D : Full draft of object ships(m)

The maximum draft in the long term plan is -13.4 m except further large vessel. Thus the required maximum depth should be,

1.1 x 13.4 = 14.7 m

However, the maximum water depth is limited upto -14.0 m considering both economy and possible lightering berthing.

8.14.2 Width of Channels

The width of operational basin for docking/undocking and the channel which leads to the interior of the port should be decided taking the use of tug boats into account. The width in this port is more than 3 x L (L: Object ship length). This is sufficient for a vessel to turn by herself.

Though, the area of a basin for turning of the bow of ship with tug boats should exceed an area of circle with the radius of 1.5 times the overall length of the ship, another ship can enter or leave the port simultaneously.

Taking above discussion into account, width of inner channels is planned as follows.

Dorag Channel,	Entrance,	Plan-1 and Plan-3,	800 m
Dorag Channel,	Entrance,	Plan-2	550 m
Dorag Channel,	Middle,	Plan-2 and Plan-3,	550 m
Zangi Channel,		Plan-2	500 m

This width shall be kept at bottom the channel. Considering both the soil condition and current intensity, the slope after dredging should be ensured.

- Slope in dredging 1:5

8.15 Maintenance of Channel and Basin

As discussed previously, the existing two channels which consist of main approach waterways and basins to the port are generally well maintained by the natural force of flooding current. However there are several locations where sedimentation is observed. Dredged basins digged deep into the flat land like the existing Barge Harbor and Grain Terminal have generally large siltation since the current force is so light that fine material is caught up on the seabed.

This section deals with the possible siltation in the future in relation between the configuration of channel and basin and possible amount of sediments around the wharf and basin.

This section also deals with the basic characteristics of existing channels and their

relationship to physical layout of port plan. The existing port area consists of an island which is surrounded by three channels namely, Zangi, Dorag and Musa. Thus it is essential to identify the changes of these channels in the past by both natural effects and artificial actions.

8.15.1 Purpose of Study

Before preparing a physical layout, hydraulic studies are required to assess the stability of the existing morphological regime and prevailing sediment transport patterns. Subsequently, the effects of a disturbance of the existing situation have to be investigated, e.g., the local accretion or scour of the coast shifting of stream channels, changes in current patterns due to the construction of waterfront facility or dredged channels and a quantitative estimate made of the maintenance dredging required in the port and its approaches.

The investigations may consist of calculations, mathematical models or physical models, sometimes with movable bed. The latter type models, though rather expensive and time consuming, may be necessary depending on the problem in hand. Even with extensive investigation, precise predictions of sediment movement cannot be expected but it is important to ascertain the dominant effects to allow effective corrective measures to be decided upon.

Thus, preliminary discussion will be conducted hereinafter using outline view on the channels based on the currently available data.

8.15.2 Basic Parameter of Channels

In the beginning of 1970s, hydraulic study including siltation aspects were conducted by CESCO. These data gave various useful information to the consultants, namely ADIBI - Harris and Iran - Kanpsa in preparation the previous master plan and port study.

It is reported that the salt content of channel water is about 4.5% which is higher figure by 50 % comparing to those of ordinary seawater. This may be contribute to high temperature of site and no fresh water discharge to them.

Two channels located north-western of the port area get together into the main one, Dorag Channel which leads water discharging the open sea of the northern part of Persian Gulf after 65 km long traveling from the port.

Since a long approaching waterway to the port, a tidal range in the spring reaches about 5 m which is 2.5 m larger than at the channel entrance, Sand Bar. This large tidal change consequently generates maximum current speed of which is generally about 1.6 knots, or 0.8 m/ sec.

Twice a day each flood current and ebb current wash the channel beds and form the existing morphological regime which is relatively stabilized. Basic physical parameter

of them can be summarized as follows:

a. All channels are salt water basins like a lagoon without freshwater discharging affecting the salt content.
b. Salt content is about 4.5 %.
c. Ordinary current velocity is less than one knot, however the maximum speed may reach upto 3.5 knots, or 1.8 m/sec.
d. Existing port area faces three channels, Zangi in the North, Dorag in the West and the mother channel Musa in the South. Average size of them surrounding the port area in the mean water are shown below.

Zangi Channel:	Average 600 m wide and 7.9 m depth
Dorag Channel:	Average 500 m wide and 17.3 m depth
Musa Channel:	Average 1,000 m wide and 20 m depth

e. At each junction point, there is a deeper water zone in about 5 to 10 ha with a double triple of the average.
f. The main stream zigzags in the lane. Where the stream hits the coastal edge, there is a scoured sharp wall with four meter horizontal travel to one meter rise. While the opposite site has a flat bed with soft sediment and accretion, though it is minor.
g. Total catchment areas of the Dorag and Zangi are about 100 km^2 and 40 km^2 respectively before their junction point. Water surface area during the mean water is about 10 km^2 for each. Channel area of Dorag after the junction to Musa Channel is about 3 km^2.

It is reported that changes of Dorag's water depth is so minor that they can provide vessels with good approach to the port. It is also reported that the existing Barge Harbor has a heavy siltation, four meters for the past 20 years.

Note: Dredging record of these areas in the past is not known, however it is assumed that dredging volume in the past is minor.

8.15.3 General Arrangement of Channel and Basin

Proposed general layout of channel and basin are given in Chapter 6 and Chapter 7. The proposed characteristics of them are summarized as below.

Zangi Channel after the south bank development

Midway	500 m wide, DL-13.0-DL-14.0 m

Dorag Channel after the west bank development

Entrance	800 m wide, DL-12.5 DL-14.0 m
Midway	550 m wide, DL-11.0 DL-13.0 m

East Musa Channel (East of existing Berth No. 11)
DL-11.0 DL-14.0 m

Barge Harbor Basin DL-4.0 m

Grain Terminal West Basin 105 m wide, DL-13.0 m

8.15.4 Siltation Volume

Maintenance dredging at Imam Khomeini port will be categorized into two types, namely, the original maintenance purpose and the advance maintenance purpose. The former is for the required works to maintain the full depth of water of the existing shallow water due to negligence of ordinary maintenance dredging by PSO. The latter will be required for maintaining the depth after initial dredging.

(1) Original Maintenance Dredging

According to the hydrographic survey by the Study Team, it was found that the existing water depth generally does not meet the original design depth. This siltation appears all the basin, in particular, at the container terminal, the grain terminal and the barge harbor.

The required depth of water is the design depth of existing waterfront facilities.

Note: It is assumed that the design depth of wharf between Berth No. 11 to 15 is DL-12.5 m instead of DL-11.0 m at present. It is also assumed that all the remaining wharf upstream of Berth No. 17 upto Berth No. 34 are DL-11.0 m instead of DL-10.0 under current use.

Fig. 8.15.4.1 indicates the area defined as the original maintenance dredging showing an example at the existing container wharf, Berth No. 13.

Note: Section No. D7 is the number of channel cross sections which were prepared each 100 m along the related channel. Drawing PM02. Used datum is so called "CESCO Datum" which is 2.60 m below the mean sea level, MSL.

As shown in the figure, the original seabed level in front of faceline before the construction of the berth was about DL+1.0 m. It is assumed that this seabed was dredged once to the design depth DL-12.5 m, around 1975. This previous dredged line raises up to DL+10.0 m by siltation since the center of stream leaves about 400 m off the faceline. The route of existing main current seems the same one as before the berth construction.

This original maintenance dredging should be conducted as soon as possible thus should be included in the Short Term Plan.

This dredging volume was roughly calculated and summarized as follows.

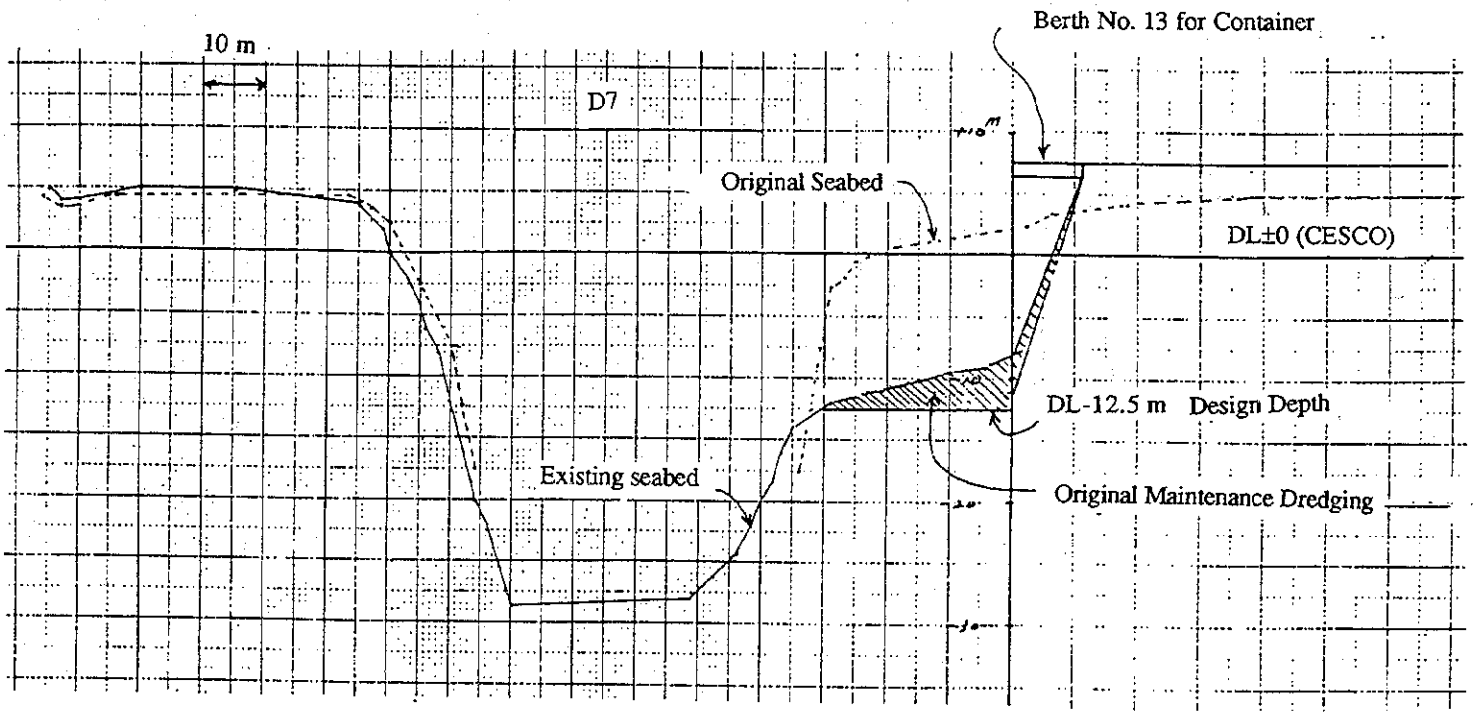


Figure 8.15.4.1 Original Maintenance Dredging

Dorag Channel	1,574,800 m^3
East Musa Channel	1,378,000 m^3
Total	2,952,800 m^3

Since the total dredging area is about 2,000,000 m^2, the required dredging per square meter is 1.5 m.

(2) Advance Maintenance Dredging

This is an ordinary maintenance dredging to be required for maintaining the design depth after the original dredging. Estimation of the required maintenance dredging is generally carried out by various methods as follows.

a. computer simulation based on, size of material, current and seabed configuration
b. estimation based on the past maintenance dredging records
c. macro study based on the change of seabed configuration

It is assumed that an ordinary computer simulation can not be applied since the simulation was developed for the coastal area but river like the project. The past dredging records are not available. Thus, the macro study method was adapted using a siltation rate (R) which is a rate of seabed recovery by sedimentation after the dredging.

Siltation rate by each section was calculated. Refer to Appendix III-5.1.

$R = S/D \times 100\ \%$

Where, S: Siltation Height (m)
D:Original Dredging Height (m)
Refer to Fig. 8.15.4.2

It is assumed that the seabed of dredged channel generally tends to recover up to the level of original seabed. Summary of analysis is shown in Fig. 8.15.3. Total period of recovery to the present level is assumed as 20 years between 1975 and 1994. It is assumed that past dredging efforts conducted by PSO seems just minor effect to prevent the basin from the sedimentation.

The figure shows three lines, namely East Musa line, Zangi line and Dorag line. East Musa and Dorag lines are based on the analysis, however, Zangi line is an average of two lines. East Musa Channel has the largest siltation rate which is about 60 % recovery in the past 20 years. This might be due to high siltation into the closed basin like a barge harbor and grain terminal. However, those of Dorag Channel is only 15 % recovery in the same period. According to the study, Zangi Channel's change in the past 20 years is about 1.2 m siltation.

Based on these data, advance maintenance dredging for each channel is calculated.

Conditions for Advance Maintenance Dredging Estimates

a. Annual dredging volume of one-third of those required every three year dredging.
b. 50 % concentration is added to the first three years.

Dorag Channel	450,000 m^3/y
East Musa Channel,	
Alternative - 1	200,000 m^3/y
Alternative - 3	200,000 m^3/y
West Musa Channel	100,000 m^3/y
Zangi Channel	
Alternative - 2	350,000 m^3/y

Detailed data is also given in Appendix 2B6.

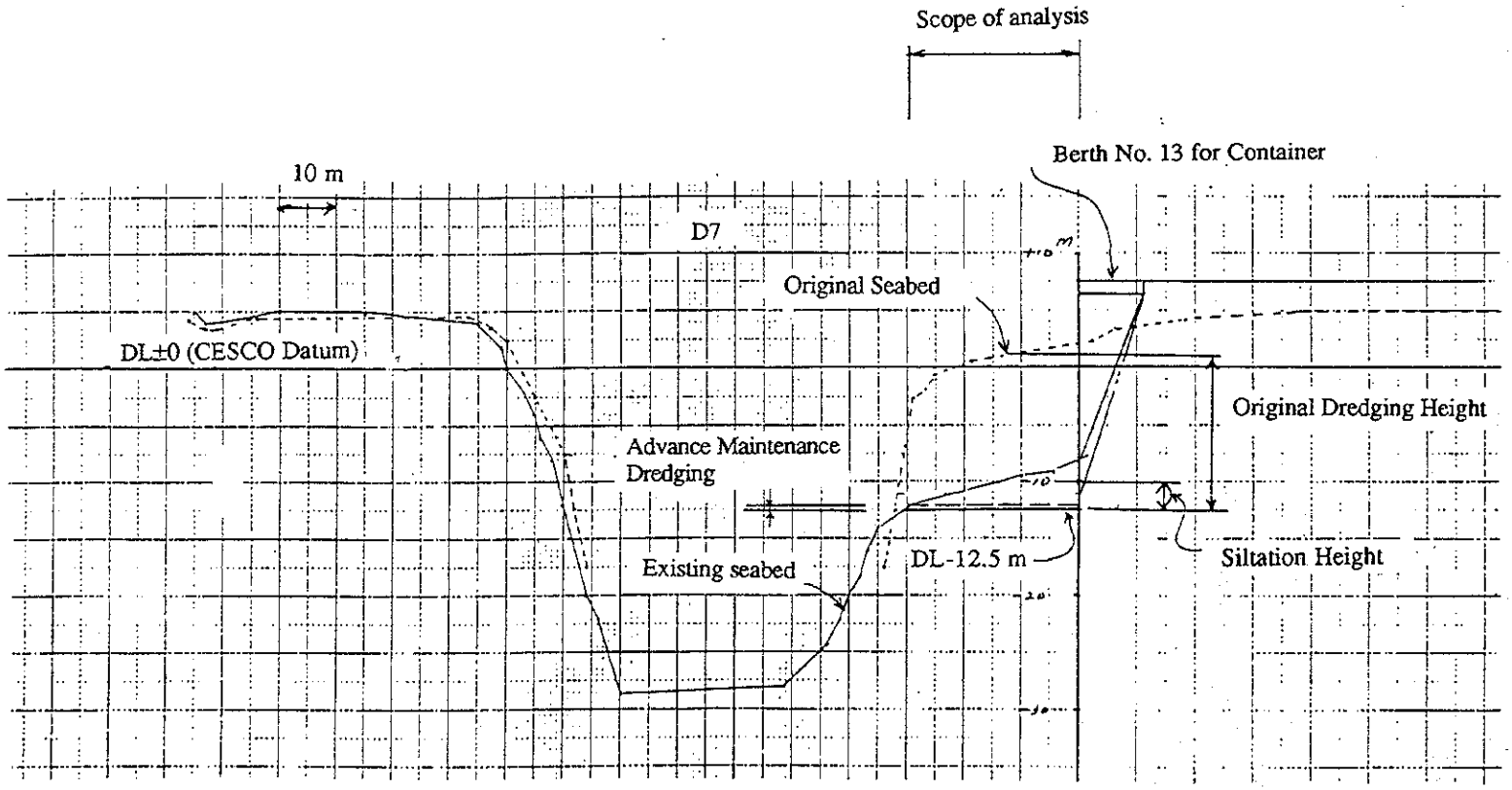


Fig. 8.15.4.2 **Advance Maintenance Dredging**

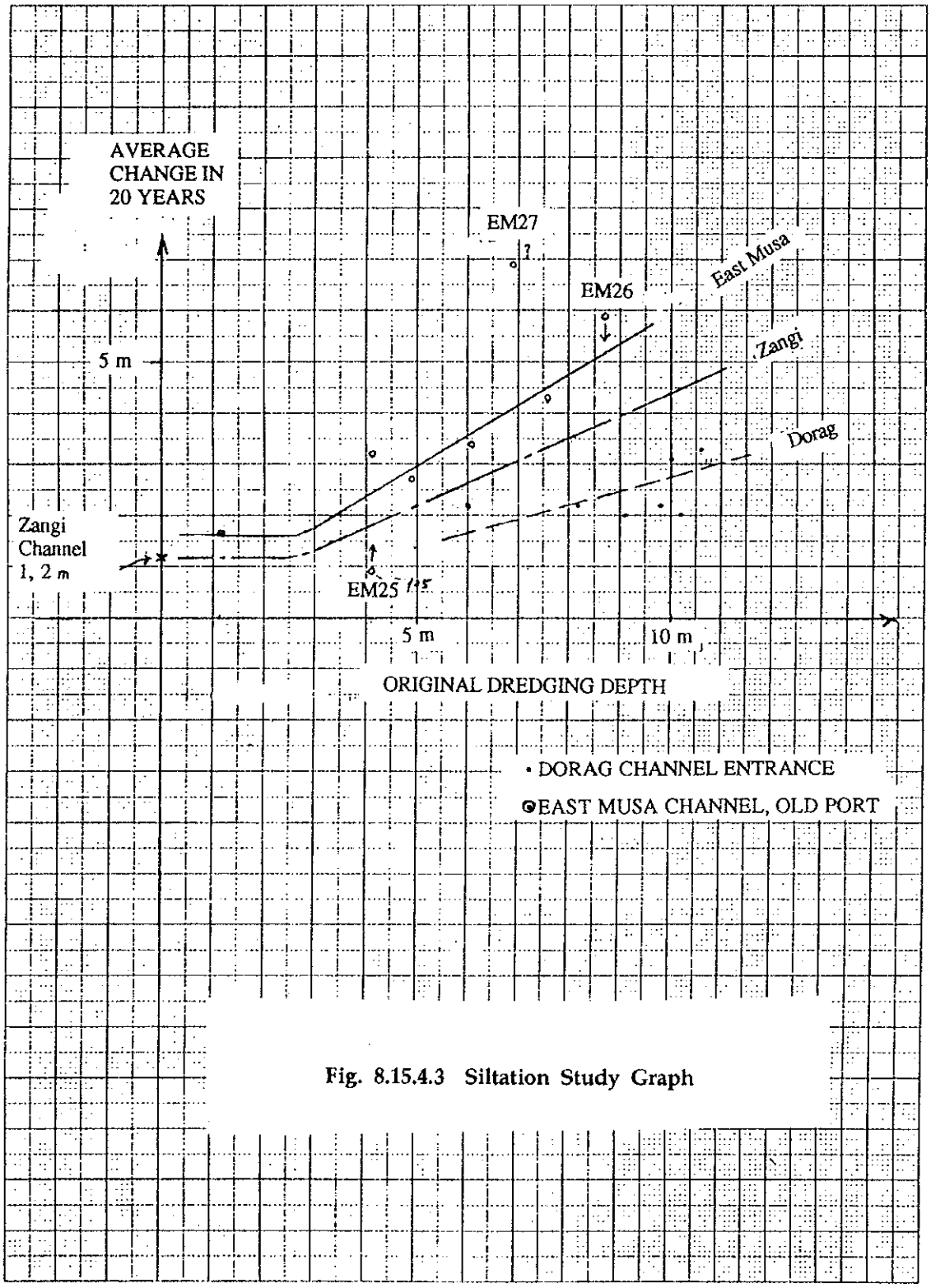


Fig. 8.15.4.3 Siltation Study Graph

Chapter 9

Preliminary Design of Cargo Handling Equipment

Chapter 9 Preliminary Design of Cargo Handling Equipment

9.1 Basic Strategy of Preliminary Design of Cargo Handling Equipment

a. All cranes to be installed at the exclusive berth will be of a rail-mounted type.
b. All cranes, except portal jib crane, to be installed at the general cargo berth will be of a tire-mounted type and they can be used at any berth.
c. Bulk grain it the general cargo berths will not be handled basically by grab buckets but to prevent the port area from air pollution.
d. Cargoes, except bulk, of large ships at the general cargo berth where jib cranes are not installed will be handled by ship gears.
e. Four (4) sets of handling equipment per ship should be required for large ship.
g. Prevention of air pollution should be considered for all equipment handling bulk cargoes.
h. All rail-mounted equipment for handling cargoes do not have spare equipment and they are repaired during their rest time.
i. Tire-mounted equipment for handling cargoes should have basically 10 % spare equipment for preventive maintenance and collective maintenance.
j. Cargoes from/to ships larger than 50,000 dwt will be handled by ship gears, cargoes from/to ships smaller than 20,000 dwt will be handled by mobile cranes and cargoes from/to ships of 30,000 dwt will be handled by both or either of ship gears and/or mobile cranes.
k. For Cargo handling from/to ships at the berth equipped with jib cranes, cargoes will be handled by jib cranes.
l. For Cargo (Metallic) handling at the apron, yard and the shed, 80 % of cargoes will be stored provisionally at the transit shed or the open yard.
Half of cargoes to be stored will be handled by fork-lift trucks with a unit-load system and the rest will be handled by mobile cranes and chassis.
m. For Cargo (except metallic) handling at the apron, yard and the shed, 80% of cargoes will be stored provisionally at the transit shed or the open yard.
Three quarter of cargoes to be stored will be handled by fork-lift trucks with a unit-load system and the rest will be handled by mobile cranes and chassis.
n. Required capacity of the mobile cranes will be as follows.

Note: Exclusive berth means berth where only specified cargoes will be handled. The followings are the exclusive berths in this project.
- *Grain berth*
- *Grain berth*
- *Grain berth*

Note: Large ship means
Small ship means

Areas	Cargoes	Vessel	Crane Capacity
For from/to ships	Metallic	30,000 dwt	60 t
	Bagged	30,000 dwt	50 t
		18,000 dwt	35 t
	General cargo	30,000 dwt	50 t
		15,000 dwt	35 t
For yard	Metallic		40 t
	Bagged,General,Refrigerator		25 t

o. Required capacity of the fork-lift trucks will be as follows.

For apron, yard and shed,	Metallic	5 t
	Bagged, General, Refrigerated	3 t

p. The number of equipment required at the port will be calculated by totalling respective requirements of each cargo. And the number will be later adjusted by the following factors.

(1) Working time ratio

Considering the berth occupancy,it is assumed to be 0.6

(2) Direct delivery ratio

It is assumed to be 0.8

(3) Spare equipment

It is assumed that spore equipment will be 10% of the required number of equipment.

9.2 Designs of Cargo Handling Equipment and Related Equipment (For Master Plan)

9.2.1 Dry Bulk (mineral) (-14m), are berths

(1) All the existing equipment can be used provided that the following conditions are ensured.

(2) The equipment are maintained in good condition, additional equipment required will be supplied.

(3) modification to prevent air pollution will be made.

9.2.2 Dry Bulk (Grain) at the Exclusive Berth (-13m), one berth.

The existing equipment will be used provided that the following measures are taken.

(1) Good maintenance

Handling equipment and other related equipment shall be maintained in good condition.

(2) Remodeling

Since the cargo flow of the existing equipment is not quite satisfactory,the following measures are recommended.

1) The receiving lines and the discharge lines will be changed for unloaded cargoes to be also discharged directly.

2) The discharge system from the silo shall be changed so that all cargoes in the silo can be discharged from the bottom of the silo.

3) Devices required to prevent air pollution shall be provided.

9.2.3 Dry Bulk (Grain) at the general cargo berth (-12.5m), one berth

(1) Tire-mounted pneumatic unloader	280 t/h	4 Units
(2) Fixed conveyor	500 t/h	3 Units
(3) Movable conveyor	300 t/h	4 Units
(4) Shovel loader	$1m^3$	4 Units

9.2.4 Bagged Cargo (-14m,-13m x 2,-11m, x 2m), 5 berths

(1) Mobile Crane		
For from/to ship	50 t	2 Units
	35 t	4 Units
(2) Fork-lift Truck	3 t	80 Units

9.2.5 Steel (-14m,-13m x 3,-11m x 4), 8 berths

(1) Jib Crane	6 t x 25m	6 Units
(2) Mobile Crane		
For from/to ship	60 t	4 Units
For Yard	40 t	32 Units
(3) Fork-lift Truck	5 t	4 Units
(4) Trailer		32 Units

9.2.6 General Cargoes (-14m,-13m x 4, -11m x 7, 11 or 12 berth)

(1) Mobile Crane		
For from/to ship	50 t	12 Units
	35 t	4 Units

For Yard	25 t	22 Units
(2) Fork-lift Truck	3 t	132 Units
(3) Trailer		22 Units

9.2.7 **Refrigerated cargoes (-11m x 2)**

(1) Mobile Crane	50 t	4 Units
(2) Fork-lift Truck	3t	32 Units

9.2.8 **Container (-14m x 2, -12.5m x 3)**

(1) Container Crane		
For panamax		4 Units
For small		6 Units
(2) Transfer Crane (Tire mounted)		
Standard type (span 23.47m)		27 Units
(3) Fork-lift Truck		
For general services (Top lifter)	40 t	2 Units
	20 t	3 Units
For empty box handling	7.5 t	5 Units
	5 t	5 Units
For CFS	3 t	8 Units
	2 t	8 Units
(4) Tractor		62 Units
(5) Chassis		71 Units
(6) Truck Scale		5 Units

9.3 Designs of Cargo Handling Equipment and Related Equipment (For Short-term Plan)

9.3.1 Dry Bulk (Ore) (-13m)

All the existing equipment should be used provided that the equipment are maintained in good condition and furthermore additional equipment required will be supplied and modification to prevent air pollution shall be made.

9.3.2 Dry Bulk (Grain) at the exclusive berth (-13m)

The existing equipment will be used provided that the following measures are taken.

(1) Good maintenance

Handling equipment and other related equipment shall be maintained in good condition.

(2) Remodeling

Since the cargo flow of the existing equipment is not quite satisfactory,the following measures are recommended.

1) The receiving lines and the discharge lines will be changed for unloaded cargoes to be also discharged directly.
2) The discharge system from the silo shall be changed for all cargoes in the silo can be discharged from the bottom of the silo.
3) Devices required to prevent air pollution shall be provided.

9.3.3 Dry Bulk (Grain) at the general berth (-12.5m)

(1) Tire-mounted pneumatic unloader	280 t/h	4 Units

9.3.4 Bagged Cargo (-12.5m,-10m)

(1) Mobile Crane		
For from/to ship	35 t	4 Units
(2) Fork-lift Truck	3 t	32 Units

9.3.5 Steel (-12.5m,,-11m x 4)

(1) Jib Crane	6 t x 25m	6 Units
(2) Mobile Crane		
For from/to ship	60 t	1 Units
For Yard	40 t	20 Units
(3) Fork-lift Truck	5 t	40 Units
(4) Trailer		20 Units

9.3.6 General Cargoes (-12.5m, -11m x 3, -10m x 8)

(1) Mobile Crane		
For from/to ship	50 t	6 Units
	35 t	32 Units
For Yard	25 t	11 Units

(2) Fork-lift Truck	3 t	144 Units
(3) Trailer		24 Units

9.3.7 Refrigeration (-11m x 2)

(1) Mobile Crane	50 t	4 Units
(2) Fork-lift Truck	3 t	32 Units

9.3.8 Container (-12.5m)

(1) Container Crane		
For small		2 Units
(2) Transfer Crane (Tire mounted)		
Standard type (span 23.47m)		5 Units
(3) Fork-lift Truck		
For general services (Top lifter)	20 t	1 Units
For empty	7.5 t	1 Units
	5 t	1 Units
For CFS	3 t	2 Units
	2 t	2 Units
(4) Tractor Head		13 Units
(5) Chassis		14 Units
(6) Truck Scale		1 Units

9.4 List of the Total Handling Equipment to Be Required

The total required handling equipment will be counted by both the totalling of required equipment of each cargo and following factors.

1) Working time ratio: It is assumed to be 0.6 considering the berth occupancy
2) Direct delivery ratio: It is assumed to be 0.2
3) Spare equipment: It is assumed to be 0.1 of the required equipment.

The results of calculation are shown in Table 9.4.1

Table 9.4.1.1 List of Equipment

Units: 1,000 US$ (KHOMEINI)

	Capacity	Existing	Unit Price	Master Plan			Short Term			Remarks
				Required	Procurement	Cost	Required	Procurement	Cost	
Unloader for Grain	1,000 t/h	2	—	2	0	0	2	0	0	
Related facilities	—	1 set	—	1 set	0	7,000	1 set	0	7,000	for remodel cost Local Currency (1,400 Million Rials)
Unloader for Mineral	1,000 t/h	2	—	2	0	0	2	0	0	
Related facilities	—	1 set	—	1 set	0	0	1 set	0	0	
Container Crane	30.5	2	9,000	4	2	18,000	2	0		for panamax
〃	30.5	0	7,000	6	6	42,000	0	0		for small ship
Jib Crane	6t × 25	6	—	6	0		6	0		
Loader for Grain	1,000 t/h	1	—	0	0		0	0		
Pneumatic Unloader	280 t/h	2	4,000	4	2	8,000	2	0		
Conveyor (Movable)	300 〃	0	100	4	4	400	0	0		at apron
〃 (Fixed)	500 〃	0	500	3	3	1,500	0	0		in shed (1+2) line ℓ=150
Transfer Crane	30.5 t	2	2,500	27	25	62,500	5	3	7,500	
Mobile Crane	550 t	1	—		0			0		
	90 〃	1	—		0			0		
	60 〃	2	—	3	0		1	0		
	50 〃	0	800	12	11	8,800	7	5	4,000	
	47.5 〃	1	—							
	40 〃	2	600	17	15	9,000	11	9	5,400	
	35 〃	1	520	6	5	2,600	22	18	9,880	
	27.5 〃	2	—							
	25 〃	4	350	14	6	2,100	12	4	1,400	
	20 〃	0	—							
	10 〃	1	—							
	8 〃	2	—							
Rail Road Crane	20 t	1	—		0	0		0	0	
	10 〃	3	—		0	0		0	0	
Fork-lift Truck	40 t	5	—	2	0		0	0		
	20 〃	0	—	3	0		1	0		
	15 〃	3	—	0	0		0	0		
	13.5 〃	1	—	0	0		0	0		
	10 〃	10	—	0	0		0	0		
	7.5 〃	0	—	5	0		1	0		
	7 〃	6	—	0	0		0	0		
	5 〃	9	82	39	10	820	23	13	1,066	
	4.5 〃	9	—	0			0	0		
	3 〃	0	35	150	141	4,935	127	118	4,130	
	2.5 〃	1	—	0	0		0	0		
	2 〃	0	25	8	7	175	2	1	25	
Shovel Loader	1 m^3	0	90	4	4	360	0	0		
Tractor Head			150	62	40	6,000	13	0		
Trailer		49		27	0		24	0		
Chassis			50	71	49	2,450	14	0		
Truck Scale		0	150	5	5	750	1	1	150	
						177,390			40,551	

9.5 Preliminary Cost Estimation

9.5.1 List of the total handling equipment to be procured

The total handling equipment to be procured is balance of the existing available equipment and the total handling equipment to be required.

The results are shown in Table 9.4.1

9.5.2 Preliminary Cost Estimation

The results of preliminary cost estimation are shown in Table 9.4.1

9.6 Outline of the Large Equipment (tentative)

9.6.1 Container Crane

(1) For panamax (Over 3,000TEU)

Hoisting capacity		
Under Spreader	For Hatch cover	35.6 t
For Container		30.5 t
Outreach		38 m
Rail gauge		20 m
Lift (total)		42 m

(2) For small size (Over 2.000 TEU)

Hoisting capacity		
Under spreader	For Hatch	35.6 t
	For Container	30.5 t
Out reach		36 m
Rail gauge		16 m
Lift (total)		37 m

9.6.2 Container Transfer Crane

(1) For 40'

Hoisting capacity (Under spreader)	30.5 t
Span	23.47 m
Lift	12.2 m

Chapter 10

Navigation Aides

Chapter 10 Navigation Aids

10.1 Navigation Facility

(1) General

In adopting measures to promote navigation safety in the ports, or to minimize the occurrence of sea accidents, it is useful to make a detailed examination of past records, in particular to trace the origins of past accidents.
The direct causes and indirect factors in the background of sea accidents are assumed to be as follows;

* Hostile weather and sea condition
* Difficult hydrographical condition
* Negligence of maneuvering
* Mal-stowage
* Machinery trouble, miss-handling, defective design and materials
* Loophole of traffic regulations and control
* Lack of navigational aids
* Deficiency of weather and sea observation and distribution system
* Lack of hydrographical information
* Deficiency of rescue force and emergency information network and sea protest
* Loophole of inspection for hull, machinery and equipment
* Over-congestion of traffic
* Lack of seafarers' training, loophole of certification system
* Unjustifiable working system for crew
* Lack of safe patrol
* Lack of tug and fire-fighting fleet
* Debris and other navigational obstacles
* Others

Based on past experience in other ports, accidents involve a variety of complex factors. However, excepting unavoidable causes such as unusual natural conditions, most of the factors are enclosed by proper countermeasures that lead to minimizing accidents.

Minding that the accidents of small boats and lighters in tow frequently involve casualties, the promotion of vocational training for seamen is extremely important as a long-range policy, and might lead to a dramatic reduction in the number of accidents caused by human error.

The waterway from the bar pilot station to the inner port through the bar channel and river channel is detailed in the Progress Report.

* A far leg of 130 km which takes more than six hours sailing by ocean going vessel.
* A restricted waterway either in terms of depth or width.
* A meandering waterway with inherent sharp bends.

* Navigational obstacles such as wrecks and fish stakes are found near the fairway.
* A falling tide likely generates currents greater than five knots during spring tide.

The layout of the waterway is such that ship handler is continuously confronted with inconvenient or even hazardous conditions.

Countermeasures to prevent sea accidents, e.g., navigational aids such as light buoys indicating center line of the fairway and lateral light buoys indicating boundary of the fairway, are arranged. But the positioning of some of them is not reliable, nor are they sufficient in number at the berth approach and manoeuvering area. Maintenance dredging is not periodically executed. Compulsory pilotage for foreign vessels and more than 1500 GRT Iranian Vessels is being enforced, but the current number of manoeuvering vessel is so small that pilot can not gaining necuday expired.

It has already been mentioned that calling vessels will increase both in size and number in line with the socioeconomic growth in Iran. Even if the current vessel traffic were to remain unchanged in future, it is an important issue for Imam Khomeini port to plan a strategy for preventing loss of lives and property from sea accidents.

Accordingly, to improve the present hydrographical conditions, the following factors should be borne in mind;

* Maintenance and accurate positioning of light buoys and beacons

* Periodical maintenance dredging and sounding of the channel

* Definition of waiting anchorage

* Relocation of the Pilot boarding point

* Removal of the wrecks

* Provision of lights and buoys in the berth approach and manoeuvering area

* Training for the Pilots

* necessary countermeasures against fishing industries

Furthermore, it is recommended that local traffic regulations, which are primarily the responsibility of the PSO, be revised to include the following;

* Definition of vessels, i.e.,"Large Vessel", "miscellaneous Vessel"

* Definition of "Fairway", "Anchorage" and "Port Limit"

* Priority of large vessel to proceed on the fairway

* Priority of vessels proceeding along the fairway

* Restriction of anchoring within the fairway in principle

* Restriction on overtaking and parallel proceeding within the specified fairway

* Priority of departing vessels in possible meeting at entrance of the fairway

* Limit on the maximum speed in specified sections of port area

* Restriction on the length and width and operation of lighters in tow

* Definition and showing obligation of destination flag

* Preservation of the waterways environment

These are all for the purpose of navigation safety and better environment.
It will be necessary to seek the cooperation of NIOC, fishery organization and other users of the water area to improve the situation.

(2) Existing situation

The main directions of approach to Imam Khomeini port will be from the Southeast, where larger vessel will set her course to the bar channel.

The approach made by the Khor Musa Light Float is located about 11 km southeast of No. 2 Light Vessel. The seaward end is marked by No. 1 and No. 6 Light Buoys. The channel between is marked by 15 pairs of light Buoys and 17 staggered lights at a longitudinal spacing of, generally, over 1500 m.

The apex of the channel bend is marked with an additional spar light buoy and the inner section of the channel, between the bend and the berth, is marked by No. 35 and 37 Light Buoy.

(3) Recommendation to the fairway approach

It is considered that No. 4 Light Buoy (Khor Musa Approaches Buoy) should be relocated to a position approximately 3 km to the west (near the Tide Gauge Platform), which is the new pilotage boarding area. The location will be approximately 3 km to the South of entrance buoy (No. 1 and No. 6 Light Buoy). While it is believed that, there will be little opportunity for confusing these marks, bearing in mind the different light characteristics, it may be prudent to add Imam Khomeini port nameboards to the light vessel, if not already so fitted.

To maintain a straight line approach through the channel, the entrance buoy (No. 1 and 6) should be marked by a pair of Cardinal Buoys. These should be located approximately 5 km to the North of the re-located No. 4 Light Buoy.

The Cardinal Buoys should be fit with suitable lanterns and radar reflectors and carry the required topmark cones, appropriate to the IALA Maritime Buoyage System (Region A), applicable to the area.

Additional buoys (A1 and B6 - No. 7 and 12) should be placed mid-way between the Entrance Buoys (No. 1 and 6) and the commencement of the entrance to the dredged channel (No. 9 and 14).

The entrance should be marked with a pair of buoyant beacons. This arrangement will provide the inward vessels with time to assess the effect of any cross winds or cross currents on course keeping, before the vessel is committed to the channel.

Four further pairs of buoyant beacons will need to be placed to mark the water way area at the entrance to the dredged channel. The total length of the approach, from the new Pilot station to the channel entrance, will be a distance of almost 30 km. It is increase of approximately 14 km over the present approach length.

(4) Recommendation to The channel marking

Conventional methods of buoying a channel are either by staggered buoys or a gate buoy system. The latter system provides vessels with greater accuracy in maintaining theirs chosen track, with a reduced risk of grounding. The closer the buoy spacing the better the ship's performance in maintaining it's chosen track.

Where the visibility is reduced to below that of the longitudinal spacing of the buoys, there is a high risk of the vessel passing outside the channel edge. This suggests that ship movements should take place only in conditions for which the range of visibility exceeds the chosen distance of buoy spacing, for both day and night navigation.

Therefore, it is considered that the channel should be marked by gate buoys, at a longitudinal spacing of 900 m. While this spacing is smaller than its present marking, it is believed to be appropriate for the prevailing visibility conditions. The longitudinal spacing given is appropriate for a one-way movement of traffic. If a two-way movement is introduced, the longitudinal spacing should be reduced to, say, 700 m, as vessels will need to move from the center of the channel for the passing manoeuver.

A pair of light buoys (No. 7 and 12) should be placed outside the seaward pair of buoys (No. 9 and 14) for providing additional assistance in longitudinal position fixing in the channel. These buoys indicate the seaward limit of the restricted dredged channel. The retention of the existing No. 2 Light vessel, would provide markers for the inward bound vessel. At this point the ship will have to ensure her required speed for proceed the channel.
To avoid confusion with the lights of the buoys, they will need to be marked with long light characteristics and will also need to give an enhanced light intensity.
The present marking of the channel bend is adequate for the traffic and bends width dimensions.

For the harbor area of the channel, between the channel bend and the berth approaches, the present marking by No. 35 and 37 light buoy, although only to one side of the channel, is considered inadequate. The distance is short, some 2 km, and from this are the larger vessels will be escorted by tugs.

The appropriate marker for the outer section of the dredged channel is considered to be buoyant beacons. They will need to be of a suitable size, and be equipped with a lantern and radar reflector.

(5) Recommendation to Berth approach and manoeuvering area

Conventionally, the ends of wharves and jetties are marked by lights. This is generally suitable, since the jetties are usually well lit with floodlighting.

It is suggested that the spar buoys are used to mark the manoeuvering area. Due to the short range of visibility required of these buoys, the present light intensity would be sufficient.
A piled beacon should also be placed within the harbor to indicate the boundary of division between the channel for Imam Khomeini port and Mahshahr port.

(6) Summary of Recommendations

The changes required for port activities recommended in the Master Plan in the provision of aids to navigation may be summarized as below.

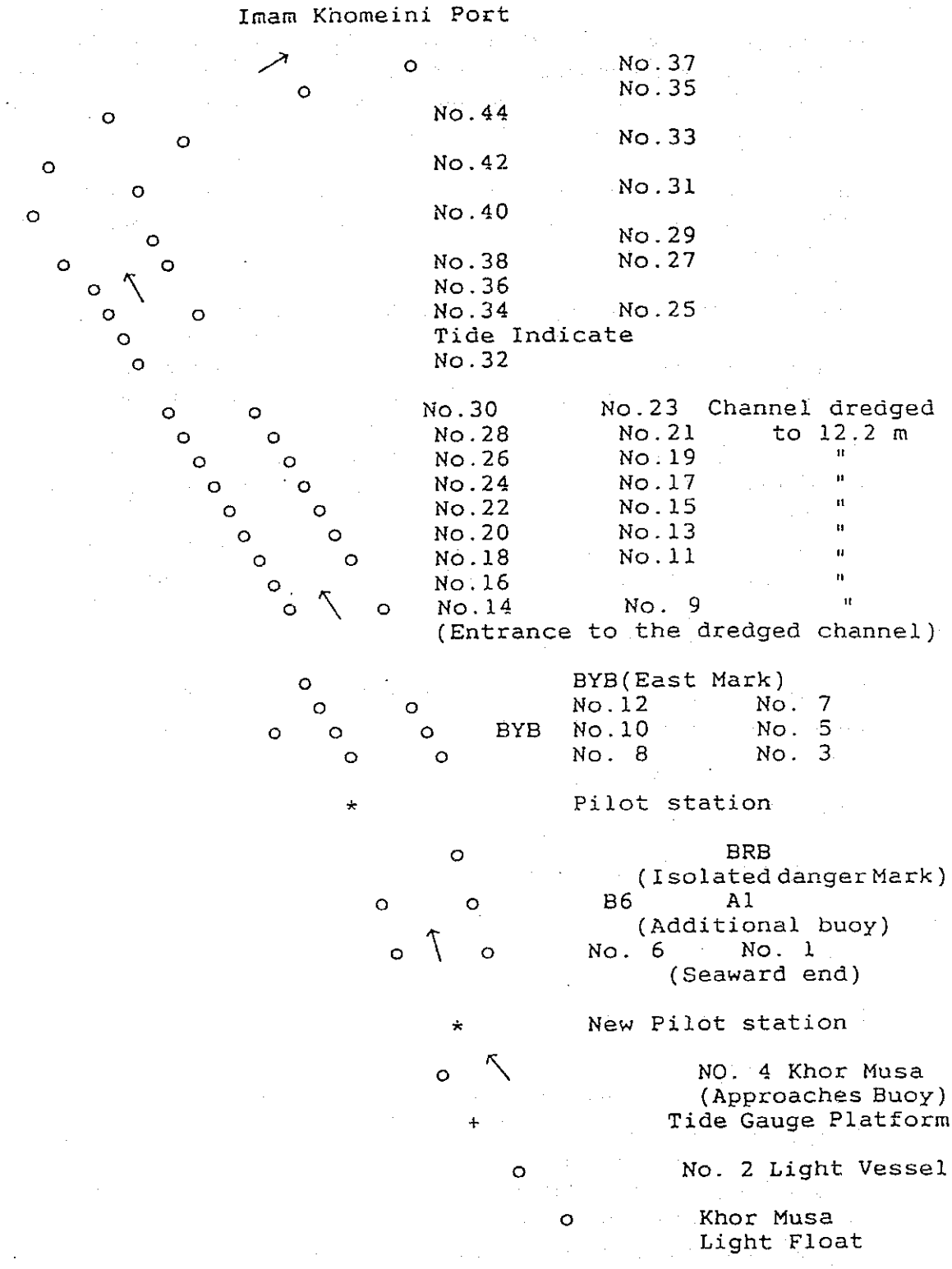
* The relocation of No. 4 Khor Musa Approach buoy to a position approximately 3 km to the west.

* The installation of a piled beacon to mark the division of the channel, within the harbor, between Imam Khomeini Port and Mahshar Port.

* The end of wharves and jetties should be marked by lights.

(7) Operation room

The existing marine operations control tower is in the Port Office building, which is located at the southern end of Imam Khomeini port. If the berths are to be located at the opposite band as envisioned in one scenario, the tower will not be well placed providing a good view out over most of the fairway. For the other options considered, in which the berths are located further to the north, visibility would be impaired. However, the entrance areas would be visible in all cases and modern radio communications and radar should enable the facility to operate satisfactorily.



No.4 Khor Musa Approach Buoy ... Relocate to 3 km to the west

Pilot station ... Relocate to 13 km to the southeast

Figure 10.1.1 The Channel Marking

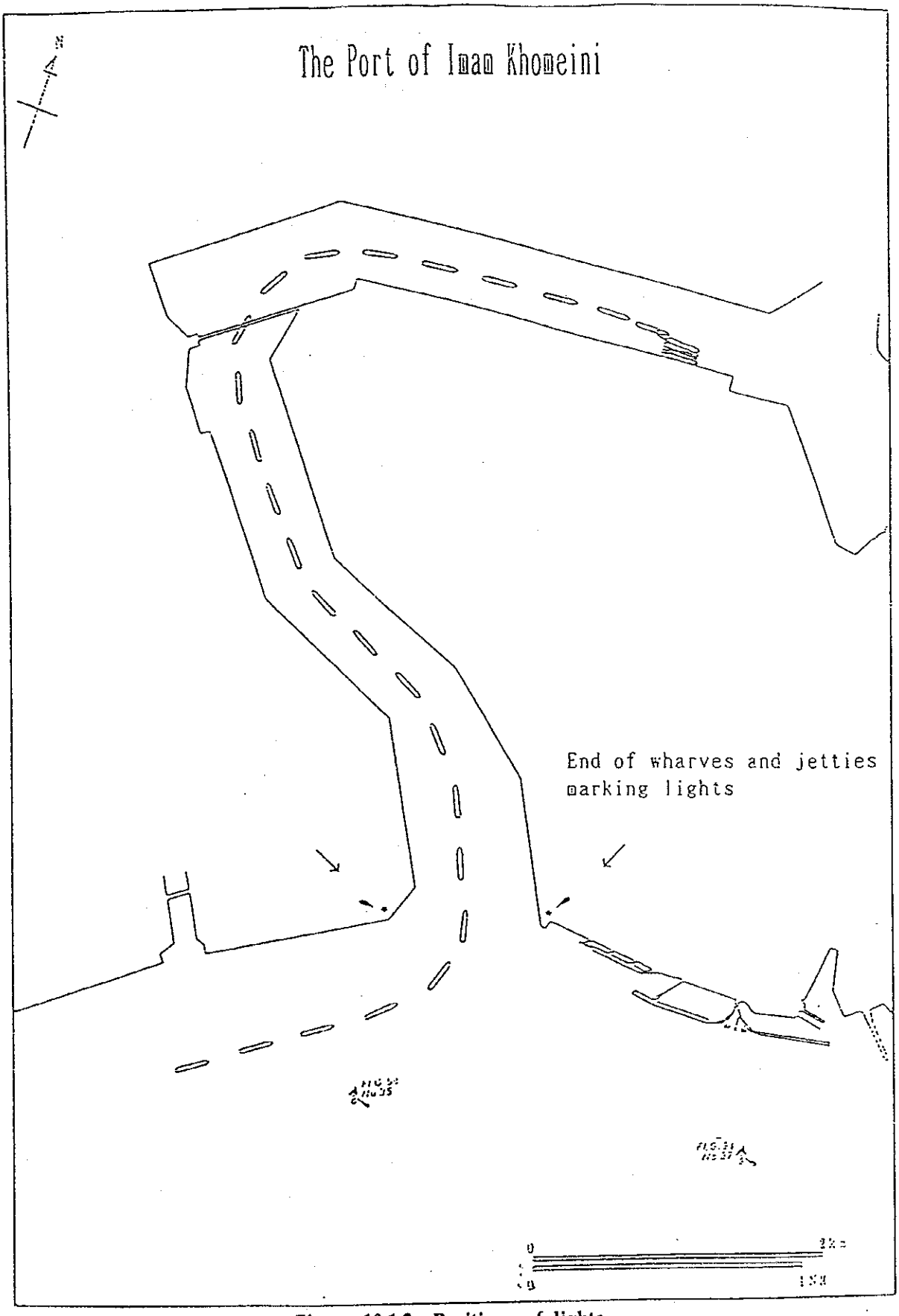


Figure 10.1.2 Positions of lights

10.2 Rehabilitation Plan and Short-term Development Plan

The Following factors should be borne in minds:

* Removal of the wrecks
  Near the way from No.1/No.6 to No.9/No.14 buoy

* The relocation of No.4 Khor Musa Approach buoy to a position approximately 3 km to the west

* Relocation of the Pilot boarding point
  (Definition of waiting anchorage)
  to a point near the above No.4 Khor Musa Approach buoy

Chapter 11

Project Implementation and Stage Development

Chapter 11 Project Implementation and Stage Development

11.1 Basic Strategy

Basic concepts of the project implementation are described as follows. These are based on both the basic policies of port development and development of alternative layout plan.

(1) To save the cost, potential capacity of the existing facilities should be utilized as much as possible.

(2) To secure the smooth transfer of the plan to meet with the change of the socio-economic environment, the Master Plan should be flexible.

(3) At the first, the investment should be conducted for increasing cargo handling efficiency of existing facilities. The development of new facilities should be conducted after the required upgrading of existing facilities are carried out.

Alternative Plan-1 was selected for the Master Plan of Imam Khomeini port development. Thus discussion in this Chapter will concentrate to the proposed Plan-1. Justification on this plan in respect of both the economical analysis and financial analysis will be given Chapters 14 and 15.

11.2 Stage Development

Project components proposed in the Master Plan contain the required works to be conducted by 2011. Among them some part of the elements should be implemented by 2000 or earlier, thus they are divided into two basic stages, namely the Short Term Stage for 2000 and the Long Term Stage for 2010.

As seen in the basic development strategy, the works to be made at the beginning should be the upgrading of existing port facilities then the new development of port facilities will follow.

In the Short Term Plan, both rehabilitation works and urgent upgrading of the existing facilities are included.

11.2.1 Short Term Stage for the Existing Facilities (Rehabilitation Plan) STD-EF1

(1) Infrastructure

Damaged structures including the existing marginal wharfs, Berths No. 11 to No. 34 (or NB7 to NB25) should be urgently repaired. The basin in front of the grain jetty, barge harbor and the container berths No. 11 to No. 15 should be dredged to secure the sufficient depth for their original capacities.

(2) Cargo handling equipment

Existing cargo handling equipment in mechanical trouble such as floating crane, pneumatic unloader and container gantry crane should be repaired as soon as possible. Refer to Chapter 9 for the details.

(3) Others

Navigation aids should be secured. Refer to Chapter 10 for the details.

11.2.2 Short Term Stage for the Existing Facilities (Before 2000/01), STD-EF2

(1) Infrastructure

The existing container terminal should be partly improved.

A general and bagged cargo berth (NB1), 200 m × DL-9.0 m, should be secured at the Eastern Jetty by means of a parallel pier in front of the existing structure.

Mechanical equipment for the tentative ore berth (NB2) should be repaired at the existing ore dolphin. Similar to NB1, a parallel pier for the mineral cargo (NB4) should be provided at the Western Jetty.

Construction of a dolphin at the grain jetty is currently conducting by PSO, thus is excluded from the project.

Basin in front of the existing Berths No.21-No.34 should be dredged upto the DL-11.0 m depth.

(2) Cargo handling Equipment

The required number of cargo handling equipment to be procured during the short term development stage will be more than 170 units which will cost 40.55 million US$ sharing about 22.9 % of the total equipment costs. The main contents will be as follows.

- Transfer cranes	3 units
- Mobile cranes (more than 25t)	37 units
- Fork-lift trucks (2t and 5t)	132 units
- Truck scale	1 units

Cargo handling equipment at the existing grain jetty was required of repairing works. However it is assumed that such work will be not needed, since PSO currently conducts an entire repair works required by an explosive accident happened in July 1994. Thus such work is excluded from the project. Refer to Chapter 9 for the details.

(3) Others

Warehouses and open yards should be secured with necessary quantity.
Two units of refrigerated warehouses will be constructed at existing Berth No. 21 and 22.

Cargo review should be conducted for the decision making of the implementation of the development.

11.2.3 Long Term Stage for Existing Facilities (Before 2010/11), LTD-EF1

Upgrading of the existing facilities of the old port area and former Four Berth Extension area should be further performed following to the schedule of the Master Plan. In particular, the more deep berth should be constructed as soon as possible for the large vessels. Long Term Development will start at upgrading of existing facilities then followed by the new development at the West Harbor, west bank of Dorag Channel.

Existing old port area is so congested due to concentration of various facilities on the limited land space. It should be reminded that this site is one of the most useful zone in respect of traffic circulation to the core of port. To solve this problem and to provide a wide space for new marginal wharfs and container berths, it is proposed to create a new area of 38.5 ha including 27.9 ha of land reclamation, then the new faceline will be located further south advancing about 165 m seaward.

(1) Infrastructure

Construction for an entire upgrading of the old port area between the existing Eastern Jetty and the former Four Berth Extension area will commence. This work will generate new berthing faceline of 1,745 m long for construction of new 6 berths as follows.

- General and Bagged cargo berths, 250 m × -13.0 m × 2 units, NB1 and NB2
- General and Bagged cargo berths, 260 m x -13.0 m x 1 unit, NB3
- Mineral berth, 260 m × -14.0 m, NB4
- Container berths, 320 m × -14.0 m × 2 units, NB5 and NB6

At the same time, the extension of existing Berth No. 11 in 200 m long to further south will be carried out then shapes a new container berth, WB7. The end of this extension will meet with the western end of NB6.

(2) Cargo handling equipment

The required cargo handling equipment for six berths shown above will be provided accordingly.

- Mineral berth

All the existing equipment will be utilized subject to PSO's best efforts. Connection conveyors and bridges between berth and storage yard will also relocated.

- General and bagged cargo berths

Mobile cranes
Forklift trucks

- Container berths

New container berths should be capable to the Pamamax type vessels. To meet this requirement, four container wharf cranes for two berths will be provided. Other equipment shown below will also be provided.

Transfer cranes
Forklift trucks
Tractors
Chassis
Truck scales

(3) Rearrangement of the on-land facilities

The existing on-land facilities behind the new six berths will be relocated or demolished in order to construct the required facilities as follows.

- Relocation or demolition of existing three transit sheds
- Relocation of existing contractor's temporary site and canteen
- Rearrangement of rail tracks
- Rearrangement of gates and access roads
- Construction of buildings

Two CFS,	2 x 40 m × 150 m
Three transit sheds,	2 x 60 m × 200 m
	1 x 60 m × 70 m

Other buildings of 2,700 m^2

- Parks as required

(4) Others

Cargo review should be conducted for the decision making of the implementation of the development.
Maintenance dredging should be conducted accordingly.

11.2.4 Long Term Stage for Existing Facilities (Before 2010/11), LTD-EF2

After conducting of the required upgrading of the old port area, further improvement of remaining existing facilities will be carried out. This work includes upgrading of both areas of the former Ten Berth Extension and Fourteen Berth Extension.

For the Former Ten Berth Extension Area

Existing wharf structure will remain as it is, however as discussed previous subsection, berth extension 200 m long will be carried out at the existing southmost end of Berth No.11. This extension aims at not only generating the long faceline but also land reclamation at the old port area.

(1) Infrastructure

The existing faceline length of 1,963 m (1,052 m plus 911 m) will be expanded to 2,163 m long for the new eight berth arrangement as follows.

- Container berths, 280 m × -12.5 m, NB7, NB8 and NB9
- Dry (grain) bulk berth, 300 m × -12.5 m, NB10
- Steel cargo berths, 220 m × -11.0 m, NB11, NB12, NB 13 and NB14

(2) Cargo handling equipment

The required cargo handling equipment for these eight berths will be provided accordingly.

Container berths

- Container wharf cranes, 8 units including existing two units
- Transfer cranes
- Others including forklift trucks, tractors and chassis

Dry (grain) bulk berth

- Pneumatic unloaders, four units including existing two units
- Conveyors, seven units
- Shovel loaders, four units

Steel cargo berths

- Wharf crane (jib crane), existing six units
- Mobile cranes
- Forklift trucks, trailers etc.

(3) Rearrangement of on-load facilities

The existing on-land facilities behind these eight berths will be rearranged to meet the new requirements.

- Relocation of a transit shed of existing Berth No.18.
- Construction of buildings,
  - Three transit sheds for the dry bulk, 60 m × 165 m each
  - CFS, 400 m × 150 m
  - Maintenance shop 50 x 80 m
  - Other buildings 7,800 m^2
- Rearrangement of rail tracks

- Rearrangement of access roads and yards

(4) Others

Maintenance dredging should be conducted accordingly.

For the Former Fourteen Berth Extension Area

Existing wharf structures and back-up areas will remain as they are. There is no new reclamation works.

(1) Infrastructure

The existing 2552 m long faceline will remain but use of them can be specified with more clear indications as follows.

- Refrigerated cargo berths, 220 m × -11.0 m, NB15 and NB16
- General cargo berths, 220 m × -11.0 m, NB17, NB18, NB19, NB22, NB23, NB24 and NB25
- Bagged cargo berths,180 m × -11.0 m NB20 220 m × -11.0 m NB21

(2) Cargo handling equipment

The required equipment for these eleven berths will be provided accordingly.

Refrigerated cargo berths, two berths
- Mobile cranes
- Forklift trucks

General cargo berths, seven berths
- Mobile cranes
- Forklift trucks

Bagged cargo berths, two berths
- Mobile cranes
- Forklift trucks

(3) Rearrangement of on-land facilities

The existing on-land facilities behind these berths will be rearranged to meet the new requirements.
- Removal of one existing transit shed at existing Berth No.23
- Construction of further two refrigerated warehouses (NB15, NB16)

(4) Others

Maintenance dredging should be conducted accordingly.

11.2.5 Long Term Stage for New Development, LTD-ND1

New development of port facilities at the West Harbor will be carried out in two stages, namely the scope 1 and scope 2. The former is the first step to the West Harbor development consisting of four steel berths. The letter is the development of other four general cargo berths.

Necessary explanation on the former will be given below.

(1) Infrastructure

Since the site has no accessibility from the existing port area nor the existing inland access, a new access should be prepared at first. It is proposed to construct an access between the existing main access to East Harbor and the West Harbor, through 7050 m long new access including two bridges over Zangi Channel and North Dorag Channel.

Dredging at Dorag Channel including a wide channel entrance for 800 m wide will be carried out.

Total faceline length of West Harbor is 2,170 m long consisting of the first faceline starting at the Dorag entrance and the second one after a bending point. Length of the former and latter are 1,020 m and 1,150 m respectively.

General arrangement of the first section in 1,020 m will be as follows.

- Steel cargo berth, 260 m × -14.0 m WB1
- Steel cargo berths, 250 m × -13.0 m WB2, WB3 and WB4

(2) Cargo handling equipment

- Mobile cranes for yard operation 16 units
- Trailers 16 units
- Forklift trucks and others

(3) One-land facilities (pavement and utilities)

- Inner access
- Yard pavement
- Utilities

(4) On-land facilities (Buildings)

- Transit sheds 60 m × 70 m four units
- Warehouses 60 m × 85 m four units
- Other buildings 6,050 m^2

(5) New main access

Construction of new access to the West Harbor area should be started in 2001. This includes 6,050 m long roads and two bridges over the channels.

11.2.6 Long Term Stage for New Development, LTD-ND2

In this stage remaining four berths at the West Harbor will be constructed together with the required on-land facilities and cargo handling equipment.

(1) Infrastructure

Total faceline length of 1,150 m will be developed for four new general cargo berths.

- General cargo berths, 250 m × -13.0 m, WB 5, WB6, WB7 and WB8

(2) Cargo handling equipment

- Mobile cranes for yard operation	8 units
- Forklift trucks	12 units
- Trailers	8 units

(3) On-land facilities (pavement and utilities)

- Inner access
- Yard pavement
- Utilities

(4) On-land facilities (Buildings)

- Transit sheds	60 m × 100 m,	four units
- Warehouses	60 m × 150 m,	four units
- Other buildings	6,050 m^2	

11.3 Implementation Schedule

This section deals with the basic implementation schedule of Alternative Plan-1.

(1) Summary of stage development

Discussions made in provisions section are summarized in Table 11.3.1. The required works are subdivided into six groups as follows.

STD-EF1

Short term development for the existing facilities scope (1): This includes the required works to be undertaken urgently. Rehabilitation of existing structures is also a part of works.

STD-EF2
Short term development for the existing facilities scope (2): Works belonging to the above two scopes are subject to the feasibility evaluation to be carried out in both Chapters 14 and 15.

LTD-EF1
Long term development for the existing facilities scope (1):

LTD-EF2
Long term development for the existing facilities scope (2):

LTD-ND1
Long term development as the new development at the Dorag west bank scope (1):

LTD-ND2
Long term development as the new development at the Dorag west bank scope (2):

Table 11.3.1.1 Major Work Components by Project Groups

Stages and Works	Present Berth No.	Future Berth No.	Quantity of Works
STD-EF1			
Structural Repair	B1-B34	NB1 to NB25	30,000m^2
Dredging (Grain J. Container Berth)	Grain J.-B20	Grain J. -	2,070,000m^3
On-land Facilities		NB10	LS
CH Equipment Repair			LS
Navigation Aids			
Others			
STD-EF2			
Dredging	B21-B34	NB11-NB25	880,000m^3
Grain Jetty (Dolphin, contracted)	Grain J.	Grain J.	One dolphin*
Bagged Cargo Berth		NB1	200m × -9.0m
Tentative Ore Berth (C.H. Repair)		NB2	Set
Mineral Berth		NB4	260m x-13.0m
C.H. Equipment			173 sets
Buildings, Refrigerated Warehouses etc.	B21, 22		18,000m^2
LTD-EF1			
(Old Port Areas)			
Cargo Review			
Demolition and Removal	B1-B10		Old structures
Container Berth		NB5 to NB6	640m
Mineral Berth		NB4	260m
Bagged Cargo Berths		NB1 to NB3	760m
Dredging			1,090,000m^3
Land Reclamation			27.9 ha
On-land Facilities		NB1 to NB6	Set
Utilities		NB1 to NB6	Set
Buildings			44,700m^2
C.H. Equipment			Set

LTD-EF2			
(Former Ten Berth Extension Area)			
Berth Extension		NB7	200m
CH Equipment			Set
On-land Facilities/Utilities	B11-B20	NB7-NB14	LS
Buildings			47,500m^2
(Former Fourteen Berth Extension)			
CH Equipment			
On-land Facilities/Utilities			Set
Building, Refrigerated Warehouses,	B21-B34	NB15-NB25	Set
	B21-B23	NB15, 16	2x9,000m^2
LTD-ND1			
Cargo Review			
Main Access (Route 5)			7,050m,2bridges
Dredging			13,930,000m^3
Reclamation			87.5 ha
Steel Berths	None	WB1 to WB4	
C.H. Equipment			Set
Navigation Aids			Set
On-land Facilities			Set
Utilities			LS
Buildings			43,200m^2
LTD-ND2			
General Cargo Berth	None	WB5 to WB8	
CH Equipment			Set
On-land Facilities			Set
Utilities			Set
Building			66,100 m^2

(2) Master schedule

As discussed in the previous paragraph, the project consists of six work groups. Each group requires various activities as follows.

1) Preparation of project

This should contain the preparation of a master plan and performing feasibility study on the priority component of project. Outline of the project should be proposed based on the required justification by both the technical feasibility and economic/financial feasibilities.

2) Preparation of implementation program

If PSO requires financial aid of external financial sources, an implementation program should be prepared summarizing the results of feasibility study. The contents of this program should also conform to the application format of the financial institution.

During this period, PSO should make its best effort to convince the government ministry concern the importance of project.

3) Financial arrangement

PSO should submit the application to the selected institution for its appraisal. Necessary discussion wit the representative of institution will be conducted. In order to conclude a loan agreement in the shortest possible time, all the documents should be carefully and completely prepared for smooth appraisal.

4) Detailed design

The loan will consist of several phased components namely, a loan for the detailed design and a loan for both the construction and procurement.

Detailed design will be conducted by the qualified consultants based on the scope of works prepared by PSO and approved by the institution. Thus, PSO should prepare the scope of works for detailed design. It should be kept in mind that it will take at least 18 months to complete both the detailed design including the site surveys after the commencement of consultant selection.

5) Contract of the construction and procurement

Before the contract, pre-qualification of applicants will be undertaken based on the condition of pre-qualification documents which will be prepared by the consultants during the detailed design stage subject to the approval of both PSO and the institution.

The contracts should be carried out based on the tender documents prepared by the consultants during the detailed design and approved by both PSO and the institution.

It will take at least 12 months to conclude the contract after the commencement of pre-qualification according to the past experience.

Table 11.3.1.2 shows a master schedule for the project implementation. Tables 11.3.1.3 and 11.3.1.4 indicate an outline schedule and a basic investment schedule respectively.

(3) Construction schedule

Table 11.3.1.5 indicates the construction schedule based on the development concepts and the estimated cargo demands.

Table 11.3.1.2 **Master Schedule**

Activities (Required months at least)	
Preparation (1) (Conducting at present)	- Master plan
	- Stage development study
	- Feasibility study
Preparation (2) (6 months)	- Priority arrangement in the port sector
	- Discussion with the Ministry concerns
	- Implementation program
Financial arrangement (12 months)	- Application through the diplomatic channel
	- Discussion with the institution
	- Appraisal of project by the institution
	- Loan agreement (1)
Detailed design (18 months)	- Preparation of the scope of works
	- Tender and contract with consultants
	- Detailed design
	- Loan agreement (2)
Contract (12 months)	- Arrangement of tender documents
	- Pre-qualification
	- Tender and evaluation
	- Contract
Constructions (see Table 11.3.5)	- Construction of works
	- Procurement of equipment
	- Supervision by the consultants
	- Completion of works

Table 11.3.1.3 Outline Schedule

Project Components	Financial and Design	Construction and Procurement	Commencement of Services
A. Existing Port Facility			
Short Term Development			
Scope 1, (STD-EF1, RH)	1995-1996	1997	1998
Scope 2, (STD-EF2)	1995-1997	1998-2000	(2000)2001
Long Term Development			
Scope 1, (LTD-EF1)	1997-2000	2001-2007	(2003)2008
Scope 2, (LTD-EF2)	1997-2000	2001-2008	(2003)2009
B. New Development			
Short Term Development			
None	-	-	-
Long Term Development			
Scope 1, (LTD-ND1)	1997-2000	2001-2008	(2996)2009
Scope 2, (LTD-ND2)	2002-2005	2006-2010	(2008)2011

Note: Figure in parenthesis indicates the year for the partial completion of works.

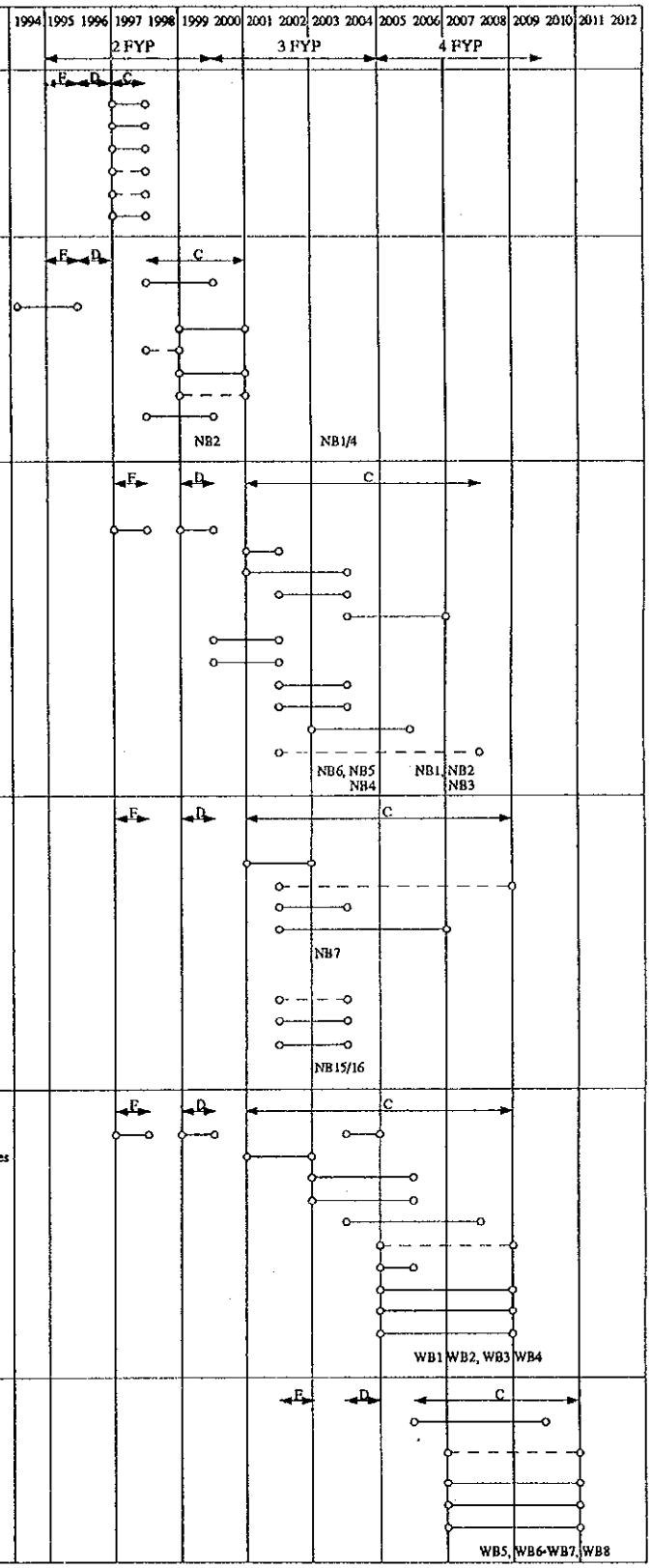
Table 11.3.1.4 Basic Investment Schedule

		Project Components					
		Existing Facilities				New Development	
		Short Term Plan		Long Term Plan		Long Term Plan	
		Rehabilitation					
		Scope 1	Scope 2	Scope 1	Scope 2	Scope 1	Scope 2
		STD-EF1 (RH)	STD-EF2	LTD-EF1	LTD-EF2	LTD-ND1	LTD-ND2
Phase	Year						
1	1994	Preparation					
1	1995	Finance	Finance				
1	1996	Design	Design				
1	1997	Construction	Contract	Finance*	Finance*	Finance*	
2	1998	Operation	Construction	-	-	-	
2	1999	-	Construction	Design	Design	Design	
2	2000	-	Construction	Contract	Contract	Contract	
3	2001	-	Operation	Construction	Construction	Construction	
3	2002	-	-	Construction	Construction	Construction	Finance*
3	2003	-	-	Construction	Construction	Construction	-
3	2004	-	-	Construction	Construction	Construction	Design
3	2005	-	-	Construction	Construction	Construction	Contract
3	2006	-	-	Construction	Construction	Construction	Construction
3	2007	-	-	Construction	Construction	Construction	Construction
3	2008	-	-	Operation	Construction	Construction	Construction
3	2009	-	-	-	Operation	Operation	Construction
3	2010	-	-	-	-	-	Construction
4	2011	-	-	-	-	-	Operation
4	2012	-	-	-	-	-	-
4	2013	-	-	-	-	-	-
4	2014	-	-	-	-	-	-
4	2015						
4	2016						
4	2017						
4	2018						
4	2019						
4	2020						
4	2021						
4	2022						
4	2023						
4	2024						
4	2025						
4	2026						
4	2027						
4	2028						
4	2029						
4	2028						
4	2029						
Prospective		1	2	2	2	3	3

Notes
1. Cargo handling equipment and navigation aids are included.
2. "Finance" means preparation and arrangement of financial sources.
3. Cargo review will be conducted during the financial arrangement (*).
4. "Design" means both the required detailed investigation and design.

Table 11.3.1.5 Construction Schedule: Imam Khomeini Port - Alternative Plan 1

Stage and Works	Present Berth No.	New Berth No.	Quantity of Works
STD-EF1			
Structural Repair	B1 ~ B34	NB1 to NB25	300,000 m²
Dredging (Grain J. Container Berth)	Grain J. ~ B20	Grain J. ~ NB10	2,070,000 m³
On-land Facilities			LS
C.H. Equipment Repair			LS
Navigation Aids			
Others			
STD-EF2			
Dredging	B21 ~ B34	NB11 ~ NB25	880,000 m³
Grain Jetty (Dolphin, contracted)	Grain Jetty	Grain Jetty	One dolphin*
Bagged Cargo Berth		NB1	200 m x -9.0 m
Tentative Ore Berth (CHE. Repair)		NB2	set
Mineral Berth		NB4	260 m x -13.0 m
C.H. Equipment			set
Buildings, Refrigerated Warehouse etc.	B21, 22		18,000 m²
<Operation>			
LTD-EF1			
(Old Port Areas)			
Cargo Review			
Demolition and Removal	B1 ~ B10		Old structures
Container Berths		NB5 to NB6	640 m
Mineral Berth		NB4	260 m
Bagged Cargo Berths		NB1 to NB3	760 m
Dredging			1,090,000 m³
Land Reclamation			27.9 ha
On-land Facilities		NB1 to NB6	set
Utilities		NB1 to NB6	set
Buildings			44,700 m²
C.H. Equipment			set
<Operation>	B3 ~ B10	NB1 ~ NB6	
LTD-EF2			
(Former Ten Berth Extension Area)			
Berth Extension		NB7	200 m
C.H. Equipment			set
On-land Facilities/Utilities	B11 ~ B20	NB7 ~ NB14	LS
Buildings			47,500 m²
<Operation>			
(Former Fourteen Berth Extension)			
C.H. Equipment			set
On-land Facilities and Utility	B21 ~ B34	NB15 ~ NB25	set
Building, Refrigerated Warehouse	B21 ~ B23	NB15, 16	2 x 9,000 m²
<Operation>			
LTD-ND1			
Cargo Review			
Main Access (Route 5)			5,350 m, 2 bridges
Dredging			13,930,000 m³
Reclamation			87.5 ha
Steel Berths	none	WB1 to WB4	
C.H. Equipment			set
Navigation Aids			set
On-land Facilities			set
Utilities			LS
Buildings			43,200 m²
<Operation>			
LTD-ND2			
General Cargo Berth	none	WB5 to WB8	
C.H. Equipment (Mobile Cr. Fork-Lift Trucks)			set
On-land Facilities			set
Utilities			set
Building			66,100 m²
Operation			



Notes. Legend. FYP: Fire years plan F = Financial, D = Design, C = Construction,

1. Dolplin construction at Grain Jetty is excluded from the project.

11.4 Preliminary Disbursement Schedule

11.4.1 Summary

Preliminary disbursement schedule is prepared in order to outline the required project finance. Refer to Tables 11.4.1.1, 11.4.1.2 and 11.4.1.3 for summary.

Table 11.4.1.1 Preliminary Disbursement Schedule (1/3), Total Costs

Total Costs

		Project Components						Annual Disbursement million US$
		Existing Facilities				New Development		
		Short Term Plan		Long Term Plan		Long Term Plan		
		Rehabilitation						
		Scope 1 STD -EF1 (RH)	Scope 2 STD - EF2	Scope 1 LTD - EF1	Scope 2 LTD - EF2	Scope 1 LTD - ND1	Scope 2 LTD - ND2	
1	1994			Preparation				
1	1995	-	-	-	-	-	-	-
1	1996	3.38	17.34	-	-	-	-	20.72
1	1997	16.87	-	-	-	-	-	16.84
2	1998	-	13.54	-	-	-	-	13.54
2	1999	-	30.16	47.30	18.50	66.84	-	162.80
2	2000	-	42.98	-	-	-	-	42.98
3	2001			33.72	14.55	65.55	-	113.82
3	2002			39.42	19.43	65.56	-	124.41
3	2003			39.42	19.43	26.45	-	85.30
3	2004			39.42	9.73	26.45	38.64	114.24
3	2005			39.42	9.73	37.50	-	86.65
3	2006			39.42	9.75	37.50	31.75	118.42
3	2007			5.71	4.88	37.50	40.30	88.39
3	2008			-	4.93	37.76	40.30	82.99
3	2009			-	-	-	40.30	40.30
3	2010					-	40.50	40.50
4	2011							-
4	2012							-
4	2013							-
4	2014							-
4	2015							-
4	2016							-
4	2017							-
4	2018							-
4	2019							-
4	2020							-
4	2021							-
4	2022							-
4	2023							-
4	2024							-
4	2025							-
4	2026							-
4	2027							-
4	2028							-
4	2029							-
4	2030							-
4	2031							-
4	2032							-
Total		20.25	104.02	283.83	110.93	401.11	231.79	1,151.93
Prospective		1	2	2	2	3	3	

Notes. 1. Cargo handling equipment and navigation aids are included.
2. Plan 1 with the main access route D5 is the basic scheme.
3. Contingency and engineering fees are included.

Table 11.4.1.2 Preliminary Disbursement Schedule (2/3), Construction and Procurement

Construction and Procurement

		Project Components						Annual Disbursement million US$
		Existing Facilities				New Development		
		Short Term Plan		Long Term Plan		Long Term Plan		
		Rehabilitation						
		Scope 1 STD -EF1 (RH)	Scope 2 STD - EF2	Scope 1 LTD - EF1	Scope 2 LTD - EF2	Scope 1 LTD - ND1	Scope 2 LTD - ND2	
1	1994				Preparation			
1	1995	-	-	-	-	-	-	-
1	1996	-	-	-	-	-	-	-
1	1997	16.87	-	-	-	-	-	16.84
2	1998	-	13.54	-	-	-	-	13.54
2	1999	-	30.16	-	-	-	-	-
2	2000	-	42.98	-	-	-	-	42.98
3	2001			33.72	14.55	65.55	-	113.82
3	2002			39.42	19.43	65.56	-	124.41
3	2003			39.42	19.43	26.45	-	85.30
3	2004			39.42	9.73	26.45	-	114.24
3	2005			39.42	9.73	37.50	-	86.65
3	2006			39.42	9.75	37.50	31.75	118.42
3	2007			5.71	4.88	37.50	40.30	88.39
3	2008			-	4.93	37.76	40.30	82.99
3	2009			-	-	-	40.30	40.30
3	2010					-	40.50	40.50
4	2011							-
4	2012							-
4	2013							-
4	2014							-
4	2015							-
4	2016							-
4	2017							-
4	2018							-
4	2019							-
4	2020							-
4	2021							-
4	2022							-
4	2023							-
4	2024							-
4	2025							-
4	2026							-
4	2027							-
4	2028							-
4	2029							-
4	2030							-
4	2031							-
4	2032							-
Total		16.87	86.68	236.53	92.43	334.27	193.15	959.93
Prospective		1	2	2	2	3	3	

Notes. 1. Cargo handling equipment and navigation aids are included.
2. Plan 1 with the main access route D5 is the basic scheme.
3. Contingency and engineering fees are excluded.

Table 11.4.1.3 Preliminary Disbursement Schedule (3/3), Physical Contingency and Engineering Fee

Physical Contingency and Engineering Fee

		Project Components						
		Existing Facilities				New Development		
		Short Term Plan						
		Rehabilitation						
		Scope 1 STD -EF1 (RH)	Scope 2 STD - EF2	Scope 1 LTD - EF1	Scope 2 LTD - EF2	Scope 1 LTD - ND1	Scope 2 LTD - ND2	
1	1994				Preparation			
1	1995	-	-	-	-	-	-	-
1	1996	3.38	17.34	-	-	-	-	20.72
1	1997		-	-	-	-	-	-
2	1998	-	-	-	-	-	-	-
2	1999	-	-	47.30	18.50	66.84	-	132.64
2	2000						-	-
3	2001						-	-
3	2002						-	-
3	2003						-	-
3	2004						38.64	38.64
3	2005							-
3	2006							-
3	2007							-
3	2008							-
3	2009							-
3	2010							-
4	2011							-
4	2012							-
4	2013							-
4	2014							-
4	2015							-
4	2016							-
4	2017							-
4	2018							-
4	2019							-
4	2020							-
4	2021							-
4	2022							-
4	2023							-
4	2024							-
4	2025							-
4	2026							-
4	2027							-
4	2028							-
4	2029							-
4	2030							-
4	2031							-
4	2032							-
Total		3.38	17.34	47.30	18.50	66.84	38.64	192.00
Prospective		1	2	2	2	3	3	

Notes. 1. Contingency and engineering fees are included.
- Physical Contingency 10% for construction work and procurement.
- Engineering Fee 10% for construction work and procurement.

11.4.2 Details of Disbursement

Table 11.4.2.1 to Table 11.4.2.5 show the details of disbursement by stage and scope of the construction works and procurement.

Table 11.4.2.1 Disbursement, Total Construction and Procurement

Unit: million US$

Year	STD	LTD	Total	
1994	-	-	-	
1995	-	-	-	
1996	-	-	-	
1997	16.87	-	16.87	(1.76%)
1998	13.54	-	13.54	(1.41%)
1999	30.16	-	30.16	(3.14%)
2000	42.98	-	42.98	(4.48%)
2001	-	113.82	113.82	(11.86%)
2002	-	124.41	124.41	(12.96%)
2003	-	85.30	85.30	(8.89%)
2004	-	75.60	75.60	(7.88%)
2005	-	86.65	86.65	(9.03%)
2006	-	118.42	118.42	(12.33%)
2007	-	88.39	88.39	(9.20%)
2008	-	82.99	82.99	(8.65%)
2009	-	40.30	40.30	(4.20%)
2010	-	40.50	40.50	(4.21%)
2011				
2012				
2013				
2014				
2015				
2016				
2017				
2018				
2019				
2020				
2021				
2022				
2023				
2024				
2025				
2026				
2027				
2028				
2029				
2028				
2029				
2030				
Total	103.55	856.38	959.93	(100%)

Table 11.4.2.2 Disbursement, Construction and Procurement in Short Term Development

Unit: million US$

Year	STD-EF1			STD-EF2			Total	
	Const. W	C.H.E NA	Subtotal	Const. W	C.H.E NA	Subtotal		
1994	-	-	-	-	-	-	-	
1995	-	-	-	-	-	-	-	
1996	-	-	-	-	-	-	-	
1997	15.87	1.00	16.87	-	-	-	16.87	(16.29%)
1998	-	-	-	13.54	-	13.54	13.54	(13.08%)
1999	-	-	-	13.54	16.62	30.16	30.16	(29.12%)
2000	-	-	-	18.05	24.93	42.98	42.98	(41.51%)
2001								
2002								
2003								
2004								
2005								
2006								
2007								
2008								
2009								
2010								
2011								
2012								
2013								
2014								
2015								
2016								
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2028								
2029								
2030								
Total	15.87	1.00	16.87	45.13	41.55	86.68	103.55	(100%)

Table 11.4.2.3 Disbursement, Total Construction and Procurement in Long Term Development

Unit: million US$

Year	STD-EF	LTD-ND	Total	
1994	-	-	-	
1995	-	-	-	
1996	-	-	-	
1997	-	-	-	
1998	-	-	-	
1999	-	-	-	
2000	-	-	-	
2001	48.27	65.55	113.82	(13.29%)
2002	58.85	65.56	124.41	(14.54%)
2003	58.85	26.45	85.30	(9.98%)
2004	49.15	26.45	75.60	(8.83%)
2005	49.15	37.50	86.65	(10.13%)
2006	49.17	69.25	118.42	(13.84%)
2007	10.59	77.80	88.39	(10.34%)
2008	4.93	78.06	82.99	(9.70%)
2009	-	40.30	40.30	(4.72%)
2010	-	40.50	40.50	(4.73%)
2011				
2012				
2013				
2014				
2015				
2016				
2017				
2018				
2019				
2020				
2021				
2022				
2023				
2024				
2025				
2026				
2027				
2028				
2029				
2028				
2029				
2030				
Total	328.96	527.42	856.38	(100%)

Table 11.4.2.4 Disbursement, Construction and Procurement in Long Term Development at the Existing Facilities

Unit: million US$

Year	LTD-EF1			LTD-EF2			Total	
	Const. W	C.H.E NA	Subtotal	Const. W	C.H.E NA	Subtotal		
1994	-	-	-	-	-	-	-	
1995	-	-	-	-	-	-	-	
1996	-	-	-	-	-	-	-	
1997	-	-	-	-	-	-	-	
1998	-	-	-	-	-	-	-	
1999	-	-	-	-	-	-	-	
2000	-	-	-	-	-	-	-	
2001	33.72	-	33.72	14.55	-	14.55	48.27	(14.67%)
2002	33.72	5.70	39.42	14.55	4.88	19.43	58.85	(17.89%)
2003	33.72	5.70	39.42	14.55	4.88	19.43	58.85	(17.89%)
2004	33.72	5.70	39.42	4.85	4.88	9.73	49.15	(14.94%)
2005	33.72	5.70	39.42	4.85	4.88	9.73	49.15	(14.94%)
2006	33.72	5.70	39.42	4.87	4.88	9.75	49.17	(14.94%)
2007	-	5.71	5.71	-	4.88	4.88	10.59	(3.22%)
2008	-	-	-	-	4.93	4.93	4.93	(1.51%)
2009	-	-	-	-	-	-	-	
2010								
2011								
2012								
2013								
2014								
2015								
2016								
2017								
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2019								
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2021								
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2028								
2029								
2030								
Total	202.32	34.21	236.53	58.22	34.21	92.43	328.96	(100%)

Table 11.4.2.5 Disbursement, Construction and Procurement in Long Term Development at the New Development

Unit: million US$

Year	LTD-ND1			LTD-ND2			Total	
	Const. W	C.H.E NA	Subtotal	Const. W	C.H.E NA	Subtotal		
1994	-	-	-	-	-	-	-	
1995	-	-	-	-	-	-	-	
1996	-	-	-	-	-	-	-	
1997	-	-	-	-	-	-	-	
1998	-	-	-	-	-	-	-	
1999	-	-	-	-	-	-	-	
2000	-	-	-	-	-	-	-	
2001	65.55	-	65.55	-	-	-	65.55	(12.43%)
2002	65.56	-	65.56	-	-	-	65.56	(12.43%)
2003	26.45	-	26.45	-	-	-	26.45	(5.01%)
2004	26.45	-	26.45	-	-	-	26.45	(5.01%)
2005	26.45	11.05	37.50	-	-	-	37.50	(7.11%)
2006	26.45	11.05	37.50	31.75	-	31.75	69.25	(13.13%)
2007	26.45	11.05	37.50	31.75	8.55	40.30	77.80	(14.75%)
2008	26.70	11.06	37.76	31.75	8.55	40.30	78.06	(14.83%)
2009	-	-	-	31.75	8.55	40.30	40.30	(7.64%)
2010	-	-	-	31.94	8.56	40.50	40.50	(7.66%)
2011								
2012								
2013								
2014								
2015								
2016								
2017								
2018								
2019								
2020								
2021								
2022								
2023								
2024								
2025								
2026								
2027								
2028								
2029								
2028								
2029								
2030								
Total	290.06	44.21	334.27	158.94	34.21	193.15	527.42	

11.5 Construction Method

This subsection deals with the basic construction method to be employed during the implementation of proposed Master Plan. Project components in the proposed scheme consists of six categorized works.

(1) General works

Mobilization, site common works and demobilization.

(2) Marine works

Including dredging and reclamation, seawalls, piers, jetties and wharfs.

(3) On-land works

Including, soil improvement, pavement, storm-water drainage and flavor.

(4) Building

Including Transit sheds, warehouses, CFS, gate house, control house and fence and parks

(5) utilities

Including water supply, sewage system, power supply and etc.

(6) Cargo handling equipment

Including container wharf cranes, container yard cranes, mobile cranes, fork-lift tracks trailers and chastises.

All these facilities except the marine works are ordinary works which have no particular consideration since they can be processed on the land instead of water basin.
Thus preliminary study were accomplished on the major marine constructions. The largest cost item among the marine works in the proposed Master Plan is the construction of marginal wharf of 2,420m long along the western bank of Dorag Channel.

11.5.1 Scale of Proposed Marginal Wharf

Basic scale of new wharf at the western bank of Dorag Channel is as follows.

Total length	2,420m
Design depth below DL (Cesco)	-13m and -14m
Number of berth	9 berths
Deck width	60m

Type of structure	same type as existing 24 berths
Piles 800 p.c. piles	8,300 each
total concrete volume for deck	102,000m^3

11.5.2 Basic construction Method

Appendix 2B5 shows the preliminary arrangement of constructional equipment. However total length of wharf in the arrangement is made for 1,200m which is just half of the proposed length. This consideration is on the basis of that 2,170m long wharf will be constructed in two stages.

Major study resulted from this arrangement can be summarized as follows.

(1) Construction speed

Time required for pile driving	338 days
3 sets of pile driving barge	D-70
3 sets of crane barge	40t

(2) Required preparation yard

piles	9,000m^2
precast deck element	18,000m^2

(3) Precast operation

To meet with piling speed.	
2 sets of main crane barge	30t

Chapter 12

Project Cost Estimation

Chapter 12 Project Cost Estimation

This chapter deals with both the cost aspects and the basic disbursement schedule based on the proposed construction program of the Master Plan project described in Chapter 11. Quantity of works are basically based on the facility planning concepts as shown in Chapter 6, Chapter 7 and Chapter 8.

The possible program for the short term project which should be selected among the Master Plan project was discussed in Chapter 11. Required costs are estimated on the basis of quantities of work and unit prices for each work component. The same unit prices are applied for both the long term project and short term project. Detailed information regarding the unit prices are provided in Appendices 2B1, 2B2 and 2B3.

An important point of the project components is the new port facility development since its required cost may share about 40% of the total initial cost except the equipment cost.

Required cont estimation should be accomplished in order to obtain the best solution among alternatives both in the site selection and the type of facilities. The former aspect is discussed separately in Chapter 7.

12.1 Basic Arrangement of Project Cost

The project cost is one of the most important aspects to be evaluated achieving the best solution. An economical terminal construction and easy maintenance will make the port charges low and maximize the operation profits. Other than these points of view, there are three prospectives with respect to the required costs since this study is for preparation of a Master Plan of the Imam Khomeini port to meet the traffic demands at the year 2010/11.

The Imam Khomeini port is an established port which is the largest one and currently handles about 40% of maritime traffics in the southern ports. Estimated cargo traffics allocated to this port in 2010/11 is about 30 million tons exceeding about 18 million tons more than those of existing port capacity. Thus this balance should be borne by both the additional cargo handling capacity after the required upgrading of existing facilities and new development. The upgrading of existing facilities should be the first choice since the required cost for an unit capacity is normally less than the new development. The new port facility development might be required at other site than the existing ones.

Note: The Short Term Development (STD) and the Long Term Development (LTD) are the proposed works for 1997/2000 and 2001/2011 respectively. Both development schemes constitute the Master Plan Development.

Design and cost estimation on the latter is rather simple than the former, because it will take place at the new site. However, those of the former are complicate ones since some of them may be left as they are and the other may require improvement in order to increase their port capacity. The following figure demonstrates the definitions of various activities.

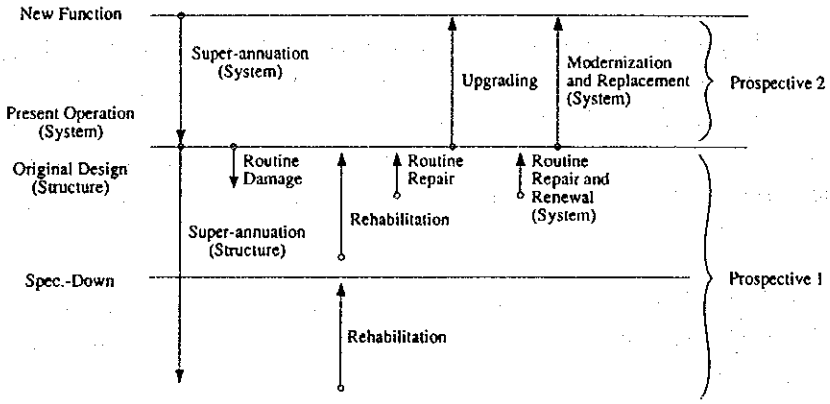

Figure 12.1.1.1 Various Countermeasures to Existing Facility

Many questions should be answered in order to cope with these aspects for example:

For the fixed facilities

1) What kind of rehabilitation on the existing facilities should be carried out?

2) What kind of upgrading works on the existing facilities should be made for the allocated new function?

For the cargo handling equipment

1) What kind of equipment purchase should be conducted for maintaining the existing service level?

2) What kind of equipment purchase should be undertaken by means of replacement of existing ones to the other type of equipment for modernization in order to cope with the required capacity increase or new function.

Considering the difference in purposes shown above, basic project cost composition is organized by the following subdivisions accordingly.

(1) Port Development Cost Subdivision

Cost components categorized in Prospective 1 are basically for maintaining the designated port capacity of the existing facilities, while those in Prospective 2 and 3 are for increasing port capacity by adding new functions on the existing facilities and undertaking a new development.

- Prospective 1 : Rehabilitation and Renewal of Existing Facilities

How much routine investment should be carried out for maintaining the existing port facilities? This category of works includes the required renewal of cargo handling equipment and large scale repair (or rehabilitation) of the existing fixed facilities. This should be based on the study results of subsection 12.10.

- Prospective 2 : Upgrading and Replacement of Existing Facilities

How much supplemental investment should be made for upgrading the existing port facilities themselves? Upgrading works, which are required for improving the existing waterfront facilities and on-land facilities will be included. This work includes also the required replacement of the existing equipment with advanced ones. This should also relate to the study resulted from Chapter 5 and Chapter 6.

- Prospective 3 : New Development

How much additional investment should be undertaken for the completely new facilities after achieving reasonable upgrading and replacement of existing facilities? Total cargo handling capacities to be borne by both the existing facilities and this new development should be meet with the future cargo traffics as discussed in Chapter 3. The required subdivision of them into these two categories is carried out as indicated in Chapter 6.

(2) Cargo Handling Equipment

Cargo handling equipment generally has shorter life than the fixed facilities including wharf and shed. Thus investment costs for them are divided into two types namely the initial one and periodical one. The periodical one is additional cost to purchase another equipment at the end of its life. This cost consists of two categories namely the equipment renewal and equipment replacement. The former means ordinary equipment purchase of the same type of machines as before, however, the latter is for upgrading of existing equipment by means of purchasing advanced one.

For the detailed classification of equipment cost, the following definitions will be used:

a. "New Investment for the new development"
b. "Renewal for new investment"
c. "Replacement of existing equipment"
d. "Renewal of existing equipment"

Item (a) is the procurement of equipment for the new development site. Item (b) is renewal of equipment for Item (a). Item (c) is replacement of previous equipment by advanced one. Item (d) is just ordinary renewal of existing equipment by the same or equivalent. Last three items belong to the periodical investment. Since the project benefits are the incremental ones over the benefit level of the existing port,

the renewal cost of existing equipment is excluded from the project cost estimation.

While the initial investment cost of equipment will consist of item (a) and a part of item (c) which will be procured during the initial investment of the fixed facilities.

(3) Phasing of Project Implementation

Another important aspect is the time table ensuring the most feasible investment. This time schedule was fixed for the Master Plan (Long Term Development and Short Term Development) on the basis of the port demands, which were supported by the traffic demands forecasts referring to Chapter 3. Thus cost subdivision between the Short Term Development stage and the Long Term Development stage should be made on the basis of this time schedule.

(4) Further Considerations

Cost should consist of an initial investment cost and maintenance and operation costs. The required cost integration will be accomplished by a selected management system the recommendations in Chapter 13.

The unit prices are basically followed by the current prices in Iran 1994 and the similar project experience in other developing countries. However, the cost estimation in this study is neither for constructional purpose nor detailed design. Thus, an appropriate contingency amount should be considered for converting uncertainty in costing conditions and required engineering fees should also be included for undertaking detailed design and construction supervision.

12.2 Application to the Proposed Project Components

(1) Prospective 1: Rehabilitation and Renewal of Existing Facilities

The Prospective 1 includes required works for maintaining the existing facilities. Thus, this does not include any initial investment costs. The required renewal cost of existing cargo handling equipment belongs to this. The operation cost for this component is the required cost for operation as PSO currently uses. The maintenance cost is the routine maintenance work cost which is required for keeping the existing facility in orderly condition by means of periodical repair works.

In addition to these, large scale repair works (rehabilitation) will be required at the damaged fixed facilities including the existing Eastern Jetty and Western Jetty and 24 marginal wharfs located westward the former Four Berth Extension. Reconstruction of unfinished parts in Four Berths Extension and widening of existing wharf deck for deepening the water depth are not in this category but Prospective 2.

(2) Prospective 2: Upgrading and Replacement of Existing Facilities

The Prospective 2 is for upgrading and replacement of existing facilities not only to

meet the new allocated function but also for increasing the present capacity for the future cargo demands. Thus, this includes the initial investment cost for upgrading of the existing fixed facilities and replacement of cargo handling equipment as follows.

1) Existing fixed facilities

- Grain terminal
- Eastern and Western Jetties
- Former Four Berth Extension area
- Berth No. 16 to No. 20 for deck widening (only for Plan 3)

2) Cargo handling equipment

- Grain terminal
- Berth No. 11 to No. 15
- Berth No. 16 to No. 20
- Berth No. 21 to No. 34

The most important improvement will be carried out by means of these replacement of equipment with advanced ones. The operation cost after these improvement should be considered. The routine maintenance work is to be provided also for ensuring the improved facilities in orderly condition by periodical repair works.

(3) Prospective 3: New Development

This part consists of works required to handle the future cargo traffic exceeding the capacity of existing facilities even after conducting Prospective 2. New berths will be constructed during the Long Term Development (LTD) as follows.

Alternative Plan 1, Eight new berths at Dorag west bank
Alternative Plan 2, Eight new berths at Zangi south bank
Alternative Plan 3, Twelve new berths at Dorag west bank

They are the development of completely new facilities. The initial investment cost includes the fixed facilities and cargo handling equipment. The required cost should be added for the renewal of initially purchased equipment. Operation and maintenance cost should also be included.

12.3 Basic Composition of Cost

Majority of cost disbursement will concentrate at the beginning of project implementation, however, the remaining cost may be spent continuously through its project life. The former is named as the initial investment cost and the latter is called as the periodical purchase cost together with the maintenance and operation cost for initial investment.

12.3.1 Existing Facility

(1) Initial Investment Cost (Fixed facilities and Equipment)

Fixed Facilities

The required initial investment costs for the existing facilities are limited to the necessary costs for maintaining or upgrading them since they are already constructed. In this project, the upgrading of the existing facilities will be carried out at all the port area. Thus, the existing 24 berths along the Dorag Channel and the former Four Berth Extension area together with the jetties and piers will be upgraded as required.

Addition to these works, rehabilitation works will be conducted at the damaged parts of existing waterfront facilities. Since they are required urgently in order to prevent these facilities from further deterioration.

Cargo Handling Equipment

For the cargo handling equipment, replacement cost, which is required to purchase advanced one than the existing system, will be classified in the investment cost. Among them, the costs which will be spent during the initial investment of fixed facilities will be categories to the initial investment cost.

(2) Periodical Purchase Cost (Equipment only)

Necessary investment for the cargo handling equipment should also be made.

All the investment costs except the initial investment will be the periodical purchase cost of the equipment.

(3) Operation and Maintenance Cost (Fixed facilities and Equipment)

Of course, the existing facilities need to be taken care for providing services to the port users. This is the operation and maintenance cost. The operation cost includes the necessary costs for both the equipment operation and fixed facility use. The required manpower costs are also included. The maintenance cost consists of the routine repair works for maintaining all the facilities in productive order.

The scale of operation cost depends on both the cargo handling method and the cargo volume, while, the maintenance cost is based on the port facility itself. Thus all the existing port facilities requires appropriate operation and maintenance works. Refer to section 12.13.

12.3.2 New Development

(1) Initial Investment Cost (Fixed facilities and Equipment)

The initial investment will consist of both the required costs for fixed facilities and cargo handling equipment for the new investment. Certain investment for the access

improvement will be required to the selected scheme among the existing access upgrading and development of new access. Of course, the largest investment in the proposed Alternative Plan 1 will be undertaken for the construction of new terminals at the west bank of Dorag Channel.

(2) Periodical Purchase Cost (Equipment only)

Certain investment for periodical purchase of equipment should be conducted for the renewal of new investment based on the scheduled length of life of each equipment.

(3) Operation and Maintenance Cost

The new investment will require the necessary cost for its operation and maintenance.

12.4 Basic Condition for Cost Estimation

This section deals with the basic conditions with respect to the construction and cost estimation.

12.4.1 Pricing Policies

The costs consists of all the necessary direct expenses including material, transportation, manufacturing and installation. Direct costs should include various taxes and customs duty. Each cost includes not only such direct costs but also management cost, reasonable over-head and profit. Unit cost of each work component was estimated by the Study Team considering the past experiences on similar type of project together with the cost information provided by PSO, local contractors and material suppliers.

Among the various port facilities, both wharf structure and seawall were roughly designed. However the size of structure may be changed subject to the required modifications during the detailed design stage to come.

12.4.2 Costing Criteria

The cost estimation made in this project are based on the following conditions:

(1) Construction efforts for the Short Term Plan is tentatively scheduled to start at the beginning of 1997 and will be completed by the end of 2000. It is also assumed that the construction efforts for the Long Term Plan will start at the beginning of 2001 and will be completed by the end of 2010.

(2) Estimation is based on the market price as of January 1994.

(3) Customs duty of 40 % on imported construction materials for permanent works are included. However those on imported equipment and materials to be imported merely to the project are excluded.

(4) Various charges to be borne by the contractors are considered. Basic tax component on the cost is assumed as follows.

Net cost (NC)	100%
Social charge on labour cost, (8 - 15%) x 0.2 NC = 1.6 - 3.0% of NC	
Mine tax and port due	0.2% of NC
Subtotal	101.8 - 103.2% of NC
Overhead and profit, 20 25% of subtotal	20.4 - 25.8% of NC
Subtotal	122.2 - 129.0% of NC
Business tax,	5 - 7 % of subtotal 6.1 - 9.0% of NC
Total	128.3 - 138.0% of NC
Average	133% of NC

It is assumed that gross cost after various charges is 133% of the net cost.

(5) Exchange rate for cost estimation is average value between government rate and city market bank rate at the beginning of 1994.
One US dollar = 2,000 Rials

(6) Any compensation for other industries including fishing rights is excluded.

(7) Engineering fee is 10.0% of the initial investment cost.

(8) Physical contingency is 10.0% of the initial investment cost.

(9) Price escalation is not considered.

Any cost for land purchase or rental otherwise for both permanent works and temporary works are excluded as far as their location is within the PSO premises. It is proposed that a part of existing wharf and reclaimed land can be utilized for a temporary construction site free of charge by the contractor. The typical unit price and major construction plants especially for floating equipment are provided in Appendix 2B2 and 2B5 respectively.

12.4.3 Cost Subdivision

(1) Basic procedure

For the evaluation of project feasibility, the following subdivisions in respect of the short term development should be conducted.

a. To estimate the economic cost

- The estimated cost should be divided into both the local cost and foreign cost components.
- Transfer item (or non-eligible portion) such as tax portion and land cost should be excluded.

b. To estimate the unskilled labor cost.
c. To estimate laborer requirement during the construction stages.
Further explanation will be provided in Chapters 14 and 15.

In order to materialize these tasks, all the cost excluding maintenance cost were subdivided by four basic components namely,

"M" Material cost component
Ml: Local material cost
Mf: Foreign material cost
"P" Plant and construction equipment cost component
"L" Labor cost component

As shown in III-3.2 Appendixes III-3, all the unit costs were indicated by these components.

Table 12.4.3.1 shows the share of these components in the case of the new development at West Harbor. these shares will be applied to cost subdivision for the upgrading cost for existing facilities and other works.

Table 12.4.3.1 Typical cost components; New Development at Dorag Bank

Unit: million US$

Work Category	Total	Material Local Ml	Material Foreign Mf	Plant P	Labor L
A. General Works	23.2	1.2	1.2	10.4	10.4
		5%	5%	45%	45%
B. Marine Works	165.5	24.8	41.4	74.5	24.8
		15%	25%	45%	15%
C. On-land Works	85.6	17.1	34.3	17.1	17.1
		20%	40%	20%	20%
D. Building	49.9	5.0	27.4	5.0	12.5
		10	55%	10%	25%
E. Utilities	14.3	0.7	9.3	1.4	2.9
		5%	65%	10%	20%
Total	338.5	48.8	113.6	108.4	67.7
		14.4%	33.6%	32.0%	20.0%

Note: Figures shown above are before adding of the contingency and engineering cost.

(2) Cost subdivision to local/foreign portions

General Background

All the unit costs consist of the combination of the following four items, namely;

a. Materials and equipment for permanent work
b. Plants and machines for construction work
   The required costs for equipment operator, fuel and miscellaneous matters are included.
c. Laborers for construction work
d. Administration management and overheads on construction activities

Each cost item can be broken down into local portion and foreign portion. The local portion means the cost component for purchasing services which is purely available in Iran.

Ordinary laborers and earth/rock materials are typical local ones. Various taxes in Iran are classified into the local portion. The foreign portion, however, is defined as the cost component for purchasing services which is not originally available in Iran. Thus, this should be a part of work or service which will be imported either temporarily or permanently. This includes re-export items such as money transfer out of Iran for the management cost and overheads of the foreign contractor's head office. Typical foreign portion is the cost of the construction equipment, since most of them might be imported to Iran.

Objectives of Cost Subdivision

There are two main reasons, why the local/foreign portion ratio should be studied. This subdivision is essential not only for the evaluation of project feasibility but also for providing necessary information to the international financial institutes, since they generally lend to borrowers of all the foreign portion of the project cost plus a part of local portion subject to the loan criteria.

In order to make possible financing projects with a high local currency portion ratio, the World Bank, ADB and IDB adopted the Pro-rated Local Cost Financing Criteria (hereinafter referred to as "the Criteria") from 1989. The Criteria are also used by OECF, the Overseas Economic Cooperation Fund of Japan.

Under the Criteria, the total loan amount is determined by calculation method as follows:

- The project cost includes the non-eligible portion such as land acquisition cost and taxes.
- The total loan amount shall be within the foreign currency portion, in case that the foreign currency portion is more than the target amount of certain percents (x%) of the project cost.

- In case that the foreign currency portion is less than that target amount, all or a part of the eligible local currency portion can be added to the loan amount however, the total loan amount shall be within x%.
- The target (x%) shall be determined by the economic index of borrower, such as GNP per capita.

It is assumed that the target amount for the project is about 75% of the project cost.

Proposed Method of Cost Subdivision

The following method for subdivision was applied for the project.

	U	=	Ul + Uf
Where,	U	:	Cost
	Ul	:	Local portion in cost
	Uf	:	Foreign portion in cost
	U	=	M + P + K
Where,	M	:	Material
	P	:	Plant component
	L	:	Labor component
	M	=	Mi + Md
	P	=	Pi + Pd
	L	=	Li + Ld
Where,	i	..	Indirect cost components for the management and overheads
	d	..	Direct cost components
	Mi	=	A·M
	Pi	=	A·P
	Li	=	A·L
Where,	A	:	constant value as a percentage to each component taking 5% for A in this project. A = 0.05
Thus,	M	=	Mi + Md = 0.05M + 0.95M
	P	=	Pi + Pd = 0.05P + 0.95P
	L	=	Li + Ld = 0.05L + 0.95L

Considering the local availability of materials, plants and laborers in Iran, it is assumed that:

a. Material cost component can be separated into the local portion and the foreign portion.
b. Required cost component for constructional plants can be recognized as the foreign portion.
c. Required cost component for laborers will be the local portion.
d. It is also assumed that the indirect cost will be classified as the foreign portion.

Thus,	Ul	:	0.95Ml + 0.95L
		=	0.95(Ml + L)
	Uf	=	0.05M + 0.05P + 0.05L + 0.95Mf + 0.95P
		=	0.05(M + P + L) + 0.95(Mf + P)
		=	0.05U + 0.95(Mf + P)

Where, Ml : local portion in material cost component
Mf : foreign portion in material cost component
Ml + Mf = M

Application by Type of Work

Based on the typical cost components shown in Table 12.4.1, standard currency portion ratio is obtained for each type of works. Table 12.4.3.2 shows these application.

Table 12.4.3.2 Applied Cost Components Ratio by Type of Works

Unit: %

Works	Local Material Ml	Foreign Material Mf	Plant P	Labor L
a. Upgrading the existing waterfront facilities	15.0	25.0	45.0	15.0
b. Structural repair	15.0	25.0	45.0	15.0
c. Road and yard pavement	20.0	40.0	20.0	20.0
d. Dredging*	2.0	3.0	90.0	5.0
e. Procurement of cargo handling equipment*	5.0	85.0	5.0	5.0
f. Procurement of navigation aids*	5.0	85.0	5.0	5.0
g. Repair of cargo handling equipment*	5.0	60.0	5.0	25.0

(3) Reduction of taxes and duties, non-eligible local currency

General Background

There are two major items belonging to this category, Business Tax and Customs Duties. Application of these to the project will be as follows:

a. Business tax taking the rate of 6% on the total costs.
Business tax = 0.06/1.06 × U
= 0.057 U
where, U: total costs

b. Customs duties taking the rate of 40% based on the current regulations.
Customs duties = 0.4/1.4 × 0.95Mf = 0.286 × 0.95Mf
= 0.272Mf
where, Mf: Foreign material cost portion

Construction plants and equipment are out of the customs duties, if they are temporarily imported and will be exported after the completion of construction work. The contractor should provide bonds or guarantees ensuring the re-export of them.

c. Miner tax items such as social charge, mine tax and port due are excluded.

It is assumed that all the procurement of cargo handling equipment and navigation aids will be exempted from the import tax and duty.

(4) Unskilled laborer cost: Lu

Unskilled laborers are incorporated in the laborers cost. The rate of their participation depends on the work characteristics. General share of unskilled laborers by type of work will be as follows:

Earth works 50%
Civil works 40%
Building works 40%
Utilities 30%

The share of unskilled laborers in this project is assumed at about 40% of the total direct laborer costs.

$$Lu = 0.4 \times Ld$$
$$= 0.4 \times 0.95L$$
$$= 0.38L$$

where, Lu : Proposed share of unskilled laborer cost
Ld : Direct laborer cost
L : Total laborer cost

12.5 Phasing of Project Implementation

This section deals with the relationship between cost estimation groups and the possible project implementation schedule as discussed in Chapter 11. Upgrading of the existing port facilities will be accomplished as soon as possible after the urgent works including rehabilitation of damaged structures. New development will be conducted to cope with the increase of traffic demands.

Construction and procurement schedule of each project facility and equipment and estimated time ready for their services are as follows:

Table 12.5.1.1 Outline Schedule

Project Components	Financial and Design	Construction and Procurement	Commencement of Services
A. Existing Port Facility			
Short Term Development			
Scope 1, (STD-EF1)	1995-1996	1997	1998
Scope 2, (STD-EF2)	1995-1997	1998-2000	(2000)2001
Long Term Development			
Scope 1, (LTD-EF1)	1997-2000	2001-2007	(2003)2008
Scope 2, (LTD-EF2)	1997-2000	2001-2008	(2003)2009
B. New Development			
Short Term Development			
None	-	-	-
Long Term Development			
Scope 1, (LTD-ND1)	1997-2000	2001-2008	(2996)2009
Scope 2, (LTD-ND2)	2002-2005	2006-2010	(2008)2011

Note: Figure in parenthesis indicates the year for the partial completion of works.

Implementation schedule of the Master Plan will be further refined on the basis of this outline schedule. Basic investment schedule is shown in Table 12.5.2 considering possible preparation periods including finance arrangement, detailed design and construction contract.

The project cost expenditure can be divided into five phases.

- Phase 1: During the undertaking of the urgent rehabilitation plan in the Short Term Development Plan
- Phase 2: During the undertaking of the Short Term Development Plan for existing facility
- Phase 3: During the undertaking of Long Term Development for existing facilities and new development.
- Phase 4: After the completion of Long Term Development

It is preferable that Phase 2 and Phase 3 will be implemented by the year 2000 and 2010 respectively.

Table 12.5.1.2 Basic Investment Schedule

Phase	Year	Project Components					
		Existing Facilities				New Development	
		Short Term Plan		Long Term Plan		Long Term Plan	
		Rehabilitation					
		Scope 1 STD-EF1 (RH)	Scope 2 STD-EF2	Scope 1 LTD-EF1	Scope 2 LTD-EF2	Scope 1 LTD-ND1	Scope 2 LTD-ND2
1	1994	Preparation					
1	1995	Finance	Finance				
1	1996	Design	Design				
1	1997	Construction	Contract	Finance*	Finance*	Finance*	
2	1998	Operation	Construction	-	-	-	
2	1999	-	Construction	Design	Design	Design	
2	2000	-	Construction	Contract	Contract	Contract	
3	2001	-	Operation	Construction	Construction	Construction	
3	2002	-	-	Construction	Construction	Construction	Finance*
3	2003	-	-	Construction	Construction	Construction	-
3	2004	-	-	Construction	Construction	Construction	Design
3	2005	-	-	Construction	Construction	Construction	Contract
3	2006	-	-	Construction	Construction	Construction	Construction
3	2007	-	-	Construction	Construction	Construction	Construction
3	2008	-	-	Operation	Construction	Construction	Construction
3	2009	-	-	-	Operation	Operation	Construction
3	2010	-	-	-	-	-	Construction
4	2011	-	-	-	-	-	Operation
4	2012	-	-	-	-	-	-
4	2013	-	-	-	-	-	-
4	2014	-	-	-	-	-	-
4	2015						
4	2016						
4	2017						
4	2018						
4	2019						
4	2020						
4	2021						
4	2022						
4	2023						
4	2024						
4	2025						
4	2026						
4	2027						
4	2028						
4	2029						
4	2028						
4	2029						
Prospective		1	2	2	2	3	3

Notes
1. Cargo handling equipment and navigation aids are included.
2. "Finance" means preparation and arrangement of financial sources.
3. Cargo review will be conducted during the financial arrangement (*).
4. "Design" means both the required detailed investigation and design.

12.6 Summary of Project Cost

There are three alternative plans for Master Plan of Imam Khomeini port, namely,

Alternative Plan-1

Dorag Channel West Bank Development, the West Harbor together with major upgrading of existing facilities.

Alternative Plan-2

Zangi Channel South Bank Development, the North Harbor together with major upgrading of existing facilities. The scope of upgrading of existing facilities is the same concepts with Plan-1.

Alternative Plan-3

Dorag Channel West Bank Development, the Expanded West Harbor together with minor upgrading of existing facilities. Development at the West Harbor is larger than those of Plan-1 by 50%, thus the required works at the existing facilities is relatively minor than Plan-1.

Detailed discussions on both the arrangement and evaluation of these schemes were given in Chapter 6 and Chapter 7. Thus this section aims at provision of cost aspects on each alternative.

Subdivision of the master plan components into the long term elements and the short term elements was carried out in Chapter 11 based on the priority requirements which should be implemented urgently to meet the estimated traffics in 2000. The short term development scheme is the subject to be evaluated in detail through a feasibility study.

Thus another topic to be discussed in this Chapter should be the cost components in the short term development together with the necessary information for evaluation. Detailed discussion of the short term development will concentrate to Alterative Plan-1 since which is selected by the Study Team for implementation.

12.6.1 Cost Summary for three Alternative Plans

The required initial investment cost for the proposed Alternative Plan-1 is 1,152 million US$. The costs required for both the construction and procurement amounts to 960 million US$ sharing 83.4% of the total costs. The remaining 192 million US$ sharing 16.6% of the total costs is required for both the physical contingency and engineering.

Table 12.6.1.1 shows the cost summary to be required for the initial investment estimated on the best plans among each alternative. It is clear that Alternative Plan-2 is the lowest cost and Alterative Plan-1 has similar characteristics with Plan-3 in respect of the initial investment cost. However Plan-1 was finally selected as the plan to be implemented, the major reasons of this selection are as follows.

a. One of advantages of Plan-2 is ease of port management since all the facilities could be located at the same port area.

b. the largest advantage of Plan-1 is a flexibility to considerable chances to expand another port areas beyond the Master Plan. There is no necessity to construct a new access to the Dorag bank after execution of its Master Plan.

c. One of disadvantages of Plan-2 is increase of the maintenance dredging cost which amounts to 2.3 million US$ for every year.

d. In Plan-2, the deepest berths of DL-14.0 m are allocated at the upper stream. This is simply against the ordinal planning concepts forming one of disadvantages of Plan-2.

More detailed discussions were carried out in Chapter 7.

Table 12.6.1.1 Initial Investment Cost Summary of Master Plan Alternatives

Unit: million US$

Cost Elements	Plan-1	Plan-2	Plan-3
1. Construction Works	770.54 (66.9%)	719.92	771.77
2. CH Equipment and Navigation Aids	189.39 (16.5%)	189.39	189.39
Subtotal (1+2)	959.93 (83.4%)	909.31	961.16
3. Physical Contingency	95.99 (8.3%)	90.93	96.12
4. Engineering Fees	95.99 (8.3%)	90.93	96.12
Total (1 to 4)	1,151.91 (100.0%)	1,091.17	1,153.40

Note: Item (2) includes both costs of the new development and a part of the replacement of existing equipment during the implementation of Item (1).

Among various aspects, the following costs element considerably affect to the required investment cost, though the difference in the total costs is minor.

1) Scale of upgrading of existing facility
2) Site of new development area
3) Route of main access and utility mains to the new development site

Table 12.6.2 shows the cost variation by the main access routes. The total initial investment cost is varying between 1,091 million US$ and 1,237 million US$.

Among these costs, a cost for both the required rehabilitation and urgent upgrading of the existing facilities amounts to 15.87 million US$. This amount will be charged to all the plans. More details on this aspect will be shown in section 12.8 and section 12.10.

There are two basic schemes for the upgrading of existing facilities, namely the major modification and the minor modification. The former scheme amounting to 306 million US$ applying for each Plan 1 or Plan 2 aims to develop an entire upgrading of the old port area consisting of Eastern Jetty, Ore dolphin, Western Jetty and the previous Four Berth Extension areas. In the latter scheme amounting to 199 million US$ applying to Plan 3, the upgrading will be performed at the limited areas.

Thus the required cost to the former is about 54% larger than those of the latter, difference of which amounts to 107 million US$.

New development is basically planned to compensate the balance of port capacity between the total requirement to meet with the cargo demands and the increased capacity after the upgrading of existing facilities. Thus larger investment is required for Plan 3 than those of each Plan 1 or Plan 2 as follows.

Plan 1	318 million US$	100%
Plan 2	389 million US$	121%
Plan 3	426 million US$	125%

Cost difference between the Plan 1 and Plan 3 amounts to 108 million US$. The required cost for Plan 2 exceeds of Plan 1 by 71 million US$ since Plan 2 requires a large volume of dredging works amounting about 20 million cubic meters more at the shallow water of Zangi Channel.

The largest cost difference appears in the required cost for the main access including utility mains to be installed along the access. The selected main access for each plan and its cost are as follows.

Plan 1, by route D5,	131 million US$
Plan 2, by route Z1,	9 million US$
Plan 3, by route D5,	131 million US$

A cost about 85% of the route D5 is for the required cost of two 500 m long bridges over the existing channel. Refer to section 12.14 for the detailed information about the new main access and utility mains. The basic specifications to route D5 will be as follows.

- Starting point will be located at the existing main access to the port area, about four km north of existing gate.
- Approach road to Zangi Channel;
- Zangi Channel crossing by a 500 m long bridge of the ten short span bridges, 50 m each
- North Dorag Channel crossing by a 500 m long bridge of the ten short span bridges, 50 m each
- A road approaching to the West Harbor to the connection point near the channel branch.

While, the route Z1 consists of a short connection access to the existing main access at the northern site of the existing port area. There is no bridge construction.

Four project elements discussed above constitute the total construction works, costs of which by Alternative Plan are as follows.

Plan 1	771 million US$	100%
Plan 2	720 million US$	93.4%
Plan 3	772 million US$	100.1%

The required cost for Plan 2 is the lowest and is less than Plan 1 by 51 million US$.

The required procurement costs of cargo handling equipment and navigation aids amount to 189 million US$ with no difference among the alternative plans.

The total costs both the construction costs and the procurement costs by alternative are as follows.

Plan 1	960 million US$	100%
Plan 2	909 million US$	94.7%
Plan 3	961 million US$	100.1%

The cost of Plan 1 amounts to 960 million US$ and the difference between Plan 1 and Plan 2 is 51 million US$.

Physical contingency is provided to cover the increase of cost due to the various physical factors which are unknown at present. Engineering fees for the detailed design and construction supervision are also considered. Each of them is ten percents of the total costs of construction and procurement.

Grand total costs for each alternative are as follows.

Plan 1	1,152 million US$	100%
Plan 2	1,091 million US$	94.7%
Plan 3	1,153 million US$	100.1%

The cost of Plan 1 amounts to 1,152 million US$ and the difference between Plan 1 and Plan 2 is 61 million US$.

Table 12.6.1.2 Cost Summary of Master Plan Alternatives by Access Route

Unit: Million US$

Cost Elements	Plan-1			Plan-2		Plan-3		
	Access Routes			Access routes		Access Routes		
	D3	D5	D6	Z1	Z3	D3	D5	D6
1. Rehabilitation	15.87	15.87	15.87	15.87	15.87	15.87	15.87	15.87
2. Upgrading Existing Facilities	305.67	305.67	305.67	305.67	305.67	199.07	199.07	199.07
3. New Development	317.89	317.89	317.89	389.33	389.33	425.72	425.72	425.72
4. Main Access and Utilities	128.81	131.11	151.07	9.05	130.44	128.81	131.11	151.07
5. Subtotal (1 to 4)	768.24	770.54	790.50	719.92	841.31	769.47	771.77	791.73
6. Cargo Handling Equipment	177.39	177.39	177.39	177.39	177.39	177.39	177.39	177.39
7. Navigation aids	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00
8. Subtotal (5 to 7)	957.63	959.93	979.86	909.31	1,030.70	958.86	961.16	981.12
9. Physical Contingency	95.76	96.00	97.99	90.93	103.07	95.89	96.12	98.11
10. Engineering Fee	95.76	96.00	97.99	90.93	103.07	95.89	96.12	98.11
Grand Total	1,149.15	1,151.93	1,175.84	1,091.17	1,236.84	1,150.64	1,153.40	1,177.34
Index (%)	(105.3%)	(105.6%)	(107.8%)	(100%)	(113.3%)	(105.5%)	(105.7%)	(107.9%)

12.6.2 Cost Summary for the Stage Development

This subsection deals with the required costs for the stage development, namely the short term development (STD) and the long term development (LTD). These two developments constitute the Master Plan.

Necessary discussion will be carried out for two plans, namely, Alternative Plan 1 and Alternative Plan 2. Table 12.6.2.1 shows the required costs by stage. As indicating in the table, the share of STD is about eleven percents of the total costs, amounting to 124.27 million US$ which can apply both plans. Thus the cost difference in 60.74 million US$ between two plans comes from LTD.

Table 12.6.2.1 Cost Summary of Master Plan Alternatives by Development Stage

Unit: Million US$

	Alternatives	Short Term Development, STD	Long Term Development, LTD	Total Master Plan
Plan 1				
1.	Rehabilitation	15.87	0	15.87
2.	Upgrading Existing Facilities	45.13	260.54	305.67
3.	New Development	0	317.89	317.89
4.	Main Access and Utilities	0	131.11	131.11
5.	Subtotal (1 to 4)	61.00	709.54	770.54
6.	Cargo Handling Equipment	40.55	136.84	177.39
7.	Navigation Aids	2.00	10.00	12.00
8.	Subtotal (6 to 7)	42.55	146.84	189.39
9.	Total (5 and 8)	103.55	856.38	959.93
10.	Physical Contingency	10.36	85.64	96.00
11.	Engineering Fees	10.36	85.64	96.00
12.	Subtotal (10 and 11)	20.72	171.28	192.00
13.	Grand Total (9 and 12)	124.27	1,027.66	1,151.93
	Index (%)	(10.8%)	(89.2%)	(100.0%)
Plan 2				
1.	Rehabilitation	15.87	0	15.87
2.	Upgrading Existing Facilities	45.13	260.54	305.67
3.	New Development	0	389.33	389.33
4.	Main Access and Utilities	0	9.05	9.05
5.	Subtotal (1 to 4)	61.00	658.92	719.92
6.	Cargo Handling Equipment	40.55	136.84	177.39
7.	Navigation Aids	2.00	10.00	12.00
8.	Subtotal (6 to 7)	42.55	146.84	189.39
9.	Total (5 and 8)	103.55	805.76	909.31
10.	Physical Contingency	10.36	80.58	90.94
11.	Engineering Fees	10.36	80.58	90.94
12.	Subtotal (10 and 11)	20.72	161.16	181.88
13.	Grand Total (9 and 12)	124.27	966.92	1,091.19
	Index (%)	(11.4%)	(88.6%)	(100.0%)

12.6.3 Cost Summary for the Short Term Development

This subsection deals with the required costs for the Short Term Development (STD). The required works and procurement for Plan 1 are the same with Plan 2 as follows. The total costs of 124.27 million US$ consists of the local currency portion of 28.78 million US$ sharing 23.2% of the total and the foreign currency portion of 95.49 million US$ sharing 76.8% of the total.

Table 12.6.3.1 Cost Summary of Short Term Development by Currency Portion

Unit: US$

	Works	Local Currency Portion (%)	Foreign Currency Portion (%)	Total
A.	Construction Works			
1.	Rehabilitation,STD-EF1	5.00 (31.5%)	10.87 (68.5%)	15.87
2.	Upgrading Existing Facilities, STD-EF2	14.77 (32.7%)	30.36 (67.3%)	45.13
	Subtotal (1+2)	19.77 (32.4%)	41.23 (67.6%)	61.00
B.	Procurement			
3.	Cargo Handling Equipment	3.85 (9.5%)	36.70 (90.5%)	40.55
4.	Navigation Aids	0.19 (9.5%)	1.81 (90.5%)	2.00
	Subtotal (3+4)	4.04 (9.5%)	38.51 (90.5%)	42.55
C.	Total Works (A+B)	23.81 (23.0%)	79.74 (77.0%)	103.55
D.	Allowance			
5.	Physical Contingency	2.38 (23.0%)	7.98 (77.0%)	10.36
6.	Engineering Fees	2.59 (25.0%)	7.77 (75.0%)	10.36
	Subtotal (5+6)	4.97 (24.0%)	15.75 (76.0%)	20.72
E.	Total Cost (C+D)	28.78	95.49	124.27
	Index (%)	(23.2%)	(76.8%)	(100.0%)

Refer to section 12.9 for more information.

12.7 New Development

This section deals with the required cost for the new development in respect of three alternatives, Plan-1, Plan-2 and Plan-3.

As discussed previously, the new development will be conducted at the new site.

New development of Plan-1 and Plan-3 ... Dorag west bank
New development of Plan-2 ..... Zangi south bank

Both Plan-1 and Plan-2 in respect of the new development have the same port capacity. Eight berths will be newly provided for each. Contrary Plan-3 will be

provided with twelve new berths to play greater roles than the former.

The required costs include various work components as follows.

- General works
  Mobilization, demobilization and site common works
- Marine works
  Dredging, reclamation, seawall, wharf
- On-land works
  Access, yard and storm water drainage
- Building
  Warehouse, transit shed, maintenance shop, weigh-bridge, misc. building, fence, park and landscaping
- Utilities
  Water supply, sewerage system, power supply, lighting, bunker system and telecommunication
- Supplemental work
  Demolishing and removal of existing facilities
- Others
  Rail track and others

Both costs of the new main access and cargo handling equipment are estimated separately, in the section 12.14 and section 12.15. Navigation aids are also separated in Chapter 10.

12.7.1 Cost Summary for New Development

Summary of cost required for each new development plan is shown below. All these development are required only for the Long Term Development (LTD).

Table 12.7.1.1 Cost Summary of New Development

Unit: Million US$

Stage	Plan 1	Plan 2	Plan 3
STD	0	0	0
LTD	317.89	389.33	425.72
Total	317.89	389.33	425.72
Index(%)	(100%)	(122%)	(134%)

As seen in the table, Plan 1 requires the lowest cost among others. Cost of Plan 2 is similar to those of Plan 3 which is the most expensive one.

12.7.2 Preliminary Evaluation

The cost difference between Plan 1 and Plan 3 is simply due to the scale of required works since the port capacity of Plan 3 in respect of the new development is about