equatorial air mass during the summer season from May to September, while under a northeasterly monsoon under a tropical air mass during the winter season. The average wind velocity during the southwesterly monsoon period is about 10 knots, while the average velocity of the northeasterly monsoon is somewhat higher than 10 knots. The results of an analysis made on annual statistics of the wind factor are shown in Table 4 of Annex IV-1.

4) Waves

The following table shows specifications of the waves:

	Direction (-)	Height (m)	Period (sec)
Off-shore Wave	N.W.	3.9	9
	E.N.E.	3.4	8
On-shore Wave	N.W.	2.6	9
	E.N.E.	3.0	8

5) Slope of sea bottom

Average slope (on-shore):	1/30	(-)
Distance until depth of 12 m:	400	(m)

6) Soil condition

No direct data are made available so far concerning the sub-soil conditions off-shore of Geukeh. However, in the LNG plant which is about 6 km to the east of the plant site, construction work has been carried out and various surveys concerning the sub-soil conditions have been made. It is therefore possible to conceptually estimate the existing soil conditions off-shore of Geukeh.

The sub-soil of this area consists mostly of alluvial sedimentation which may be broadly categorized into the upper layer and the lower layer.

The upper layer consists mostly of dark-grey fine sand, fine silt, sandy silt, silt, and silty clay. On the whole, the silty fine sand is prevailing among the components. The N-value is generally less than 10; however, it is likely that some distribution of the soft layer of 0 to 4 N-value exists in the shore ridges. Certain areas in the shoreline sometimes show an irregularly high N-value. The thickness of the upper layer is estimated to be approximately 20 to 30 m.

The lower layer mostly consists of consolidated sandy soil, clays and soft lime rocks. The N-value in the lower layer ranges from 30 to over 50 in the shoreline and frequently over 20 even in off-shore areas. However, the N-value in the lower layer presents irregular variations in location, depth, and direction.

2-2 Harbor plan

2-2-1 Harbor layout

The layout of the harbor facilities must be planned by taking into due consideration the ultimate objective of safe and smooth towing and loading operations. The factors to be taken into consideration are topography, geology, climatic conditions, oceanographic conditions, types of subject vessels, conditions of supporting facilities, etc. In order to achieve this objective, facilities such as the approach channel, the entrance channel, etc., must secure ample area, having the width required for tugging and towing operations. At the same time, the layout must be so planned that the calmness of the inner harbor will be maintained. The layout for the envisaged harbor is to satisfy all the requirements as a harbor for the project with a minimum length of breakwater. The location of the harbor has been selected on the basis of the bathymetric map of the area.

The following paragraphs will make a conceptual design of the harbor in terms of the depth of the inner harbor, the entrance channel, approach channel, turning basin, and loading area.

2-2-2 Depth of the inner harbor

The depth of inner harbor has been established as follows:

1) Depth at the berth

Depth at the berth shall be the full-load draft plus an allowance depth of 0.5 m to 1.5 m depending on the type of vessel.

2) Depth of the approach channel and the inner harbor

If the Japanese standard for harbor construction is applied, the required depths of the berth, etc. for standard-type vessels are defined as follows.

Ship size (DWT)	Depth of berth, etc. (m)
10,000	9.0
15,000	10.0

In the case of this project, the depth of the inner harbor and the berth are set as -10 m in order to accommodate the subject vessel of 10,000 DWT as maximum. Therefore, it is possible for a vessel of 15,000 DWT to enter this harbor if all the other conditions are satisfactorily met.

2-2-3 Entrance channel

The entrance channel must be located to avoid the most frequent and strongest wave direction in order to prevent the intrusion of waves into the harbor so that the calmness of the harbor will be satisfactorily maintained. At the same time, the channel must be wide enough to allow smooth movement of the vessels, and the direction of the entrance must be so selected that the heading of the vessel will cause no difficulty. The following paragraphs will discuss the direction, width, and depth of the entrance channel.

1) Direction

The wind and wave direction of the envisaged area prevails in the direction of northeast and northwest. During the summer, swells from the northwest direction will affect harbor availability. During the winter, wind waves in the northeast direction will be the main cause of reducing the availability.

The effects of tail waves are high in the case of a large-sized vessel, particularly when the vessel proceeds at a low speed in the vicinity of the entrance channel. The steering may be adversely affected, if tail waves should take place, because the relative speed between the vessel and the wave slows down. Selecting a direction in which vessels would be hit by a tail wave within 45° at the stern in the vicinity of the entrance channel should be avoided.

In view of the above points, the entrance channel should be facing almost due north in consideration of harbor availability and the maneuverability of the vessels.

2) Width

The width of the entrance channel is normally decided on the basis of the following criteria:

Two-way channel:	1 to 1.5 times the overall length of the vessel
One-way channel:	(On the condition that the harbor is calm and the current is flowing parallel to the channel.)
	Over 0.5 times the overall length of the vessel

A one-way channel will be employed for this project. However, the current of this area flows perpendicular to the channel (the direction of the current is parallel to the coastline). Considering that the rugboat will assist the vessels at the time of entering the port, the width of the entrance channel shall be equivalent approximately to the full length of the vessel. On the basis of the dimensions of the largest subject vessel, the width of the entrance channel shall be established as 140 m.

3) Depth

The depth at the entrance channel shall be -12m, including a certain allowance in addition to the depth at the berth in order to cope with the pitching of the vessel due to waves, the trim of the vessel, and effects of the swell upon the vessel.

2-2-4 Approach channel

1) Width

The width of the approach channel must be determined on the basis of various factors such as: the type of subject vessels, topography, climatic conditions, oceanographic conditions, whether the channel is for a one-way or two-way voyage, whether tugboat assistance is available, etc. It is customary to determine the width of the approach channel in accordance with the following criteria:

One-way channel

Width (B) = 1.33L + 20 (m)

Two-way channel

Width (B) = 1.5L + 20 (m)

L: Overall length of the vessel

Since the envisaged harbor will employ a one-way channel, the width will be determined as follows on the basis of the length of the subject vessel (Refer to Paragraph 2-1-1 of this Annex):

B = 1.3 x 142 + 20 = 204.6 (m)

On the basis of this calculation, the width of the approach channel shall be established as 200m.

2) Length

When a vessel is approaching a harbor, it must maintain a speed above a certain level while outside the breakwater in order to avoid the adverse effects of wind and current. The length of the approach channel is established on the basis of the stopping distance of a vessel.

The minimum straight length of the approach channel must be decided in relation to the loading area in front of the berth to be constructed. As to the stopping distance of the vessel, it is recommended that four times the overall length of the subject vessel shall be taken as the basis of a standard vessel approaching speed ranging from 4 knots to 6 knots. As the minimum straight length of the approach channel, the standard practice is to adopt 5L in due consideration on the overall length as well as on the stopping distance.

On the basis of the above discussion, the straight length of the approach channel up to the turning basin shall be decided as 750 m. (With subject vessel of 10,000 DWT, L = 142, 5L = 710 m)

2-2-5 Turning basin

There are three elements of which the turning basin shall be designed. Those are depth, area and position.

Factors which will affect the decision of these elements are natural conditions, vessel specifications and maneuvering operations. The following paragraphs will discuss each of the elements of the turning basin.

1) Depth

It is a standard practice to employ for a turning basin the same figure as the depth of the berth.

2) Area

The area required for a turning basin depends on the availability of tugboats, turning angle, and the effects of wind and current. The turning basin must be wide enough to ensure safe maneuvering of the vessel. The standard practice in this respect is as follows:

Shape of Turning Basin

Turning Angle (Degree)	With Tug Assistance	Without Tug Assistance
0 – 20	Equilateral triangle with side length of 2L	Equilateral triangle with side length of 3L
More than 120	Circle with diameter of 2L	Circle with diameter of 3L

Note: L = Length of ship

As for the necessity of tugboats, since the harbor facilities for this project are so designed as to accommodate subject vessel size of 10,000 DWT maximum, the maneuvering at the inner harbor will most likely be difficult regardless of the area for the turning basin, because of the following reasons:

(1) The vessels are subject to the shallow effect and/or the breast effect.

(2) Generally in this size of vessel, the driving force for backward movement is relatively small compared with the strong forward inertia.

(3) The turning function is adversely affected because of the size and the draft of the vessel.

(4) Increase in the effects of wind wave due to the comparatively long time required for towing.

Under these circumstances, the tugboat is necessary for assisting in the towing of incoming and outgoing vessels.

The area for the turning basin shall have a diameter two times the overall length of the vessel plus adequate allowance. Therefore, 284 m (2L = 2 x 142 = 284) plus allowance becomes 330 m. The diameter of the turning basin shall be 330 m on an assumption that the tugboat will assist the towing operation and the turning angle will be over 120°.

3) Position

The position of the turning basin must be determined in due consideration of the towing method at the time of berthing and deberthing. With this regard, determinging the position of the turning basin is closely related to the planning of the berth layout. Therefore, the next section will study the layout of the berth to be installed inside the harbor.

2-2-6 Loading area

The loading area shall be designed so as to make the berthing and deberthing operation smooth and to make the loading operation possible even in rough whether such as wind wave, swell, and current. In due consideration of these requirements, the layout is set as shown in Figure IV-11.

2-3 Arrangement of the harbor facilities

In this section, discussion will be made about four major civil works to be involved in the construction of the dredged inner harbor.

These works are:

(1) Breakwater construction
(2) Shore work inside the harbor
(3) Wharf construction
(4) Shore protection work

2-3-1 Breakwater

The rubble mound type is the best suited type for a breakwater on a comparatively soft sub-soil. However, if the rubble mound type is employed, the required amount of rubble will be as much as approximately 450,000 m^3 in order to construct the rubble mound up to a point where the depth is 12 m. On the other hand, the suppliability of the rubble from Kalimun Island is reported to be 100,000 m^3/Y; therefore, the suppliable amount of rubble is 250,000 m^3 throughout the whole breakwater construction period, which is projected to be 2.5 years. These being the circumstances, it is necessary to combine other types of breakwater in order to cope with this problem. As to other possible types, there are the caisson and the composite type. If the caisson type is employed, it would necessitate a large volume of caisson, because of the two major reasons, i.e., the depth of water is 12 m and the sub-soil is comparatively soft. In addition, the seabed must be improved a great deal.

Therefore, it is recommended that the composite type should be employed where the water is deep, while the rubble mound type should be used for shallower water. However, according to a survey made in connection with the Arun LNG project, it was revealed that a soft layer exists 6 m to 15 m from the surface of the seabed in deep water. This being the circumstance, seabed improvement is still necessary even if the composite type is employed.

According to the above discussion, it has been concluded that a combination of rubble mound type and composite type will be employed as the type of breakwater to be constructed for this project. In the following paragraphs, a discussion will be made concerning determination of water depth to a point at which the rubble mound type is to be connected to the composite type.

It is technically and economically advantageous to maximize the length of the rubble mound within the suppliable range of rubble, thereby minimizing the length of the composite. This shifting point, the water depth where the rubble mound shifts to the composite, shall be determined by a comparison study of the following three cases in view of requirements and suppliability of the rubble:

Case	Water Depth at the Shifting Point (m)	Suppliability of Rubble ($000 m^3$)	Requirement of Rubble ($000 m^3$)	Evaluation
1	All rubble		450	Impossible
2	8	250	260	Impossible
3	6		230	Best
4	4		210	Good

In cases 1 and 2, the requirement of rubble exceeds suppliability, thereby making implementation obviously impossible. In case 4, on the other hand, the surplus amount of rubble is too excessive, and the length of the composite type also becomes high, so that it is not economical in view of utilization of resources as well as from an investment cost point of view. In case 3, about 10% of rubble allowance is available as surplus for unexpected requirements. Therefore, case 3 appears to be the best alternative.

The conclusions drawn so far may be summarized as follows:

Type of Breakwater	Water Depth
Rubble Mound	Shallower than - 6 m
Composite	- 6 m to - 12 m

The following table summarizes the features of the rubble mound type and the composite type

	Rubble Mound	Composite
Merit	- Easy Construction - Less Wave Reflection	- Good for Deep Water - Less Width of Entrance Channel
Demerit	- More Materials and Labor for Deep Water	- Installation of Caisson is Bottle-neck for Construction Schedule

2-3-2 Shore work inside the harbor

The dredged inner harbor envisaged for this project involves four shore works, i.e., works for the northside, southside, westside and eastside shores. Of these, the northside shore shall be constructed by sheet piles, while the other three shores will be constructed by the beach-type shore. The reasons for deciding upon the sheet pile shore for the north and the beach-type shore for the south, east and west are explained as follows:

(1) On the west and north shores, there is protection from the oceanographic effects of the outer sea such as waves, swells, and currents, so that the calmness inside the harbor will not be disturbed even though the vertical shore is employed for construction.

(2) A beach-type shore consisting of a natural slope tends to collapse during high-intensity rainfall or under the attack of high waves. The northside shore especially is to be built with the berth so that, if the beach-type is employed for the shore, the function of the berth will be affected.

The above being the case, the types shore works shall be determined as follows:

a) Sheet piles with tie-rod: some portion of the westside shore

b) Self-standing sheet pile: balance portion of the west shore and the north shore

c) Beach-type: other side of the shores

1) Sheet piles with tie-rod

As for the westside shore, its calmness will be maintained since the area is in an insulated zone. Therefore, this area will be provided with a berth of five-meter depth so that small vessels can be accommodated. The total length of this shore amounts to approximately 160 m. In view of the available depth in this area, it is possible to berth a vessel of 1,000 DWT capacity. It is also possible to moor tugboats which are to be used for maneuvering operations. The slope of the sea bed of this shore should be determined in accordance with the characteristics of the sub-soil and the waves. In this feasibility study, however, a slope of 1 : 4, which is equivalent to the case of the LNG project, has been employed.

2) Self-standing sheet pile

As has been mentioned earlier, the remaining portion of the west shore and the entire portion of the north shore shall be of a sheet pile type, so that there will be no danger of shore collapse. The depth of the water in front of the shore shall be E.L. -0 (= I.S.L.W.), so that the shoreline may be secured economically by employing self-standing sheet piles. If it becomes necessary in the future to use some portion of this area for mooring small vessels, it is possible to change this area into a sheet pile with tie-rod type by increasing the depth of the water in front of the shore.

3) Beach-type shore

If a vertical shore wall is installed at a portion on which the waves intrude directly from the entrance channel, the intruding waves will be reflected, thereby disturbing the calmness of the harbor. Therefore, in order to minimize the effects of the reflected waves, the southside shore shall be made on the beach-type of 1 : 4 slope up to a point of E.L. -10.0 to E.L. -2.0, and the slope shall be 1 : 7 up to E.L. -2.0 to E.L. +4.5.

At places where E.L. is less than -2.0, the affecting wave force is lower than it is in the vicinity of the water surface. Therefore, it is possible to employ a somewhat steeper slope than that in the vicinity of the surface, so that the slope of this area will have the same slope as that of the sheet pile type.

On the other hand, where E.L. is over -2.0, the wave force will be high because of proximity to the surface. Therefore, the slope shall be made lower in order to secure the stability of the shore. In consideration of the fact that the natural slope of a beach ranges from 1 : 6 to 1 : 7, the shore slope for areas over E.L. -2.0 has been decided at 1 : 7.

Another reason for adopting the beach-type for the south shore is the absence of direct adverse effects upon the functions of the harbor even if the shore is slightly collapsed. With same reason as for the south shore, a beach-type will be employed for the east.

2-3-3 Berth

1) Determination of the berth dimensions

a) Length of berth

The length of the berth has been determined on the basis of the hatch length of the largest subjedt vessel to be called, i.e., a vessel with 15,000 DWT capacity together with some allowances.

Length of 15,000 DWT vessel:	165 m
Hatch distance for 15,000 DWT vessel:	165 x 0.7 = 116 m
Berth length*:	116 + 2 x 20 = 156 m

* Allowances are included for both sides with 20 m each.

b) Width of the berth

The width of the berth has been decided in such a manner that the rail width of the loader, the space for the belt conveyor, and the piles in front of the berth will not exceed the front plane of the towing line, together with necessary width allowance.

Width of the berth: 15.8 m

2) Floor of the berth

The floor of the berth shall be determined so that the upward pressure will not affect the berth and the bottom side of the berth will have a certain extent of the allowances when the highest water level hits the berth.

E.L. of the bottom floor of the berth = H.W.L. + allowance = 1.88 + 0.5
= E.L. + 2.5

E.L. of the top floor of the berth = 2.5 + thickness of the floor
= + 4.5 m

Therefore, E.L. of the top floor of the berth shall be + 4.50.

2-3-4 Shoreline protection

The subject coast area is an alluvial coast. It is difficult to clarify the effects of the construction of the breakwater upon the coastal current and the effect of consequential siltations. In order to forecast the actual extent of such phenomena, it seems necessary to undertake a large-scaled hydraulic model study.

According to past breakwater construction practice, an extreme degree of errosion has been reported at the connecting position between the shoreline and the breakwater. Further, there have been a number of cases in which the general shoreline area outside the connecting points has also been affected by errosion.

In the case of this project, the plant site is about 150 m inland from the shoreline. Therefore, it has been deemed unnecessary to install any protection for the general area of the shoreline. Shoreline protection shall consequently be limited to the connection point of the breakwater and the shoreline in order to prevent errosion caused by waves. These being the circumstances, it has been proposed to install a 200 m each shoreline protection on both the east and the west side of the breakwater.

Annex IV-3 Further Survey Requirements

3-1 General

As soon as the project company is incorporated, surveys should be conducted for the clarification of the geographical and oceanographic situation of the project site. In this Annex, the requirements of the surveys shall be defined for Phase I, in which the survey should be conducted before the issuance of the bid invitations, and for Phase II, in which the survey should be conducted by the awarded general contractor.

3-2 Phase I

The objective of the survey to be made during Phase I is to collect sufficient data to prepare the bid specifications. On the basis of these data, determinations will be made as to the positions of the plant site, harbor, water intake facilities, and housing colony. In addition, the type of structures to be constructed will also be finalized on the basis of these data.

3-2-1 Survey items

The survey items for each of the survey areas shall be as follows:

	Boring Test	Penetration Test	Sonic Survey	Bathymetric Survey	Topographic Survey
Plant site	o				o
Harbor	o		o	o	
Housing colony		o			
Water intake		o			
Bridges		o			

3-2-2 Scope and methodology of survey

1) Plant site

a) Boring tests

Refer to Figure 1 concerning the positions of the boring work to be made.

The depth of the bore holes shall be as shown in the following table. These figures have been estimated on the basis of boring data which had already been obtained during the field survey.

(1) Position and depth of boring

Number of Bore Holes	Depth	Boring Points in Figure 1	Remarks
24	30 m from the surface	$A_1 - A_8$	A4 up to 50 m
		$B_1 - B_8$	B4 up to 50 m
		$C_1 - C_8$	C4 up to 50 m

(2) Survey method

- The depth of the bore holes shall be decided in accordance with the existing conditions. The boring should be penetrated at least 5 m into the consolidated clay layer.

- The standard penetration test shall be carried out.

- Unless otherwise specified, the N-value shall be measured at 1 m intervals.
  The samples shall be collected every 2 m unless otherwise specified. However, if there is any change in the stratum within 2 m, the samples of the changing position shall be collected.

- The collection points of undisturbed samples shall be the points as shown in Figure 1. More than five samples shall be collected from each of the bore holes. The samples shall be collected as and when the layer changes; however, if the thickness of one layer is large, more than two samples shall be collected from the same layer.

- Concerning the undisturbed samples collected, the following soil test shall be conducted:

  Physical tests: Specific gravity, moisture content, particle size distribution, limit of liquefaction, limit of plasticity, and bulk density

Mechanical tests: Axial and triaxial compression, consolidated-drained direct shear tests

(3) Analysis of boring results

- Preparation of bore hole records

- Preparation of samples

- Physical and mechanical tests on the undisturbed samples

b) Topographic survey

Refer to Figure 1 concerning the scope of the topographic survey. The topographic survey shall be conducted on the basis of the bench marks already established.

2) Harbor

a) Boring tests

Refer to Figure 1 concerning boring positions. The boring positions shall be scattered by covering necessary area, scope, and intervals for the purpose of establishing the exact position of harbor arrangement by concurrently conducting a sonic survey.

(1) Positions and depth of the boring

Number of bore holes:	10
Depth:	-30 m from the seabed
Boring points in Figure 1:	D_1 to D_5
	E_1 to E_5

However, point E_2 shall be bored up to 50 m

(2) Survey method

- Standards the same as employed for the land area boring survey shall be adopted concerning boring depth, N-value measurement, and positions for sample collection.

- Refer to Figure 1 concerning the boring number for collection of undisturbed samples. Four samples should be taken for the undisturbed samples.

(3) Analysis of the results

The same standards as taken for the land area shall also be applied.

b) *Sonic wave test*

(1) Scope of survey

Refer to Figure 1 concerning scope of survey.

(2) Survey method

The sonic wave test will be carried out by continuously recording the reflected sonic waves on paper. By means of analyzing the recorded reflection waves, the soil profile of the underground layer will be clarified. The actual off-shore survey shall be conducted by installing a sonic wave generator on board a survey ship. Connected receiver equipment shall be floated 20 m behind the survey ship.

(3) Sorting of results

i. Lines of reflection waves
ii. Cross-section drawings
iii. Topographic map of the seabed
iv. Contour maps for foundation stratum
v. Iso-thickness map of each alluvial layer

c) Sounding test

(1) Scope of survey

Refer to Figure 1 as to the scope of survey. The sounding test in the subject area shall be conducted centering on E -500 to E +500 and on an area N + 1,500 from the shoreline with an incorporation of some additional areas on the periphery as an allowance. These areas cover the candidate site for the construction of the proposed harbor. The interval between the measuring lines shall be a 20 m pitch unless otherwise specified in view of a comparatively steep slope of the subject seabed ranging from 1 : 20 to 1 : 50.

(2) Survey method

Unless otherwise specified, the method of survey shall be the sounding test which shall be conducted continuously on the subject area. However, if the survey ship cannot be used because of the shallowness of the water or if it is impossible to employ the sounding method, the water depth shall be surveyed by the sounding lead. The measurement of the ship's position shall be conducted at an interval of every 20 to 40 m by the triangulation method.

(3) Control point survey

Four controlling points shall be established on land facing the subject sea area prior to the commencement of the sounding test. These control points shall be established on the basis of the existing points such as the bench mark for the construction of the LNG plant. In addition, the referring points shall be established by means of the traverse survey in such a manner that the lines of sounding interval will become 200 m unless otherwise specified. The referring points shall be increased as and when necessary.

(4) Analysis of sounding test results

The analysis of the sounding test results shall be conducted while referring to the trace of the surveying ship and reading out the depth of water at a pre-designated interval. The obtained values shall be transferred to a plane map in order to draw the bathymetric chart of the area.

3) Housing colony, water intake facilities, and bridges

Concerning the sites for the housing colony, water intake facilities, and bridges, the statistic penetration test shall be conducted. The number of the test points are as follows:

	Static penetration test
Housing Colony	Three candidate sites, two points for each candidate
Water Intake	– ditto –
Bridges	– ditto –

Therefore, the total number of the static penetration test will be 18 points. The depth of the test shall be 13 m.

3-3 Phase II

The objectives of the surveys to be conducted during Phase II are to clarify the detailed data for the design and construction of facilities for the project. However, the methodology and scope of the surveys involved shall vary depending upon the plans made for Phase I.

3-3-1 Survey items

The survey items for each of the subject sites shall be as follows:

	Boring test	Static penetration test	River survey
Plant site	o		
Harbor	o		
Housing colony	o	o	
Water intake	o		o
Bridges	o		

3-3-2 Scope and method of survey

1) Plant site

a) Boring test

Refer to Figure 2 concerning the bore hole positions. The depth of the boring hole shall be decided by the boring data collected through Phase I.

(1) Positions and depth of boring test.

At this stage, the boring depth shall be tentatively determined as follows:

Boring points:	56 points
Depth:	-30 m from the surface

(2) Survey method

The survey method shall be in accordance with the surveys made during Phase I. Refer to Figure 2 concerning the positions of the undisturbed samples.

2) Harbor

a) Boring test

Refer to Figure 2 concerning the boring positions.

(1) Positions and depth of boring

The depth of the boring test shall be decided by the boring data collected through Phase I. At this stage, the boring depth shall be tentatively determined as follows:

	Boring Points	Depth
On-shore	18	-30 m from the ground surface
Off-shore	12	-30 m from the seabed

(2) Survey method

The survey method shall be in accordance with the surveys conducted during Phase I. Refer to Figure 2 concerning the positions of the undisturbed samples.

3) Housing colony

a) Boring test

The specifications of the boring test shall be as follows:

Boring points:	2
Depth:	-30 m from the ground surface

b) Static penetration test

Testing points:	10
Depth:	-20 m from the ground surface

4) Water intake

a) Boring test

The specifications of the boring test shall be as follows:

Boring point:	3
Depth:	-30 m from the ground surface

b) River survey

The cross-section of the river, flow quantity, and flow velocity shall be surveyed for a period of one year in the vicinity of the location where the water intake facilities are planned to be constructed.

5) Bridge

At the points where the water pipeline crosses the Mane River, a bridge shall be installed for the pipeline. The bridge shall be constructed in the form of a combination of a girder type and a truss type. For the design and construction of the bridge, the following survey must be conducted:

Boring Test

Boring points:	4 points on the ground
Depth:	-30 m from the ground surface

UNOPERABLE DAYS IN CASE A

(Unit: days)

	Tugging Operation			Towing and Loading Operation		
	Dec.	Jan.	Feb.	Dec.	Jan.	Feb.
Wind	1	3	0	1	3	0
Wave	13	12	10	11	7	7
Rain*1	0	0	0	6.3	5.5	2.5
Total Days	14	15	10	17.3*2	12.5*2	9.5*2

Note: *1 Total rainy day x 1/2
*2 Wave + Rain

HARBOR CLOSURE DAYS BY WIND WAVES

(Unit: days/month)

Hs (ft)	Dec. ≥4.0	Dec. ≥4.5	Jan. ≥4.0	Jan. ≥4.5	Feb. ≥4.0	Feb. ≥4.5
1971 - '72	6	3	12	6	1	0
1972 - '73	13	11	12	7	8	7
1973 - '74	12	9	8	1	10	5
1974 - '75	3	1	9	3	3	2
Max. Occurence	13	11	12	7	10	7

Note: Hs; Significant wave height

HARBOR CLOSURE DAYS BY WIND WAVES

(Unit: days/month)

Month	May		June		July		Aug.		Sep.	
Hs (ft)	≥4.0	≥4.5	≥4.0	≥4.5	≥4.0	≥4.5	≥4.0	≥4.5	≥4.0	≥4.5
1960	0	0	0	0	0	0	1	1	0	0
1961	3	2	2	0	0	0	0	0	0	0
1962	0	0	0	0	4	2	1	0	3	3
1963	0	0	3	2	0	0	0	0	1	0
1964	3	1	0	0	0	0	0	0	2	0
1965	0	0	1	0	0	0	0	0	0	0
1966	0	0	0	0	0	0	0	0	5	5
1967	0	0	2	1	0	0	0	0	0	0
Max. Occurence	3	2	3	2	4	2	1	1	5	5

Note: Hs; Significant wave height

SUSTAINED HARBOR CLOSURE DAYS BY WIND WAVES

	Dec.	Jan.	Feb.	Days
1971 – '72	8 – ① – 2 – ② – 2 – ③ – 13 ––	① – 4 – ① – 6 – ⑥ – 2 ② – 4 – ① – 1 – ① – 2	8 – ① – 19	18
1972 – '73	③ – 1 – ① – 6 – ⑥ – 1 ① – 6 – ① – 3 – ① – 1	① – 1 – ③ – 4 – ④ 14 – ④	② – 6 – ⑥ – 14	33
1973 – '74	4 – ① – 4 – ③ – 3 – ② 7 – ② – 1 – ④	① – 10 – ② – 1 – ① 1 – ③ – 11 – ①	6 – ⑦ – 1 – ① 11 – ②	30
1974 – '75	21 – ② – 7 – ① –––––––––––––	3 – ② – 3 – ① – 8 ③ – 1 – ③ – 7	6 – ① – 12 – ① 7 – ①	15

Notes: Number with ◯ ; Sustained days when significant wave height ≥ 4.0 ft
Number without ◯ ; Sustained days when significant wave height < 4.0 ft

WIND DATA FOR THE COASTAL SITE, ACEH

ANNEX IV-1
Tab. 4

Month	12	1	2	3	4	5	6	7	8	9	10	11	Annual
Wind Speed (%)													
≥15 kts	88	83	88	95	95	93	90	88	88	91	95	95	90.8
16 - 21 kts	11	14	12	5	5	7	9	11	11	8	5	5	8.6
22 - 27 kts	1	3					1	1	1	1			0.7
Prevailing Wind Direction													
Day	ENE	ENE	NE	NE	N	NNE	NNE	NNE	ENE	N	N	ENE	
Night	SSW	SSE	S	S	SSW	SSW	S	S	SSW	SSW	S	S	
Wind Direction with Greatest Mean Force	NW	ESE	NE	NNE	NW	SW	E	ENE	NW	WNW	WSW	SSW	
Six-hour Sustained Winds (knots)													
2 years Return		25			18			22			20		25
50 years Return		33			32			26			33		33
100 years Return		35			36			29			38		38
Sustained Wind Speeds in Squalls: (1/4 to 1/2 hr)	May occur throughout the year, but most probable from May through September.												
2 years Return													45
100 years Return													55

AVERAGE PRECIPITATION FOR LHOKSEUMAWE AND ARUN AREA

Location	Lhokseumawe				Arun	
Year	1931 - 1960		1962 - 1973		1975	1976
Month	Total (mm)	Rain Days	Total (mm)	Rain Days	Total (mm)	Total (mm)
1	214	11.0	130.0	6.6	21.7	1.8
2	57	4.1	74.5	5.0	52.0	2.5
3	91	5.9	48.6	3.7	81.4	43.6
4	97	6.4	70.8	4.2	120.4	131.9
5	105	7.9	103.3	4.7	109.6	214.0
6	91	5.7	52.0	5.0	49.2	154.7
7	91	6.3	101.8	7.3	155.2	23.7
8	101	7.5	123.1	7.4	49.7	137.4
9	125	8.0	150.0	5.0	221.0	34.7
10	155	10.5	202.0	10.9	276.1	168.1
11	187	11.2	206.0	10.3	175.5	429.0
12	239	12.3	239.9	12.5	298.0	75.3
Annual	1553	96.8	1502.0	82.6	1563.0	1416.7

SURVEY PLAN (PHASE 1)

ANNEX.Ⅳ – 3

FIG.1

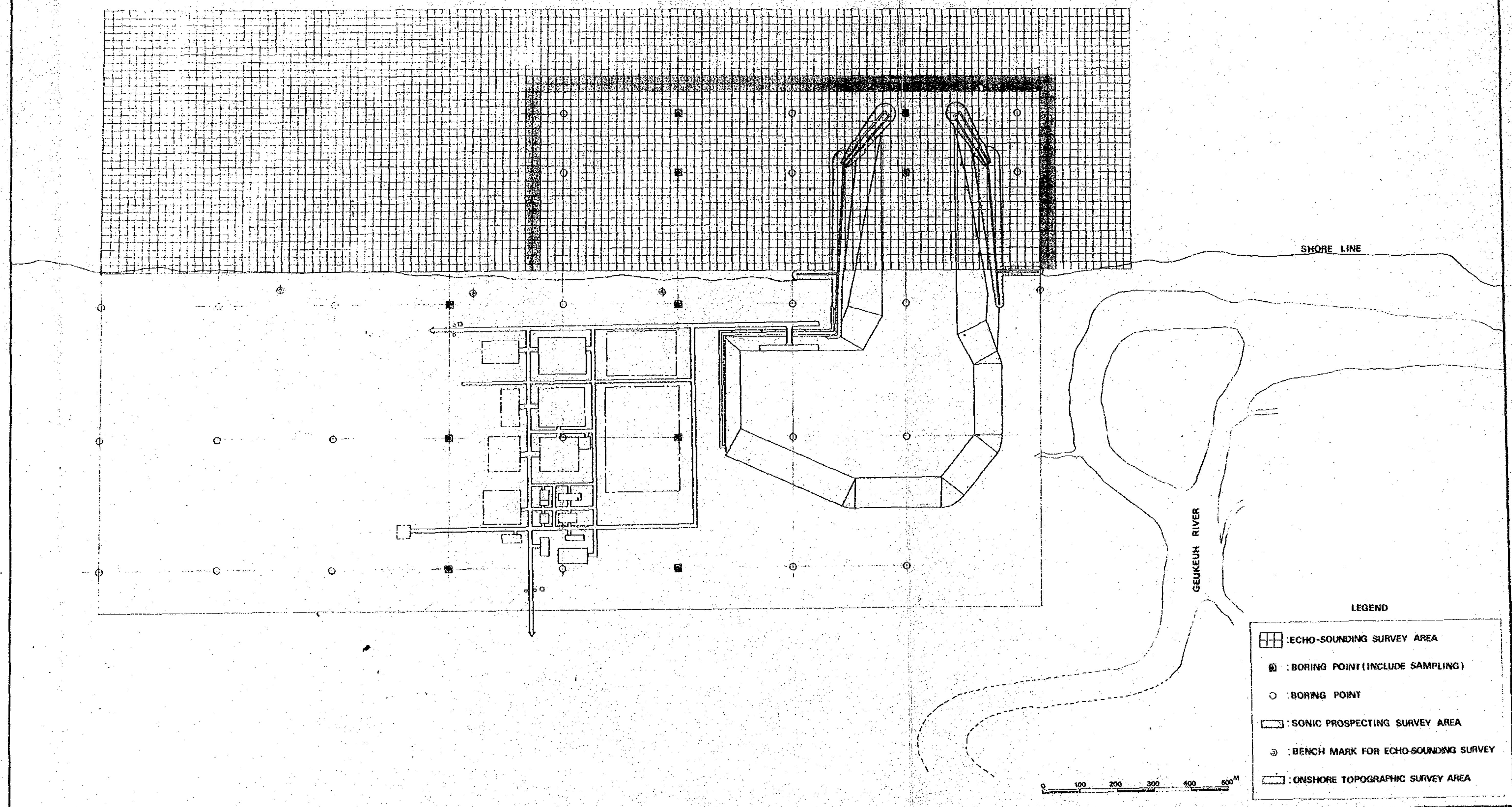
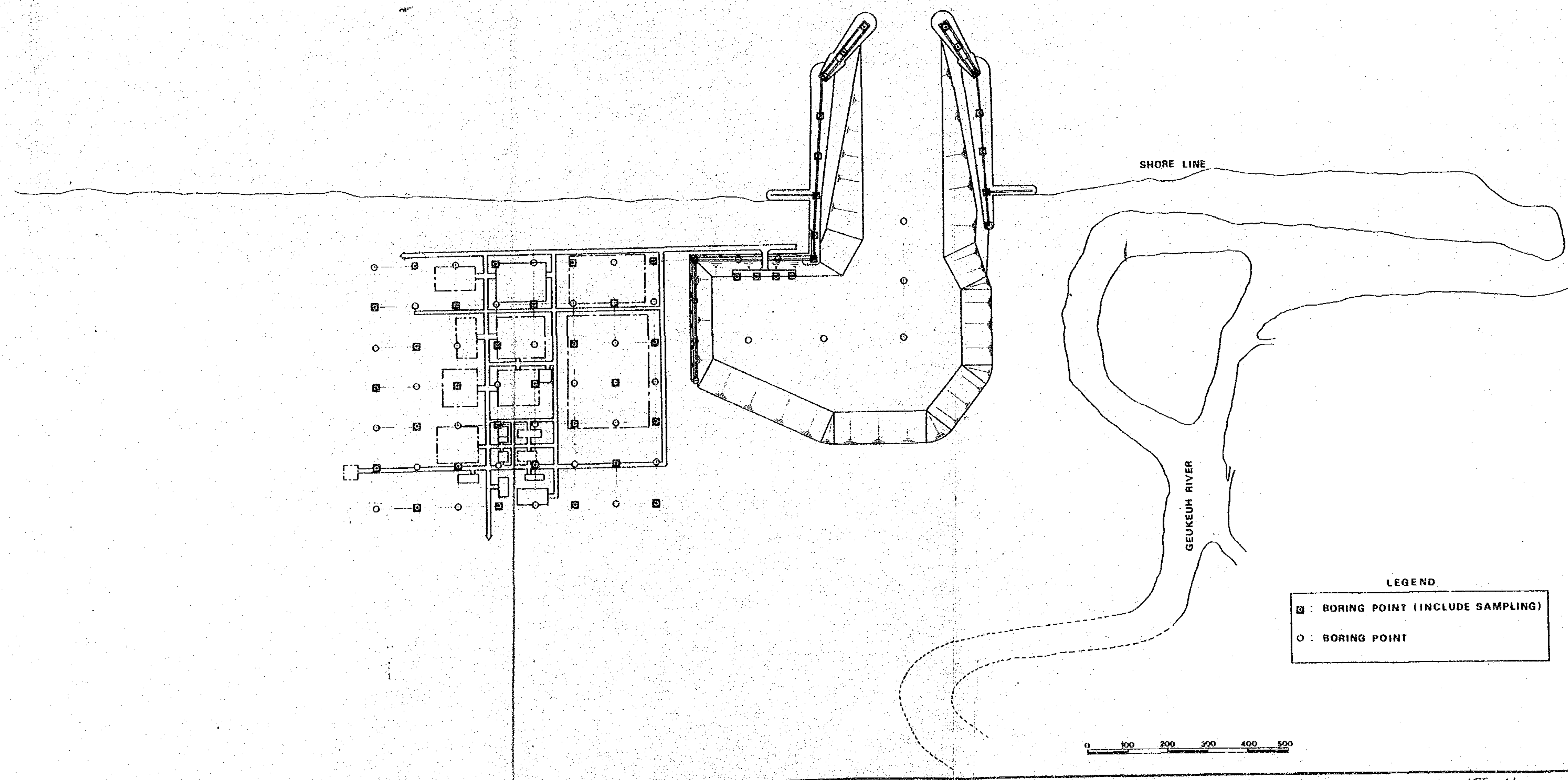


FIG.2

SURVEY PLAN (PHASE 2)



PART V ANNEX

ANNEX V
Tab. 1

ESCALATED CAPITAL COST ESTIMATE

	1978 - Beginning (US$'000)			Combined Contingency (%)		1982 - Beginning (US$'000)		
	(Foreign)	(Local)	(Total)	(Foreign)	(Local)	(Foreign)	(Local)	(Total)
A. LAND ACQUISITION[1)]	0	1,610	1,610	-	-	0	1,610	1,610
B. SITE PREPARATION								
(a) Plant Site	210	1,070	1,280	15.7	29.8	240	1,390	1,630
(b) Housing Colony	200	1,000	1,200	17.9	34.2	240	1,340	1,580
B. SITE PREPARATION TOTAL	410	2,070	2,480			480	2,730	3,210
C. PLANT DIRECT COST								
(a) Plant Equipment & Materials								
- Ammonia Plant	30,500	0	30,500	25.3	-	38,220	0	38,220
- Urea Plant	15,100	0	15,100	25.3	-	18,920	0	18,920
- Utilities Facilities	18,000	0	18,000	25.3	-	22,550	0	22,550
- Offsite Facilities	6,290	0	6,290	25.3	-	7,880	0	7,880
(a) Sub-total	69,890	0	69,890			87,570	0	87,570
(b) Catalyst & Spares								
- Initial Charge of Catalyst	720	0	720	25.3	-	900	0	900
- Spares (Parts, Catalyst & Chemicals)	6,110	0	6,110	25.3	-	7,650	0	7,650
(b) Sub-total	6,830	0	6,830			8,550	0	8,550
(c) Civil Materials								
- Pavement, Foundations & Structures	1,330	5,210	6,540	30.4	49.4	1,730	7,780	9,510
- Battery Limit Buildings	840	2,110	2,950	30.4	49.4	1,100	3,150	4,250
- Urea Storage	1,010	2,290	3,300	30.4	49.4	1,320	3,420	4,740
- Auxiliary Buildings	780	1,660	2,440	30.4	49.4	1,020	2,480	3,500
(c) Sub-total	3,960	11,270	15,230			5,170	16,830	22,000
(d) Direct Labour	0	4,700	4,700	-	70.4	0	8,000	8,000
C. PLANT DIRECT COST	80,680	15,970	96,650			101,290	24,830	126,120
D. HARBOR & BREAK WATER[2)]	14,700	16,640	31,340	25.2	43.3	18,400	23,850	42,250
E. WATER INTAKE & WATER PIPELINE[3)]	3,900	1,960	5,860	33.4	59.9	5,200	3,130	8,330
F. HOUSING COLONY[4)]	1,400	13,000	14,400	28.4	56.3	1,800	20,320	22,120

ESCALATED CAPITAL COST ESTIMATE
(CONT'D.)

	1978 - Beginning (US$'000)			Combined Contingency (%)		1982 - Beginning (US$'000)		
	(Foreign)	(Local)	(Total)	(Foreign)	(Local)	(Foreign)	(Local)	(Total)
G. CONSTRUCTION EQUIPMENT	6,910	700	7,610	15.7	23.9	8,000	870	8,870
H. OCEAN FREIGHT, INSURANCE & LOCAL HAND'G	11,020	700	11,720	21.0	33.7	13,340	930	14,270
I. INDIRECT FIELD EXPENSES[5)]	1,910	1,230	3,140	21.2	35.7	2,320	1,670	3,990
J. SERVICES								
(a) General Contractor's Fixed Fee	19,500	0	19,500	22.4	-	23,860	0	23,860
(b) Bonus Provision	1,000	0	1,000	22.4	-	1,220	0	1,220
(c) General Contractor's Expatriates[6)]	8,400	1,800	10,200	22.4	22.4	10,280	2,200	12,480
(d) Vendor's Servicemen[6)]	1,120	240	1,360	22.4	22.4	1,370	290	1,660
(e) Local Staff Supervision[6)]	0	1,500	1,500	-	22.4	0	1,830	1,830
J. SERVICES TOTAL	30,020	3,540	33,560			36,730	4,320	41,050
K. PROJECT MANAGEMENT								
(a) Project Implementation[6)]	1,800	850	2,650	30.4	49.4	2,400	1,270	3,670
(b) Operation Advisor[6)]	2,800	600	3,400	40.8	70.4	3,940	1,020	4,960
K. PROJECT MANAGEMENT TOTAL	4,600	1,450	6,050			6,340	2,290	8,630
L. PRE-OPERATIONAL EXPENSES[7)]	1,720	5,050	6,770	44.1	74.4	2,480	8,800	11,280
O. INITIAL WORKING CAPITAL						3,970	3,920	7,890
TOTAL PROJECT COST						200,350	99,270	299,620
P. INTEREST DURING CONSTRUCTION						13,380	0	13,380
TOTAL FINANCING REQUIRED						213,730	99,270	313,000

Notes: See ANNEX V/Tab. 1-1 for 1) to 7) in detail

EXPLANATORY NOTES TO ANNEX V/Tab. 1

1) LAND ACQUISITION

1. Plant	50	Ha
2. Harbor	50	Ha
3. Housing	70	Ha
4. Water Intake & Water Pipeline	16	Ha
Total	186	Ha

Unit price: Rp360/m^2

Total price: 1,860,000m^2 x Rp360/m^2 = Rp66,960,000
(US$1,610,000)

2) HARBOR AND BREAK WATER

Type of Harbor: Dredged inner harbor with break water

Standard capacity of vessel: 7,500 DWT to 10,000 DWT

Water depth: -10m

Loading pier: One complete for bulk urea loading

3) WATER INTAKE & WATER PIPELINE

Pipe: 24 inches Dia., coated steel pipe

Length of right of way: 25km

4) HOUSING COLONY

1. Houses for staff and non-staff

Class	Floor area (m^2)	nos.
A	300	2
B	220	17
C	160	63
D	120	103
E	85	115
	Total	300

2. Other facilities

a guest house, utility supply facilities and miscellaneous common facilities

5) INDIRECT FIELD EXPENSES

1. Temporary field buildings
2. Utilities supply facilities for temporary works
3. Construction supplies (fuel, lub-oil, etc.)
4. Field office expenses
5. Miscellaneous expenditures for the field works

6) SERVICES AND PROJECT MANAGEMENT

		(man-months)
1. General contractor's Expatriates (construction & start-up)	:	1,200
2. Vendor's servicemen	:	160
3. Local staff supervision	:	500
4. Project implementation	:	250
5. Operation advisor	:	400

Assumed unit price:

for expatriates; US$7,000/m-m including international air fare in foreign exchanges and US$1,500/m-m including out-of-pocket expenses in local currencies

for local staff; US$2,250/m-m including out-of-pocket expenses in local currencies

7) PRE-OPERATIONAL EXPENSES

1. Training costs and fees for permanent staff

2. Labor cost before commensement of commercial operation (6 months equivalent)

3. Losses during test operation
   Natural gas (cost of 2 months operation)
   Catalyst and chemicals (cost of 3 months operation)
   Spare parts (cost of 3 months operation)

4. Miscellaneous

CONTINGENCY SCHEDULE (PHYSICAL & PRICE)

ANNEX V
Tab. 2

Unit: %

	PHYSICAL CONTINGENCY		PRICE CONTINGENCY TO BEG.-1982			COMBINED CONTINGENCY	
	(Foreign)	(Local)	Months to Expend Date	(Foreign)	(Local)	(Foreign)	(Local)
A. LAND ACQUISITION	0	0	(0)	0	0	0	0
B. SITE PREPARATION							
(a) Plant Site	5	10	(15)	10.2	18	15.7	29.8
(b) Housing Colony	5	10	(18)	12.3	22	17.9	34.2
C. PLANT DIRECT COST							
(a) Plant Equipment & Materials							
- Ammonia Plant	7.5	-	(24)	16.6	-	25.3	-
- Urea Plant	7.5	-	(24)	16.6	-	25.3	-
- Utilities Facilities	7.5	-	(24)	16.6	-	25.3	-
- Offsite Facilities	7.5	-	(24)	16.6	-	25.3	-
(b) Catalyst & Spares							
- Initial Charge of Catalyst	7.5	-	(24)	16.6	-	25.3	-
- Spares (Parts, Catalyst & Chemicals)	7.5	-	(24)	16.6	-	25.3	-
D. (c) Civil Materials							
- Pavement, Foundations & Structures	7.5	7.5	(30)	21.3	39	30.4	49.4
- Battery Limit Buildings	7.5	7.5	(30)	21.3	39	30.4	49.4
- Urea Storage	7.5	7.5	(30)	21.3	39	30.4	49.4
- Auxiliary Buildings	7.5	7.5	(30)	21.3	39	30.4	49.4
(d) Direct Labour & Overhead	-	15	(36)	0	48.2	0	70.4
D. HARBOR & BREAK WATER	10	15	(20)	13.8	24.6	25.2	43.3
E. WATER INTAKE & WATER PIPELINE	10	15	(30)	21.3	39	33.4	59.9
F. HOUSING COLONY	5	10	(32)	22.3	42.1	28.4	56.3

ANNEX V
Tab. 2

CONTINGENCY SCHEDULE (PHYSICAL & PRICE)
(CONT'D.)

Unit: %

	PHYSICAL CONTINGENCY		PRICE CONTINGENCY TO BEG.-1982			COMBINED CONTINGENCY	
	(Foreign)	(Local)	Months to Expend Date	(Foreign)	(Local)	(Foreign)	(Local)
G. CONSTRUCTION EQUIPMENT	5	5	(15)	10.2	18	15.7	23.9
H. OCEAN FREIGHT, INSURANCE & LOCAL HAND'G	5	5	(22)	15.2	27.3	21	33.7
I. INDIRECT FIELD EXPENSES	10	15	(15)	10.2	18	21.2	35.7
J. SERVICES							
(a) General Contractor's Fixed Fee	5	5	(24)	16.6	-	22.4	-
(b) Bonus Provision	5	5	(24)	16.6	-	22.4	-
(c) General Contractor's Expatriates	5	5	(24)	16.6	16.6	22.4	22.4
(d) Vendor's Servicemen	5	5	(24)	16.6	16.6	22.4	22.4
(e) Local Staff Supervision	-	5	(24)	-	16.6	-	22.4
K. PROJECT MANAGEMENT							
(a) Project Implementation	7.5	7.5	(30)	21.3	39	30.4	49.4
(b) Operational & Marketing Advisor	7.5	7.5	(42)	31	58.5	40.8	70.4
L. PRE-OPERATIONAL EXPENSES	10	10	(42)	31	58.5	44.1	74.4

Remarks: Price Contingency (Escalation in compound rate)
Foreign exchange; 8% per annum
Local currency ; 14% per annum

WORKING CAPITAL CALCULATION (IN BEG.-1982 PRICES)

	(US$'000)
A. Material Inventories	
a) One spare set of catalysts	900
b) One year supply of chemicals	1,670
c) Bags for one month operation 1)	20
d) Two years supply of spare parts	5,250
B. Finished Goods Inventory	
- 1 month cash operating cost 2)	3,150
C. Accounts Receivable	
- 1.5 months cash operating cost 2)	4,740
D. Cash Balance	700
GROSS WORKING CAPITAL	16,430
E. Accounts Payable	
- 1 month natural gas consumption	720
NET WORKING CAPITAL	15,710
F. Working Capital Included Base Project Cost	
a) One spare set of catalysts	900
b) One year supply of chemicals	1,670
c) Two years supply of spare parts	5,250
INITIAL WORKING CAPITAL	7,890

Notes: 1) Bags cost for packing 4% of total urea production

2) Cash operating cost
= (Total production cost - Depreciation)

All "costs" and "month(s)" are based on the figures of initial year's operation (1982).

DISBURSEMENT AND INTEREST DURING CONSTRUCTION

(US$'000)

Total financing required:	313,000
Debt (70%)	219,100
Equity (30%)	93,900

Interest rate: 4% per year

Disbursement (assumed):

	(%)	(US$'000)
1979	30	65,730
1980	40	87,640
1981	30	65,730
		219,100

Interest during construction;

	At End of Year: (1st)	(2nd)	(3rd)
a. Already drawn	0	65,730	153,370
b. Previous year's interest	0	1,315	4,435
c. Opening debt (a + b)	0	67,045	157,805
d. Interest on opening debt (c x 4%)	0	2,682	6,312
e. Drawn during year	65,730	87,640	65,730
f. Interest on current drawings (e x 2%)	1,315	1,753	1,315
g. Total interest for year (d + f)	1,315	4,435	7,627

Interest during construction: 1,315 + 4,435 + 7,627 = 13,377
(13,380)

TENTATIVE LOAN REPAYMENT SCHEDULE

Total Debt: US$219.1 million
Interest Rate: 4% per annum
Grace Period: 4 years
Repayment: 11 year-equal-installment-repayment after the grace period

(US$'000)

Year	Principal	Interest	Total	Loan Balance after payment
1979	0	1,315	1,315	65,730
1980	0	4,435	4,435	153,370
1981	0	7,627	7,627	219,100
1982	0	8,764	8,764	219,100
1983	19,918	8,764	28,682	199,182
1984	19,919	7,967	27,886	179,264
1985	19,919	7,171	27,090	159,345
1986	19,918	6,374	26,292	139,427
1987	19,918	5,577	25,495	119,509
1988	19,918	4,780	24,698	99,591
1989	19,918	3,984	23,902	79,673
1990	19,918	3,187	23,105	59,755
1991	19,918	2,390	22,308	39,836
1992	19,918	1,593	21,511	19,918
1993	19,918	797	20,715	0
	219,100	74,725	293,825	

PART VI ANNEX

DEPRECIATION SCHEDULE IN BEG. – 1982 PRICES (in US$'000)

A. Non-Depreciable Assets

a) Land Aquisition	1,610
b) Site Preparation	3,210
c) Catalysts and Spares included in Plant Direct Cost	8,550
d) Initial Working Capital	7,890
	21,260

B. Depreciable Assets

12-Year Depreciation Assets

a) Plant Direct Cost	126,120
b) Construction Equipment	8,870
c) Ocean Freight Insurance & Local Handling	14,270
d) Indirect Field Expenses	3,990
e) Services	41,050
f) Project Management	8,630
g) Pre-operational Expenses	11,280
h) Interest during Construction	13,380
i) (Less) Catalysts & Spares in Plant Direct Cost	(8,550)
	219,040

30-Year Depreciation Assets

a) Harbor and Break Water	42,250
b) Water Intake and Water Pipeline	8,330
c) Housing Colony	22,120
	72,700

C. Annual Depreciation Charges (straight line method)

Annual Depreciation Charge

$$: \frac{219,040}{12} + \frac{72,700}{30} = 20,677$$

DIRECT LABOUR COST

ANNEX VI
Tab. 2

	Monthly 1/ Basic Salary (B/S) (Rp/mo.)	Salary 2/ Fringe Benefits (F/B) (Rp/mo.)	Labour 3/ Related Cost (Rp/mo.)	Direct Labour Cost (Rp/mo.)	Nos. of person	(1978) Total Direct Labour Cost (Rp'000/mo.)
General Manager/ Asst. Gen. Mngr.	300,000	150,000	225,000	675,000	2	1,350
Administrator/ Production Mngr.	250,000	125,000	187,500	562,500	2	1,125
Depertment Head	200,000	100,000	150,000	450,000	25	11,250
Section Head	105,000	52,500	78,750	236,250	47	11,104
Supervisor/Foreman	60,000	30,000	45,000	135,000	89	12,015
Operator/Clerk	30,000	15,000	22,500	67,500	378	25,515
Unskilled Labour	18,000	9,000	13,500	40,500	82	3,321
					625	65,680

- average monthly labour cost (Beg.-1978): Rp65,680,000/625men = Rp105,100/man-month
- average yearly labour cost in US$(1978): Rp105,100/m-m x 12 m/y ÷ Rp415/$ = US$3,040/man-year
- average yearly labour cost in US$(1982): $3,040/man-year x $(1.14)^4$ = $5,134/man-year
- Total direct labour cost in 1982: $5,134 x 625 = US$3,209,000/year

Notes: 1/ P.T. PUSRI's actual basic salary

2/ Allow 50% of B/S, Followings are P.T. PUSRI's system (at Palembang)

- Family Allowance:
  a) Wife: 5% of B/S
  b) Children: 2% of B/S per child, maximum 4 children
- Cost of Living Allowance: 25% of B/S
- Regional Allowance: 7.5% of B/S
- Food Allowance: Rp.2,000/month

3/ Allow 50% of (B/S + F/B), includes following costs

- Holiday/Long Service Leave Provision
- Holiday Expenses and Welfare
- Life Insurance, Workmen's Compensation Insurance
- Education & Training
- Severance pay, Retirement pay
- Bonus, Pension fund
- Meals and Drinks

PRODUCTION COST STATEMENTS
(BASE CASE): SALES PRICE US$160/T, INTEREST 4%

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
NATURAL GAS	8618.	9193.	10342.	10342.	10342.	10342.	10342.	10342.	10342.	10342.	10342.
CATALYSTS & CHEMICALS	1532.	1687.	1898.	1898.	1898.	1898.	1898.	1898.	1898.	1898.	1898.
BAG	209.	223.	251.	251.	251.	251.	251.	251.	251.	251.	251.
FUEL OIL	525.	560.	630.	630.	630.	630.	630.	630.	630.	630.	630.
UTILITIES AND SUPPLIES	2315.	2470.	2778.	2778.	2778.	2778.	2778.	2778.	2778.	2778.	2778.
VARIABLE COST	10934.	11663.	13120.	13120.	13120.	13120.	13120.	13120.	13120.	13120.	13120.
DEPRECIATION (PRE-OPE)	940.	940.	940.	940.	940.	940.	940.	940.	940.	940.	940.
DEPRECIATION (PLANT COST)	16193.	16198.	16198.	16198.	16198.	16198.	16198.	16198.	16198.	16198.	16198.
DEPRECIATION(HARBOR)	1408.	1408.	1408.	1408.	1408.	1408.	1408.	1408.	1408.	1408.	1408.
DEPRECIATION (WATER INTAKE)	279.	278.	278.	278.	278.	278.	278.	278.	278.	278.	278.
DEPRECIATION(HOUSING COLONY)	737.	737.	737.	737.	737.	737.	737.	737.	737.	737.	737.
DEPRECIATION(INT. D. CONST)	1115.	1115.	1115.	1115.	1115.	1115.	1115.	1115.	1115.	1115.	1115.
DEPRECIATION	20677.	20677.	20677.	20677.	20677.	20677.	20677.	20677.	20677.	20677.	20677.
AMORTIZATION	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
DEPRECIATION & AMORTIZATION	20677.	20677.	20677.	20677.	20677.	20677.	20677.	20677.	20677.	20677.	20677.
MAINTENANCE COST(PLANT COST)	4500.	4500.	4500.	4500.	4500.	4500.	4500.	4500.	4500.	4500.	4500.
MAINTENANCE COST(W. INTAKE)	42.	42.	42.	42.	42.	42.	42.	42.	42.	42.	42.
MAINTENANCE COST(HARBOR)	120.	120.	120.	120.	120.	120.	120.	120.	120.	120.	120.
MAINTENANCE (HOUSING)	221.	221.	221.	221.	221.	221.	221.	221.	221.	221.	221.
MAINTENANCE COST	4863.	4883.	4883.	4883.	4883.	4883.	4883.	4883.	4883.	4883.	4883.
LABOUR COST	3209.	3209.	3209.	3209.	3209.	3209.	3209.	3209.	3209.	3209.	3209.
OVERHEAD	4814.	4814.	4814.	4814.	4814.	4814.	4814.	4814.	4814.	4814.	4814.
TAX & INSURANCE	1186.	1104.	1021.	938.	855.	773.	690.	607.	525.	442.	359.
OTHER FIXED COST	14092.	14009.	13926.	13843.	13761.	13678.	13595.	13513.	13430.	13347.	13265.
EX-FACTORY PRODUCTION COST	45702.	46348.	47723.	47641.	47558.	47475.	47393.	47310.	47227.	47144.	47062.
UNIT DIRECT OPERATING COST	0.1069	0.1016	0.0930	0.0929	0.0927	0.0925	0.0924	0.0922	0.0921	0.0919	0.0917
SALES EXPENSES	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
INTEREST ON LONG TERM DEBT	8764.	8764.	7967.	7171.	6374.	5577.	4780.	3984.	3187.	2390.	1593.
INTEREST ON SHORT TERM DEBT	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL PRODUCTION COST	54466.	55112.	55691.	54811.	53932.	53052.	52173.	51293.	50414.	49535.	48655.
UNIT PRODUCTION COST	0.1274	0.1209	0.1086	0.1068	0.1051	0.1034	0.1017	0.1000	0.0983	0.0966	0.0948

PRODUCTION COST STATEMENTS
(BASE CASE): SALES PRICE US$160/T, INTEREST 4%
(CONT'D.)

	1993
NATURAL GAS	10342.
CATALYST& CHEMICALS	1098.
BAG	251.
FUEL OIL	630.
UTILITIES AND SUPPLIES	2778.
VARIABLE COST	13120.
DEPRECIATION (PRE-OPE)	940.
DEPRECIATION (PLANT COST)	16198.
DEPRECIATION(HARBOR)	1408.
DEPRECIATION (WATER INTAKE)	278.
DEPRECIATION(HOUSING COLONY)	737.
DEPRECIATION(INT. D. CONST)	1115.
DEPRECIATION	20677.
AMORTIZATION	0.
DEPRECIATION & AMORTIZATION	20677.
MAINTENANCE COST(PLANT COST)	4500.
MAINTENANCE COST(W. INTAKE)	42.
MAINTENANCE COST(HARBOR)	120.
MAINTENANCE (HOUSING)	221.
MAINTENANCE COST	4883.
LABOUR COST	3209.
OVERHEAD	4814.
TAX & INSURANCE	276.
OTHER FIXED COST	13182.
EX-FACTORY PRODUCTION COST	46979.
UNIT DIRECT OPERATING COST	0.0916
SALES EXPENSES	0.
INTEREST ON LONG TERM DEBT	797.
INTEREST ON SHORT TERM DEBT	0.
TOTAL PRODUCTION COST	47776.
UNIT PRODUCTION COST	0.0931

INCOME STATEMENTS (FOR YEARS ENDING DECEMBER 31) (BASE CASE): SALES PRICE US$160/T, INTEREST 4%

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
VOLUME OF PRODUCTION AND SALES											
PRODUCTION	427500.	456000.	513000.	513000.	513000.	513000.	513000.	513000.	513000.	513000.	513000.
INCREASE IN INVENTORIES	35625.	2375.	4750.	0.	0.	0.	0.	0.	0.	0.	0.
SALES VOLUME	391875.	453625.	508250.	513000.	513000.	513000.	513000.	513000.	513000.	513000.	513000.
SALES REVENUE	62700.	72580.	81320.	82080.	82080.	82080.	82080.	82080.	82080.	82080.	82080.
COST OF SALES	41893.	46107.	47281.	47641.	47558.	47475.	47393.	47310.	47227.	47144.	47062.
VARIABLE COST	10934.	11063.	13120.	13120.	13120.	13120.	13120.	13120.	13120.	13120.	13120.
DEPRECIATION & AMORTIZATION	20677.	20677.	20677.	20677.	20677.	20677.	20677.	20677.	20677.	20677.	20677.
OTHER FIXED COST	14092.	14009.	13926.	13843.	13761.	13678.	13595.	13513.	13430.	13347.	13265.
(INC) IN PRODUCT INVENTORIES	-3308.	-241.	-442.	0.	0.	0.	0.	0.	0.	0.	0.
GROSS PROFIT OR (LOSS) ON SALES	20807.	26473.	34039.	34439.	34522.	34605.	34687.	34770.	34853.	34936.	35018.
LESS. SALES EXPENSES	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
OPERATING PROFIT OR (LOSS)	20807.	26473.	34039.	34439.	34522.	34605.	34687.	34770.	34853.	34936.	35018.
LESS. INTEREST											
ON LONG TERM DEBT	8764.	9764.	7967.	7171.	6374.	5577.	4780.	3984.	3187.	2390.	1593.
ON SHORT TERM DEBT	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NET PROFIT OR (LOSS) BEFORE TAX	12043.	17709.	26071.	27269.	28148.	29028.	29907.	30787.	31666.	32545.	33425.
LESS. INCOME TAX	0.	0.	0.	0.	0.	13062.	13458.	13854.	14250.	14645.	15041.
NET PROFIT OR (LOSS) AFTER TAX	12043.	17709.	26071.	27269.	28148.	15965.	16449.	16933.	17416.	17900.	18384.

INCOME STATEMENTS (FOR YEARS ENDING DECEMBER 31) (BASE CASE): SALES PRICE US$160/T, INTEREST 4% (CONT'D.)

	1993
VOLUME OF PRODUCTION AND SALES	
PRODUCTION	513000.
INCREASE IN INVENTORIES	0.
SALES VOLUME	513000.
SALES REVENUE	82080.
COST OF SALES	46979.
VARIABLE COST	13120.
DEPRECIATION & AMORTIZATION	20677.
OTHER FIXED COST	13182.
(INC) IN PRODUCT INVENTORIES	0.
GROSS PROFIT OR (LOSS) ON SALES	35101.
LESS. SALES EXPENSES	0.
OPERATING PROFIT OR (LOSS)	35101.
LESS. INTEREST	
ON LONG TERM DEBT	797.
ON SHORT TERM DEBT	0.
NET PROFIT OR (LOSS) BEFORE TAX	34304.
LESS. INCOME TAX	15437.
NET PROFIT OR (LOSS) AFTER TAX	18867.

CASH FLOW STATEMENTS (FOR YEARS ENDING DECEMBER 31)
(BASE CASE): SALES PRICE US$160/T, INTEREST 4%

ANNEX VI
Tab. 5

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
SOURCES OF CASH	93900.	125200.	93900.	42201.	47198.	54811.	55116.	55199.	55281.	55364.	55447.
CASH GENERATED FROM OPERATION	0.	0.	0.	41483.	47150.	54715.	55116.	55199.	55281.	55364.	55447.
PROFIT BEFORE TAX, INTEREST	0.	0.	0.	20807.	26473.	34039.	34439.	34522.	34605.	34687.	34770.
DEPRECIATION & AMORTIZATION	0.	0.	0.	20677.	20677.	20677.	20677.	20677.	20677.	20677.	20677.
FINANCIAL RESOURCES	93900.	125200.	93900.	0.	0.	0.	0.	0.	0.	0.	0.
SHARE CAPITAL	28170.	37560.	28170.	0.	0.	0.	0.	0.	0.	0.	0.
LONG TERM DEBT	65730.	87640.	65730.	0.	0.	0.	0.	0.	0.	0.	0.
SHORT TERM DEBT	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
INCREASE IN ACCT PAYABLE	0.	0.	0.	718.	48.	96.	0.	0.	0.	0.	0.
USES OF CASH	88847.	114667.	109393.	20411.	30161.	29420.	27184.	26292.	25495.	37761.	37360.
INVESTMENT IN FIXED ASSET	88847.	114667.	101596.	0.	0.	0.	0.	0.	0.	0.	0.
LAND AND SITE IMPROVEMENT	4320.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
CONSTRUCTED FACILITIES	82689.	110252.	82689.	0.	0.	0.	0.	0.	0.	0.	0.
PRE-INVEST. & START-UP EXP	0.	0.	11280.	0.	0.	0.	0.	0.	0.	0.	0.
INTEREST DURING CONSTRUCTN	1838.	4415.	7627.	0.	0.	0.	0.	0.	0.	0.	0.
INCREASE IN CURRENT ASSET OTHER THAN CASH	0.	0.	7797.	11647.	1479.	1534.	95.	0.	0.	0.	0.
INCR(DECR) ACCT RECEIVABLE	0.	0.	0.	7838.	1235.	1092.	95.	0.	0.	0.	0.
INCR(DECR) IN INVENTORIES											
PRODUCTS	0.	0.	0.	3808.	241.	442.	-0.	0.	0.	0.	0.
MATERIALS	0.	0.	7797.	1.	2.	0.	0.	0.	0.	0.	0.
DEBT SERVICES	0.	0.	0.	8764.	28682.	27885.	27089.	26292.	25495.	24699.	23902.
REPAYMENT OF LONG TERM DEBT	0.	0.	0.	0.	19918.	19918.	19918.	19918.	19918.	19918.	19918.
REPAYMNT OF SHORT TERM DEBT	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
INTEREST ON LONG TERM DEBT	0.	0.	0.	8764.	8764.	7967.	7171.	6374.	5577.	4780.	3984.
INTEREST ON SHORT TERM DEBT	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
INCOME TAX PAYMENT	0.	0.	0.	0.	0.	0.	0.	0.	0.	13062.	13458.
DIVIDENDS PAYMENT	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
CASH INCREASE OR (DECREASE)	5053.	10533.	-15493.	21790.	17037.	25391.	27932.	28907.	29786.	17603.	18087.
BEGINNING CASH BALANCE	0.	5053.	15586.	93.	21883.	38920.	64311.	92243.	121150.	150936.	168539.
ENDING CASH BALANCE	5053.	15586.	93.	21883.	38920.	64311.	92243.	121150.	150936.	168539.	186626.

CASH FLOW STATEMENTS (FOR YEARS ENDING DECEMBER 31) (BASE CASE): SALES PRICE US$160/T, INTEREST 4% (CONT'D.)

	1990	1991	1992	1993
SOURCES OF CASH	55530.	55612.	55695.	55778.
CASH GENERATED FROM OPERATION	55530.	55612.	55695.	55778.
PROFIT BEFORE TAX, INTEREST	34853.	34936.	35018.	35101.
DEPRECIATION & AMORTIZATION	20677.	20677.	20677.	20677.
FINANCIAL RESOURCES	0.	0.	0.	0.
SHARE CAPITAL	0.	0.	0.	0.
LONG TERM DEBT	0.	0.	0.	0.
SHORT TERM DEBT	0.	0.	0.	0.
INCREASE IN ACCT PAYABLE	0.	0.	0.	0.
USES OF CASH	36959.	36558.	36157.	35756.
INVESTMENT IN FIXED ASSET	0.	0.	0.	0.
LAND AND SITE IMPROVEMENT	0.	0.	0.	0.
CONSTRUCTED FACILITIES	0.	0.	0.	0.
PRE-INVEST. & START-UP EXP	0.	0.	0.	0.
INTEREST DURING CONSTRUCTN	0.	0.	0.	0.
INCREASE IN CURRENT ASSET OTHER THAN CASH	0.	0.	0.	0.
INCR(DECR) ACC T RECEIVABLE	0.	0.	0.	0.
INCR(DECR) IN INVENTORIES				
PRODUCTS	0.	0.	0.	0.
MATERIALS	0.	0.	0.	0.
DEBT SERVICES	23105.	22308.	21512.	20715.
REPAYMENT OF LONG TERM DEBT	19918.	19918.	19918.	19918.
REPAYMNT OF SHORT TERM DEBT	0.	0.	0.	0.
INTEREST ON LONG TERM DEBT	3187.	2390.	1593.	797.
INTEREST ON SHORT TERM DEBT	0.	0.	0.	0.
INCOME TAX PAYMENT	13854.	14250.	14645.	15041.
DIVIDENDS PAYMENT	0.	0.	0.	0.
CASH INCREASE OR (DECREASE)	18571.	19054.	19538.	20022.
BEGINNING CASH BALANCE	186626.	205197.	224251.	243789.
ENDING CASH BALANCE	205197.	224251.	243789.	263810.

BALANCE SHEET (FOR YEARS ENDING DECEMBER 31)
(BASE CASE): SALES PRICE US$160/T, INTEREST 4%

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
ASSETS	93900.	219100.	213000.	325761.	323600.	329848.	337199.	345429.	354539.	351465.	348875.
CURRENT ASSETS	5053.	15586.	7890.	41327.	59843.	86768.	114796.	143702.	173489.	191092.	209179.
CASH	5053.	15586.	93.	21383.	38920.	64311.	92243.	121150.	150936.	163539.	186626.
ACCOUNTS RECEIVABLE	0.	0.	0.	7838.	9072.	10165.	10260.	10260.	10260.	10260.	10260.
INVENTORIES											
PRODUCTS	0.	0.	0.	3808.	4050.	4492.	4492.	4492.	4492.	4492.	4492.
MATERIALS	0.	0.	7797.	7799.	7601.	7601.	7801.	7801.	7801.	7801.	7801.
NET FIXED ASSETS	88847.	203514.	305110.	284433.	263757.	243080.	222403.	201727.	181050.	160373.	139697.
INVESTMENT	88847.	203514.	305110.	305110.	305110.	305110.	305110.	305110.	305110.	305110.	305110.
LAND & SITE IMPROVEMENT	4820.	4820.	4820.	4820.	4820.	4820.	4820.	4820.	4820.	4820.	4820.
CONSTRUCTED FACILITIES	82689.	192941.	275630.	275630.	275630.	275630.	275630.	275630.	275630.	275630.	275630.
PRE-INVEST. & START-UP EXP	0.	0.	11280.	11280.	11280.	11280.	11280.	11280.	11280.	11280.	11280.
INTEREST DURING CONSTRUCTN	1338.	5753.	13380.	13380.	13380.	13380.	13380.	13380.	13380.	13380.	13380.
LESS.DEPRECIATN & AMORTIZTN	0.	0.	0.	20677.	41353.	62030.	82707.	103383.	124060.	144737.	165413.
LIABILITIES	65730.	153370.	219100.	219818.	199946.	180125.	160207.	140289.	133433.	113911.	94389.
CURRENT LIABILITIES	0.	0.	0.	20636.	20684.	20780.	20780.	20780.	33842.	34238.	34634.
ACCOUNTS PAYABLE	0.	0.	0.	718.	766.	862.	862.	862.	862.	862.	862.
INCOME TAX PAYABLE	0.	0.	0.	0.	0.	0.	0.	0.	13062.	13458.	13854.
DIVIDENDS PAYABLE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
CURRENT PORTION OF DEBT											
LONG TERM DEBT	0.	0.	0.	19918.	19918.	19918.	19918.	19918.	19918.	19918.	19918.
SHORT TERM DEBT	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
FIXED LIABILITIES	65730.	153370.	219100.	199182.	179264.	159345.	139427.	119509.	99591.	79673.	59755.
LONG TERM DEBT BALANCE	65730.	153370.	219100.	199182.	179264.	159345.	139427.	119509.	99591.	79673.	59755.
STOCK HOLDERS EQUITY	28170.	65730.	93900.	105942.	123652.	149723.	176992.	205140.	221105.	237554.	254487.
SHARE CAPITAL	28170.	65730.	93900.	93900.	93900.	93900.	93900.	93900.	93900.	93900.	93900.
RETAINED EARNINGS	0.	0.	0.	12043.	29752.	55823.	83092.	111240.	127205.	143654.	160587.

BALANCE SHEET (FOR YEARS ENDING DECEMBER 31) (BASE CASE): SALES PRICE US$160/T, INTEREST 4% (CONT'D.)

	1990	1991	1992	1993
ASSETS	346769.	345147.	344008.	343353.
CURRENT ASSETS	227749.	246803.	266341.	286363.
CASH	205197.	224251.	243789.	263810.
ACCOUNTS RECEIVABLE	10260.	10260.	10260.	10260.
INVENTORIES				
PRODUCTS	4492.	4492.	4492.	4492.
MATERIALS	7801.	7801.	7801.	7801.
NET FIXED ASSETS	119020.	98343.	77667.	56990.
INVESTMENT	305110.	305110.	305110.	305110.
LAND & SITE IMPROVEMENT	4820.	4820.	4820.	4820.
CONSTRUCTED FACILITIES	275630.	275630.	275630.	275630.
PRE-INVEST. & START-UP EXP	11280.	11280.	11280.	11280.
INTEREST DURING CONSTRUCTN	13380.	13380.	13380.	13380.
LESS.DEPRECIATN & AMORTIZTN	186090.	206767.	227443.	248120.
LIABILITIES	74866.	55344.	35821.	16299.
CURRENT LIABILITIES	35030.	35425.	35821.	16299.
ACCOUNTS PAYABLE	862.	862.	862.	862.
INCOME TAX PAYABLE	14250.	14645.	15041.	15437.
DIVIDENDS PAYABLE	0.	0.	0.	0.
CURRENT PORTION OF DEBT				
LONG TERM DEBT	19918.	19918.	19918.	0.
SHORT TERM DEBT	0.	0.	0.	0.
FIXED LIABILITIES	39836.	19918.	0.	0.
LONG TERM DEBT BALANCE	39836.	19918.	0.	0.
STOCK HOLDERS EQUITY	271903.	289803.	308187.	327054.
SHARE CAPITAL	93900.	93900.	93900.	93900.
RETAINED ERNINGS	178003.	195903.	214287.	233154.

PROFITABILITY AND FINANCIAL INDICATORS
(BASE CASE): SALES PRICE US$160/T, INTEREST 4%

YEAR	(1) AFT TAX PROFIT -TO- SALES REV (PCT)	(2) AFT TAX PROFIT -TO- S/H EQUITY (PCT)	(3) BFR TAX PROFIT -TO- INVESTMNT (PCT)	(4) BFR TAX PROFIT -TO- S/CAPITAL (PCT)	(5) CURRENT RATIO	(6) QUICK RATIO	(7) DEBT SERVICE RATIO	(8) L/T DEBT -TO- S/H EQUITY	(9) BREAK EVEN POINT (PCT)	FIXED COST	VARIABLE COST
1962	19.2	11.4	3.8	12.8	2.00	1.44	4.73	65./ 35.	56.8	43532.	10934.
1983	24.4	14.3	5.7	18.9	2.89	2.32	1.64	59./ 41.	56.7	43450.	11663.
1984	32.1	17.4	8.3	27.8	4.18	3.59	1.96	52./ 48.	55.6	42570.	13120.
1985	33.2	15.4	8.7	29.0	5.52	4.93	2.03	44./ 56.	54.4	41691.	13120.
1986	34.3	13.7	9.0	30.0	6.92	6.32	2.10	37./ 63.	53.3	40811.	13120.
1987	19.5	7.2	9.3	30.9	5.13	4.76	1.66	31./ 69.	52.1	39932.	13120.
1988	20.0	6.9	9.6	31.9	5.58	5.22	1.70	25./ 75.	51.0	39052.	13120.
1989	20.6	6.7	9.8	32.8	6.04	5.68	1.74	19./ 81.	49.8	38173.	13120.
1990	21.2	6.4	10.1	33.7	6.50	6.15	1.79	13./ 87.	48.7	37294.	13120.
1991	21.8	6.2	10.4	34.7	6.97	6.62	1.84	6./ 94.	47.5	36414.	13120.
1992	22.4	6.0	10.7	35.6	7.44	7.09	1.89	0./100.	46.4	35535.	13120.
1993	23.0	5.8	11.0	36.5	17.57	16.82	1.95	0./100.	45.2	34655.	13120.
AVERAGE	24.3	9.8	8.9	29.5	6.39	5.91	2.09	29./ 71.	51.5	39426.	12817.

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