14. RECOMMENDATION ON PORT MANAGEMENT AND OPERATION

14.1 Operating System

14.1.1 Iron ore handling

Generally speaking, iron ore cargo handling operations are well conducted by Kudremukh at present. However, it is also true that there is still room for improvement here.

(1) Result of the site survey

The ship performances of iron ore carriers between 1985/86 and 1987/88 are as follows:

Table-14.1.1 Ship performance of iron ore carriers

	85/86	86/87	87/88
1. Total No. of vessels left	54	97	107
2. Total tonnage handled in tonnes	2,260,139	3,873,289	4,327,359
3. Average tonnage per ship	41,854	39,931	40,443
4. Total No. of hours spent by ships	2,505	5,830	6,023
(1) Working hours of vessels left	1,873	3,300	3,622
(2) Idling hours at berth	632	2,530	2,401
5. Average No. of berth hours per ship	46	60	56
(1) Average working hours per ship	35	34	34
(2) Average idling hours per ship	11	26	22
6. Average output per berth hours	902	664	718
7. Average output per working hours by vessels	1,207	1,174	1,195
8. Average pre-berthing time per ship	159	148	130

From the above data it can be said:

i) The cargo volume of iron ore is increasing year by year and the number of iron ore carriers calling is also increasing.

ii) Average ship size is about 40,000DWT.

iii) Average berthing time per ship has increased in the past two years. This is because that idling hours are twice as long as in 1985/86, while cargo handling time has unchanged during the past three years.

iv) Average output in terms of working hours in the past three years was about 1,200 ton/hour. This shows that productivity is low compared with the nominal capacity of the ship loader, which is 6,000 ton/hour.

v) Average pre-berthing waiting time is about 5 days per ship, which must be improved.

(2) Future perspective

It is estimated that the following trends and factors will obtain in the future as Kudremukh is aiming at the establishment of a 7.5 million tonnes' exporting system as soon as possible and estimates that demand for iron ore will be 10 million tonnes in the future:

i) There is a tendency toward larger carriers of iron ore in proportionate with the increase in demand for iron ore. Therefore it is necessary to make larger berths to accomodate larger carriers.

ii) Pre-berthing waiting time will be longer in proportionate to the increased demand for iron ore without any improvement of iron ore handling facilities.

iii) 7.5 million tonnes of iron ore is too much to handle at one berth even if a larger berth is constructed in the future. Therefore it is expected to be a burden for the shiploader and other cargo handling facilities. It is necessary to allow for a large amount of maintenance expenditures.

iv) It is commonly said that the capacity of a stockyard should not be less than 20% of the annual throughput. Therefore it is necessary to have stockyard of this capacity.

(3) Countermeasures

Under the conditions where demand for iron ore increases, as outlined in Chapter 7, and a port plan for larger iron ore carriers is implemented as in Chapter 10, the following countermeasures are needed:

i) It is necessary to improve the chute of the shiploader and expand the stockyard for larger iron ore carriers.

ii) It is necessary to efficiently operate each system in the shiploading process to increase the efficiency of iron ore handling as a whole.

iii) The main cause of idling hours, a part from rain, deballasting and draft check, is mechanical trouble. It is necessary to carry out periodical maintenance/repair of the control system to reduce the incidence of mechanical trouble.

14.1.2 General cargo handling

Currently, cargo handling productivity at the general cargo berths of New Mangalore Port is almost the worst among the major ports in India, which means weakened competitiveness vis-a-vis these ports. This is due to:

a. low cargo handling productivity

b. long non-working time while ships are berthing.

Therefore, an appropriate cargo handling flow system from ship to storage facilities and truck/train, and vice versa, should be established. This system might include adequate usage of handling equipment for prompt conveyance of cargo unloaded from ships to a storage area/shed and vice versa. Additionally, simpification and quickening of the custom and trading procedures are required.

14.1.3 Handling of hanzardous materials and products

Hazardous materials and products, crude oil, oil products and LPG will be handling at the crude jetty and oil product jetty. An adequate distance between the two jetties to ensure safety is guaranteed in the plan. Additionally, an adequate fire extinguisher system should be provided at each jetty. Moreover, it is recommended that a berth master should be put to control hazardous commodity handling and the ship maneuvering.

14.1.4 Navigational aids

After the improvement of the facilities, the length of the channel would be extended to about eight KM. In such a long waterway with limited width only leading lights on the center line of the channel, as are currently installed, is not enough. In addition, advanced navigational aids such as a radio beacon system and flashing light buoys are required.

Moreover, powerful tugboats are needed to attend large vessels such as 100,000DWT iron ore carriers and crude oil takers. The NMPT currently has two 2,000 HP tugs and one smaller oil, and they are not adequate for maneuvering large vessels. So, at least two more powerful tugs of 3,000 HP or so should be procured.

14.2 Maintenance System

14.2.1 Iron ore handling equipment

The handling capacity at the berth depends upon handling machine capacity and working hours which are affected by machine's breakdowns and the time required for maintenance. As stated in chapter 7, the number working days (hours) are expected to increase by 20 days in 1994/95 expanding the handling capacity upto 6800/h (concentrate) and 3500t (pellets). This will result in increased maintenance time.

Possible maintenance procedures are shown below.

(1) Preventive Maintenance System

At the present time, the maintenance organization at K.I.O.C.L. is doing a good job and normally operates under the card system in which a of breakdown record is kept for each shiploading machine.

However, it seems there is too much shiploading work and thus they do not have enough time to maintain the machines systematically. Thus, it is very important to establish a preventive maintenance system that will be able to prevent the sudden breakdown of the machines during shiploading operations.

The procedure to establish the preventive maintenance system is described as follows:

i) Execution of periodic inspection
(Daily, weekly, monthly or annually depending on the items to be checked)

ii) Record card system of parts breakdown

iii) Providing spare parts after estimating the working life of each part

iv) exchanging the main key parts before breakdown, according to the preventive maintenance schedule.

The number of idling hours will be controlled and reduced after applying this preventive maintenance system.

(2) Maintenance of Conveyors

Maintenance of the ore handling equipments of the shiploading system requires a large number of well-trained personnel. They should receive training in the preventive maintenance program to minimize replacement and repair costs.

Because belt conveyor is the most common and essential machine in the whole system, important maintenance points for the conveyors are described as follows:

1) The conveyor belt represents a high proportion of the conveyor's cost. Therefore, it is very important to prevent accidential damage by developing a good maintenance system.

2) Cleaning up of ore spillage is necessary both for safety and reducing the cost of maintenance. A build-up of ore on the conveyor frame will cause the rollers to brake, and a build-up of pellet of the walkway is dangerous.

3) An adequate lubrication program is required so that all rotating parts will have a long life and consume less power. Periodical replacement of the oil in the gear boxes is also important.

4) Inspections before, during and after loading operations are important. Especially, transfer points of the material, such as chute, skirt board and take-up devices, etc., should be watched carefully.

5) A sample checklist for the belt conveyor is shown below:

Table-14.2.1 Maintenance Check List of Belt Conveyor

Location		Inspection Item		Result Yes or No	Inspection Period			
					Daily	Weekly	Monthly	Annually
DRIVE UNIT	Reducer	Irregular Noise			x			
		Irregular Heat			x			
		Vibration			x			
		Gears	Tooth Surface					v
			Wear Condition					v
			Lubrication					v
		Bear-ings Cas-ings	Metal Powder in Oil				x	
			Loose Bolts		x			
		Cas-ings	Volume, Dirt & Quality Change of Lubricant			x		
			Anti-friction Bearing Damage					
		Key	Looseness Deformation					x
			Key Groove Crack					
	Brake	Lin-ing	Abrasion				x	
			Gap to Pulley		x			
		Brake Pulley	Roughness of Surface				x	
			Abrasion			x		

Location		Inspection Item	Result Yes or No	Inspection Period			
				Daily	Weekly	Monthly	Annually
DRIVE UNIT	Coupling	Eccentricity				x	
		Loose Bolt				x	
		Leakage Oil		x			
	Chute	Liner Abasion				x	
		Deformation		x			
		Build-up of Ore			x		
	Cleaner	Gap in belt		x			
		Loose Bolt		x			
	Take Up Unit	Pulley Height		x			
		Belt Tension		x			
		Loose Bolt			x		
FRAME	Roller	Lubrication					x
		Rotation		x			
		Heat from Bearing		x			
		Abrasion		x			
		Noise		x			
		Vibration		x			
		Loose Bolt		x			

Location		Inspection Item	Result Yes or No	Inspection Period			
				Daily	Weekly	Monthly	Annually
FRAME	Belt	Runoff		x			
		Surface Damage		x			
		Speed				x	
	Steel Structure	Crack, Damage or Deform					x
		Rust					v
		Remove Paint Film					v
		Loose Bolt				x	
DISCHARGE POINT	Immpact Roller	Lubrication					x
		Abrasion of Rubber Ring				x	
		Deformed Rubber Ring		x			
		Damage to Roller		x			
		Noise		x			
		Vibration		x			
		Loose Bolt			x		
	Skirt	Abrasion of Rubber Plate			x		
		Gap in Belt			x		
		Loose Bolt		x			

Note : 1) The symbol "v" in the List means the Inspection Period shall be half a year.

14.2.2 Navigational aids

In order to keep the navigational aid equipments mentioned in Chapter 10.3.5 in proper condition, the equipment should be well-maintained. Buoys are apt to be corroded, worn out and adhered to by marine organism. Especially, the anchoring chaines of buoys are especially prone to being worn out in the open sea. Therefore, these buoys should be frequently checked and periodically replaced by spare bouys. This means that parts and spare buoys for the exchange have to be prepared and that a maintenance shop and a storage yard are required at the port.

For this project, more buoys and other equipment will be required and a effective navigational aids maintenance system would be established at New Mangalore Port.

Additionally, detailed maintenance procedures for navigational aid equipments of the are shown in Appendix-14.1.

14.3 Environmental Impact

14.3.1 Disposal of dredged material

(1) Production of turbidity due to construction works and its influence on water quality

Turbidity is produced in an offshore disposal area by the disposal of materials dredged in the channel and the lagoon. This turbidity is in addition to naturally existing turbidity and has some impact on the natural environment.

The amount of maintenance dredging in New Mangalore Port is about 3 million m^3/year at present, and the amount of offshore disposal is the same amount. The dredging operations are carried out between November and February, when dredging efficiency is the highest.

According to Japanese experience in field tests, the production rate of turbidity during the operation of a trailer suction hopper dredger is about 20Kg/m^3 in the case of fine silt material. That is, the amount of suspended material produced in water is 20Kg for the dredging of 1 m^3 of sediment. The amount of suspended material produced by the offshore desposal may be of the same order.

The production rate of turbidity varies considerably due to differences in various conditions, such as soil characteristics when working, oceanographical conditions, etc. Therefore, it is not clear whether the same production rate of turbidity obtained in Japan is applicable to New Mangalore Port or not. However, it is recommended that water quality during construction be monitored, because the present amount of three million cubic meters of material being dredged and disposed is very large. Moreover, the amount of maintenance dredging volume (and accordingly the amount of offshore disposal) has been estimated to be six million cubic meters after the improvement of the Port.

It is recommended that monitoring of water quality be performed in the area near the construction site (site A) and also in the area where no effect of construction is expected (site B). By monitoring the difference in water quality between sites A and B, the influence of construction works on water quality can be examined.

There is a possibility that marine organisms such as plankton, benthic organisms and commercial marine fishes, etc. are affected by turbid water. Therefore, it is recommended that these marine organism be monitored around the channel and the area of offshore disposal, together with SS (suspended sediment) concentration, nutrient elements, dissolved oxygen, and concentration of heavy metals in sediment.

(2) Possible countermeasures

It is necessary to mitigate the production of turbidity as far as possible. One of the ways of suppressing the production of turbidity in Japan is to spread a silt protector, which is somewhat like oil-fences, around the area under construction, and prevent the turbid water from flowing out to the surrounding area by concentrating the turbid water in a small area and promoting the aggregate sinking. To promote this aggregate sinking, some chemical aids can be used.

Besides the spreading of a silt protector, there is a method of preventing turbidity in the dredging area by using a closed grab (turbid water in a grab does not leak outside when a grab is hoisted in the air) dredger. But, in this case, the efficiency of dredging decreases.

It is worth taking into consideration the countermeasures mentioned above.

14.3.2 Extension of the breakwaters

(1) Hindrance of water exchange between the lagoon and the open sea.

It is expected that the water exchange between the lagoon and the open sea will be hindered by the extension of breakwaters. In a report of a bottom sediment survey carried out in 1985 and 1986, the cases of high concentration of organic nitrogen observed occasionally were attributed to the discharges from ships. Iron shows the highest concentration among trace metals, and this is explained by discharges from loading of iron slurry. If the water exchange between the lagoon and the open sea is reduced by the extension of breakwaters, the concentration of organic nitrogen, iron, etc., is expected to increase.

(2) Influence on the surrounding seashore.

Littoral sand drift prevails in the direction from north to south during the southwest monsoon period. In fact even at present, the shoreline on the northern side of the north breakwater protrudes offshore compared with the shoreline of the southern side of the south breakwater, showing that the prevailing direction of sand drift is from north to south. It is believed that the present shoreline is being maintained almost in a state of equilibrium, but there is a possibility that this equilibrium might be disturbed by the further extension of breakwater. On the other hand, the present equilibrium of the shoreline is believed to be maintained by the whole range of oceanographical conditions, including both the southwest and northeast monsoon seasons. In the southwest monsoon season, littoral sand drift prevails in the direction from north to south, but in the northeast monsoon season the opposite direction seems to be dominant. Therefore, the extension of breakwaters might not so seriously disturb the equilibrium of the shoreline.

(3) Possible countermeasures

By extending the breakwaters, it is inevitable that the exchange of water between the lagoon and the open sea will be reduced. If the same load of environmental impact is added to the lagoon as in the case of non extension of breakwater, the environmental conditions will become worse. Therefore, it seems necessary to suppress the disposal of materials into the sea from ships and also to introduce some measures to lessen the disporsal of iron slurry into the sea. Furthermore, the concentration of nutrient salts and heavy metals should be monitored regularly for a long time.

As for coastal conservation, it is useful to continue the present sounding survey operated by the NMPT in the sea area of approximately 5 Km x 7 Km, including the area shallower than -6m. If conspicuous coastal erosion is observed after the completion of the breakwater extension, it may be worth considering some construction of jetties and/or offshore breakwaters along the eroded shoreline.

15. ECONOMIC ANALYSIS

15.1 Purpose and Methodology of the Economic Analysis

15.1.1 Purpose

The purpose of this chapter is to appraise the economic feasibility of the Short-term Plan of New Mangalore Port explained in Chapter 10.

The economic evaluation of a project should show whether the project is justifiable from the economic point of view by assessing its contribution to the national economy.

Thus, the basic purpose of this chapter is to investigate the economic benefits as well as the economic costs which will arise from the project, and to evaluate whether the net benefits exceed those which could be derived from other investment opportunities in India (the opportunity cost of Capital).

15.1.2 Methodology

The economic internal rate of return (EIRR) based on cost-benefit analysis is used in order to appraise the feasibility of the project. In estimating the costs and benefits of the Short-term Plan of New Mangalore Port, "economic pricing" is applied. "Economic pricing" here means the appraisal of costs and benefits in terms of international prices (border prices). Fig. 15.1.1 shows the process of the economic analysis in this study.

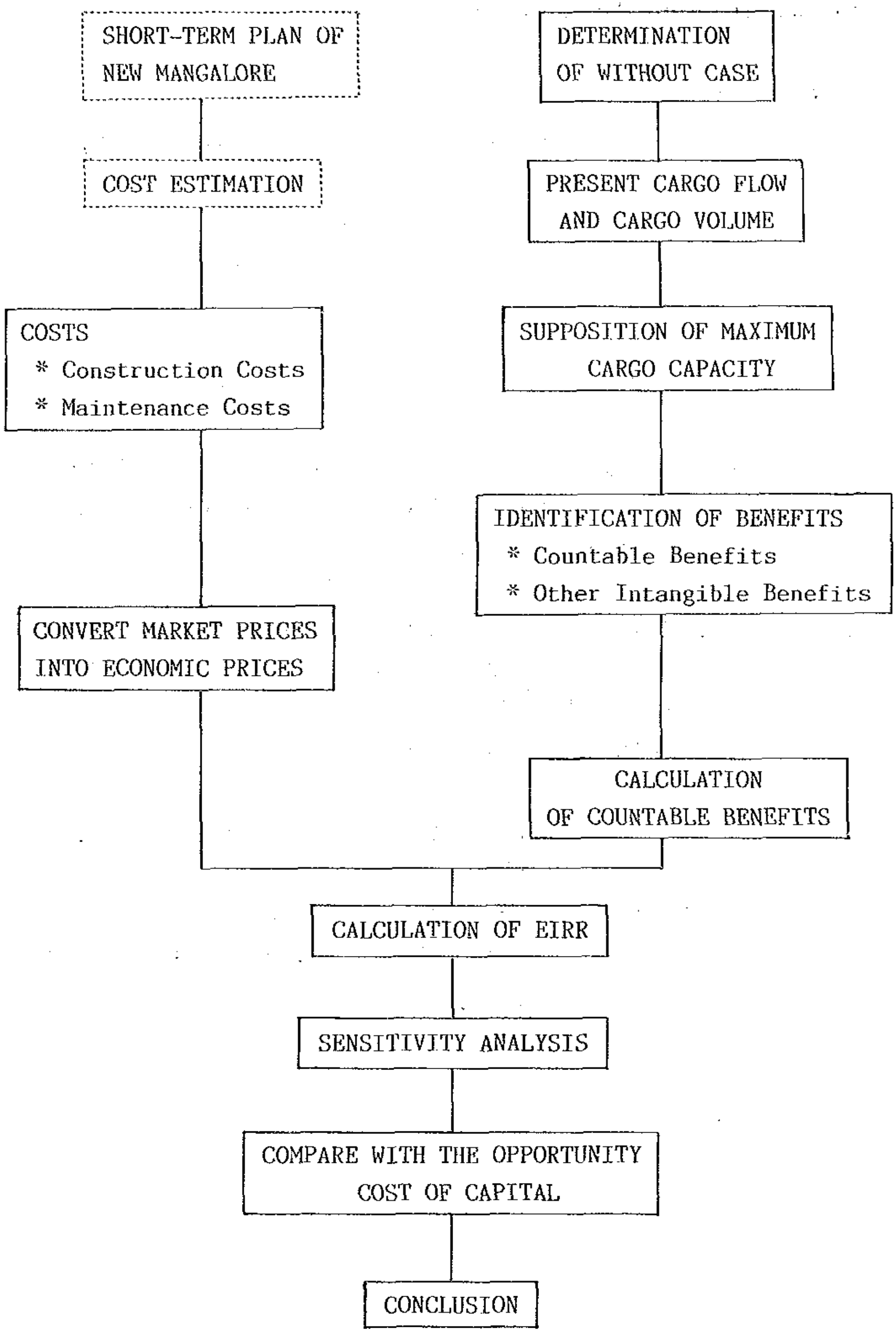


Figure-15.1.1 Process of the Economic Analysis

15.2 Prerequisites of the Economic Analysis

15.2.1 "With" case

As alternative short-term plans are shown in Chapter 10, the major projects of this study are the improvement of the iron ore berth and the oil jetty and extension of the breakwater. We have selected four cases as "With" cases from combinations among the iron ore and oil berths and the breakwater as follows:

Case	Iron Ore Berth	Break Water		Oil Berth	
Case 1	100,000 DWT	North	930 m	Crude Oil	100,000 DWT
		South	930 m	Product Oil	85,000 DWT
	(Improvement of existing berth)				
Case 2	100,000 DWT	North	930 m	Crude Oil	100,000 DWT
		South	930 m	Product Oil	85,000 DWT
	(Breasting Dolphin 231m)				
Case 3	150,000 DWT	North	1,430 m	Crude Oil	150,000 DWT (Outer area)
		South	2,270 m	Product Oil	35,000 DWT
	(Breasting Dolphin 264m)				
Case 4	150,000 DWT	North	1,430 m	Crude Oil	150,000 DWT
		South	2,270 m	Product Oil	35,000 DWT

15.2.2 "Without" case

A cost-benefit analysis is conducted on the difference between the "With" and "Without" investment cases. In other words, incremental benefits and costs arising from the proposed investment are compared, and it is examined whether or not the net benefits generated by the project exceed the opportunity cost of capital in India. Therefore, determining the "Without" case is one of the key points of the economic appraisal. In this study, the following conditions are adopted as the "Without" Case after various possibilities are discussed.

(1) It is assumed that 7,500 thousand tonnes of iron ore can be handled in 1994/95 by improvement of the present mechanical equipment even at the "without" case.

(2) It is assumed that as for oil berths, one additional small jetty that can accommodate up to 35,000 DWT tankers will be constructed in the "without" case instead of the above "with" case.
The construction cost of two small jetties is estimated as 62.7 million rupees.

15.2.3 Base year

The "base year" here means the starting year of the economic evaluation, and therefore the year of 1990 is set as the base year for this study.

15.2.4 Project life

The economic cost/benefit evaluation is carried out starting in 1990/91 and ending 2019/20 (the 30th year from the engineering service starting year, 1990/91)

15.2.5 Foreign currency exchange rate

US $ 1 = Rs 16.75

15.3 Benefit

15.3.1 Benefit items

As benefits brought about by the improvement of New Mangalore Port, the following items are identified (See Appendix 15.1):

1 Savings in ships' staying costs.
2 Savings in freight costs.
3 Savings in time costs.
4 Savings in cargo handling costs.
5 Reduction in damages, accidents and pilferage.
6 Improvement of cargo handling safety.
7 Increase in employment opportunities.
8 Promotion of regional economic development through development of port-related industries and agriculture.
9 Other intangible benefits.

Some of the above-mentioned benefits (4 - 8) are difficult to evaluate in strictly monetary terms.

In this report the two benefits (1 - 3) which can be evaluated monetarily are considered as countable benefits.

15.3.2 Savings in ships' staying costs

The cargo volume of iron ore handled at New Mangalore Port will increase in the future. In our economic analysis the cargo volume of iron ore is equal in the "With" case and the "Without" case, that is 7,500 thousand tonnes in 1994/95. However, if the cargo volume of iron ore were to be handled only by the existing facilities with the present (1988/89) productivity (Without case), then the number of ships waiting for berth space would increase to the point where port congestion would become a serious problem.

Implementing the project will prevent this problem. Investment in improved port facilities will reduce the waiting time for berth space and the time for loading and unloading cargo. The staying time of ships will be reduced, and this cost reduction is a major benefit of the project.

Benefits that will accrue to India from the improved facilities can be calculated by comparing the "With" case with the "Without" case.

The formula used to calculated this benefit is as follows:

Savings in ships' staying costs	=	Difference of Staying time between "With" & "Without" cases	x	Ship cost (Unit cost)	x	Share of benefits accruing to India

(1) Difference of Staying Time

The difference of staying time was estimated as follows:

Table-15.3.1 Staying Time

(Unit : Hours)

	Operation Time			Waiting Time			Total		
	"Without" case	"With" case	Difference	"Without" case	"With" case	Difference	"Without" case	"With" case	Total
Iron Ore	4,090	3,492	598	9,448	3,771	5,677	13,538	7,263	6,275
P.O.L.	4,464	1,452	3,012	9,285	363	8,922	13,749	1,815	11,934

(2) Ship Cost (Unit Cost)

The following table shows the ship staying cost as estimated by a Japanese shipping company.

Table 15.3.2 Ship Cost

	Ship Size (DWT)	Ship Cost (US$/Ship/day)	No. ships calling in 1994/95		Weighted average Ship costs (US$)
			No.	Share(%)	
Iron Ore	10,000	8,980	3	2.2	190
	30,000	11,780	19	14.1	1,660
	50,000	14,290	44	32.6	4,660
	70,000	16,030	34	25.2	4,040
	90,000	18,060	35	25.9	4,680
	Total		135	100.0	15,230
Oil Tanker	65,000	15,590	13	32.5	5,070
	85,000	17,520	10	25.0	4,380
	100,000	19,020	17	42.5	8,080
	Total		40	100.0	17,530

(3) Share of Benefits Accruing to India

The savings in ships' staying costs are primarily realized by shipping companies. For foreign ships, therefore, the benefits accrue to foreign countries. However, some portion of these benefits should be returned to India. It is possible for India to acquire some of the benefits by, for example, increasing tariffs because the service level at the port will be improved or by decreasing freight rates reflecting the reduced incidence of delays at the port. In this study, we assume that 50% of the benefits attributed to foreign ship operators will be transferred to the Indian economy.

The average share of Indian vessels in the country's foreign trade from 1980/81 to 1988/89 is 20%. Therefore, the total benefit to the Indian economy from the reduced staying costs is the sum of the direct benefits (100%) from Indian vessels and the indirect benefits (50%) from foreign vessels.

The formula used to calculate the share of the benefit to India is as follows:

$$\boxed{\text{Share of Benefit to India}} = \boxed{\text{Share of Indian vessels}} \times 100\% + \boxed{\text{Share of foreign vessels}} \times 50\%$$

$$= 20\% \times 100\% + 80\% \times 50\%$$

$$= 60\%$$

(4) Calculation of saving in ship's staying costs

Table-15.3.3 Saving in Ship's Staying Costs

Item	Different of Staying between "With" and "Without" case (days)	Ship cost (US$/ship day)	Share of benefits accruing to India (%)	Exchange Rate (US$1=)	Saving in ships' staying cost (million Rs.)
Iron Ore	261.5	15,230	60	Rs. 16.75	40.0
Oil	497.3	17,530			87.6

15.3.3 Savings on freight costs

Table-15.3.4 shows the calculation result of the savings on freight costs of iron ore carrier and oil tanker.

From this table the saving on freight costs is 104.7 million rupees for iron ore carrier and 127.9 million rupees for oil tanker. We assume that the share of benefits accruing to India is 60 percent of the savings on freight cost. Thus the savings on freight costs, in India is 62.8 million rupees for iron ore carier and 76.7 million rupees for oil tanker.

Table-15.3.4 Savings in Freight Cost

Ship Size (DWT)	Freight Cost (US$/ton)		Cargo Volume (1,000 tonnes)				Saving in freight cost (million Rs.)
			Without case		With case		
	India-Japan	India-other countries	India-Japan	India-other countries	India-Japan	India-other countries	
10,000	12.2	4.9		90		30	4.9
30,000	10.9	4.4		2,310		510	132.7
50,000	9.5	3.9	550	2,100	120	1,860	84.1
70,000	8.2	3.3	2,450		320	1,820	192.0
90,000	6.9	2.8			2,560	280	(-)309.0
Total			3,000	4,500	3,000	4,500	104.7

Ship Size (DWT)	Freight Cost (US$/ton)		Cargo Volume (1,000 tonnes)				Saving in freight cost (million Rs.)
			Without case		With case		
	Mangalore-Middle East	Mangalore-Bombey	Mangalore-Middle East	Mangalore-Bombey	Mangalore-Middle East	Mangalore-Bombey	
35,000	15.9	4.0	1,500	1,500			500.0
65,000	13.3	3.4	-	-	400	350	(-)109.0
85,000	11.7	3.0	-	-	400	350	(-) 96.0
100,000	10.6	2.7	-	-	750	750	(-)167.1
Total			1,500	1,500	1,550	1,450	127.9

15.3.4 Saving in time costs

The reduction of staying time due to the implementation of the project brings about a remarkable reduction in the time required for imports and exports. By the reduction of staying time, the importer/exporter can collect funds faster and have more opportunity to invest the money in other activities and thus the importer/exporter can earn more profit from this working capital. If the reduced time is converted into monetary terms, it can be estimated using the following equation:

$$STC = Q \times D \times V \times I/365$$

Where, Q : Average parcel size (tons/ship)
D : Reduction of ships' staying time (days)
V : Average cargo value (US$/ton)
I : Interest rate of funds (%/year)

Table 15.3.5 presents the estimated saving in time costs by imports and exports.

Table-15.3.5 Savings in Time Costs

	Average Parcel Size (Tons/vessel)	Cargo Value (US$/ton)	Interest Rate (%)	Different of Staying time between "With" & "Without" case	Savings in time cost (million Rs.)
Iron Ore	28,000 (Concentrate)	13.0	8	261.5 days	0.3
	28,000 (Pellets)	30.0	8	261.5 days	0.8 (Total) 1.1
P.O.L.	75,000	164.2	8	497.3 days	22.5

15.4 Costs

The costs considered in this section are construction costs of the iron ore and, oil berths, breakwater and iron ore handling equipment, dredging costs, maintenance costs and operating costs.

15.4.1 Construction costs

The annual construction costs, estimated at market prices, are shown in Chapter 13.

15.4.2 Dredging costs

Capital dredging costs, estimated at market prices, are shown in Chapter 13.

15.4.3 Maintenance costs and operating costs

The maintenance costs and operating costs per year for the facilities are assumed to be 1.0 percent of the original investment, excluding consultant services.

The maintenance dredging costs per year are shown in Chapter 13.

15.5 Economic Pricing

15.5.1 Methodology

(1) Introduction

The purpose of the economic analysis is to examine the value of a project, that is, to see if it represents an efficient allocation of resources. The values of goods quoted at a given market price do not always represent the true value of those goods to the nation. Thus, planners often use "economic pricing" to examine the costs of labor, capital, and imported goods, as well as the benefits of development, to evaluate a project from the economic viewpoint.

All the costs and benefits examined in previous sections have been calculated based on market prices (world prices and domestic prices). There are several ways of applying the concept of economic pricing, but in this study, the prices of domestic goods and service are revised to border prices in an effort to determine a more rational valuation. In general, these border prices are intended to represent the international market value, or world prices, of these goods and services.

(2) Method for converting to Economic Prices

In general, all the costs and benefits are divided into three categories: tradable goods, non-tradable goods and labour.

The prices of tradable goods are expressed in CIF values for import goods. These are actual border prices.

In contrast, however, non-tradable goods are generally valued at domestic market prices adjusted for taxes and subsidies. That is, import duties and export subsidies create a price differential between the domestic market and the international market. For the purpose of analysing benefits and costs within the domestic market, the standard conversion factor is applied in order to convert domestic market prices to border prices.

Because of minimum wage laws, regulations, and other inflexibilities, wages actually paid may not be a correct measure of the real costs of labor-the value of the marginal output of labor forgone elsewhere because of its use in the project. In an economy marked by extensive unemployment or underemployment, the real costs of labor used in the project may be less than actual wage rates. When this is a widely prevailing condition that is likely to remain for some time, the cost of unskilled labor should be calculated at less than actual wage payments. In other instances, the real costs of skilled labor may be greater than the wages paid, and shadow pricing should be applied accordingly.

Thus the following formulas are used to convert from market prices to border prices:

Item	Border Prices (MP: Market Price)
Skilled Labour	MP x CFC (Conversion Factor for Consumption)
Unskilled Labour	Norminal Wage Rate x Shadow Wage Rate x CFC
Imported Goods	CIF (Imports) x 1.0
Exported Goods	FOB (Exports) x 1.0
Non-Tradable Goods (Local Materials/ Equipment)	MP x SCF (Standard Conversion Factor)

15.5.2 Calculation of conversion factors

(1) Standard Conversion Factor (SCF)

Import duties and export subsidies create a price differential between the domestic market and the international market. For the purpose of analysing benefits and costs within the domestic market, the standard conversion factor is applied in order to convert domestic market prices to border prices.

The standard conversion factor is the reciprocal of the shadow exchange rate, and is obtained by the following formula:

$$SCF = \frac{1}{\text{Shadow Exchange Rate}}$$

The shadow exchange rate in India is set as 1.25 because India recommends the application of the shadow value of foreign exchange as 25%. Therefore in this study the "Standard Conversion Factor" (SCF), 0.80 is adopted.

$$SCF = \frac{1}{1.25} = 0.80$$

Note: When "The comprehensive study on the development of Calcutta and Haldia dock systems of Calcutta Port Trust in India" was conducted from 1988 to 1989, India recommended the application of the shadow value of foreign exchange at 25%.

(2) Conversion Factor for Consumption (CFC)

This factor is used for converting the prices of consumer goods from domestic market prices to border prices. This is required to convert domestic labour costs to the corresponding border prices. In this study, the conversion factor for consumption is set as equivalent to the standard conversion factor.

CFC = SCF = 0.80

(3) Conversion Factor for Skilled Labour

The cost of skilled labour is calculated based on actual market wages, assuming that the market mechanism is functioning properly. However, as these are domestic costs, they are converted to border prices by multiplying the local wage by the conversion factor for consumption (CFC). Thus, the conversion factor for skilled labour

= (Local Market Wage Rate) x (CFC)
= 1 x (CFC)
= (CFC)
= 0.80

(4) Conversion Factor for Unskilled Labour

The costs of unskilled labour does not always reflect a correct measure of the real cost of the labour because of minimum wage and other regulations. In an economy marked by extensive unemployment or unemployment, the real costs of labour used in the project may be less than actual wage rates. Therefore the cost of unskilled labour should be calculated at less than the actual wage rate.

When a project is conducted, the inflow of unskilled labour to the project is mainly from the agricultural sector, which is relatively elastic in its use of labour. Therefore it is proper that the cost of unskilled labour be set as equivalent to the income level (Opportunity cost) of workers in the agricultural sector.

Thus, the conversion factor for unskilled labour

= (Norminal wage) x 0.688 x (CFC)
= 1 x 0.688 x 0.80
= 0.55

	Unit	GDP	Agricultural Sector
Amount at 1970/71 prices	Crores Rs.	50,705	21,103
Number of workers	Lahk persons	2,466	1,480
Per capita	R.s.	2,073	1,426

Source: India A Statistical Outline 1987

15.5.3 Conversion from market price to border prices

Subtracting the 9% sales tax from material/equipment of domestic currency and using conversion factor of 15.5.2, it is possible to calculate the border prices of the construction costs of a short-term project. Table 15.5.1 shows the border prices of the construction costs and Table 15.5.2 shows the annual investment schedule in border prices.

From 15.2.2, the "Without" case, it is assumed that as for oil berths, two additional small jetties that can accommodate up to 35,000 DWT tankers for one jetty will be constructed in 1993/94 in the "Without" case. The construction cost of the two small jetties is estimated at 62.7 million rupees at market prices and 51.30 million rupees at border prices. Thus we substrate 51.30 million rupees from the total construction cost (border prices) in 1993/94.

For maintenance dredging costs, the same method was used for converting market prices to border prices. In addition, maintenance dredging costs were compared in terms of the "With" and the "Without" cases subtracting that of the "Without" case from that of the "With" case. Table 15.5.3 shows the border prices of maintenance dredging costs.

Table-15.5.1 Construction Costs (Border Prices)

(Unit: 1,000 Rs.)

Item	Total Cost	Foreign Currency	Domestic Currency			
			Total	Materials Equipment	Skilled Labour	Unskilled Labour
Survey Consultant Work	7,380	7,380	0	0	0	0
Iron Ore Berth	30,881	19;431	11,450	9,452	1,030	968
Production Oil Berth	44,694	14,370	30,324	25,037	2,718	2,569
Crude Oil Berth	29,301	10,040	19,261	15,903	1,726	1,632
Breakwaters (Southern)	73,523	0	73,523	70,130	2,011	1,382
Breakwaters (Northern)	75,606	0	75,606	72,116	2,068	1,422
Dredging(Channel)	174,388	63,154	111,234	60,700	50,534	0
Dredging(Lagoon)	203,584	107,180	96,404	55,230	41,022	152
Dredging (Soft Rock)	33,851	29,058	4,793	4,415	371	7
Dredging (Hard Rock)	176,110	158,821	17,289	15,103	2,186	0
Navigation Aids	31,800	31,800	0	0	0	0
Tug Boat	41,430	41,430	0	0	0	0
Contingency(5%)	46,127	24,133	21,994	16,404	5,183	407
Sub-total	968,675	506,797	461,878	344,490	108,849	8,539
Handling Equipment (Shiploader)	2,857	1,266	1,591	670	921	0
Handling Equipment (Conveyor)	83,031	42,578	40,453	25,551	9,206	5,696
Handling Equipment (Stock Shed)	79,375	0	79,375	53,196	12,888	13,291
Contingency (5%)	8,263	2,192	6,071	3,971	1,151	949
Sub-total	173,526	46,036	127,490	83,388	24,166	19,936
Total	1,142,201	552,833	589,368	427,878	133,015	28,475

Table-15.5.2 Annual Investment Schedule (Border Prices)

(Unit: Million Rs.)

		1990/91		1991/92		1992/93		1993/94	
		Foreign	Domestic	Foreign	Domestic	Foreign	Domestic	Foreign	Domestic
Survey/Consultant Work		2.06		1.7		3.62			
Iron Ore Berth								19.43	11.45
Product Oil Berth						14.37	30.32		
Crude Oil Berth								10.04	19.26
Breakwaters	Southern				20.60		35.28		17.64
	Northern				21.12		36.32		18.16
Dredging	Channel					21.05	37.08	42.10	74.15
	Lagoon			107.18	96.40				
	Soft Rock			29.06	4.79				
	Hard Rock			52.94	5.77	105.88	11.52		
Navigation Aids								31.80	
Tug Boats								41.43	
Contingency	5%	0.10		9.54	7.37	7.25	7.60	7.24	7.02
Total		2.16		200.42	156.05	152.17	158.12	152.04	147.68
Handling Equipment	Shiploader							1.27	1.59
	Conveyor							42.58	40.45
	Stock Shed						39.69	0.00	39.69
Contingency	5%					0.00	1.99	2.19	4.08
Total (including Handling Equip.)		2.16		200.42	156.05	152.17	199.8	198.08	233.49

Table-15.5.3 Maintenance Dredging Cost (Border Prices)

(Unit: 1,000 Rs.)

		Total Cost	Foreign Cost	Domestic Currency			
					Materials Equipment	Skilled Labour	Unskilled Labour
"Without" Case	P	37,404	13,500	23,904	13,104	10,800	0
"With" Case	B	92,763	33,717	59,046	32,165	26,881	0
	A1	48,293	17,430	30,863	16,919	13,944	0
	A2	60,262	21,750	38,512	21,112	17,400	0

P : Present maintenance dredging

B : The year just before starting the capital dredging

A1: The first year after the completion of the proposed project

A2: From the second year after the completion of the proposed project

Therefore, annual maintenance dredging costs are as follows:

Annual Maintenance Dredging Costs (Border Prices)

(Unit : Million Rs.)

Year	"With" case	"Without" case	Net maintenance dredging costs
1990/ 91	92.76	37.40	55.36
91/ 92	37.40	37.40	0
92/ 93	37.40	37.40	0
93/ 94	37.40	37.40	0
94/ 95	48.29	37.40	10.89
95/ 96	60.26	37.40	22.86
	≀	≀	≀
2019/2020	60.26	37.40	22.86

15.6 Evaluation

15.6.1 Calculation of the EIRR

As mentioned in Section 15.1.2, the economic profitability of the project is evaluated in terms of the economic internal rate of return. The internal rate of return is a discount ratio satisfying the following equation.

$$\sum_{i=0}^{n} \frac{Bi - Ci}{(1 + r)^{i}} = 0$$

Where, Bi: Benefit at i-th year
Ci: Cost at i-th year
r: Rate of discount
n: Period of Economic Calculation

The EIRR of the Short-term Plan(Case 1) is calculated as 22.9% (See Appendix 15.2) The leading view is that a project is feasible if the EIRR exceeds the opportunity cost of capital, which is estimated to be 12% in developing countries according to the IBRD and the ADB (Appendix 15.3).

According to this standard, this project is considered feasible.

15.6.2 Sensitivity analysis

(1) Identification of Cases

In order to see if the project is still feasible when some factors are varied, several cases are examined as follows.

Case A : The construction costs are increased by 10%.
Case B : The benefits are decreased by 10%.
Case C : The construction costs are increased by 10% and the benefits are decreased by 10%.

(2) Results

The results of the sensitivity tests are shown in Table 15.6.1.

Table-15.6.1 Sensitivity Analysis for EIRR

Case	EIRR (%)
Base Case	22.9
Case A : Increase in Costs by 10%	20.7
Case B : Decrease in Benefits by 10%	20.3
Case C : Increase in Costs by 10% and decrease in benefits by 10%	18.3

In addition to the above sensitivity analysis for Case 1, we also conducted the calculation of EIRR for Case 2, 3 and 4 (See Appendix 15.4). These four cases are feasible from the point of the national economy based upon the EIRR of the project. But it is only feasible for Case 1 and infeasible for Case 2, 3 and 4 from the point of FIRR; Financial Internal Rate of Return (See Chapter 16).

We also conducted the calculation of EIRR for the case which is same with Case 1 except not constructing oil berth.

In this case EIRR is 2.55%, that is, this project is infeasible from the point of the national economy.

15.6.3 Conclusion

The Short-term Plan is judged to be feasible from the viewpoint of the national economy based upon the EIRR of the project as well as the uncountable benefits arising from this project.

16. FINANCIAL ANALYSIS

16.1 Purpose of the Analysis

The purpose of the analysis is to examine the viability of the project itself and the financial soundness of the NMPT during the project life.

The viability of the project itself is analyzed using the Financial Internal Rate of Return calculated by means of the Discount Cash Flow Method.

The financial soundness of the NMPT is appraised using the projected financial statements.

16.2 General Prerequisites of the Analysis

(1) Project Life

Based on the same factors as the economic analysis, the project life for the financial analysis is determined as 30 years, consisting of 5 years of detailed design and construction and 25 years of operation.

(2) Base Year

For the estimation, all costs, expenses and revenues analyzed here are indicated in prices as of 1989/90, when the price survey was conducted. Neither inflation of prices nor the nominal increase of salaries are considered during the project life.

(3) Cargo Volume

The cargo volume that can handled through the proposed project, i.e. the "With Case", is assumed to reach the maximum capacity at the iron ore berth and oil jetty at the end of the short-term plan period, i.e. 1990/1995, and the same volume will be handled continuously thereafter.

In the "Without Case", it is assumed that the cargo handling capacity will basically reach the limit at the beginning of the planning period, 1994/95.

The assumptions are listed below:

In 1994/95	"Without case"	"With case"
Iron ore	6,200,000 t	7,500,000 t
Crude oil	1,600,000	3,000,000
P.O.L.	800,000	1,570,000
L.P.G.	0	200,000

(4) Costs/Expenses

1) Investment

The initial investment is estimated in Chapter 15 and the import tax on the proposed project is assumed to be 90 % for foreign procurements.

However, the impact of the import tax on the proposed project is analyzed taking into account the fact that a different import tax rate con be applied to public sector projects.

2) Re-investment

The facilities and equipment will be renewed based don their service lives, which are shown in the following table:

Table-16.2.1 Service lives of Port Facilities

Facility	Service life
Wharf & Jetty	50
Breakwater	50
Capital Dredging	100
Tugboat	30
Navigational Aid	8

The expenditures for renewal are considered as re-investments and will be financed by the NMPT's internal resources.

3) Operating and Maintenance Expenses

The annual operation and maintenance costs of the NMPT are set as follows:

Operating and maintenance costs of the facilities related to the project are set as 1% of the original construction costs.

Operating and maintenance costs of other facilities are set considering the correlation with the annual cargo handling volume of the port.

4) Depreciation

The annual depreciation costs of the proposed project are calculated by the straight line method based on their service lives. Residual values of the project-related items are considered as a negative investment cost at the end of the project life.

16.3 Viability of the Project Itself

(1) Based for the Appraisal

1) FIRR

The viability of the project is analyzed based on the Discount Cash Flow method and appraised by the FIRR, which makes the costs and the benefits during the project life equal. The FIRR is calculated using the following formula:

$$\sum_{1=i}^{n} \frac{Bi - Ci}{(1 + r)^{i-1}} = 0$$

Where N : Project life

Bi : Benefit in the i-th year

Ci : Cost in the i-th year

r : Discount rate

2) The Costs and Benefits that are taken into account for the calculation of the FIRR are summarized as follows:

Costs	Benefit
Initial investment cost including re-investment for renewal	Port operating revenue Residual value of the fixed assets at the end of the project life
Operating cash expenses including maintenance dredging cost	

3) Costs and Benefits that are exempted from the calculation of the FIRR are summarized as follows:

Cost	Benefit
Depreciation cost	Fund management income
Repayment of the loan principal	
Interest on loans	

4) Tariff Increase

Three cases are considered as follows:

(a) No tariff increase during the Short Term Development Plan period,

(b) 10% after the implementation of the project (from 1994/95)

(c) 20% 10 years after the implementation of the project (from 2,000/1)

16.4 Results

(1) FIRR

Based on the prerequisites of the financial analysis and the viability of the project, the FIRR of each case is as follows:

Table-16.4.1 Results of FIRR Calculation

Case	FIRR
No tariff increase (Case-a)	8.6%
10% increase from 1994/95 (Case-b)	12.5%
20% increase from 2000/01 (Case-c)	12.3%

Case-b is set as a Base Case in the following examination.

(2) Sensitivity Analysis

In order to see if the project is still feasible when some factors vary, several cases are examined as follows:

Case a: The construction costs increase by 10%

Case b: The benefits decrease by 10%.

Case c: The construction costs increase by 10% and the benefits decrease by 10%.

The results of the sensitivity tests are shown in the following table:

Table-16.4.2 Sensitivity Analysis for FIRR

Case	FIRR(%)
Base Case	12.5
Case a: Increase in Costs by 10%	11.4
Case b: Decrease in Benefits by 10%	11.0
Case c: Increase in Costs by 10% and Decrease in Benefits by 10%	10.0

16.5 Financial Soundness of the NMPT

(1) Indices

The financial soundenss of the NMPT is appraised using the following indices calculated based on the projected financial statements.

Working Ratio and Operating Raatio for the appraisal of the soundness of contnuing operations

Return on Net fixed Assets for the assessment of earning power

(2) Scenario

In order to examine the impact of various factors on the indices employed, a Fund Raising Plan is set up as follows;

i) Foreign currency

Necessary funds for the project are covered by Government Loans

Interest Rate: 10.5%

Grace Period: 5 years

Repayment Period: 20 years

ii) Local currency

Source: Reserves of the NMPT

Any cash shortage should be covered by short-term loans with an interest rate of 10.5% per annum.

(3) Results

The financial soundness of the NMPT is appraised based on its projected financial statements (profits and losses statement, cash flow statement and balance sheet). The appraisal is made from the viewpoints of profitability, loan repayment capacity and operational efficiency.

i) Profitability

The rate of return on net fixed assets is calculated as follows:

$$\frac{\text{Net operating income}}{\text{Total fixed assets}} \times 100\ \%$$

This indicator shows the profitability of the investment, which is presented as the net total fixed assets. It is necessary to Keep the rate above the average interest rate of the total funds for the investment.

The Results of the rate of return on net fixed assets are listed below:

Table-16.5.1 Result of Rate of Return on Net Fixed Assets

Year	Profitability
1987/88	6.1%
1994/95	15.14
2000/01	16.10
2010/11	19.15
2019/20	23.54

The rate of return on net fixed assets is less than the average interest rate of the total funds until 1994/95, but after 1995/96 the rate of return will exceed the average interest rate.

ii) Operational efficiency

The operating ratio is calculated suing the following formula:

$$\frac{\text{Operating expenses}}{\text{Operating revenues}} \times 100\ \%$$

The working ratio is calculated as follows

$$\frac{\text{Operating expense} - \text{Depreciation cost}}{\text{Operating revenues}} \times 100\ \%$$

The operating ratio shows the operational efficiency of NMPT and the working ratio shows the efficiency of the routine operation of the port.

When the calculated operating ration is less than 70-75% and the working ratio is less than 50-60%, the operation of the port is efficient.

The results of the operating ratio and the working ratio are shown in the following tables:

Table-16.5.2 Result of Operating Ratio

Year	Operation Ratio
1987/88	67.1%
1990/91	54.0
1991/92	49.1
1992/93	45.6
1993/94	52.6
1994/95 -	49.2

Table-16.5.3 Result of Working Ratio

Year	Working Ratio
1987/88	58.8&
1990/91	49.0
1991/92	44.9
1992/93	42.0
1993/94	49.5
1994/95 -	43.0

Both the operating ratio and the working ratio remain at favorable levels. The operating ratio is less than 60% from 1990/91 the working ratio constantly maintains a low level, under 60%.

ii) Loan repayment capacity

Debt service coverage ratio:

$$\frac{\text{Net operating income before depreciation}}{\text{Repayment of and interest on long-term loans}}$$

This indicator shows whether the operating income can cover the repayment of the interest on long-term loans, and must be more than 1.

Table-16.5.4 Result of Debt Service Coverage Ratio

Year	Debt Service Coverage Ratio
1987/88	10.64
1994/95	2.23
2000/01	1.75
2010/11	3.19
2019/20	-

(No long-term loans)

The debt service coverage ratio exceeds 1.0 from the beginning of the project life. There will be no problem with the repayment of the long-term loans using the annual operating revenues.

The financial statement of the NMPT is listed in Table-16.5.5.

(4) Conclusions

Judging from the above analysis, this project is financially feasible for the NMPT.

However, it is recommended that the following measures be taken in order to improve the financing during the project life in view of the current political situation, the economy and the cost of the future development of the port.

i) The re-lending rate on the long-term loans from the government to the NMPT should be kept as low as possible.

ii) NMPT should maintain its efforts to secure a sufficient cargo volume and improve cargo handling efficiency from now on.

iii) Tariffs

Since the tariffs at New Mangalore Port such as port dues, berth hire charge, wharfage, etc., were raised in April, 1990, the financial status of the port trust has improved. Financial analysis made in this report shows that the FIRR of the proposed project is calculated to be about 8% under new current tariff conditions. If more FIRR, for instance 12% is required, the tariffs will have to be raised by 10% from fiscal year 1994 when improved facilities are commissioned, or by 20% from fiscal year 1999.

The iron ore berth is being used exclusively by the K.I.O.C.L. in spite of having been constructed as a public berth. Again, the crude oil and oil products jetties will be in a similar situation. As the exclusive users will enjoy the convenience of exclusive use, the possibility of imposing special tariffs or charging the users part of the berth construction costs can be examined.

iv) Financial Aids for Non-profitable Public facilities

A port works only when several basic facilities, such as breakwaters, channels, basins, wharves, handling equipment, etc., have been prepared. Of these facilities, the breakwater, channel and basin are expensive and at the same time do not generate profit on their own. On the other hand, a great deal of demand for labor during construction of these facilities would be produced, production demands would be stimulated in industries that supply materials and construction equipment, course other forms of demand would be stimulated in the service sector. In other words, the economic effects of the construction of these facilities would spread nation-wide. Therefore, part of the capital for construction/maintenance of the breakwater, channel and basin could be supplied by the national government. Subsidies, low-interest loans, tax exemptions, etc., are possible policies. Moreover, these policies could be also applied to facilities essential to exports, for instance, the iron ore berth in this project.

As a reference financial arrangements for port development in Japan is listed in Appendix 16.4.

Table-16.5.5 Financial Statement

PROFITS AND LOSSES	90	91	92	93	94	95	96	97	98	99
Operating Revenue	332,177	397,194	462,242	527,291	592,340	592,340	592,340	592,340	592,340	592,340
Working Expense	162,875	178,670	194,465	260,880	239,855	254,835	254,835	254,835	254,835	254,835
Depreciation	16,408	16,408	16,408	16,408	36,465	36,465	36,465	36,465	36,465	36,465
Total Operating Expense	179,283	195,078	210,873	277,288	276,320	291,300	291,300	291,300	291,300	291,300
Operating Income	152,894	202,116	251,369	250,003	316,020	301,040	301,040	301,040	301,040	301,040
Non-Operating Income	21,439	23,670	25,903	28,137	31,435	31,435	31,435	31,435	31,435	31,435
Interest on Long Term Debt	27,730	26,579	68,175	105,302	140,694	139,167	137,641	136,103	132,414	128,792
Interest on short term debt	0	0	0	0	0	0	0	0	0	0
Other Non-Operating Expense	47,618	47,618	47,618	47,618	47,613	47,618	47,618	47,618	47,618	47,618
Net Income	98,985	151,589	161,479	125,220	159,143	145,690	147,216	148,754	152,443	158,065
BALANCE SHEET										
ASSETS	1,299,172	1,719,371	2,018,741	2,295,859	2,370,210	2,501,146	2,630,503	2,740,912	2,836,172	2,919,088
Current Assets	257,432	284,021	231,341	173,039	283,427	450,500	615,894	762,540	893,937	1,012,990
Cash & deposits	169,028	178,805	109,305	34,182	127,483	294,556	460,051	606,596	737,993	857,046
Other current assets	88,404	105,216	122,036	138,857	155,944	155,944	155,944	155,944	155,944	155,944
Fixed Assets	1,041,740	1,435,350	1,787,400	2,122,920	2,086,783	2,050,646	2,014,509	1,978,372	1,942,235	1,906,098
Depreciable Assets	1,061,401	1,471,479	1,839,937	2,191,865	2,192,193	2,192,521	2,192,849	2,193,177	2,193,505	2,193,833
Accumulated depreciation	61,562	77,970	94,378	110,786	147,251	183,716	220,181	256,646	293,111	329,576
Net depreciable assets	999,839	1,393,509	1,745,559	2,081,079	2,044,942	2,008,805	1,972,668	1,936,531	1,900,394	1,864,257
Non-Depreciable Assets	30,972	30,972	30,972	30,972	30,972	30,972	30,972	30,972	30,972	30,972
Other fixed Assets	10,869	10,869	10,869	10,869	10,869	10,869	10,869	10,869	10,869	10,869
Equities and Liabilities	1,299,172	1,719,371	2,018,741	2,295,859	2,370,210	2,501,146	2,630,503	2,740,912	2,836,172	2,919,088
Liabilities	387,087	655,697	793,588	845,588	860,694	845,940	828,081	789,738	732,553	657,404
Current Liabilities	48,142	132,577	135,743	153,146	85,699	88,390	88,084	87,777	87,039	85,915
Short term debt	0	0	0	0	0	0	0	0	0	0
Other current liabilities	48,142	132,577	135,743	153,146	85,699	88,390	88,084	87,777	87,039	85,915
Fixed liabilities	338,945	523,120	657,845	792,440	774,995	757,550	739,997	701,959	645,514	571,489
Long Term Debt	338,945	523,120	657,845	792,440	774,995	757,550	739,997	701,959	645,514	571,489
Other fixed Liabilities										
Equities	16,543	16,543	16,543	16,543	16,543	16,543	16,543	16,543	16,543	16,543
Reserves	796,557	895,542	1,047,131	1,208,810	1,333,830	1,492,973	1,638,863	1,785,879	1,934,633	2,087,076
Net Income	98,985	151,589	161,479	125,220	159,143	145,690	147,216	148,754	152,443	158,065
CASH FLOW										
Balance brought forward	160,630	169,028	178,805	109,305	34,182	127,483	294,558	460,051	606,596	737,993
Cash in										
Operating income	152,894	202,116	251,369	250,003	318,020	301,040	301,040	301,040	301,040	301,040
Depreciation	16,408	16,408	16,408	16,408	36,465	36,465	36,465	36,465	36,465	36,465
Equity increase	0	0	0	0	0	0	0	0	0	0
Long term loans	2,180	200,420	152,170	152,040						
Non operating income	21,439	23,670	25,903	28,137	31,435	31,435	31,435	31,435	31,435	31,435
Increase of other current liabilities	-2,518	84,435	3,166	17,402	-87,447	2,891	-305	-308	-738	-1,124
Increase of other fixed liabilities	0	0	0	0	0	0	0	0	0	0
Cash in total	180,383	527,049	449,018	483,980	318,473	371,631	368,635	368,832	368,202	367,816
Cash out										
Investment	2,488	410,018	366,458	351,928	328	328	328	328	328	328
Repayment for long term loans	15,745	16,245	17,445	17,445	17,445	17,445	17,553	38,038	56,445	74,025
Interest on long term loans	27,730	26,579	68,175	105,302	140,694	139,167	137,641	136,103	132,414	128,792
Interest on short term loans	0	0	0	0	0	0	0	0	0	0
Increase of other current assets	88,404	16,812	16,820	16,821	17,087	0	0	0	0	0
Increase of other fixed assets	0	0	0	0	0	0	0	0	0	0
Other non operating expense	47618	47618	47618	47618	47618	47618	47618	47618	47618	47618
Cash out total	181,985	517,272	518,516	559,114	223,172	204,558	203,140	222,087	236,805	248,763
Cash inflow-outflow	8,398	9,777	-69,500	-75,123	93,302	167,073	165,495	146,545	131,397	119,053
Cash ending	169,028	178,805	109,305	34,182	127,483	294,558	460,051	606,596	737,993	857,046
Cash excess	169,028	178,805	109,305	34,182	127,483	294,558	460,051	606,596	737,993	857,046
Short term Loans	0	0	0	0	0	0	0	0	0	0
Profitability	14.68	14.08	14.06	11.78	15.14	14.68	14.94	15.22	15.50	15.79
Loan Repayment Capacity	3.89	5.10	3.13	2.17	2.23	2.18	2.17	1.84	1.79	1.68

PROFITS AND LOSSES	2000	1	2	3	4	5	6	7	8	9
Operating Revenue	592,340	592,340	592,340	592,340	592,340	592,340	592,340	592,340	592,340	592,340
Working Expense	254,835	254,835	254,835	254,835	254,835	254,835	254,835	254,835	254,835	254,835
Depreciation	36,465	36,465	36,465	36,465	36,465	36,465	36,465	36,465	36,465	36,465
Total Operating Expense	291,300	291,300	291,300	291,300	291,300	291,300	291,300	291,300	291,300	291,300
Operating Income	301,040	301,040	301,040	301,040	301,040	301,040	301,040	301,040	301,040	301,040
Non-Operating Income	31,435	31,435	31,435	31,435	31,435	31,435	31,435	31,435	31,435	31,435
Interest on Long Term Debt	119,325	111,858	104,391	96,924	89,456	81,989	74,521	87,272	60,468	53,863
Interest on short term debt	0	0	0	0	0	0	0	0	0	0
Other Non-Operating Expense	47,618	47,618	47,618	47,618	47,618	47,618	47,618	47,618	47,618	47,618
Net Income	165,532	172,999	180,466	187,933	195,401	202,868	210,336	217,585	224,389	230,994
BALANCE SHEET										
ASSETS	3,009,101	3,112,942	3,211,529	3,323,944	3,443,826	3,571,178	3,708,488	3,858,174	4,017,037	4,191,105
Current Assets	1,139,140	1,247,318	1,382,042	1,530,594	1,686,613	1,850,100	2,023,549	2,209,372	2,404,372	2,582,777
Cash & deposits	983,196	1,091,374	1,226,099	1,374,650	1,530,670	1,694,156	1,867,606	2,053,428	2,248,428	2,426,833
Other current assets	155,944	155,944	155,944	155,944	155,944	155,944	155,944	155,944	155,944	155,944
Fixed Assets	1,869,961	1,865,624	1,829,487	1,793,350	1,757,213	1,721,076	1,684,939	1,648,802	1,612,665	1,608,328
Depreciable Assets	2,194,161	2,226,289	2,226,617	2,226,945	2,227,273	2,227,601	2,227,929	2,228,257	2,228,585	2,260,713
Accumulated depreciation	366,041	402,506	438,971	475,436	511,901	548,366	584,831	621,296	657,761	694,226
Net depreciable assets	1,828,120	1,823,783	1,787,646	1,751,509	1,715,372	1,679,235	1,643,098	1,606,961	1,570,824	1,566,487
Non-Depreciable Assets	30,972	30,972	30,972	30,972	30,972	30,972	30,972	30,972	30,972	30,972
Other fixed Assets	10,869	10,869	10,869	10,869	10,869	10,869	10,869	10,869	10,869	10,869
Equities and Liabilities	3,009,101	3,112,942	3,211,529	3,323,944	3,443,826	3,571,176	3,708,488	3,858,174	4,017,037	4,191,105
Liabilities	581,885	512,727	430,848	355,330	279,811	204,293	131,269	63,370	-2,158	-59,082
Current Liabilities	84,421	89,288	81,434	79,941	78,447	76,954	75,460	74,011	72,650	77,689
Short term debt	0	0	0	0	0	0	0	0	0	0
Other current liabilities	84,421	89,288	81,434	79,941	78,447	76,954	75,460	74,011	72,650	77,689
Fixed liabilities	497,464	423,439	349,414	275,389	201,364	127,339	55,809	-10,641	-74,808	-136,771
Long Term Debt	497,464	423,439	349,414	275,389	201,364	127,339	55,809	-10,641	-74,808	-136,771
Other fixed Liabilities										
Equities	16,543	16,543	16,543	16,543	16,543	16,543	16,543	16,543	16,543	16,543
Reserves	2,245,141	2,410,673	2,583,672	2,764,138	2,952,071	3,147,472	3,350,340	3,560,676	3,778,261	4,002,650
Net Income	165,532	172,999	180,466	187,933	195,401	202,868	210,336	217,585	224,389	230,994
CASH FLOW										
Balance brought forward	857,046	983,198	1,091,374	1,226,099	1,374,650	1,530,670	1,694,158	1,867,606	2,053,428	2,248,428
Cash in										
Operating income	301,040	301,040	301,040	301,040	301,040	301,040	301,040	301,040	301,040	301,040
Depreciation	36,465	36,465	36,465	36,465	36,465	36,465	36,465	36,465	36,465	36,465
Equity increase	0	0	0	0	0	0	0	0	0	0
Long term loans										
Non operating income	31,435	31,435	31,435	31,435	31,435	31,435	31,435	31,435	31,435	31,435
Increase of other current liabilities	-1,493	4,867	-7,853	-1,403	-1,494	-1,493	-1,494	-1,450	-1,361	5,039
Increase of other fixed liabilities	0	0	0	0	0	0	0	0	0	0
Cash in total	367,447	373,807	361,087	367,447	367,446	367,447	367,446	367,490	367,579	373,979
Cash out										
Investment	328	32,128	328	328	328	328	328	328	328	32,128
Repayment for long term loans	74,025	74,025	74,025	74,025	74,025	74,025	71,530	66,450	64,165	61,965
Interest on long term loans	119,325	111,858	104,391	96,924	89,456	81,989	74,521	67,272	60,468	53,863
Interest on short term loans	0	0	0	0	0	0	0	0	0	0
Increase of other current assets	0	0	0	0	0	0	0	0	0	0
Increase of other fixed assets	0	0	0	0	0	0	0	0	0	0
Other non operating expense	47618	47618	47618	47618	47618	47618	47618	47618	47618	47618
Cash out total	241,296	265,629	228,362	218,895	211,427	203,960	193,997	181,668	172,579	195,574
Cash inflow-outflow	126,151	108,178	134,725	148,552	150,019	163,487	173,449	185,822	195,000	178,405
Cash ending	983,196	1,091,374	1,226,099	1,374,650	1,530,670	1,694,156	1,867,606	2,053,428	2,248,428	2,426,833
Cash excess	983,196	1,091,374	1,226,099	1,374,650	1,530,670	1,694,156	1,867,606	2,053,428	2,248,428	2,426,833
Short term Loans	0	0	0	0	0	0	0	0	0	0
Profitability	16.10	16.14	16.45	16.79	17.13	17.49	17.87	18.26	18.67	18.72
Loan Repayment Capacity	1.75	1.82	1.89	1.97	2.06	2.16	2.31	2.52	2.71	2.91

PROFITS AND LOSSES	10	11	12	13	14	15	16	17	18	19
Operating Revenue	592,340	592,340	592,340	592,340	592,340	592,340	592,340	592,340	592,340	592,340
Working Expense	254,835	254,835	254,835	254,835	254,835	254,835	254,835	254,835	254,835	254,835
Depreciation	36,465	36,465	36,465	36,465	36,465	36,465	36,465	36,465	36,465	36,465
Total Operating Expense	291,300	291,300	291,300	291,300	291,300	291,300	291,300	291,300	291,300	291,300
Operating Income	301,040	301,040	301,040	301,040	301,040	301,040	301,040	301,040	301,040	301,040
Non-Operating Income	31,435	31,435	31,435	31,435	31,435	31,435	31,435	31,435	31,435	31,435
Interest on Long Term Debt	47,451	41,361	35,316	29,735	23,434	17,493	11,552	5,623	1,846	0
Interest on short term debt	0	0	0	0	0	0	0	0	0	0
Other Non-Operating Expense	47,618	47,618	47,618	47,618	47,618	47,618	47,618	47,618	47,618	47,618
Net Income	237,406	243,496	249,541	255,122	261,423	267,364	273,305	279,234	283,011	284,857
BALANCE SHEET										
ASSETS	4,362,588	4,547,086	4,738,838	4,936,264	5,139,847	5,349,443	5,565,098	5,807,169	6,078,204	6,356,332
Current Assets	2,790,307	3,011,032	3,238,921	3,472,484	3,712,204	3,957,937	4,209,729	4,487,937	4,763,309	5,077,574
Cash & deposits	2,634,454	2,855,089	3,082,978	3,316,540	3,556,260	3,801,993	4,053,785	4,331,993	4,607,366	4,921,630
Other current assets	155,944	155,944	155,944	155,944	155,944	155,944	155,944	155,944	155,944	155,944
Fixed Assets	1,572,191	1,536,054	1,499,917	1,463,780	1,427,643	1,391,506	1,355,369	1,319,232	1,314,895	1,278,758
Depreciable Assets	2,261,041	2,261,369	2,261,697	2,262,025	2,262,353	2,262,681	2,263,009	2,263,337	2,295,465	2,295,793
Accumulated depreciation	730,691	767,156	803,621	840,086	876,551	913,016	949,481	985,946	1,022,411	1,058,876
Net depreciable assets	1,530,350	1,494,213	1,458,076	1,421,939	1,385,802	1,349,665	1,313,528	1,277,391	1,273,054	1,236,917
Non-Depreciable Assets	30,972	30,972	30,972	30,972	30,972	30,972	30,972	30,972	30,972	30,972
Other fixed Assets	10,869	10,869	10,869	10,869	10,869	10,869	10,869	10,869	10,869	10,869
Equities and Liabilities	4,362,588	4,547,086	4,738,838	4,936,264	5,139,847	5,349,443	5,565,098	5,807,169	6,078,204	6,356,332
Liabilities	-125,005	-184,003	-241,792	-299,488	-357,328	-415,098	-472,746	-509,909	-521,885	-528,614
Current Liabilities	70,048	68,828	67,619	66,503	65,243	64,055	62,867	61,681	67,285	60,558
Short term debt	0	0	0	0	0	0	0	0	0	0
Other current liabilities	70,048	68,828	67,619	66,503	65,243	64,055	62,867	61,681	67,285	60,558
Fixed liabilities	-195,051	-252,831	-309,411	-365,991	-422,571	-479,151	-535,613	-571,590	-589,170	-589,170
Long Term Debt	-195,051	-252,831	-309,411	-365,991	-422,571	-479,151	-535,613	-571,590	-589,170	-589,170
Other fixed Liabilities										
Equities	16,543	16,543	16,543	16,543	16,543	16,543	16,543	16,543	16,543	16,543
Reserves	4,233,644	4,471,050	4,714,546	4,964,087	5,219,209	5,480,632	5,747,996	6,021,301	6,300,535	6,583,546
Net Income	237,406	243,496	249,541	255,122	261,423	267,364	273,305	279,234	283,011	284,857
CASH FLOW										
Balance brought forward	2,426,833	2,634,454	2,855,089	3,082,978	3,316,540	3,558,260	3,801,993	4,053,785	4,331,993	4,607,366
Cash in										
Operating income	301,040	301,040	301,040	301,040	301,040	301,040	301,040	301,040	301,040	301,040
Depreciation	36,465	36,465	36,465	36,465	36,465	36,465	36,465	36,465	36,465	36,465
Equity increase	0	0	0	0	0	0	0	0	0	0
Long term loans										
Non operating income	31,435	31,435	31,435	31,435	31,435	31,435	31,435	31,435	31,435	31,435
Increase of other current liabilities	-7,842	-1,218	-1,209	-1,118	-1,260	-1,188	-1,188	-1,188	5,605	-6,729
Increase of other fixed liabilities	0	0	0	0	0	0	0	0	0	0
Cash in total	361,298	367,722	367,731	367,824	367,680	367,752	367,752	367,754	374,545	362,211
Cash out										
Investment	328	328	328	328	328	328	328	328	32,128	328
Repayment for long term loans	58,280	57,780	56,580	56,580	56,580	56,580	56,462	35,977	17,580	0
Interest on long term loans	47,451	41,361	35,316	29,735	23,434	17,493	11,552	5,623	1,846	0
Interest on short term loans	0	0	0	0	0	0	0	0	0	0
Increase of other current assets	0	0	0	0	0	0	0	0	0	0
Increase of other fixed assets	0	0	0	0	0	0	0	0	0	0
Other non operating expense	47618	47618	47618	47618	47618	47618	47618	47618	47618	47618
Cash out total	153,677	147,087	139,842	134,261	127,960	122,019	115,960	89,546	99,172	47,946
Cash inflow-outflow	207,621	220,635	227,889	233,563	239,720	245,733	251,702	278,208	275,373	314,265
Cash ending	2,634,454	2,855,089	3,082,978	3,316,540	3,556,260	3,801,993	4,053,785	4,331,993	4,607,366	4,921,630
Cash excess	2,634,454	2,855,089	3,082,978	3,316,540	3,556,260	3,801,993	4,053,785	4,331,993	4,607,366	4,921,630
Short term Loans	0	0	0	0	0	0	0	0	0	0
Profitability	19.15	19.60	20.07	20.57	21.09	21.63	22.21	22.82	22.89	23.54
Loan Repayment Capacity	3.19	3.40	3.67	3.91	4.22	4.56	4.96	8.11	17.37	#DIV/0!

17. Conclusion of Feasibility Study

The feasibility study of the short-term plan was analysed both economically and financially and evaluated using EIRR and FIRR.

The EIRR is calculated based on cost-benefit analysis from the view point of the national economy. The FIRR is calculated to evaluate the profitability of the short-term plan. From Chapter 15 and 16, the calculation results of EIRR and FIRR are as follows:

Table-17.1.1 Calculation Results of EIRR and FIRR

Item	EIRR	FIRR
Base case	22.9	12.5
Sensitivity analysis		
(A) Increase in costs by 10 %	20.7	11.4
(B) Decrease in benefits by 10 %	20.3	11.0
(C) Increase in costs by 10 % and decrease in benefits by 10 %	18.3	10.0
Calculation of viability of the project	12.0	12.0

The EIRR exceeds 12%, which is the guideline of viability of the project, that is, the opportunity cost of capital in developing countries according to the IBRD and the ADB. As for FIRR, unless there is subsidy from the Government, The FIRR can only exceed 12% which is the guideline of the viability of the project since 12% is the lending rate fixed by the Indian Government, under the conditions of the raising port tariff by 10% in 1994/95%.

The financial analysis also evaluated the financial viability of the operating entity responsible for the short-term plan. From our financial analysis, the NMPT would maintain its financial viability throughout the entire project life including the construction period. It will be able to pay all expenditures and have some surplus even after appropriating funds for the repayment of foreign loans including interest.

Judging from the above, we conclude that the short-term plan with the target year of 1994/95 is feasible both economically and financially.

APPENDIX

LIST OF APPENDICES

Appendix-2.1 Tidal Current Observations (1 Day) (7-8, Oct. 1989)

C-2-1							C-2-2						
ITEM	Surface		Mid-Dep.		Bed		ITEM	Surface		Mid-Dep.		Bed	
DAY.TIME	DIR.	VLT.	DTR.	VLT.	DIR.	VLT.	DAY.TIME	DIR.	VLT.	DTR.	VLT.	DIR.	VLT.
07-22-20	330	0.12	300	0.12	010	0.09	07 22-45	280	0.11	350	0.14	350	0.10
23-25	330	0.10	330	0.12	030	0.07	23-40	310	0.10	320	0.09	340	0.07
08 00-25	070	0.13	090	0.10	100	0.08	08 00-40	250	0.10	040	0.07	060	0.05
01-10	070	0.10	080	0.10	070	0.08	01-35	250	0.12	260	0.10	260	0.10
02-15	270	0.08	290	0.08	020	0.07	02-40	290	0.14	290	0.12	310	0.10
03-15	280	0.12	300	0.10	030	0.07	03-35	120	0.10	130	0.08	140	0.12
04-10	350	0.07	320	0.10	310	0.07	04-25	330	0.10	310	0.07	310	0.09
04-55	320	0.12	320	0.10	260	0.10	05-10	330	0.14	040	0.12	310	0.12
05-45	300	0.10	270	0.08	250	0.07	06-00	270	0.10	340	0.07	300	0.08
06-35	310	0.09	270	0.07	240	0.08	06-50	110	0.08	110	0.06	100	0.06
07-25	230	0.10	250	0.07	210	0.05	07-45	230	0.10	250	0.14	250	0.10
08-15	230	0.07	250	0.09	270	0.08	08-35	220	0.09	250	0.09	240	0.11
09-10	290	0.12	280	0.12	250	0.10	09-30	070	0.08	260	0.09	350	0.07
10-10	310	0.10	260	0.08	250	0.08	10-30	250	0.07	130	0.08	260	0.07
11-05	250	0.10	270	0.08	250	0.08	11-25	230	0.11	240	0.12	240	0.10
12-10	310	0.12	280	0.10	270	0.08	12-35	260	0.11	250	0.07	260	0.11
13-10	320	0.11	320	0.10	300	0.06	13-30	350	0.11	250	0.00	240	0.00
14-20	290	0.10	290	0.10	280	0.08	14-45	270	0.00	340	0.00	260	0.00
15-15	220	0.11	270	0.12	290	0.06	15-30	290	0.00	260	0.00	290	0.00
16-15	310	0.12	310	0.10	270	0.08	16-35	330	0.00	320	0.00	300	0.00
17-25	210	0.14	230	0.10	290	0.09	17-45	250	0.11	240	0.07	260	0.05
18-30	190	0.13	250	0.12	270	0.10	18-50	270	0.13	300	0.17	320	0.09
19-25	280	0.10	220	0.11	230	0.06	19-50	230	0.08	240	0.09	230	0.07
20-25	210	0.13	210	0.10	-	-	20-50	160	0.11	150	0.10	050	0.07
21-30	230	0.08	210	0.05	190	0.06	21-50	130	0.07	150	0.06	150	0.07

C-2-3						
ITEM	Surface		Mid-Dep.		Bed	
DAY.TIME	DIR.	VLT.	DTR.	VLT.	DIR.	VLT.
07-23-10	260	0.11	330	0.11	310	0.10
08 00-10	080	0.11	070	0.10	070	0.09
00-55	040	0.10	030	0.10	010	0.11
02-00	080	0.10	060	0.06	020	0.07
03-00	080	0.10	070	0.09	050	0.07
03-50	260	0.14	010	0.11	310	0.07
04-40	270	0.09	310	0.09	320	0.07
05-30	330	0.11	020	0.10	360	0.10
06-20	320	0.07	330	0.06	040	0.07
07-10	120	0.12	130	0.07	210	0.05
08-00	120	0.09	160	0.07	220	0.06
08-50	210	0.07	230	0.07	230	0.06
09-45	280	0.13	300	0.12	280	0.10
10-50	320	0.09	240	0.07	330	0.09
11-50	340	0.10	240	0.08	330	0.07
12-50	210	0.12	250	0.12	230	0.13
13-55	310	0.11	300	0.10	270	0.15
14-55	310	0.10	300	0.09	270	0.07
15-45	210	0.13	210	0.13	200	0.10
16-50	-	0.13	160	0.11	250	0.11
18-10	260	0.11	230	0.09	190	0.09
19-10	210	0.12	230	0.12	250	0.10
20-10	260	0.09	220	0.10	230	0.08
21-15	130	0.12	140	0.11	130	0.08
22-10	130	0.07	140	0.07	140	0.07

Appendix-2.2 Tidal Current Observations St. C-1-1 (15 Days)

TIDAL CURRENT OBSERVATIONS St. C-1-1(15 Days) No.1

DAY H.M.	DIR.	VLT.	DAY H.M.	DIR.	VLT.	DAY H.M.	DIR.	VLT.
6 16-00	339	18.2	8 05-00	125	3.7	9 18-00	143	3.4
17-00	117	3.4	06-00	151	4.6	19-00	132	4.6
18-00	326	3.7	07-00	182	3.7	20-00	138	3.4
19-00	32	4.9	08-00	126	4.3	21-00	146	2.8
20-00	47	4.9	09-00	104	4.3	22-00	137	3.1
21-00	66	4.9	10-00	66	4.0	23-00	140	2.6
22-00	49	4.0	11-00	88	3.7	10 00-00	138	2.3
23-00	44	7.5	12-00	106	3.4	01-00	109	2.8
7 00-00	66	6.0	13-00	108	4.3	02-00	139	4.0
01-00	94	6.3	14-00	120	5.2	03-00	121	2.8
02-00	111	3.7	15-00	121	4.6	04-00	355	2.6
03-00	111	3.7	16-00	146	2.8	05-00	112	2.3
04-00	155	3.1	17-00	127	3.4	06-00	105	2.6
05-00	334	3.7	18-00	135	3.4	07-00	139	3.1
06-00	85	1.7	19-00	125	3.4	08-00	132	2.6
07-00	51	2.8	20-00	119	3.4	09-00	125	4.0
08-00	26	4.0	21-00	56	6.6	10-00	121	2.8
09-00	40	5.2	22-00	89	7.2	11-00	132	3.4
10-00	83	6.6	23-00	86	6.3	12-00	133	3.1
11-00	93	4.9	9 00-00	86	5.2	13-00	169	2.3
12-00	114	4.0	01-00	58	4.0	14-00	279	1.7
13-00	119	3.4	02-00	146	3.1	15-00	299	2.8
14-00	109	3.7	03-00	122	3.1	16-00	275	2.6
15-00	128	3.7	04-00	98	2.8	17-00	277	2.3
16-00	140	3.4	05-00	144	2.6	18-00	286	3.1
17-00	140	3.4	06-00	77	2.3	19-00	113	3.4
18-00	98	2.8	07-00	196	3.1	20-00	120	3.7
19-00	6	3.1	08-00	215	3.4	21-00	123	4.6
20-00	344	3.4	09-00	272	3.1	22-00	113	4.6
21-00	3	3.4	10-00	299	2.6	23-00	106	6.9
22-00	321	3.4	11-00	354	3.1	11 00-00	89	5.2
23-00	162	3.4	12-00	352	2.6	01-00	91	4.0
8 00-00	101	5.7	13-00	54	3.4	02-00	87	2.8
01-00	112	5.7	14-00	207	1.7	03-00	89	3.1
02-00	99	9.8	15-00	135	2.8	04-00	70	4.0
03-00	152	5.2	16-00	136	4.0	05-00	93	4.3
04-00	146	4.9	17-00	153	4.6	06-00	122	3.4

※ 1) CURRENT MAGNITUDE IS IN CM/SEC 2) CURRENT DIRECTION IS IN DEGREES MAGN

TIDAL CURRENT OBSERVATIONS St. C-1-1(15 days) No.2

DAY H.M.	DIR.	VLT.	DAY H.M.	DIR.	VLT.	DAY H.M.	DIR.	VLT.
11 07-00	133	3.7	12 20-00	344	8.4	14 09-00	185	4.0
08-00	148	4.6	21-00	344	3.4	10-00	169	4.6
09-00	140	4.9	22-00	1	4.6	11-00	139	3.7
10-00	146	3.7	23-00	314	2.8	12-00	149	3.1
11-00	127	3.7	13 00-00	30	4.3	13-00	170	3.4
12-00	124	2.8	01-00	351	3.4	14-00	356	2.3
13-00	121	3.4	02-00	7	3.7	15-00	10	4.9
14-00	139	2.6	03-00	1	4.9	16-00	353	3.4
15-00	108	2.6	04-00	356	5.7	17-00	356	3.4
16-00	116	2.8	05-00	8	9.2	18-00	353	4.9
17-00	115	2.8	06-00	358	6.0	19-00	74	4.6
18-00	113	5.7	07-00	352	4.3	20-00	108	3.7
19-00	134	3.4	08-00	156	2.8	21-00	177	4.0
20-00	143	3.1	09-00	136	3.4	22-00	116	4.3
21-00	131	2.8	10-00	158	4.9	23-00	122	4.3
22-00	131	2.8	11-00	166	4.0	15 00-00	132	4.0
23-00	123	2.8	12-00	187	3.7	01-00	134	4.0
12 00-00	113	2.8	13-00	281	2.8	02-00	113	3.4
01-00	351	3.1	14-00	18	2.8	03-00	58	3.7
02-00	62	3.1	15-00	337	3.7	04-00	47	6.0
03-00	31	3.7	16-00	334	3.4	05-00	10	5.2
04-00	18	3.4	17-00	331	3.7	06-00	4	3.1
05-00	83	3.1	18-00	262	5.5	07-00	346	4.6
06-00	348	2.6	19-00	141	2.3	08-00	2	3.4
07-00	305	1.7	20-00	218	4.3	09-00	350	2.3
08-00	126	2.3	21-00	138	3.7	10-00	212	4.0
09-00	141	2.8	22-00	155	3.7	11-00	217	3.4
10-00	147	3.1	23-00	167	3.7	12-00	200	3.4
11-00	157	2.6	14 00-00	181	3.7	13-00	282	3.1
12-00	206	2.8	01-00	295	1.7	14-00	324	3.1
13-00	328	3.1	02-00	343	3.4	15-00	338	4.9
14-00	328	4.0	03-00	4	4.0	16-00	334	5.5
15-00	343	6.0	04-00	356	3.4	17-00	1	2.6
16-00	345	9.2	05-00	308	3.1	18-00	347	6.0
17-00	344	8.9	06-00	342	3.1	19-00	1	5.5
18-00	348	6.3	07-00	159	3.7	20-00	352	8.1
19-00	346	6.0	08-00	169	3.7	21-00	311	6.6

TIDAL CURRENT OBSERVATIONS St. C-1-1(15 Days) No.3

DAY H.M.	DIR.	VLT.	DAY H.M.	DIR.	VLT.	DAY H.M.	DIR.	VLT.
15 22-00	228	4.9	17 11-00	130	3.1	19 00-00	79	2.0
23-00	251	6.9	12-00	167	3.1	01-00	130	2.3
16 00-00	254	4.6	13-00	202	3.7	02-00	120	2.6
01-00	55	1.7	14-00	112	2.6	03-00	126	2.8
02-00	9	3.4	15-00	14	3.4	04-00	116	2.8
03-00	293	3.7	16-00	53	3.7	05-00	95	2.3
04-00	292	3.4	17-00	39	3.4	06-00	86	2.8
05-00	352	1.1	18-00	270	8.4	07-00	74	6.9
06-00	258	5.2	19-00	310	5.5	08-00	74	11.3
07-00	203	4.9	20-00	284	6.9	09-00	80	7.2
08-00	241	4.0	21-00	273	5.2	10-00	123	5.2
09-00	172	3.4	22-00	324	18.0	11-00	200	4.9
10-00	311	2.6	23-00	235	9.2	12-00	120	3.7
11-00	286	3.1	18 00-00	250	8.4	13-00	118	6.0
12-00	275	6.6	01-00	267	4.6	14-00	126	4.3
13-00	272	6.0	02-00	37	3.4	15-00	153	2.3
14-00	263	9.8	03-00	74	5.5	16-00	273	4.9
15-00	270	6.0	04-00	73	10.4	17-00	271	5.5
16-00	280	7.2	05-00	79	14.8	18-00	274	2.8
17-00	278	6.3	06-00	76	9.5	19-00	275	4.0
18-00	218	5.5	07-00	63	8.7	20-00	188	3.7
19-00	62	6.0	08-00	56	5.2	21-00	303	3.1
20-00	96	6.0	09-00	38	4.0	22-00	255	5.7
21-00	75	13.6	10-00	36	2.8	23-00	238	4.9
22-00	89	9.5	11-00	316	2.6	20 00-00	339	2.6
23-00	89	6.3	12-00	148	2.6	01-00	100	2.8
17 00-00	113	4.9	13-00	147	3.4	02-00	111	3.1
01-00	79	6.3	14-00	121	3.7	03-00	78	5.7
02-00	66	3.7	15-00	110	3.1	04-00	88	7.5
03-00	79	4.3	16-00	110	3.4	05-00	112	3.1
04-00	50	6.6	17-00	277	3.1	06-00	175	3.4
05-00	45	6.3	18-00	321	2.6	07-00	199	2.6
06-00	10	3.7	19-00	275	5.5	08-00	257	3.7
07-00	29	6.0	20-00	237	6.9	09-00	336	2.6
08-00	88	2.8	21-00	275	3.1	10-00	278	6.0
09-00	291	2.6	22-00	146	2.3	11-00	340	2.8
10-00	61	1.7	23-00	129	3.1	12-00	130	2.6

TIDAL CURRENT OBSERVATIONS St. C-1-1(15 Days) No.4

DAY H.M.	DIR.	VLT.	DAY H.M.	DIR.	VLT.	DAY H.M.	DIR.	VLT.
20 13-00	249	4.0	22 02-00	224	4.9	23 15-00	89	4.6
14-00	274	2.6	03-00	253	8.1	16-00	84	3.7
15-00	278	2.8	04-00	248	10.4	17-00	123	2.0
16-00	262	5.7	05-00	259	6.3	18-00	264	3.1
17-00	272	7.8	06-00	245	4.9	19-00	276	3.1
18-00	281	2.8	07-00	104	2.8	20-00	259	3.7
19-00	271	5.2	08-00	104	3.7	21-00	266	3.4
20-00	223	6.3	09-00	116	3.1	22-00	271	2.6
21-00	227	4.6	10-00	58	3.1	23-00	311	2.0
22-00	285	2.8	11-00	210	1.7	24 00-00	150	2.8
23-00	44	6.3	12-00	96	3.7	01-00	83	2.6
21 00-00	38	12.7	13-00	155	3.4	02-00	120	2.3
01-00	27	17.1	14-00	319	2.8	03-00	187	2.8
02-00	42	12.4	15-00	188	3.4	04-00	311	3.1
03-00	55	9.8	16-00	255	3.7	05-00	178	2.6
04-00	87	5.2	17-00	241	4.3	06-00	282	3.7
05-00	87	6.3	18-00	277	3.1	07-00	269	3.1
06-00	106	3.4	19-00	248	3.7	08-00	228	2.6
07-00	79	4.3	20-00	298	2.6	09-00	271	2.6
08-00	99	2.8	21-00	36	2.0	10-00	237	2.8
09-00	65	2.8	22-00	187	3.4	11-00	327	1.4
10-00	68	3.4	23-00	84	3.4			
11-00	1	1.1	23 00-00	99	4.3			
12-00	354	2.8	01-00	92	3.4			
13-00	317	2.8	02-00	103	6.6			
14-00	217	3.1	03-00	79	3.1			
15-00	229	4.9	04-00	80	7.2			
16-00	107	3.4	05-00	76	6.3			
17-00	113	4.0	06-00	81	7.8			
18-00	81	4.9	07-00	65	6.6			
19-00	277	4.3	08-00	44	8.1			
20-00	1	3.4	09-00	77	5.7			
21-00	181	2.8	10-00	85	6.9			
22-00	29	2.8	11-00	86	4.0			
23-00	12	2.6	12-00	80	8.4			
22 00-00	224	3.1	13-00	71	6.0			
01-00	233	4.0	14-00	66	4.6			

TIDAL CURRENT OBSERVATIONS St. C-1-2(15 Days) No.5

DAY H.M.	DIR.	VLT.	DAY H.M.	DIR.	VLT.	DAY H.M.	DIR.	VLT.
6 15-00	286	19.4	8 04-00	170	6.0	9 17-00	150	6.6
16-00	181	4.9	05-00	167	5.2	18-00	166	6.6
17-00	176	5.5	06-00	183	4.6	19-00	165	7.5
18-00	160	5.2	07-00	134	6.0	20-00	158	6.6
19-00	11	5.7	08-00	138	6.3	21-00	162	6.6
20-00	300	9.8	09-00	146	5.7	22-00	141	5.7
21-00	329	8.7	10-00	140	5.7	23-00	117	5.5
22-00	1	5.5	11-00	156	6.0	10 00-00	163	4.3
23-00	38	8.4	12-00	147	6.9	01-00	146	4.9
7 00-00	68	7.8	13-00	143	6.3	02-00	167	7.2
01-00	96	6.6	14-00	152	5.2	03-00	152	5.2
02-00	84	8.4	15-00	157	5.7	04-00	150	4.6
03-00	69	7.8	16-00	176	7.2	05-00	160	4.0
04-00	108	8.4	17-00	183	6.9	06-00	166	4.3
05-00	63	4.3	18-00	188	8.7	07-00	175	4.6
06-00	241	2.8	19-00	188	5.2	08-00	173	5.2
07-00	49	2.6	20-00	240	5.5	09-00	174	5.7
08-00	20	3.7	21-00	16	5.5	10-00	174	4.9
09-00	24	5.2	22-00	18	5.7	11-00	184	5.2
10-00	76	6.9	23-00	54	8.4	12-00	169	5.2
11-00	66	8.7	9 00-00	75	8.1	13-00	152	4.6
12-00	80	6.3	01-00	25	5.5	14-00	205	4.9
13-00	101	6.9	02-00	87	8.1	15-00	246	7.5
14-00	128	6.0	03-00	105	7.2	16-00	271	6.6
15-00	133	6.3	04-00	115	6.0	17-00	280	7.2
16-00	128	6.0	05-00	128	4.6	18-00	284	12.1
17-00	134	6.6	06-00	154	5.5	19-00	276	9.5
18-00	151	5.7	07-00	135	4.6	20-00	174	5.2
19-00	138	6.0	08-00	174	3.1	21-00	112	7.8
20-00	245	2.3	09-00	267	6.9	22-00	115	7.8
21-00	227	3.1	10-00	279	8.1	23-00	115	5.2
22-00	343	6.9	11-00	309	6.6	11 00-00	2	4.3
23-00	16	6.6	12-00	308	7.5	01-00	105	4.9
8 00-00	91	7.2	13-00	317	5.7	02-00	73	2.6
01-00	144	5.7	14-00	324	5.7	03-00	358	4.3
02-00	161	5.2	15-00	123	1.7	04-00	44	7.8
03-00	155	6.6	16-00	165	5.5	05-00	70	8.1

TIDAL CURRENT OBSERVATIONS St. C-1-2(15 Days) No.6

DAY H.M.	DIR.	VLT.	DAY H.M.	DIR.	VLT.	DAY H.M.	DIR.	VLT.
11 06-00	104	5.7	12 19-00	354	8.1	14 08-00	55	6.0
07-00	149	5.2	20-00	5	8.1	09-00	138	6.3
08-00	140	6.0	21-00	8	5.7	10-00	162	6.6
09-00	155	6.3	22-00	356	5.2	11-00	160	6.6
10-00	155	7.5	23-00	348	4.6	12-00	159	7.5
11-00	160	8.1	13 00-00	334	4.3	13-00	158	6.3
12-00	160	6.0	01-00	327	4.6	14-00	166	6.3
13-00	147	5.2	02-00	324	4.6	15-00	147	4.9
14-00	141	5.2	03-00	14	11.0	16-00	83	2.0
15-00	199	4.6	04-00	5	8.7	17-00	21	6.9
16-00	116	2.3	05-00	354	11.3	18-00	31	6.9
17-00	94	6.3	06-00	14	8.7	19-00	347	7.2
18-00	147	4.9	07-00	11	6.9	20-00	355	6.0
19-00	159	6.0	08-00	20	5.7	21-00	85	6.0
20-00	172	6.6	09-00	113	6.3	22-00	202	7.8
21-00	166	8.1	10-00	150	6.3	23-00	177	7.8
22-00	160	6.6	11-00	174	7.5	15 00-00	135	7.5
23-00	160	5.5	12-00	178	7.8	01-00	166	6.9
12 00-00	149	5.7	13-00	182	6.6	02-00	150	7.5
01-00	134	4.0	14-00	192	5.5	03-00	138	4.9
02-00	11	4.0	15-00	324	5.7	04-00	70	6.3
03-00	344	4.9	16-00	341	5.7	05-00	31	9.2
04-00	5	5.2	17-00	348	6.9	06-00	10	8.7
05-00	357	5.2	18-00	335	5.5	07-00	329	10.7
06-00	341	5.2	19-00	296	6.0	08-00	59	8.4
07-00	3	5.5	20-00	298	6.6	09-00	92	6.3
08-00	319	5.5	21-00	133	5.5	10-00	38	4.9
09-00	325	5.2	22-00	132	8.1	11-00	165	6.6
10-00	339	4.9	23-00	167	8.9	12-00	169	6.9
11-00	345	4.9	14 00-00	177	11.6	13-00	176	6.9
12-00	346	4.6	01-00	167	9.2	14-00	193	5.7
13-00	354	5.5	02-00	138	5.7	15-00	325	4.6
14-00	351	6.0	03-00	103	2.3	16-00	356	5.5
15-00	346	9.8	04-00	33	7.5	17-00	1	6.3
16-00	345	11.0	05-00	1	6.3	18-00	3	6.0
17-00	357	13.0	06-00	356	6.0	19-00	325	8.7
18-00	356	10.7	07-00	356	4.9	20-00	353	6.6

TIDAL CURRENT OBSERVATIONS St. C-1-2(15 Days) No.7

DAY H.M.	DIR.	VLT.	DAY H.M.	DIR.	VLT.	DAY H.M.	DIR.	VLT.
15 21-00	347	7.2	17 10-00	177	6.3	18 23-00	326	5.2
22-00	331	6.0	11-00	197	7.5	19 00-00	357	5.5
23-00	142	6.9	12-00	204	8.1	01-00	18	6.3
16 00-00	334	5.5	13-00	207	8.7	02-00	49	6.9
01-00	290	8.4	14-00	169	4.9	03-00	111	6.3
02-00	311	10.4	15-00	184	5.2	04-00	119	6.0
03-00	324	7.2	16-00	328	5.2	05-00	107	7.2
04-00	322	6.6	17-00	325	6.0	06-00	96	7.2
05-00	12	6.0	18-00	313	9.2	07-00	97	5.7
06-00	344	5.7	19-00	309	10.4	08-00	71	8.1
07-00	1	4.6	20-00	296	12.4	09-00	65	8.4
08-00	31	4.9	21-00	346	7.2	10-00	92	5.7
09-00	23	4.6	22-00	338	10.1	11-00	105	4.0
10-00	337	4.9	23-00	326	11.0	12-00	172	7.2
11-00	295	5.2	18 00-00	303	25.8	13-00	176	8.1
12-00	138	5.2	01-00	284	15.0	14-00	156	5.5
13-00	45	5.7	02-00	284	15.3	15-00	151	5.5
14-00	37	7.2	03-00	201	4.3	16-00	233	11.3
15-00	349	4.9	04-00	325	3.7	17-00	266	13.6
16-00	3	7.5	05-00	332	4.0	18-00	269	19.4
17-00	337	8.1	06-00	12	4.6	19-00	263	12.4
18-00	346	11.0	07-00	1	5.5	20-00	281	12.4
19-00	1	7.5	08-00	54	8.9	21-00	297	11.3
20-00	36	14.2	09-00	72	9.2	22-00	315	9.8
21-00	24	5.2	10-00	90	6.6	23-00	331	11.6
22-00	44	7.8	11-00	88	6.0	20 00-00	337	7.5
23-00	101	10.7	12-00	80	6.0	01-00	342	6.9
17 00-00	104	13.0	13-00	87	6.0	02-00	33	5.5
01-00	115	8.1	14-00	98	7.5	03-00	98	8.1
02-00	116	7.8	15-00	102	4.9	04-00	110	8.1
03-00	102	7.5	16-00	97	6.0	05-00	102	8.7
04-00	85	7.2	17-00	87	5.2	06-00	49	9.8
05-00	89	6.6	18-00	1	4.9	07-00	78	7.8
06-00	87	7.5	19-00	287	6.6	08-00	351	3.7
07-00	54	6.6	20-00	345	3.4	09-00	311	4.3
08-00	75	5.2	21-00	350	3.7	10-00	304	5.2
09-00	167	5.2	22-00	356	4.0	11-00	301	5.2

TIDAL CURRENT OBSERVATIONS St. C-1-2(15 Days) No.8

DAY H.M.	DIR.	VLT.	DAY H.M.	DIR.	VLT.	DAY H.M.	DIR.	VLT.
20 12-00	281	11.3	22 01-00	8	5.5	23 14-00	59	4.3
13-00	35	6.0	02-00	65	4.6	15-00	151	4.3
14-00	354	2.3	03-00	13	4.3	16-00	107	3.7
15-00	281	4.9	04-00	13	4.3	17-00	132	2.6
16-00	283	12.1	05-00	345	4.9	18-00	192	4.9
17-00	337	4.3	06-00	254	5.7	19-00	152	3.7
18-00	341	4.9	07-00	226	6.0	20-00	163	3.7
19-00	351	9.8	08-00	272	5.2	21-00	208	3.4
20-00	358	12.1	09-00	262	6.3	22-00	262	10.4
21-00	356	10.7	10-00	294	6.0	23-00	301	4.0
22-00	1	10.1	11-00	249	4.6	24 00-00	1	5.5
23-00	4	9.2	12-00	10	5.5	01-00	329	7.8
21 00-00	358	9.5	13-00	69	8.7	02-00	347	5.5
01-00	12	11.0	14-00	319	4.9	03-00	1	5.7
02-00	27	10.1	15-00	25	4.9	04-00	335	5.7
03-00	98	7.8	16-00	306	4.9	05-00	336	7.5
04-00	104	7.5	17-00	205	4.9	06-00	121	3.1
05-00	96	6.3	18-00	270	5.2	07-00	107	4.3
06-00	96	8.1	19-00	266	5.2	08-00	129	4.3
07-00	79	7.5	20-00	239	4.3	09-00	142	3.4
08-00	83	5.7	21-00	94	3.4			
09-00	82	5.7	22-00	23	6.0			
10-00	91	7.2	23-00	326	5.2			
11-00	115	5.5	23 00-00	337	6.9			
12-00	132	4.3	01-00	313	5.5			
13-00	181	3.1	02-00	1	6.9			
14-00	138	5.7	03-00	16	6.0			
15-00	145	5.2	04-00	17	4.6			
16-00	105	3.7	05-00	32	5.2			
17-00	148	8.4	06-00	22	5.2			
18-00	166	4.9	07-00	97	7.2			
19-00	201	3.7	08-00	114	6.9			
20-00	147	4.6	09-00	103	6.6			
21-00	273	4.0	10-00	104	6.0			
22-00	59	6.6	11-00	71	5.5			
23-00	32	7.2	12-00	56	4.6			
22 00-00	50	5.5	13-00	137	4.9			

TIDAL CURRENT OBSERVATIONS St. C-1-3(15 Days) No.9

DAY H.M.	DIR.	VLT.	DAY H.M.	DIR.	VLT.	DAY H.M.	DIR.	VLT.
6 15-00	277	11.6	8 04-00	298	8.7	9 17-00	254	10.7
16-00	263	11.6	05-00	249	7.2	18-00	279	8.9
17-00	229	12.4	06-00	243	6.0	19-00	249	6.6
18-00	250	12.1	07-00	263	8.4	20-00	235	6.3
19-00	317	7.5	08-00	260	13.9	21-00	263	8.1
20-00	314	9.2	09-00	257	12.4	22-00	31	5.2
21-00	80	7.8	10-00	248	8.7	23-00	353	5.2
22-00	5	7.8	11-00	243	6.3	10 00-00	293	7.5
23-00	48	10.7	12-00	219	4.3	01-00	317	5.2
7 00-00	23	5.2	13-00	313	6.0	02-00	269	13.9
01-00	91	8.1	14-00	273	10.7	03-00	261	10.7
02-00	101	5.7	15-00	281	6.3	04-00	236	8.1
03-00	86	2.8	16-00	280	10.4	05-00	270	6.0
04-00	340	3.1	17-00	311	6.0	06-00	294	5.2
05-00	258	9.2	18-00	264	12.1	07-00	296	4.9
06-00	260	3.1	19-00	248	8.4	08-00	25	3.4
07-00	280	4.3	20-00	353	4.0	09-00	63	7.2
08-00	341	3.1	21-00	46	7.8	10-00	43	4.3
09-00	283	5.7	22-00	46	6.6	11-00	22	4.0
10-00	152	4.0	23-00	345	5.2	12-00	41	4.3
11-00	219	4.6	9 00-00	29	4.3	13-00	32	3.4
12-00	194	5.5	01-00	262	4.9	14-00	351	2.8
13-00	187	4.0	02-00	313	4.6	15-00	225	3.7
14-00	236	7.5	03-00	238	7.8	16-00	225	4.3
15-00	237	8.7	04-00	290	7.5	17-00	268	4.6
16-00	275	8.7	05-00	196	5.7	18-00	261	7.2
17-00	257	7.5	06-00	205	5.7	19-00	265	7.2
18-00	284	13.3	07-00	216	5.7	20-00	242	5.5
19-00	271	10.4	08-00	246	11.9	21-00	119	2.6
20-00	245	5.5	09-00	248	12.7	22-00	9	2.3
21-00	352	4.3	10-00	238	8.1	23-00	269	3.1
22-00	295	6.3	11-00	298	6.6	11 00-00	323	2.8
23-00	348	8.4	12-00	263	11.9	01-00	31	2.8
8 00-00	48	6.6	13-00	281	7.8	02-00	336	2.6
01-00	149	3.4	14-00	262	10.4	03-00	12	2.6
02-00	344	5.7	15-00	311	4.3	04-00	27	3.4
03-00	311	5.7	16-00	255	9.8	05-00	79	6.3

TIDAL CURRENT OBSERVATIONS St. C-1-3(15 Days) No.10

DAY H.M.	DIR.	VLT.	DAY H.M.	DIR.	VLT.	DAY H.M.	DIR.	VLT.
11 06-00	339	2.0						
07-00	334	2.3						
08-00	345	3.1						
09-00	288	3.1						
10-00	272	5.2						
11-00	275	6.0						
12-00	286	6.3						
13-00	276	6.6						
14-00	259	6.3						
15-00	261	10.7						
16-00	265	12.4						
17-00	65	4.9						
18-00	64	3.1						
19-00	295	4.9						
20-00	275	11.9						
21-00	276	3.1						
22-00	251	2,6						

Appendix- 2.3 Wave Observation Data

STATISTICAL WAVE DATA ANALYSIS OF NEW MANGALORE PORT
LOCATION OF WAVE RIDER BUOY

LAT 12°-55'- 0" N
LON 74°-45'-15" E
DEPTH: 12.8M
MONTH & YEAR: OCTOBER 1989

Date	Time hrs	Hs (m)	Tz sec	H.max (m)	T(Hmax) sec	Wave direction in degrees
Wave rider buoy was installed at site on 6th October 1989						
7.10.89	1200	0.82	11.1	1.1	15	
	1500	0.88	11.3	1.3	18	
	1800	1.14	8.5	1.4	15	-
	2100	1.33	6.0	1.5	16	
8.10.89	0900	0.86	8.4	1.3	15	-
	1200	1.17	8.1	1.6	11	
	1500	1.02	6.5	1.2	7	
	1800	1.03	7.1	1.3	17	-
	2100	0.85	8.0	1.0	13	
9.10.89	0000	1.07	7.6	1.3	18	
	0300	1.07	7.6	1.2	16	
	0600	0.92	8.8	1.1	6	
	0900	0.87	8.8	0.9	11	-
	1200	0.91	7.8	1.1	10	
	1500	0.90	6.9	0.9	12	
	1800	0.81	8.8	0.8	6	-
11.10.89	0900					0
	1200	0.37	13.3	0.9	12	
	1500	0.69	9.9	0.9	12	
	1800	0.80	9.9	0.9	14	300
	2100	0.68	10.4	1.0	12	
12.10.89	0000	0.71	11.9	1.0	12	
	0300	0.79	11.3	0.9	14	
	0600	0.90	9.6	1.1	9	
	0900	0.78	10.3	1.1	14	320
	1200	0.92	8.1	1.1	18	
	1500	0.87	6.8	1.2	12	
	1800	0.86	9.2	1.2	12	280
	2100	0.87	10.2	1.1	12	

Date	Time hrs	Hs (m)	Tz sec	H.max (m)	T(Hmax) sec	Wave direction in degrees
13.10.89	0000	0.77	9.5	0.9	12	
	0300	0.91	10.5	1.2	18	
	0600	0.91	10.3	1.0	13	
	0900	0.90	10.0	1.3	16	260
	1200	0.96	9.0	1.1	16	
	1500	1.15	8.9	1.7	16	
	1800	1.07	7.7	1.4	16	300
	2100	0.96	8.5	1.3	16	
14.10.89	0000	1.12	8.8	1.5	10	
	0300	0.86	8.6	1.2	12	
	0600	0.93	9.7	1.5	14	
	0900	0.89	12.1	1.3	15	280
	1200	1.01	11.1	1.4	14	
	1500	1.00	10.2	1.3	16	
	1800	0.87	10.5	1.2	15	300
	2100	0.94	10.6	1.1	12	
15.10.89	0000	0.78	11.0	1.2	15	
	0300	0.95	11.2	1.0	16	
	0600	0.94	9.8	1.2	12	
	0900	0.84	10.7	1.0	12	0
	1200	0.82	11.4	1.1	14	
	1500	0.89	12.2	1.2	16	
	1800	0.87	13.3	1.0	18	240
	2100	0.80	10.7	1.0	12	
16.10.89	0000	0.88	11.4	1.0	8	
	0300	0.78	11.2	1.2	6	
	0600	0.64	14.0	0.9	18	
	0900					320
	1800	0.73	9.7	0.9	10	0
17.10.89	0900					260
	1200	0.69	13.0	0.8	15	
	1500	0.63	13.3	0.8	10	
	1800	0.88	9.8	1.0	14	340
	2100	0.86	10.9	1.0	15	
18.10.89	0000	0.94	9.8	1.0	15	
	0300	0.66	9.5	1.0	18	
	0900					0
	1200	0.59	9.1	0.8	9	
	1500	0.45	9.2	0.6	8	
	1800	0.57	9.0	1.0	12	0
	2100	0.60	8.6	0.9	8	

Date	Time hrs	Hs (m)	Tz sec	H.max (m)	T(Hmax) sec	Wave direction in degrees
19.10.89	0000	0.42	10.1	0.7	10	
	0300	0.48	9.8	0.8	8	
	0600	0.45	8.9	0.6	10	
	0900	0.42	10.3	0.5	10	280
	1200	0.52	10.4	0.6	14	
	1500	0.50	7.4	0.6	10	
	1800	0.57	8.2	0.6	8	320
	2100	0.51	9.3	0.8	10	
20.10.89	0000	0.48	9.2	0.7	9	
	0300	0.54	8.6	0.7	6	
	0600	0.41	8.8	0.7	9	
	0900	0.51	10.4	0.8	12	0
	1200	0.65	10.7	0.8	10	
	1800	0.64	7.8	1.0	9	0
21.10.89	0900	0.87	8.0	1.3	6	0
	1200	0.77	6.9	1.0	6	
	1800	0.72	7.2	1.0	8	280
	2100	0.84	6.9	1.1	6	
22.10.89	0000	0.75	7.4	1.1	6	
	0300	0.58	7.7	1.0	6	
	0600	0.66	8.4	0.9	8	
	0900				320	
	1200	0.66	7.6	0.9	6	
	1800				300	
	2100	0.59	8.1	0.9	6	
23.10.89	0300	0.58	6.7	0.8	12	
	0600	0.58	6.1	0.8	4	
	0900				240	
24.10.89	0300	0.53	8.0	0.7	14	
	0900	0.38	8.7	0.5	10	280
25.10.89	0600	0.62	11.2	0.9	12	
	0900	0.49	12.0	0.6	12	320
	1200	0.53	11.9	0.6	11	
	1500	0.51	8.5	0.8	14	
	1800	0.58	9.2	0.7	16	340
	2100	0.59	10.8	0.9	16	

Date	Time hrs	Hs (m)	Tz sec	H.max (m)	T(Hmax) sec	Wave direction in degrees
	0300	0.46	10.3	0.7	13	
	0900	0.61	14.0	0.8	14	280
	1200	0.58	10.3	1.0	14	
	1500	0.60	8.3	0.9	14	
	1800	0.55	14.6	0.8	12	200
	2100	0.61	15.0	0.8	14	
27.10.89	0000	0.59	12.3	0.9	14	
	0300	0.60	13.6	0.9	14	
	0600	0.54	15.6	0.8	14	
	0900	0.49	16.9	0.7	12	0
	1200	0.57	14.5	1.0	14	
	1500	0.51	13.4	0.7	11	
	1800	0.55	13.2	0.8	12	240
	2100	0.62	11.5	1.0	12	
28.10.89	0000	0.65	11.5	1.0	14	
	0300	0.55	10.6	0.8	12	
	0600	0.65	10.9	1.0	14	
	0900	0.54	9.2	0.8	13	280
29.10.89	0900	0.61	9.2	0.9	11	200
	1200	0.80	10.0	1.0	8	
	1500	0.72	10.1	1.1	10	
	1800					320
30.10.89	0000	0.54	9.1	0.8	12	
	0300	0.57	8.6	0.9	10	280
	0900	0.57	8.6	0.9	10	
	1200	0.60	8.1	0.9	10	
	1500	0.50	6.7	0.6	11	
	1800					240
	2100	0.47	7.9	0.6	9	
31.10.89	0000	0.54	8.0	0.7	6	
	0300	0.47	7.3	0.7	6	
	0600	0.51	8.4	0.8	8	
	0900	0.48	9.1	0.7	10	200
	1200	0.51	8.4	0.8	9	
	1500	0.47	6.9	0.7	10	
	1800	0.46	6.1	0.7	11	300
	2100	0.44	6.9	0.7	10	

MON TH & YEAR : NOVEMBER 1989

Date	Time hrs	Hs (m)	Tz sec	H.max (m)	T(Hmax) sec	Wave direction in degrees
1.11.89	0000	0.59	8.3	0.6	12	
	0300	0.54	8.3	0.7	8	
	0600	0.44	8.2	0.6	7	
	0900					260
2.11.89	0900	0.58	8.5	0.7	12	0
3.11.89	0900	0.49	11.5	0.7	13	260
	1200	0.34	11.4	0.4	11	
	1500	0.52	9.5	0.6	12	
	1800	0.39	11.0	0.5	14	300
4.11.89	0000	0.42	9.9	0.6	10	
	0300	0.39	10.2	0.5	10	
	0600	0.31	10.3	0.5	12	
	0900	0.36	10.0	0.5	10	280
	1200	0.44	7.5	0.6	11	
	1500	0.48	4.7	0.7	10	
	1800	0.40	6.3	0.5	5	280
5.11.89	0900					240
	1200	0.31	8.5	0.4	10	
	1500	0.45	6.5	0.6	8	
	1800	0.45	7.1	0.6	6	
	2100	0.51	6.8	0.6	6	
6.11.89	0000	0.49	6.7	0.6	12	
	0300	0.47	7.3	0.6	13	
	1500	0.51	8.2	0.8	9	
	1800					300
7.11.89	0900	0.81	7.1	1.1	10	240
	1200	0.66	8.4	1.2	10	
	1500	0.65	9.2	0.8	10	
	1800	0.50	6.5	0.7	6	260
	2100	0.50	6.6	0.6	10	
8.11.89	0000	0.48	7.1	0.7	12	
	0300	0.56	7.7	0.7	10	
	0900					0
9.11.89	0900	0.42	8.0	0.7	12	240
	1200	0.38	8.7	0.5	12	

Date	Time hrs	Hs (m)	Tz sec	H.max (m)	T(Hmax) sec	Wave direction in degrees
10.11.89	0900	0.41	8.5	0.5	12	0
	1200	0.45	6.8	0.6	8	
	1500	0.42	5.6	0.6	8	
	1800	0.42	6.6	0.5	10	280
	2100	0.28	8.2	0.5	9	
11.11.89	0000	0.39	8.3	0.5	10	
	0900					260
	1200	0.35	8.8	0.5	9	
	1500	0.43	6.0	0.6	8	
	1800	0.44	5.3	0.6	8	280
	2100	0.43	6.3	0.5	8	
12.11.89	0000	0.47	6.2	0.7	8	
	0300	0.40	6.2	0.6	8	
	0600	0.37	6.2	0.6	9	
	0900					320
	1200	0.38	6.5	0.5	6	
	1500	0.31	6.2	0.4	6	
	1800	0.31	6.4	0.4	11	280
	2100	0.44	4.3	0.5	6	
13.11.89	0900					0
	1800					300
14.11.89	0900					240

Note: The wave rider buoy was drifted from its position since 13th November 1989.

MONTH & YEAR : DECEMBER 1989

Date	Time hrs	Hs (m)	Tz sec	H.max (m)	T(Hmax) sec	Wave direction in degrees
1.12.89	0900				260	
	1800				280	
2.12.89	0900				240	
	1800	--WAREP not functioning----				
3.12.89	0900				240	
	1800				280	
4.12.89	0900				220	
	1800				260	
	2100	0.44	4.3	0.5	6	
5.12.89	0900					220
	1500	0.51	8.9	0.7	13	
	1800	0.53	7.2	0.8	8	-
	2100	0.50	7.7	0.6	10	
6.12.89	0000	0.53	9.0	0.7	12	
	0300	0.45	7.1	0.7	9	
	0600	0.48	8.8	0.6	12	
	0900	0.51	8.3	0.7	12	-
	1200	0.53	9.4	0.8	12	
	1500	0.43	6.5	0.6	10	
	1800	0.54	5.3	0.7	8	
8.12.89	0900	WAREP not functioning			240	
9.12.89	0900	0.44	7.5	0.7	12	260
	1200	0.33	8.7	0.4	10	
	1500	0.41	7.9	0.6	11	
	1800					280
	2100	0.50	6.9	0.6	11	
10.12.89	0000	0.50	7.1	0.6	12	
	0300	0.44	7.5	0.6	14	
	0600	0.50	7.2	0.6	10	
	0900	0.54	6.5	0.7	11	220
	1200	0.55	5.5	0.8	10	
	1500	0.37	6.4	0.6	11	
	1800	0.49	5.6	0.6	12	260
	2100	0.55	5.6	0.8	11	

Date	Time hrs	Hs (m)	Tz sec	H.max (m)	T(Hmax) sec	Wave direction in degrees
11.12.89	0000	0.48	5.9	0.8	10	
	0300	0.48	6.1	0.7	10	
	0900	0.47	7.8	0.8	11	220
	1200	0.39	8.3	0.5	10	
	1800					280
	2100	0.57	5.0	1.0	12	
12.12.89	0000	0.50	5.0	0.8	10	
	0900					240
	1200	0.51	6.7	0.8	11	
	1800					300
13.12.89	0900					260
	1800					260
14.12.89	0900					220
	1800					300
15.12.89	0900	0.56	5.5	0.8	11	220
	1800	0.54	9.3	0.9	12	260
16.12.89	0900					240
	1200	0.51	9.1	0.7	12	
	1800	0.53	9.5	0.7	12	300
	2100	0.54	10.3	0.7	12	
17.12.89	0000	0.45	9.1	0.7	12	
	0300	0.53	6.9	0.7	12	
	0600	0.55	6.3	0.8	10	
	0900					240
	1200	0.44	6.9	0.6	12	
	1500	0.41	8.8	0.6	13	
	1800					320
18.12.89	0900	0.58	7.9	0.8	12	220
	1200	0.58	6.5	0.9	12	
	1500	0.44	9.4	0.7	12	
	1800	0.52	9.8	0.7	12	300
	2100	0.44	8.8	0.8	12	
19.12.89	0000	0.39	9.8	0.6	11	
	0300	0.39	6.6	0.6	10	
	0600	0.39	5.0	0.7	9	
	0900	0.46	10.5	0.7	12	240
	1800	0.42	9.8	0.6	14	280

Date	Time hrs	Hs (m)	Tz sec	H.max (m)	T(Hmax) sec	Wave direction in degrees
20.12.89	0300	0.42	9.4	0.6	12	
	0600	0.35	11.8	0.6	10	
	0900					220
	1800					280
	2100	0.47	6.5	0.6	8	
21.12.89	0000	0.36	6.4	0.6	10	
	0300	0.40	5.9	0.6	10	
	0900					240
	1800	0.42	5.0	0.6	10	280
	2100	0.41	5.6	0.6	10	
22.12.89	0000	0.44	6.4	0.6	10	
	0300	0.41	8.0	0.6	11	
	0600	0.42	8.0	0.5	10	
	0900					220
	1800	0.62	5.0	0.8	10	260
	2100	0.48	5.7	0.8	8	
23.12.89	0000	0.42	7.0	0.7	9	
	0300	0.54	5.5	0.6	8	
	0900	0.38	8.0	0.6	10	200
	1200	0.32	6.0	0.5	8	
	1500	0.39	5.1	0.5	9	
	1800	0.57	5.2	0.7	10	300
	2100	0.49	6.0	0.7	8	
24.12.89	0000	0.44	7.2	0.6	14	
	0300	0.43	6.6	0.7	12	
	0600	0.47	6.3	0.6	8	
	0900	0.53	6.9	0.6	9	220
	1200	0.43	4.9	0.6	6	
	1800	0.69	5.7	1.0	10	280
	2100	0.74	6.6	1.1	12	
25.12.89	0000	0.66	9.2	1.1	12	
	0300	0.63	6.9	1.0	8	
	0600	0.60	8.6	0.9	12	
	0900					240
	1500	0.57	6.7	0.8	11	
	1800	0.60	5.6	0.8	10	280
	2100	0.60	5.5	1.0	11	

Date	Time hrs	Hs (m)	Tz sec	H.max (m)	T(Hmax) sec	Wave direction in degrees
26.12.89	0000	0.60	5.7	0.8	12	
	0300	0.53	6.5	0.6	9	
	0900	0.65	7.0	1.0	9	220
	1200	0.64	5.6	1.0	10	
	1800					280
	2100	0.74	5.2	1.0	11	
27.12.89	0900	0.63	6.1	0.8	10	240
	1200	0.57	7.2	0.8	12	
	1800					300
28.12.89	0900	0.54	8.3	0.8	11	220
	1200	0.57	8.8	0.9	12	
	1500	0.60	8.0	0.8	11	
	1800					300
29.12.89	0900	0.48	10.6	0.8	12	0
	1200	0.48	11.3	0.6	13	0
	1500	0.60	9.5	0.7	12	
	1800					260
	2100	0.49	7.8	0.7	9	
30.12.89	0000	0.60	10.9	0.9	12	
	0600	0.43	9.1	0.7	11	
	0900	0.57	9.4	0.8	10	260
	1200	0.54	10.3	0.8	11	
	1500	0.46	10.5	0.8	12	
	1800	0.68	8.3	1.0	10	280
	2100	0.54	9.2	0.8	11	
31.12.89	0000	0.62	8.2	0.8	10	
	0300	0.59	10.0	0.9	11	
	0600	0.64	9.0	0.9	12	
	0900	0.55	10.3	0.8	12	220
	1200	0.70	8.6	1.1	10	
	1500	0.68	6.3	1.1	10	
	1800	0.77	6.2	1.1	8	280
	2100	0.77	6.3	1.2	8	

MONTH & YEAR : JANUARY 1990

Date	Time hrs	Hs (m)	Tz sec	H.max (m)	T(Hmax) sec	Wave direction in degrees
1. 1.90	0000	0.74	6.5	1.1	8	
	0300	0.67	7.1	1.2	10	
	0600	0.64	7.1	1.1	11	
	0900	0.74	7.6	1.1	12	220
	1200	0.68	6.6	1.0	10	
	1500	0.72	5.6	1.1	6	
	1800	0.95	5.5	1.2	12	260
	2100	0.70	5.6	1.0	8	
2. 1.90	0000	0.77	6.0	1.1	6	
	0300	0.86	5.9	1.2	8	
	0600	0.72	6.1	1.0	7	
	0900	0.68	6.4	0.9	7	240
	1200	0.58	5.8	1.0	9	
	1500	0.79	5.5	1.1	6	
	1800	0.64	5.1	1.0	6	280
	2100	0.64	5.7	1.0	7	
3. 1.90	0000	0.67	6.1	0.9	7	
	0300	0.64	6.6	0.9	8	
	0600	0.58	6.3	0.8	10	
	0900	0.68	6.5	1.0	8	0
	1200	0.68	6.1	0.9	7	
	1500	0.72	5.0	1.2	10	
	1800	0.61	5.8	0.8	8	300
	2100	0.67	6.1	1.0	8	
4. 1.90	0000	0.62	6.8	0.8	9	
	0300	0.63	6.9	1.0	10	
	0900	0.69	9.6	0.8	12	200
	1200	0.64	10.7	0.8	12	
	1500	0.57	7.7	0.8	12	
	1800	0.66	7.8	0.9	12	280
	2100	0.65	8.0	1.1	10	
5. 1.90	0000	0.66	10.3	1.0	12	
	0300	0.52	10.0	0.7	10	
	0600	0.64	9.6	0.9	12	
	0900	0.59	9.2	0.9	11	220
	1500	0.59	8.6	0.8	10	
	1800	0.40	13.6	0.5	14	280

Date	Time hrs	Hs (m)	Tz sec	H.max (m)	T(Hmax) sec	Wave direction in degrees
6. 1.90	0000	0.43	10.9	0.5	12	
	0300	0.52	11.4	0.8	14	
	0900	0.42	11.1	0.5	12	220
	1200	0.51	8.7	0.6	10	
	1500	0.51	8.6	0.8	12	
	1800	0.47	7.6	0.7	9	280
	2100	0.44	7.9	0.6	12	
7. 1.90	0300	0.54	8.5	0.7	13	
	0600	0.41	7.3	0.7	12	
	0900	0.53	7.1	0.9	11	220
	1800	0.54	6.2	0.8	11	300
	2100	0.50	6.7	0.7	8	
8. 1.90	0000	0.38	7.6	0.5	11	
	0300	0.35	8.6	0.5	11	
	0600	0.40	7.8	0.6	12	
	0900	0.43	11.0	0.7	14	240
	1200	0.68	6.1	1.0	7	
	1500	0.64	6.9	1.0	7	
	1800	0.52	10.9	0.8	12	280
	2100	0.52	10.9	0.8	12	
9. 1.90	0000	0.46	10.4	0.7	11	
	0300	0.59	11.4	0.8	12	
	0600	0.54	8.9	0.8	10	
	0900	0.63	9.2	1.0	10	200
	1200	0.49	11.3	0.7	12	
	1500	0.57	8.0	0.8	10	
	1800	0.64	7.6	0.8	8	240
	2100	0.63	8.0	1.0	9	
10. 1.90	0000	0.52	9.9	0.7	10	
	0300	0.57	8.8	0.8	10	
	0600	0.57	8.7	0.8	10	
	0900	0.60	7.5	0.9	12	240
	1200	0.49	10.9	0.8	11	
	1500	0.62	9.4	0.8	11	
	1800	0.64	9.2	1.2	12	280
	2100	0.70	9.4	1.0	12	

Date	Time hrs	Hs (m)	Tz sec	H.max (m)	T(Hmax) sec	Wave direction in degrees
11. 1.90	0000	0.81	10.3	1.1	12	
	0300	0.68	10.1	1.0	12	
	0600	0.66	9.0	1.1	12	
	0900	0.69	9.9	1.2	12	240
	1200	0.46	11.9	0.6	13	
	1500	0.68	10.4	0.9	14	
	1800	0.80	9.0	1.0	12	260
	2100	0.65	10.4	1.0	12	
12. 1.90	0000	0.57	8.8	0.8	10	
	0300	0.57	8.6	0.9	11	
	0600	0.62	10.0	0.9	10	
	0900	0.64	5.6	1.0	12	220
	1200	0.76	8.2	1.2	10	
	1500	0.63	7.8	1.0	11	
	1800	0.47	7.6	0.7	12	280
	2100	0.64	6.9	0.8	11	
13. 1.90	0000	0.68	6.9	0.9	11	
	0300	0.69	7.1	1.0	11	
	0600	0.64	7.1	0.9	12	
	0900	0.56	5.6	0.7	12	000
	1200	0.46	10.2	0.6	12	
	1500	0.47	9.6	0.7	10	
	1800	0.59	9.8	1.0	12	280
	2100	0.53	9.9	0.7	13	
14. 1.90	0000	0.52	10.1	0.8	12	
	0300	0.64	8.9	1.0	11	
	0600	0.61	9.8	0.8	12	
	0900	–	–	–	–	200
	1800	–	–	–	–	220
	2100	0.53	8.0	0.8	14	
15. 1.90	0000	0.64	9.4	1.1	11	
	0300	0.62	10.5	0.9	12	
	0600	0.55	10.9	0.8	12	
	0900	–	–	–	–	240
	1800	0.54	8.6	0.8	13	260
	2100	0.52	6.7	0.6	8	

Date	Time hrs	Hs (m)	Tz sec	H.max (m)	T(Hmax) sec	Wave direction in degrees
16. 1.90	0300	0.48	11.1	0.7	14	
	0600	0.59	10.9	0.8	12	
	0900	0.46	12.2	0.6	14	220
	1200	0.36	12.5	0.6	14	
	1500	0.41	9.2	0.6	10	
	1800	0.46	7.7	0.7	10	280
17. 1.90	0000	0.46	8.9	0.6	12	
	0300	0.40	8.3	0.6	10	
	0600	0.40	8.7	0.8	11	
	0900	0.44	9.9	0.6	10	220
	1200	0.52	10.0	0.7	12	
	1500	0.65	8.9	0.8	10	
	1800	0.44	8.0	0.7	11	300
	2100	0.57	8.4	0.8	10	
18. 1.90	0000	0.56	8.7	0.8	10	
	0300	0.44	8.2	0.7	10	
	0600	0.41	8.3	0.5	10	
	0900	0.36	7.6	0.6	10	200
	1200	0.35	8.8	0.5	12	
	1500	0.43	6.9	0.6	7	
	1800	0.45	5.1	0.6	8	260
	2100	0.47	5.4	0.7	6	
19. 1.90	0000	0.46	5.6	0.6	8	
	0300	0.47	6.1	0.6	8	
	0600	0.39	7.0	0.6	10	
	0900	–	–	–	–	000
	1800	–	–	–	–	260
20. 1.90	0900	–	–	–	–	220
	1800	–	–	–	–	260
	2100	0.49	6.4	0.8	10	
21. 1.90	0000	0.42	8.0	0.6	12	
	0300	0.44	8.2	0.8	10	
	0600	0.49	7.3	0.7	12	
	0900	0.53	8.8	0.7	12	240
	1200	0.47	10.3	0.8	12	
	1500	0.51	7.5	0.8	11	
	1800	0.59	6.3	1.0	8	280
	2100	0.58	6.7	0.9	12	

Date	Time hrs	Hs (m)	Tz sec	H.max (m)	T(Hmax) sec	Wave direction in degrees
22. 1.90	0000	0.64	7.5	1.1	12	
	0900	0.64	9.5	1.0	10	240
	1200	0.64	9.4	1.1	10	
	1800	-	-	-	-	220
23. 1.90	0900	0.51	8.8	0.8	10	
	1200	0.53	10.3	0.8	12	
	1500	0.61	7.2	1.0	8	
	1800	0.75	6.3	1.2	7	
	2100	0.66	6.3	0.9	10	
24. 1.90	0900	0.56	10.8	0.8	14	
	1200	0.56	10.3	0.7	12	
	1500	0.52	6.3	0.9	11	
	1800	0.67	6.3	1.2	8	
25. 1.90	0900	-	-	-	-	
	1500	0.64	10.7	0.8	12	
	1800	-	-	-	-	
26. 1.90	0900	0.41	10.0	0.6	12	
	1200	0.54	11.4	0.8	12	
	1500	0.46	6.1	0.7	8	
	1800	-	-	-	-	
	2100	0.58	6.0	0.8	8	
27. 1.90	0000	0.52	6.1	0.8	8	
	0300	0.50	7.4	0.7	10	
	0600	0.54	7.9	0.8	12	
	0900	0.50	8.5	0.6	12	
	1200	0.42	10.0	0.6	10	
	1500	0.49	8.6	0.7	10	
	1800	0.63	7.5	0.9	12	
	2100	0.55	7.1	0.8	8	
28. 1.90	0000	0.48	7.7	0.7	10	
	0300	0.51	9.2	0.7	10	
	0600	0.47	10.4	0.7	12	
	0900	0.53	11.5	0.6	12	
	1200	0.41	8.7	0.6	12	
	1500	0.46	8.5	0.7	12	
	1800	0.68	6.5	0.9	12	
	2100	0.48	5.5	0.7	8	

Date	Time hrs	Hs (m)	Tz sec	H.max (m)	T(Hmax) sec	Wave direction in degrees
29. 1.90	0000	0.56	6.5	0.8	10	
	0300	0.47	7.1	0.7	10	
	0600	0.53	7.6	0.8	9	
	0900	0.42	7.1	0.8	10	
	1200	0.50	7.5	0.7	8	
	1500	0.56	8.1	0.9	9	
	1800	0.62	5.9	0.8	9	
	2100	0.59	6.0	0.9	8	
30. 1.90	0300	0.44	7.0	0.6	8	
	0900	-	-	-	-	
	1200	0.53	7.6	0.8	8	
	1500	0.60	8.7	0.8	12	
	1800	0.53	7.8	0.8	8	
	2100	0.47	8.5	0.6	10	
31. 1.90	0000	0.43	8.4	0.6	10	
	0300	0.48	7.4	0.8	8	
	0600	0.40	9.4	0.5	10	
	0900	0.51	10.3	0.7	12	
	1200	0.58	7.8	0.8	8	
	1500	0.58	7.4	0.9	9	
	1800	0.58	7.3	0.8	10	
	2100	0.53	7.4	0.7	11	

MONTH & YEAR : FEBRUARY 1990

Date	Time hrs	Hs (m)	Tz sec	H.max (m)	T(Hmax) sec	Wave direction in degrees
1. 2.90	0000	0.58	8.3	0.7	11	
	0300	0.54	9.5	0.8	10	
	0900	0.46	7.9	0.7	12	–
	1500	0.60	7.0	0.8	12	
	1800	0.50	7.6	0.7	11	–
	2100	0.56	7.6	0.9	10	
2. 2.90	0000	0.64	9.0	0.8	8	
	0300	0.70	8.3	1.0	10	
	0600	0.64	7.8	0.9	8	
	0900	0.54	9.0	0.8	11	–
	1200	0.68	7.9	1.0	7	
	1500	0.68	7.0	1.0	8	
	1800	0.64	6.9	1.0	8	–
	2100	0.68	8.2	1.0	8	
3. 2.90	0000	0.76	7.9	1.1	8	
	0300	0.76	8.2	1.0	8	
	0900	0.64	9.1	0.9	9	–
	1200	0.48	9.7	0.6	10	
	1500	0.52	8.3	0.7	9	
	1800	0.52	7.3	0.8	8	
	2100	0.52	9.4	0.7	10	
4. 2.90	0000	0.42	10.3	0.6	11	
	0300	0.60	8.5	0.9	10	
	0600	0.54	8.2	0.8	10	
	0900	0.42	11.5	0.6	11	
	1200	0.42	12.5	0.5	11	
	1500	0.54	7.1	0.8	8	
	1800	0.46	6.3	0.7	6	280
	2100	0.52	8.2	0.8	12	
5. 2.90	0000	0.44	8.3	0.6	12	
	0300	0.50	9.5	0.8	14	
	0600	0.48	8.5	0.6	10	
	0800	0.46	10.6	0.7	12	280
	1200	0.44	13.3	0.6	12	
	1800	–	–	–	–	280
6. 2.90	0900	0.48	13.0	0.5	12	220
	1200	0.42	10.7	0.5	10	
	1800	0.46	7.5	0.6	10	300
	2100	0.54	8.2	0.7	12	

Date	Time hrs	Hs (m)	Tz sec	H.max (m)	T(Hmax) sec	Wave direction in degrees
7. 2.90	0300	0.42	8.8	0.6	10	
	0900	0.48	11.1	0.7	11	220
	1200	0.56	9.2	0.8	10	
	1500	0.64	6.3	1.0	8	
	1800	0.64	4.4	0.9	6	330
	2100	0.58	5.5	0.9	10	
8. 2.90	0000	0.52	6.3	0.8	12	
	0300	0.64	6.8	0.8	10	
	0900	0.48	8.5	0.6	12	000
	1200	0.56	6.3	0.8	11	
	1500	0.56	4.6	0.7	6	
	1800	0.42	6.3	0.6	12	300
	2100	0.40	6.5	0.6	11	
9. 2.90	0000	0.42	7.8	0.5	12	
	0900	–	–	–	–	240
	1500	0.54	4.4	0.6	6	
	1800	–	–	–	–	300
	2100	0.64	4.3	0.9	6	
10. 2.90	0000	0.56	5.3	0.9	6	
	0300	0.40	6.5	0.5	8	
	0600	0.38	6.4	0.6	10	
	0900	0.44	5.3	0.6	6	200
	1500	0.42	6.0	0.7	11	
	1800	–	–	–	–	260
11.2.90	0900	0.48	8.7	0.7	10	240
	1800	–	–	–	–	300
	2100	0.60	6.7	0.7	6	
12. 2 90	0000	0.60	6.6	0.7	12	
	0300	0.66	7.0	1.2	12	
	0600	0.46	7.4	0.7	12	
	0900	–	–	–	–	220
	1500	0.60	7.2	0.8	10	
	1800	0.72	5.2	1.0	6	280
	2100	0.64	6.1	0.9	12	

Date	Time hrs	Hs (m)	Tz sec	H.max (m)	T(Hmax) sec	Wave direction in degrees
13. 2.90	0000	0.78	7.7	0.8	12	
	0300	0.56	7.8	0.8	12	
	0900	0.48	9.6	0.7	12	200
	1200	0.54	9.5	0.7	13	
	1500	0.66	8.6	0.9	12	
	1800	0.56	6.7	0.9	12	260
	2100	0.50	6.2	0.6	12	
14. 2.90	0900	–	–	–	–	200
	1800	0.56	4.5	0.9	6	280
	2100	0.76	4.3	1.0	6	
15. 2.90	0000	0.72	4.7	1.2	6	
	0900	0.50	8.0	0.6	12	240
	1200	0.60	5.8	0.9	6	
	1800	–	–	–	–	300
16. 2.90	0900	0.56	5.7	0.8	6	220
	1200	0.56	6.5	0.8	6	
	1800	0.68	5.1	1.0	10	320
	2100	0.68	4.5	1.2	6	
17. 2.90	0000	0.74	6.0	1.0	8	
	0300	0.62	6.9	0.8	10	
	0600	0.54	7.5	0.7	10	
	0900	0.46	8.3	0.7	10	180
	1500	0.60	4.5	0.8	6	
	1800	0.68	4.8	1.1	5	280
	2100	0.80	4.4	1.0	6	
18. 2.90	0000	0.72	4.4	1.2	12	
	0300	0.80	5.2	1.0	6	
	0600	0.68	5.6	1.1	6	
	0900	0.68	7.0	1.0	8	200
	1200	0.76	6.3	0.9	6	
	1500	0.72	5.8	0.9	5	
	1800	0.70	5.6	1.0	6	280
19. 2.90	0900	0.78	4.5	1.2	6	260
	1200	0.80	4.6	1.1	6	
	1800	–	–	–	–	300
	2100	0.92	4.2	1.3	6	

Date	Time hrs	Hs (m)	Tz sec	H.max (m)	T(Hmax) sec	Wave direction in degrees
20. 2.90	0000	0.88	4.9	1.3	9	
	0300	0.76	5.3	1.1	6	
	0600	0.68	5.6	1.0	6	
	0900	–	–	–	–	200
	1200	0.60	7.5	0.8	8	
	1500	0.68	6.4	1.0	12	
	1800	0.64	5.8	0.9	11	280
	2100	0.68	5.3	1.0	10	
21. 2.90	0000	0.68	5.8	1.0	9	
	0300	0.72	5.9	1.1	11	
	0600	0.64	6.4	0.8	10	
	0900	–	–	–	–	200
	1800	–	–	–	–	300
22. 2.90	0900	–	–	–	–	180
	1800	–	–	–	–	320
23. 2.90	0900	–	–	–	–	240
	1800	0.64	6.8	0.9	6	300
	2100	0.72	5.7	1.2	8	
24. 2.90	0000	0.78	6.7	1.0	6	
	0900	0.52	7.8	0.8	8	200
	1200	0.48	7.6	0.8	8	
	1500	0.54	7.7	0.7	8	
	1800	–	–	–	–	260
25. 2.90	0900	–	–	–	–	220
	1800	–	–	–	–	280
	2100	0.70	5.8	1.0	6	
26. 2.90	0900	0.44	8.0	0.7	10	200
	1500	0.56	5.3	0.6	9	
	1800	–	–	–	–	260
27. 2 90	0900	0.38	8.3	0.5	8	180
	1800	1.14	6.4	1.6	10	260
28. 2.90	0900	0.38	7.5	0.6	10	200
	1800	–	–	–	–	300

MONTH & YEAR : MARCH 1990

Date	Time hrs	Hs (m)	Tz sec	H.max (m)	T(Hmax) sec	Wave direction in degrees
1. 3.90	0900	-	-	-	-	180
	1800	-	-	-	-	280
2. 3.90	0900	-	-	-	-	200
	1800	-	-	-	-	280
3. 3.90	0900	1.1	8.0	1.8	12	0
	1800	-	-	-	-	280
4. 3.90	0900	-	-	-	-	180
	1500	1.1	8.3	1.8	12	
	1800	1.1	6.3	1.7	10	280
5. 3.90	0900	0.8	10.3	1.1	10	160
	1200	0.9	8.5	1.2	12	
	1800	-	-	-	-	300
6. 3.90	0600	0.7	8.3	1.1	11	
	0900	-	-	-	-	220
	1800	-	-	-	-	280
7. 3.90	0900	0.8	8.8	1.4	11	200
	1800	-	-	-	-	300
8. 3.90	0900	-	-	-	-	200
	1800	-	-	-	-	320
9. 3.90	0300	1.3	9.3	1.7	10	
	0900	0.8	8.4	1.0	14	180
	1800	-	-	-	-	280
10. 3.90	0900	-	-	-	-	0
	1200	1.0	7.7	1.5	14	
	1500	1.3	8.4	1.6	14	
	1800	-	-	-	-	260
11. 3.90	0900	1.0	13.0	1.4	12	160
	1800	-	-	-	-	280

Date	Time hrs	Hs (m)	Tz sec	H.max (m)	T(Hmax) sec	Wave direction in degrees
12. 3.90	0300	1.0	8.8	1.5	12	
	0900	-	-	-	-	220
	1200	1.3	4.8	1.7	6	
	1800	-	-	-	-	280
	2100	0.64	6.9	0.8	11	
13. 3.90	0900	0.8	7.3	1.2	10	180
	1800	-	-	-	-	300
	2100	0.8	4.9	1.5	6	
14. 3.90	0900	-	-	-	-	200
	1500	0.7	4.7	1.0	10	
	1800	-	-	-	-	300
	2100	0.8	4.3	1.2	6	
15. 3.90	0000	0.7	5.9	1.2	10	
	0300	0.7	5.4	0.9	12	
	0900	0.6	7.1	0.9	12	200
	1800	-	-	-	-	320
	2100	1.3	6.6	1.6	8	
16. 3.90	0000	1.1	6.2	1.4	14	
	0900	-	-	-	-	220
	1800	-	-	-	-	260
17. 3.90	0900	0.8	9.5	1.1	14	
	2100	0.9	6.6	1.4	10	
18. 3.90	0000	1.0	7.1	1.4	4	
	1200	0.8	8.7	1.2	12	
19. 3.90	0900	0.5	8.0	0.6	10	
21. 3.90	0000	0.52	5.7	0.7	10	
22. 3.90	1200	0.53	7.5	0.8	14	
	1500	0.60	6.5	0.7	12	
	1800	0.67	5.9	0.9	9	
	2100	0.52	5.6	0.6	8	
25. 3.90	0900	-	-	-	-	180
	1200	0.6	12.7	0.8	12	
	1800	-	-	-	-	280

Date	Time hrs	Hs (m)	Tz sec	H.max (m)	T(Hmax) sec	Wave direction in degrees
26. 3.90	0900	0.6	11.1	0.8	9	200
	1200	0.6	10.4	1.1	10	
	1500	0.6	14.1	0.9	11	
	1800	0.6	13.8	0.7	16	260
	2100	0.6	9.2	0.8	6	
27. 3.90	0000	0.6	13.3	0.7	13	
	0300	0.7	12.9	1.0	12	
	0600	0.5	10.9	0.7	12	
	0900	0.6	9.4	0.8	10	160
	1200	0.5	11.8	0.7	12	
	1500	0.7	8.8	1.2	11	
	1800	0.7	9.0	1.0	12	300
	2100	0.6	8.2	0.9	13	

MONTH & YEAR : APRIL 1990

Date	Time hrs	Hs (m)	Tz sec	H.max (m)	T(Hmax) sec	Wave direction in degrees
26.10.89	0000	0.60	10.3	0.9	16	
2. 4.90	0900	0.71	7.9	1.0	8	220
	1200	0.58	8.1	0.9	11	
	1500	0.61	6.4	0.9	6	
	1800	0.85	6.8	1.0	7	300
	2100	0.70	6.2	1.1	6	
3. 4.90	0000	0.61	7.0	0.8	4	
	0300	0.56	9.3	0.7	6	
	0600	0.57	10.9	0.7	6	
	0900	0.45	10.1	0.6	5	160
	1200	0.47	9.6	0.7	7	
	1500	0.59	7.4	0.8	6	
	1800	0.50	9.4	0.7	10	
	2100	0.54	8.8	0.8	4	
4. 4.90	0000	0.41	8.7	0.6	6	
	0300	0.44	11.9	0.6	6	
	0600	0.48	21.4	0.6	7	
	1800	0.55	22.6	0.6	21	280
	2100	0.49	9.2	0.7	4	
5. 4.90	0000	0.55	13.6	0.8	13	
	0300	0.67	13.9	0.9	16	
	0600	0.59	16.0	0.8	16	
	0900	0.50	13.9	0.7	14	180
	1200	0.57	17.9	0.8	15	
	1800	-	-	-	-	280
6. 4.90	0900	0.56	16.0	0.8	14	200
	1200	0.59	11.6	0.9	13	
	1500	0.64	9.9	1.1	11	
	1800	0.76	10.5	1.1	11	290
	2100	0.76	10.6	1.1	12	
7. 4.90	0000	0.73	8.9	1.3	14	
	0300	0.68	10.3	1.0	10	
	0600	0.55	10.9	0.8	11	
	0900	0.54	10.3	0.7	12	

BUOY RETRIEVED : 07.04.1990 - 1130 hours
NEW BUOY INSTALLED : 24.04.1990 - 1115 hous

Date	Time hrs	Hs (m)	Tz sec	H.max (m)	T(Hmax) sec	Wave direction in degrees
24. 4.90	1800	0.91	9.1	1.4	9	280
	2100	0.87	8.1	1.3	11	
25. 4.90	0000	0.92	8.5	1.4	11	
	0300	0.87	8.0	1.2	11	
	0600	0.98	8.6	1.6	10	
	0900	0.86	7.9	1.1	10	200
	1200	0.90	8.2	1.2	12	
	1500	0.78	7.5	1.1	10	
	1800	0.85	7.1	1.3	10	300
	2100	0.76	8.7	0.9	11	
26. 4.90	0000	0.79	9.7	1.0	11	
	0300	0.83	9.2	1.0	12	
	0600	0.81	8.9	1.1	12	
	0900	0.69	12.4	0.8	12	220
	1200	0.79	13.2	1.2	14	
	1800	0.75	10.4	1.2	12	280
	2100	0.85	9.8	1.2	10	
27. 4.90	0000	0.78	12.2	1.1	12	
	0300	0.90	9.1	1.4	10	
	0600	0.68	9.9	1.0	10	
	0900	0.71	12.1	0.9	14	250
	1200	0.71	11.1	1.1	12	
	1500	0.85	7.6	1.3	14	
	1800	0.99	7.5	1.4	10	320
	2100	0.79	8.6	1.3	11	
28. 4.90	0000	0.76	9.7	1.2	11	
	0300	0.88	9.4	1.3	12	
	0600	0.73	10.2	1.0	10	
	0900	0.80	9.3	1.2	12	220
	1200	0.80	9.0	1.1	14	
	1500	0.68	10.0	1.1	12	
	1800	0.78	10.7	1.1	10	300
29. 4.90	1200	0.76	11.8	1.0	11	
	1500	0.76	13.6	1.3	14	
	1800	0.79	8.3	1.1	12	320
	2100	0.82	12.1	1.1	14	
30. 4.90	0000	0.79	9.3	1.2	13	
	0300	0.80	9.5	1.2	11	
	0900	0.69	12.1	1.0	12	240
	1200	0.77	11.6	1.0	12	
	1800	-	-	-	-	290

MONTH & YEAR : MAY 1990

Date	Time hrs	Hs (m)	Tz sec	H.max (m)	T(Hmax) sec	Wave direction in degrees
1. 5.90	0900	-	-	-	-	
	1800	-	-	-	-	
2. 5.90	0900	-	-	-	-	
	1800	-	-	-	-	
	2100	0.91	6.0	1.4	12	
3. 5.90	0000	0.76	7.2	1.0	12	
	0300	0.76	6.5	1.3	13	
	0600	0.73	6.1	1.0	10	
	0900	0.62	7.6	0.9	10	
	1200	0.67	6.9	1.0	11	
	1500	0.79	4.5	1.4	10	
	1800	0.86	5.3	1.1	8	
	2100	0.78	5.0	1.2	10	
4. 5.90	0900	-	-	-	-	
	1800	-	-	-	-	
5. 5.90	0000	0.76	4.7	1.0	6	
	0300	0.67	4.6	1.0	6	
	0900	-	-	-	-	
	1800	-	-	-	-	
6. 5.90	0000	1.00	4.4	1.3	5	
	0900	-	-	-	-	
	1800	-	-	-	-	
7. 5.90	0900	-	-	-	-	
	1800	-	-	-	-	
8. 5.90	0000	1.23	4.8	1.7	6	
	0900	-	-	-	-	
	1800	-	-	-	-	
	2100	1.17	5.5	1.6	6	
9. 5.90	0000	0.55	5.0	1.4	6	
	0300	0.85	5.0	1.4	6	
	0900	0.98	4.8	1.5	6	
	1800	-	-	-	-	
	2100	1.06	5.1	1.5	6	

Date	Time hrs	Hs (m)	Tz sec	H.max (m)	T(Hmax) sec	Wave direction in degrees
10. 5.90	0900	1.17	5.1	1.6	8	
	1200	0.95	5.8	1.4	8	
	1800	–	–	–	–	
	2100	1.22	5.5	1.7	6	
11. 5.90	0000	1.11	5.5	1.4	6	
	0900	1.17	6.1	1.9	6	
	1200	1.17	5.9	1.5	7	
	1500	1.05	5.2	1.6	7	
	1800	1.11	5.3	1.6	10	
12. 5.90	0900	–	–	–	–	
	1800	–	–	–	–	
13. 5.90	0900	0.84	8.6	1.5	8	
	1200	0.85	6.6	1.2	8	
	1500	0.79	5.8	1.2	11	
	1800	0.77	5.2	1.2	6	
	2100	0.88	5.6	1.3	7	
14. 5.90	0000	0.85	5.6	1.1	7	
	0300	0.79	5.5	1.3	7	
	0600	0.74	4.9	1.1	5	
	0900	–	–	–	–	
	1800	0.79	9.0	1.1	10	
	2100	0.74	7.2	1.1	7	
15. 5.90	0900	0.65	11.8	0.9	12	
	1200	0.64	7.5	1.0	8	
	1500	0.67	6.5	1.0	11	
	1800	0.74	6.9	1.2	9	
	2100	0.73	8.3	1.1	11	
16. 5.90	0900	0.51	12.5	0.6	14	
	1200	0.65	10.2	0.8	9	
	1500	0.84	8.7	1.3	9	
	1800	1.00	8.2	1.7	10	
	2100	0.93	8.9	1.6	10	

Date	Time hrs	Hs (m)	Tz sec	H.max (m)	T(Hmax) sec	Wave direction in degrees
17. 5.90	0000	1.06	8.4	1.9	11	
	0300	1.00	8.8	1.8	9	
	0600	0.92	8.4	1.3	12	
	0900	0.87	8.5	1.4	10	
	1200	1.21	7.6	2.0	10	
	1500	1.18	6.8	2.0	10	
	1800	1.20	7.1	1.9	10	
	2100	1.40	6.1	2.3	10	
18. 5.90	0000	1.50	5.7	2.4	8	
	0900	1.47	5.8	2.1	9	
	1200	1.17	5.8	1.6	8	
	1500	1.42	6.7	1.9	9	
	1800	–	–	–	–	
	2100	1.49	6.7	2.5	8	
19. 5.90	0000	1.29	9.2	1.7	12	
	0300	1.24	6.8	1.9	8	
	0600	1.29	7.2	1.8	7	
	0900	1.01	7.2	1.4	11	
	1200	1.06	7.5	1.4	8	
	1500	1.02	8.0	1.3	8	
	1800	1.20	6.3	1.9	9	
	2100	1.00	6.6	1.5	6	
20. 5.90	0000	1.01	7.1	1.4	9	
	0300	1.09	6.0	1.7	8	
	0900	1.30	6.2	1.8	8	
	1800	1.28	6.7	1.9	9	
	2100	1.28	7.1	1.8	8	
21. 5.90	0000	1.47	6.7	2.2	7	
	0300	1.56	6.7	2.3	10	
	0600	1.52	6.4	2.5	8	
	0900	1.51	6.9	2.2	8	
	1200	1.65	6.9	2.4	7	
	1500	1.50	7.5	2.2	10	
	1800	1.62	8.0	2.7	11	
	2100	1.72	8.8	2.4	10	
22. 5.90	0300	2.04	8.2	3.5	9	
	0600	1.84	8.0	2.5	10	
	0900	1.84	8.7	2.5	10	
	1800	1.66	7.4	2.2	11	

Date	Time hrs	Hs (m)	Tz sec	H.max (m)	T(Hmax) sec	Wave direction in degrees
23. 5.90	0900	–	–	–	–	
	1800	–	–	–	–	
	2100	1.57	7.8	2.4	11	
24. 5.90	0000	1.51	7.4	2.2	10	
	0300	1.52	6.4	2.4	11	
	0600	1.34	6.9	2.1	11	
	0900	1.12	9.8	1.6	10	
	1800	–	–	–	–	
25. 5.90	0900	–	–	–	–	
	1500	1.31	7.0	1.7	12	
	1800	1.25	6.8	1.9	7	
	2100	1.39	6.5	2.1	11	
26. 5.90	0000	1.35	6.5	2.1	10	
	0300	1.47	7.7	2.1	10	
	0600	1.44	6.4	2.0	8	
	0900	1.62	7.8	2.2	11	
	1500	1.58	7.7	2.0	10	
	1800	1.61	7.2	2.4	11	
27. 5.90	0000	1.66	7.8	2.5	12	
	0300	1.55	7.5	2.0	10	
	0900	1.81	8.2	2.4	8	
	1200	2.14	7.4	3.1	10	
	1500	1.98	7.0	2.8	8	
	1800	1.95	6.7	3.1	10	
	2100	1.77	5.7	2.7	8	
28. 5.90	0000	1.90	6.2	3.0	7	
	0300	1.82	6.9	3.0	8	
	0600	1.85	7.6	2.8	9	
	0900	–	–	–	–	
	1800	–	–	–	–	
29. 5.90	0900	1.51	7.4	2.5	8	
	1200	1.59	7.1	2.6	8	
	1500	1.62	7.1	2.2	8	
	1800	1.83	7.0	3.0	7	
	2100	2.13	7.4	3.5	10	

Date	Time hrs	Hs (m)	Tz sec	H.max (m)	T(Hmax) sec	Wave direction in degrees
30. 5.90	0000	1.87	7.1	2.7	8	
	0300	1.96	7.1	3.5	8	
	0600	1.90	7.1	3.5	8	
	0900	1.68	7.2	2.8	8	
	1800	-	-	-	-	
31. 5.90	0900	1.76	7.9	2.6	10	
	1200	1.94	7.2	2.8	9	
	1500	2.06	7.1	3.2	8	
	1800	1.85	7.3	2.8	10	
	2100	1.79	7.7	2.7	8	

Appendix- 3.1 No. of Vessels at New Mangalore Port by Commodity

	1983-84	1984-85	1985-86	1986-87	1987-88
P.O.L	53	71	68	84	76
Liquired Ammonia & Phosphoric Acid	-	2	4	15	12
Edible Oil	-	2	9	8	17
Fertilizers	12	17	14	11	3
Iron Ore	36	42	54	97	107
Other Ore	5	10	6	3	3
Steel Scrap	2	4	5	5	5
Sugar	6	2	7	1	-
Cement	19	8	6	1	1
Timber	-	-	15	38	52
Other	161	184	121	142	150
Total	294	342	309	405	426

Appendix- 3.2 Cargo Volume Handled at New Mangalore Port by Commodity (Export)

(unit: 1000t)

Commodity	1978-79	79-80	80-81	81-82	82-83	83-84	84-85	85-86	86-87	87-88	88-89
Iron Ore	21	-	3	547	1,122	1,231	1,727	2,260	3,873	4,354	5,011
Manganese Ore	14	18	13	17	9	21	15	33	16	15	33
Chrome Ore	21	21	30	49	61	26	79	47	21	32	
Granite Stones	38	111	174	118	147	168	273	215	244	314	386
Coffee	38	36	63	45	47	39	32	43	49	46	43
Reefer Cargo	4	6	5	5	6			2	2	1	NA
Batteries	1	2	3	3	5			3	6	3	NA
Cashew Products	1	1	2	6	2			0	1	1	NA
Coated Pipes								63	9	15	NA
Other	65	32	30	40	32	110	261	24	15	19	NA
(EX TOTAL)	203	27	323	830	1,431	1,595	2,387	2,690	4,236	4,803	5,517

Appendix- 3.3 Cargo Volume Handled at New Mangalore Port by Commodity (Import)

(unit: 1000t)

Commodity	1978-79	79-80	80-81	81-82	82-83	83-84	84-85	85-86	86-87	87-88	88-89
Cement	138	83	87	86	278	359	36	44	14	1	1
Machinery	18	11			1						NA
Fertilizers	167	208	207	180	153	211	247	219	165	93	46
Steel Scrap	7	3	21	37	42	39	59	81	120	90	117
Sugar								92	14		NA
Timber								65	204	342	375
P.O.L	338	352	310	364	351	348	437	412	533	455	571
Liquid Ammonia							16	17	57	16	} 141
Phosphoric Acid										63	
Edible Oil							27	47	57	116	42
Coal										65	NA
Foodgrains		14	4	152	22	141	83			2	62
Other (IM)	3	3	10	3	6			19	33	62	NA
(IM TOTAL)	671	674	639	822	853	1,242	995	996	1,197	1,305	1,567

Appendix- 7.1 Annual Working Days of the Iron Ore Berth

Annual working days are set as follows:
Current annual idling hours at the berth,

due to rain	250 hours	
deballasting and draft check	120	
power failure & mechanical breakdown	1000	
others	150	
Sub total	1520 hours =	63 days
Periodical maintenance of machines (annually)		30 days
Total		93 days

therefore,
working days at present: 365 - 93 = 272 days --- 270 days

Time to be spent by "power failure & mechanical breakdown" is assumed to reduce to the half with more maintenance efforts in the future. Then, the annual idling hours would be reduce to 1020 hours (43 days), and working days in the future: 365 - (43+30) = 292 days - 290 days.

Appendix- 7.2 Loading Capacity of the Handling System at the Existing Iron Ore Berth

The loading capacity of the berth depends on operating time, which consists of loading, docking, undocking and non-operation time while berthing. Loading time depends on the capacities of reclaimers at the stockyard, the conveyers and the shiploader. In fact, the loading capacity is the capacity of the loading stream from reclaiming to shiploading via conveyers. So, the capacity is determined by the minimum capacity of all the equipment in the stream.

-- Present --

(For Concentrate Exports)

Present Condition of Equipment

Reclaimer	:	3500 t/h x 2
Out-going Conveyer	:	3000 t/h x 2
Cross Conveyer	:	6800 t/h
Wharf Conveyer	:	6800 t/h
Shiploader	:	6800 t/h

Out-going Capacity from the Yards: 3000 x 2 - 1500 = 4500 t/h
(1500 t/h is consumed for pelletization)*
Direct Loading Capacity from the Filter Plant 1500 t/h

TOTAL 6000 t/h

* Pellets Production: 1500 t/h x 6 h/d x 200 d = 1.8 mil t/y

(For Pellets Exports)

Present Condition of Equipment

Reclaimer	:	3500 t/h (5000 x 0.7)
Out-going Conveyer	:	6600 t/h
Cross Conveyer	:	3500 t/h
Wharf Conveyer	:	3500 t/h
Shiploader	:	3500 t/h

Out-going Capacity from the Yards 3500 t/h

TOTAL 3500 t/h

Table-A.7.1 Loading Capacity (Present)

	Concentrate	Pellets
Reclaimer	7,000	3,500
Out-going Conveyer	6,000	6,600
Direct Loading	+1,500	-
Pellets Plant	-1,500	-
Cross Conveyer	6,800	3,500
Wharf Conveyer	6,800	3,500
Shiploader	6,800	3,500
Capacity of the System	6,000	3,500

-- Minor Modifications --

Modification:

Capacity Upgrading of the Out-going Conveyers (Con)
3000 x 2 → 3500 t/h x 2

Capacity Upgrading of the Cross Conveyer
6800(3500)→7000(3600) t/h

Capacity Upgrading of the Wharf Conveyer
6800(3500)→7000(3600) t/h

Capacity Upgrading of the Shiploader
6800(3500)→8000(4100) t/h

( ): for pellets

(For Concentrate Exports)

Condition of Equipment after Modification

Reclaimer : 3500 t/h x 2
Out-going Conveyer : 3500 t/h x 2
Cross Conveyer : 7000 t/h
Wharf Conveyer : 7000 t/h
Shiploader : 8000 t/h

Out-going Capacity from the Yards: 3500 x 2 - 1500 = 5500 t/h
(1500 t/h is consumed for pelletization)*
Direct Loading Capacity from the Filter Plant 1500 t/h

TOTAL 7000 t/h

* Pellets Production: 1500 t/h x 10 h/d x 200 d = 3.0 mil t/y

(For Pellets Export)

Condition of Equipment after Modification

Reclaimer : 3500 t/h
Out-going Conveyer: 6600 t/h
Cross Conveyer : 3600 t/h
Wharf Conveyer : 3600 t/h
Shiploader : 4100 t/h

Out-going Capacity from the Yards	3500 t/h
TOTAL	3500 t/h

Table-A.7.2 Loading Capacity (Minor Modifications)

	Concentrate	Pellets
Reclaimer	7,000	3,500
Out-going Conveyer	7,000	6,600
Direct Loading	+1,500	-
Pellets Plant	-1,500	-
Cross Conveyer	7,000	3,500
Wharf Conveyer	7,000	3,500
Shiploader	8,000	4,100
Capacity of the System	7,000	3,500

-- Major Modifications --

Modification:

Installation of an additional Reclaimer (for concent.) ... +3500 t/h
3500 t/h x 2 → 3500 t/h x 3

Capacity Upgrading of Reclaimer (for pellets) ... +3600 t/h
3500 t/h → 4100 t/h

Capacity Upgrading of Out-going Conveyer (con.).. +2500 t/h
3000 t/h x 2 → 4250 t/h x 2

Capacity Upgrading of the Cross Conveyer
6800(3500)→8000(4100) t/h

Capacity Upgrading of the Wharf Conveyer
6800(3500)→8000(4100) t/h

Capacity Upgrading of the Shiploader
6800(3500)→8000(4100) t/h

( ): for pellets

(For Concentrate Exports)

Condition of Equipment after Modification

Reclaimer	: 3500 t/h x 3
Out-going Conveyer	: 4250 t/h x 2
Cross Conveyer	: 8000 t/h
Wharf Conveyer	: 8000 t/h
Shiploader	: 8000 t/h

Out-going Capacity from the Yards: 4250 x 2 - 2000 = 6500 t/h
(2000 t/h is consumed for pelletization)*
Direct Loading Capacity from the Filter Plant 1500 t/h

TOTAL 8000 t/h

* Pellets Production: 2000 t/h x 15 h/d x 200 d = 6.0 mil t/y

(For Pellets Export)

Condition of Equipment after Modification

Reclaimer	: 4100 t/h
Out-going Conveyer	: 6600 t/h
Cross Conveyer	: 4100 t/h
Wharf Conveyer	: 4100 t/h
Shiploader	: 4100 t/h

Out-going Capacity from the Yards 4100 t/h

TOTAL 4100 t/h

Table-A.7.3 Loading Capacity (Major Modifications)

	Concentrate	Pellets
Reclaimer	10,500	4,100
Out-going Conveyer	8,500	6,600
Direct Loading	+1,500	-
Pellets Plant	-2,000	-
Cross Conveyer	8,000	4,100
Wharf Conveyer	8,000	4,100
Shiploader	8,000	4,100
Capacity of the System	8,000	4,100

Appendix- 7.3 Transshipper System

When it is difficult to berth bigger ships due to shallow water, it will be effective to use the transshipper system. Ocean-going ships will load the material offshore from the hatch hold of the transshipper using its shiploading facilities.

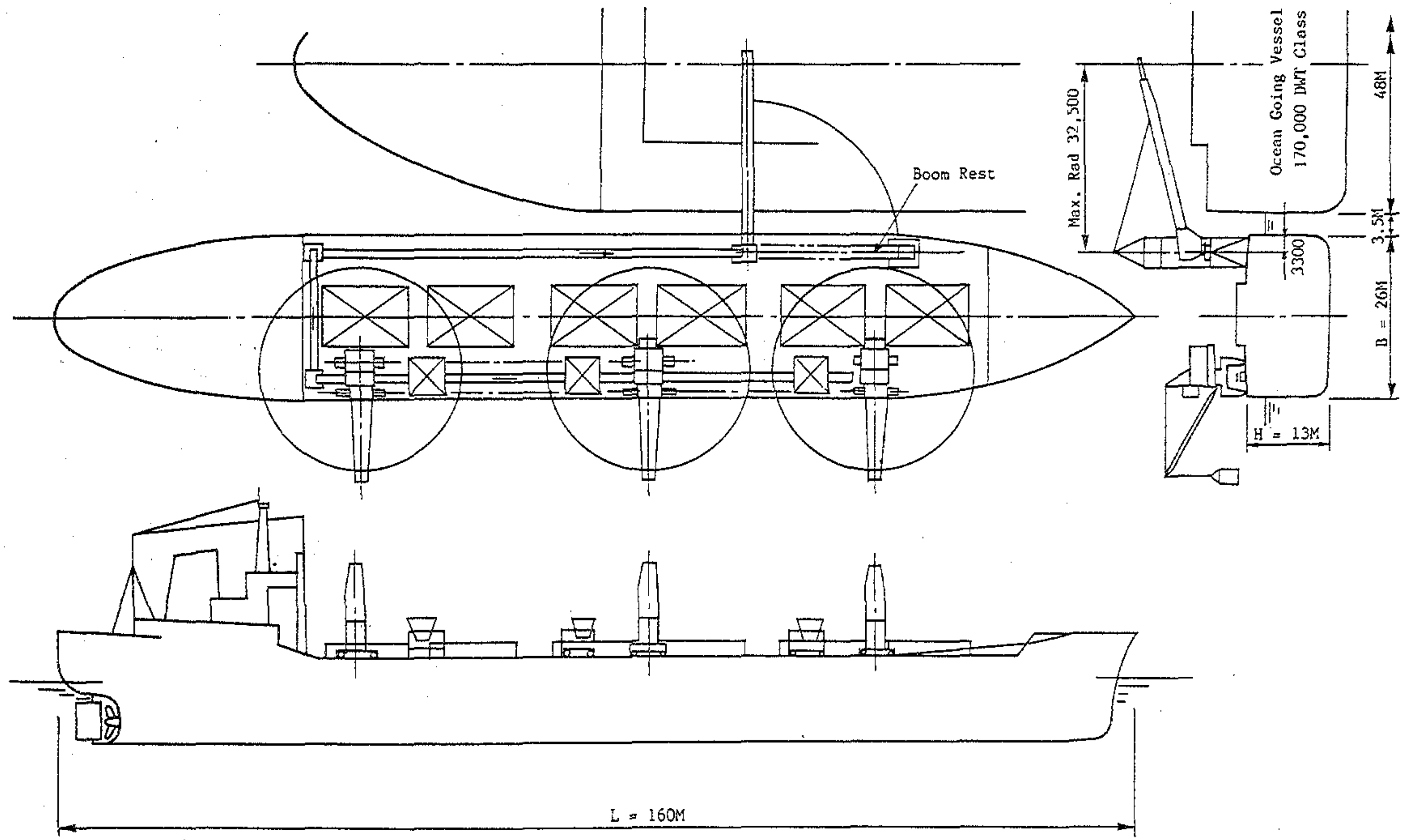
(Example and Cost)

One example of this system is shown below, and the layout is shown in Figure-A.7.1.

The Transshipper		
	Ship size	20,000 DWT
	(L x B x H	160m x 26m x 13m)
	No. of hatch holds	6
Iron ore shiploading facility		
	Total weight	800 tons
	Shiploader	1 set
	Capacity	1,500 t/h
	Boom radius from portside	27.5m
	(suitable for 170,000 DWT class ship)	
	Unloading cranes	3 sets
	With 9 ton coal grab bucket, traveling type	
	Traveling hoppers	3 sets

Total Cost Estimate

Ship	¥ 1,000 million
Handling Equipment	¥ 1,500 million
Total Cost	¥ 2,500 million



Specification

Transshipper L x B x H   160M x 26M x 13M
20,000 DWT Class

Shiploader   1,500 t/h Iron Ore

Travelling Cranes   3 sets

with 9ton Grab Bucket, Travelling Hopper

Figure-A-7.1 Transshipper Layout

(Transshipment System Berth Occupancy)

The numbers of Iron Ore carriers by DWT class and transshippers in the case of a 60,000 DWT class berth (allowable drought is 12.5m) being used and carriers of following size distribution (Table-A.7.4) call at the berth are as shown in Table-A.7.5.

Table-A-7.4 Ship Size Distribution

Ship Size (DWT)	No. of Ship
0 - 20,000	2
20,000 - 40,000	9
40,000 - 60,000	13
60,000 - 80,000	14
80,000 - 100,000	13
100,000 - 130,000	17
130,000 - 150,000	13
150,000 - 170,000	9

Table-A.7.5

Ship Size (DWT)	Av.Size	No.of Ship (Annual Throughput) (million tonnes)		Iron Ore Tonnage Loaded at Berth	Required No. of Transhippers** (20,000 DWT) (Annual Throughput) (million tonnes)	
		7.5	10.0		7.5	10.0
0 - 20,000	10,000	2	3	9,000	0	0
20,000 - 40,000	30,000	9	12	27,000	0	0
40,000 - 60,000	50,000	13	17	45,000	0	0
60,000 - 80,000	70,000	14	19	63,000	0	0
80,000 - 100,000	90,000	13	17	75,600*	4	6
100,000 - 130,000	115,000	17	23	82,800*	20	26
130,000 - 150,000	140,000	13	17	93,800*	24	31
150,000 - 170,000	160,000	9	12	100,800*	22	29
		90	120	Ave.69,800*	70	92

* These figures are calculated using a load factor where the draught of each vessel class is 12.5m. The load factors can be obtained from Figure-A.7.2.

** These figures are calculated as follows.
[(Average Ship Size) x 0.9 - Average Iron Ore Tonnage Loaded at Berth] x No. of ship ÷ (20,000 x 0.9)

Operation times of ocean-going carriers and transshippers can be calculated as follows:

Operation Time of Ocean-going Carriers

Average Service Time

7.5m t	Conc.	69,000/(7000*0.7) + (2+2+6) = 24.1 hrs
	Pellets	69,000/(3500*0.7) + (2+2+6) = 29.7 hrs
10.0m t	Conc.	69,000/(8000*0.7) + (2+2+6) = 22.3 hrs
	Pellets	69,000/(4100*0.7) + (2+2+6) = 34.0 hrs

Total Service Time

7.5m t	24.1 x 90 x 0.6 + 29.7 x 90 x 0.4 = 2,371 hrs
10.0m t	22.3 x 120 x 0.4 + 34.0 x 120 x 0.6 = 3,518 hrs

Operation time of Transshipper

Average Service Time

7.5m t	Conc.	18,000/(7000*0.7) + (2+2+3) = 10.7
	Pellets	18,000/(3500*0.7) + (2+2+3) = 14.3
10.0m t	Conc.	18,000/(8000*0.7) + (2+2+3) = 10.2
	Pellet	18,000/(4100*0.7) + (2+2+3) = 13.3

Total Service Time

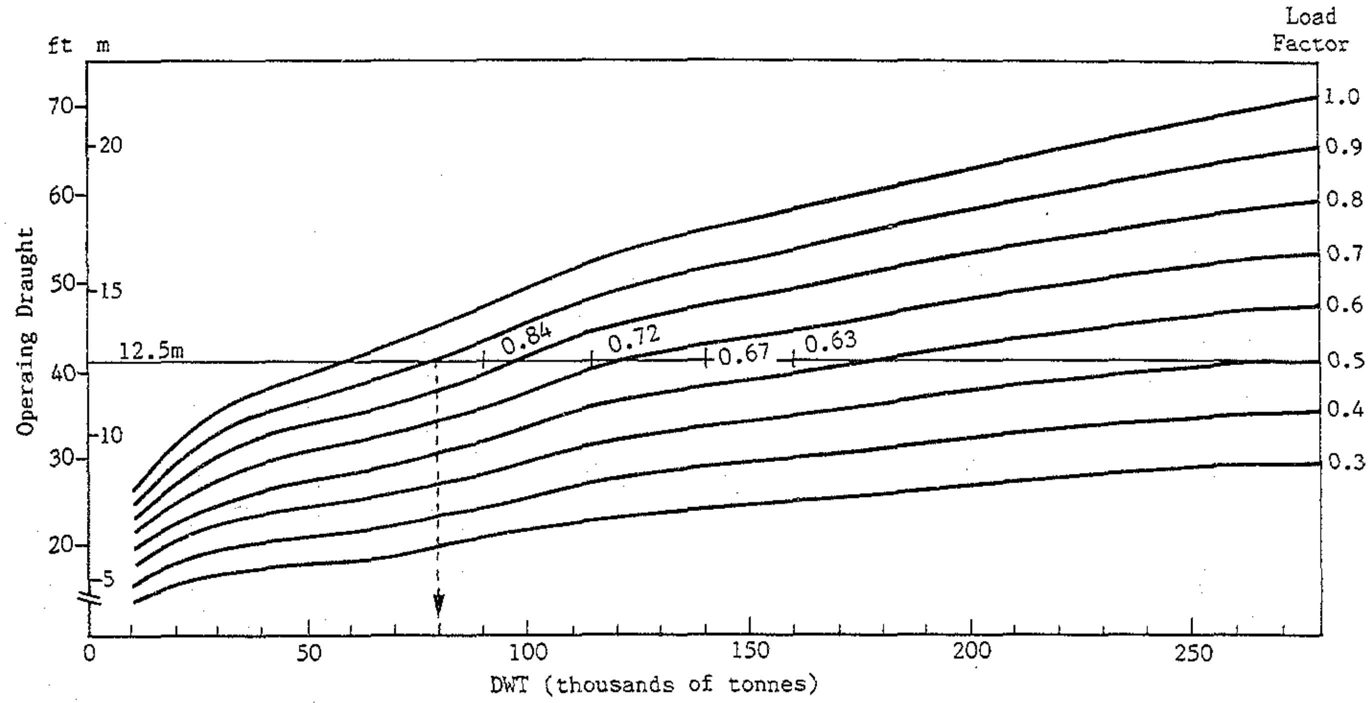
7.5m t	10.7 x 70 x 0.6 + 14.3 x 70 x 0.4 = 850
10.0m t	10.2 x 92 x 0.4 + 13.3 x 92 x 0.6 = 1110

Therefore,
the total service times of the transshippment system are:

7.5m t	2,371 + 850 = 3,221 hrs
10.0m t	3,518 + 1,110 = 4,628 hrs

and,
berth occupancies are:

7.5m t	3221 ÷ (290days x 20 h/day) = 0.55
10.0m t	4628 ÷ (290days x 20 h/day) = 0.80



Source: University of Liverpool. Marine Transport Centre.
The Principal Dimensions and Operating Draughts of Bulk Carriers.

Figure-A-7.2 Operating Draughts for Different Load Factor Against DWT for Dry Bulk Carries

Appendix- 7.4 Required Coal Unloading Capacity for an Annual Throughput of 12 Million Tonnes

Required coal unlaoding capacity for an Annual Throughput of 12 million tons.

The required capacity is calculated by the following formula:

$$Q = \frac{M \times \eta_2}{(D \times \rho \times T - t) \times \eta_1},$$

here,

Q: Required total unloading capacity per one berth: t/h

M: Mean ship size: DWT (50,000 DWT)

η_2: Coal loading efficiency: 0.95

η_1: Unloading efficiency for one ship: 0.65

ρ: Berth occupancy factor: 0.6

T: Daily working hours: 20h

t: Non-operating hours after berthing the ship: 6h

D: Allowable max. Working days for one ship,

$$D = N \times \frac{M \times \eta_2}{W} \times S,$$

N: Annual working days: 270 days (same to iron ore berth)

W: Annual throughput: tons

S: Number of berth: 3 for year 2004-05

then, $D = 270 \times \frac{5 \times 0.95}{1200} \times 3 = 3.2,$

so, $$Q = \frac{50000 \times 0.95}{(3.2 \times 0.6 \times 20 - 6) \times 0.65} \approx 2256 \text{ t/h}$$

Conclusion:

2 sets of 1200 t/h capacity bridge type unloader per berth, a total of 6 sets will be required.

If using a continuous bucket chain-type unloader,

$$Q' = \frac{50000 \times 0.95}{(3.2 \times 0.6 \times 20 - 6) \times 0.8} = 1832 \text{ t/h}$$

2 sets of 1000 t/h capacity continuous unloader per berth, a total of 6 sets will be required. (The unloading efficiency of continuous type is better than that of bridge type.)

Stockyard capacity

The stockyard capacity is calculated by the following formula:

$$E = \frac{M \times \eta_2 \times S}{D} \times m,$$

$$\sigma = \frac{M \times \eta_2 \times S}{D} \times \sqrt{\frac{D \times m}{2 \times S}},$$

here,

E = Mean stock quantity: t

σ = Variable quantity: t

m = Mean staying days of coal = 14 days

Therefore,

$$E = \frac{50000 \times 0.95 \times 3}{3.2} \times 14 = 623438,$$

$$\sigma = \frac{50000 \times 0.95 \times 3}{3.2} \times \sqrt{\frac{3.2 \times 14}{2 \times 3}} = 121683,$$

the required total capacity of the coal stockyard will be

$E + \sigma = 623438 + 121683 = 745121$ tons

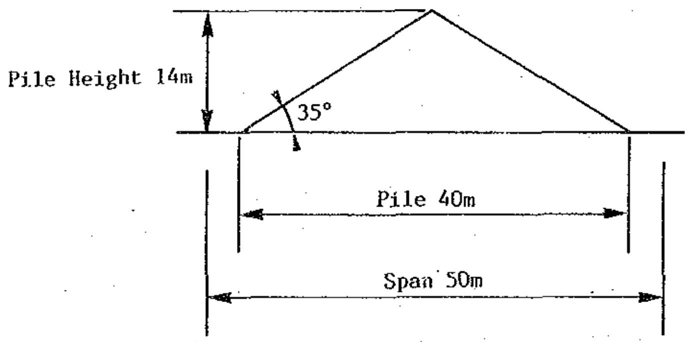
If the stockpile base is 40m, the angle of repose for coal is 35° and the specific gravity of coal is 0.8, the required stockyard length L will be

$$L = \frac{745121 \times 2}{14 \times 40 \times 0.8} = 3326\text{m}$$

here, stockpile height is $40/2 \times \tan 35^{\circ} = 14$m

Thus, the required stockyard will be

4 x 50m x 850m area.



Note: For 1990/2000, Annual throughput 6.24 million tons,
No. of berths S = 2

$$D = 270 \times \frac{5 \times 0.95 \times 2}{624} = 4.11 \text{ days,}$$

$$Q = \frac{50000 \times 0.95}{(4.11 \times 0.6 \times 20 - 6) \times 0.65} = 1687 \text{ t/h}$$

Thus, 4 sets of 900 t/h capacity bridge type unloader will be required.

Stockyard capacity

$$E = \frac{50000 \times 0.95 \times 2}{4.11} \times 14 = 323601 \text{ t}$$

$$\sigma = \frac{50000 \times 0.95 \times 2}{4.11} \times \sqrt{\frac{4.11 \times 14}{2 \times 2}} = 87667 \text{ t}$$

$$E + \sigma = 323601 + 87667 = 411268 \text{ tons}$$

$$L = \frac{411268 \times 2}{14 \times 40 \times 0.8} = 1836\text{m}$$

Thus, the stockyard area will be 4 x 50m x 500m

For 1994-95, annual throughput 0.45 million tons,
No. of berth S = 1

$$D = 270 \times \frac{5 \times 0.95 \times 1}{45} = 28.5$$

$$Q = \frac{50000 \times 0.95}{(28.5 \times 0.6 \times 20 - 6)} = 217 \text{ t/h}$$

Stockyard Capacity

$$E = \frac{50000 \times 0.95 \times 1}{28.5} \times 14 = 23333 \text{ t}$$

$$= \frac{50000 \times 0.95 \times 1}{28.5} \times \sqrt{\frac{28.5 \times 14}{2 \times 1}} = 23541 \text{ t}$$

$$E + \sigma = 23333 + 23541 = 46874 \text{ t}$$

$$L = \frac{46874 \times 2}{14 \times 40 \times 0.8} = 210\text{m}$$

Thus, the stockyard area will be 2 x 50m x 105m

Appendix- 9.1 Daily Report of Maintenance Dredging

DAILY REPORT OF MAINTENANCE DREDGING 1986-87

TRAILING SUCTION HOPPER DREDGER MOT Ⅷ

MONTH	DAY	NO.OF CYCLE	DREDGING TIME	SAILING TIME GOING	DUMPING TIME	SAILING TIME RETURNING	TOTAL WORKING TIME	INTER-MISSION TIME	DREDGING VOLUME AT LAGOON	DREDGING VOLUME AT CHANNEL	TOTAL DREDGING VOLUME	KIND OF SOIL
			(MIN.)	(MIN.)	(MIN.)	(MIN.)	(MIN.)	(MIN.)	(M3)	(M3)	(M3)	
OCT.	2	10	200	390	50	440	1,080	360	24,810	16,540	41,350	ALL
	3	12	250	485	60	645	1,440	0	24,810	24,810	49,620	-DITTO-
	4	11	260	485	55	640	1,440	0	20,675	24,810	45,485	SILT & CLAY
	5	11	220	480	55	625	1,380	60	24,810	20,675	45,485	-DITTO-
	6	11	250	495	55	640	1,440	0	20,675	24,810	45,485	ALL
	7	12	250	515	60	615	1,440	0	24,810	24,810	49,620	-DITTO-
	8	12	280	520	60	580	1,440	0	24,810	24,810	49,620	-DITTO-
	9	7	160	395	35	430	1,020	420	16,540	12,405	28,945	-DITTO-
	10	0	0	0	0	0	0	1,440	0	0	0	
	11	0	0	0	0	0	0	1,440	0	0	0	
	12	0	0	0	0	0	0	1,440	0	0	0	
	13	7	140	310	35	320	805	635	12,405	16,540	28,945	ALL
	14	11	240	525	55	620	1,440	0	24,810	20,675	45,485	-DITTO-
	15	5	100	185	25	290	600	840	4,135	16,540	20,675	-DITTO-
TOTAL		109	2,350	4,785	545	5,845	13,525	6,635	223,290	227,425	450,715	

TOTAL NOS. OF CYCLE:	109	(NOS.)			
AVE. DREDGING TIME:	21.56	(MIN.)			
AVE. SAILING TIME (GOING):	43.90	(MIN.)			
AVE. DUMPING TIME:	5.00	(MIN.)			
AVE. SAILING TIME (RETURNING):	53.62	(MIN.)			
WORKING TIME PER CYCLE:	124.08	(MIN.)			
TOTAL WORKING TIME:	13,525	(MIN.)	≒	225	(Hrs.)
TOTAL INTERMISSION TIME:	6,635	(MIN.)	=	111	(Hrs.)
DREDGING VOLUME AT LAGOON:	223,290	(M3)			
DREDGING VOLUME AT CHANNEL:	227,425	(M3)			
TOTAL DREDGING VOLUME:	450,715	(M3)			

TRAILING SUCTION HOPPER DREDGER MOT IX

MONTH	DAY	NO.OF CYCLE	DREDGING TIME	SAILING TIME GOING	DUMPING TIME	SAILING TIME RETURNING	TOTAL WORKING TIME	INTER-MISSION TIME	DREDGING VOLUME AT LAGOON	DREDGING VOLUME AT CHANNEL	TOTAL DREDGING VOLUME	KIND OF SOIL
			(MIN.)	(MIN.)	(MIN.)	(MIN.)	(MIN.)	(MIN.)	(M3)	(M3)	(M3)	
OCT.	22	8	215	320	80	300	915	525	29,456	0	29,456	SILT
	23	12	320	510	120	470	1,420	20	26,411	17,955	44,366	-DITTO-
	24	13	305	485	120	480	1,390	50	25,865	21,545	47,410	-DITTO-
	25	12	290	475	130	545	1,440	0	20,636	21,362	41,998	-DITTO-
	26	12	270	475	120	505	1,370	70	22,407	18,136	40,543	-DITTO-
	27	12	240	495	120	585	1,440	0	25,455	13,273	38,728	-DITTO-
	28	10	215	395	90	380	1,080	360	10,409	22,954	33,363	-DITTO-
	29	12	255	470	130	555	1,410	30	17,882	24,410	42,292	-DITTO-
	30	13	290	475	130	545	1,440	0	15,955	28,728	44,683	-DITTO-
	31	13	295	500	120	525	1,440	0	24,050	20,272	44,322	SILT & CLAY
NOV.	1	13	290	450	130	525	1,395	45	21,728	26,410	48,138	-DITTO-
	2	12	295	475	130	540	1,440	0	19,047	25,319	44,366	SILT
	3	13	290	485	130	535	1,440	0	21,910	24,774	46,684	SILT & CLAY
	4	13	295	485	130	530	1,440	0	22,638	24,228	46,866	-DITTO-
	5	13	285	470	120	565	1,440	0	22,638	25,499	48,137	-DITTO-
	6	3	75	110	40	150	375	1,065	0	12,409	12,409	-DITTO-
	7	0	0	0	0	0	0	1,440	0	0	0	
	8	0	0	0	0	0	0	1,440	0	0	0	
	9	9	205	355	90	330	980	460	15,092	17,773	32,865	SILT & CLAY
	10	13	305	475	130	530	1,440	0	22,165	25,863	48,028	-DITTO-
	11	14	325	505	130	480	1,440	0	25,319	25,863	51,182	-DITTO-
	12	13	305	495	130	510	1,440	0	29,092	20,318	49,410	-DITTO-
	13	13	285	510	130	515	1,440	0	25,683	23,000	48,683	-DITTO-

	14	13	285	490	130	535	1,440	0	14,546	35,047	49,593	-DITTO-
	15	12	280	520	130	530	1,440	0	25,410	19,591	45,001	-DITTO-
	16	13	300	505	130	505	1,440	0	23,863	22,636	46,499	-DITTO-
	17	13	305	465	120	520	1,440	0	24,591	24,091	48,682	-DITTO-
	18	12	275	525	130	510	1,440	0	24,864	19,228	44,092	-DITTO-
	19	13	310	470	120	540	1,440	0	21,546	26,046	47,592	-DITTO-
	20	13	320	415	130	530	1,395	45	24,700	21,673	46,373	-DITTO-
	21	12	295	455	130	560	1,440	0	17,227	26,954	44,181	-DITTO-
	22	13	315	435	130	560	1,440	0	14,000	33,228	47,228	-DITTO-
	23	14	300	440	140	560	1,440	0	0	51,366	51,366	-DITTO-
	24	4	80	120	40	180	420	1,020	0	14,545	14,545	-DITTO-
	25	0	0	0	0	0	0	1,440	0	0	0	
	26	0	0	0	0	0	0	1,440	0	0	0	
	27	10	210	310	90	410	1,020	420	0	36,638	36,638	SILT & CLAY
	28	14	295	440	140	565	1,440	0	0	50,163	50,163	-DITTO-
	29	14	295	440	140	565	1,440	0	0	50,163	50,163	-DITTO-
	30	15	300	445	150	545	1,440	0	0	53,134	53,134	-DITTO-
DEC.	1	15	340	440	150	510	1,440	0	0	53,098	53,098	-DITTO-
	2	14	285	495	140	510	1,440	0	4,136	46,863	50,999	-DITTO-
	3	13	350	435	130	526	1,440	0	10,955	35,727	46,682	-DITTO-
	4	11	480	390	110	460	1,440	0	8,161	28,726	36,887	ALL
	5	13	330	440	130	540	1,440	0	0	46,318	46,318	SILT & CLAY
	6	12	275	455	120	590	1,440	0	0	37,893	37,893	-DITTO-
	7	11	345	450	110	535	1,440	0	3,179	36,272	39,451	ALL
	8	12	320	445	120	555	1,440	0	2,333	34,954	37,287	-DITTO-
	9	12	300	475	120	545	1,440	0	1,900	37,320	39,220	-DITTO-
	10	12	245	455	120	620	1,440	0	0	39,017	39,017	SILT & CLAY
	11	12	265	460	120	595	1,440	0	0	40,873	40,873	-DITTO-
	12	12	270	435	120	615	1,440	0	0	37,416	37,416	-DITTO-
	13	3	70	125	40	135	370	1,070	0	10,774	10,774	-DITTO-
	14	0	0	0	0	0	0	1,440	0	0	0	
	15	0	0	0	0	0	0	1,440	0	0	0	
	16	9	195	320	80	410	1,005	435	0	32,865	32,865	SILT & CLAY
	17	12	275	435	120	610	1,440	0	0	47,526	47,526	-DITTO-
	18	12	270	455	120	595	1,440	0	0	48,326	48,326	-DITTO-
	19	12	300	425	120	595	1,440	0	0	48,908	48,908	-DITTO-
	20	12	310	410	120	600	1,440	0	0	49,674	49,674	-DITTO-
	21	11	290	335	120	635	1,380	60	0	46,407	46,407	-DITTO-
	22	13	350	440	120	520	1,430	10	16,000	36,390	52,390	-DITTO-
	23	12	310	415	120	595	1,440	0	0	51,390	51,390	-DITTO-
	24	12	325	415	120	580	1,440	0	0	51,199	51,199	-DITTO-
	25	12	345	360	120	615	1,440	0	4,136	47,134	51,270	-DITTO-
	26	13	345	345	130	620	1,440	0	0	55,627	55,627	-DITTO-
	27	12	345	340	120	635	1,440	0	0	50,545	50,545	-DITTO-
	28	12	335	380	120	605	1,440	0	0	49,999	49,099	-DITTO-
	29	12	355	320	120	645	1,440	0	0	52,217	52,217	-DITTO-
	30	12	350	350	120	620	1,440	0	0	51,891	51,891	-DITTO-
	31	12	360	335	120	625	1,440	0	0	52,183	52,183	-DITTO-
JAN.	1	5	155	180	60	265	660	780	0	19,955	19,955	-DITTO-
	2	0	0	0	0	0	0	1,440	0	0	0	
	3	0	0	0	0	0	0	1,440	0	0	0	
	4	7	240	225	60	255	780	660	0	24,773	24,773	SILT & CLAY
	5	12	460	430	120	430	1,440	0	0	39,816	39,816	-DITTO-
	6	12	565	350	120	405	1,440	0	0	44,547	44,547	-DITTO-
	7	12	510	405	120	405	1,440	0	0	44,072	44,072	-DITTO-
	8	12	470	385	120	390	1,365	75	5,660	36,304	41,964	-DITTO-
	9	11	410	335	110	445	1,300	140	0	38,227	38,227	-DITTO-
	10	11	405	385	110	400	1,300	140	0	40,410	40,410	-DITTO-
	11	11	305	380	110	455	1,250	190	0	33,589	33,589	-DITTO-
	12	12	410	405	120	440	1,375	65	0	35,820	35,820	-DITTO-
	13	4	120	150	50	160	480	960	0	13,636	13,636	-DITTO-
TOTAL		882	22,790	31,130	8,820	38,005	100,745	20,215	691,045	2,553,275	3,244,320	

TOTAL NOS. OF CYCLE:	882	(NOS.)			
AVE. DREDGING TIME:	25.84	(MIN.)			
AVE. SAILING TIME (GOING):	35.29	(MIN.)			
AVE. DUMPING TIME:	10.00	(MIN.)			
AVE. SAILING TIME (RETURNING):	43.09	(MIN.)			
WORKING TIME PER CYCLE:	114.22	(MIN.)			
TOTAL WORKING TIME:	100,745	(MIN.)	=	1,679	(Hrs.)
TOTAL INTERMISSION TIME:	20,215	(MIN.)	=	337	(Hrs.)
DREDGING VOLUME AT LAGOON:	691,045	(M3)			
DREDGING VOLUME AT CHANNEL:	2,553,275	(M3)			
TOTAL DREDGING VOLUME:	3,244,320	(M3)			

DAILY REPORT OF MAINTENANCE DREDGING 1987-88

TRAILING SUCTION HOPPER DREDGER MOT VII

MONTH	DAY	NO.OF CYCLE	DREDGING TIME (MIN.)	SAILING TIME GOING (MIN.)	DUMPING TIME (MIN.)	SAILING TIME RETURNING (MIN.)	TOTAL WORKING TIME (MIN.)	INTER-MISSION TIME (MIN.)	DREDGING VOLUME AT LAGOON (M3)	DREDGING VOLUME AT CHANNEL (M3)	TOTAL DREDGING VOLUME (M3)	KIND OF SOIL
OCT.	25	9	220	330	40	275	865	575	18,860	15,088	33,948	SILT & CLAY
	26	13	325	560	65	490	1,440	0	33,948	15,088	49,036	-DITTO-
	27	13	325	540	65	510	1,440	0	26,404	22,632	49,036	-DITTO-
	28	13	330	530	65	515	1,440	0	22,632	26,404	49,036	-DITTO-
	29	13	325	540	65	510	1,440	0	11,316	38,948	50,264	-DITTO-
	30	14	350	530	70	490	1,440	0	11,316	41,492	52,808	-DITTO-
	31	14	350	535	70	475	1,430	10	16,544	41,360	57,904	-DITTO-
NOV.	1	13	345	550	65	480	1,440	0	20,680	33,088	53,768	-DITTO-
	2	13	335	545	65	· 495	1,440	0	16,544	37,224	53,768	-DITTO-
	3	9	250	360	45	305	960	480	8,272	28,952	37,224	-DITTO-
	4	12	305	530	65	540	1,440	0	16,544	33,088	49,632	-DITTO-
	5	13	330	565	60	485	1,440	0	20,680	33,088	53,768	-DITTO-
	6	13	340	560	65	475	1,440	0	21,952	33,088	55,040	-DITTO-
	7	13	350	525	65	500	1,440	0	18,728	39,044	57,772	-DITTO-
	8	8	225	370	45	320	960	480	14,592	23,228	37,820	-DITTO-
	9	0	0	0	0	0	0	1,440	0	0	0	
	10	0	0	0	0	0	0	1,440	0	0	0	
	11	0	0	0	0	0	0	1,440	0	0	0	
	12	10	255	395	45	310	1,005	435	0	41,360	41,360	SILT & CLAY
	13	15	410	450	75	505	1,440	0	0	62,040	62,040	-DITTO-
	14	15	410	560	75	395	1,440	0	0	62,040	62,040	-DITTO-
	15	13	335	495	70	400	1,300	140	0	53,768	53,768	-DITTO-
	16	16	435	535	75	395	1,440	0	0	66,176	66,176	-DITTO-
	17	15	385	550	75	430	1,440	0	0	62,040	62,040	-DITTO-
	18	16	410	495	80	410	1,395	45	0	66,176	66,178	-DITTO-
	19	15	375	550	75	440	1,440	0	0	62,040	62,040	-DITTO-
	20	15	380	555	75	430	1,440	0	0	62,040	62,040	-DITTO-
	21	15	395	475	75	450	1,395	45	0	67,136	67,136	-DITTO-
	22	15	380	515	75	470	1,440	0	0	67,500	67,500	-DITTO-
	23	15	400	505	80	455	1,440	0	0	67,500	67,500	-DITTO-
	24	15	395	495	70	480	1,440	0	0	68,228	68,228	-DITTO-
	25	15	380	525	75	460	1,440	0	0	67,500	67,500	-DITTO-
	26	15	395	560	75	410	1,440	0	0	67,500	67,500	-DITTO-
	27	4	115	115	25	165	420	1,020	0	18,000	18,000	-DITTO-
	28	0	0	0	0	0	0	1,440	0	0	0	
	29	0	0	0	0	0	0	1,440	0	0	0	
	30	9	230	430	45	315	1,020	420	28,952	8,272	37,224	SILT & CLAY
DEC.	1	15	395	505	70	470	1,440	0	37,224	24,816	62,040	-DITTO-
	2	15	385	515	80	460	1,440	0	37,224	24,816	62,040	-DITTO-
	3	15	390	470	70	510	1,440	0	37,224	24,816	62,040	-DITTO-
	4	15	395	550	75	420	1,440	0	41,360	20,680	62,040	-DITTO-
	5	15	380	505	75	480	1,440	0	37,224	24,816	62,040	-DITTO-
	6	15	370	505	75	470	1,420	20	37,224	24,816	62,040	-DITTO-
	7	14	360	500	70	455	1,385	55	33,088	24,816	57,904	-DITTO-
	8	14	385	505	75	475	1,440	0	37,224	20,680	57,904	-DITTO-
	9	15	375	515	70	480	1,440	0	37,224	24,816	62,040	-DITTO-
	10	12	350	430	65	505	1,350	90	33,088	16,544	49,632	-DITTO-
	11	5	110	185	20	175	490	950	16,544	4,136	20,680	-DITTO-
	12	14	370	560	70	440	1,440	0	49,632	8,272	57,904	-DITTO-
	13	13	355	565	65	455	1,440	0	51,700	2,068	53,768	-DITTO-
	14	12	310	535	65	495	1,405	35	49,632	0	49,632	-DITTO-
	15	4	115	145	20	140	420	1,020	12,408	4,136	16,544	-DITTO-
	16	0	0	0	0	0	0	1,440	0	0	0	
	17	0	0	0	0	0	0	1,440	0	0	0	
	18	5	125	190	25	200	540	900	12,408	8,272	20,680	SILT & CLAY
	19	14	375	515	65	485	1,440	0	28,952	28,952	57,904	-DITTO-
	20	13	360	460	70	550	1,440	0	28,952	24,816	53,768	-DITTO-
	21	14	365	485	65	505	1,420	20	28,952	28,952	57,904	-DITTO-
	22	13	365	480	70	525	1,440	0	28,952	24,816	53,768	-DITTO-
	23	14	390	500	65	485	1,440	0	28,952	28,952	57,904	-DITTO-
	24	14	405	495	70	470	1,440	0	28,952	28,952	57,904	-DITTO-
	25	13	365	520	65	490	1,440	0	28,952	24,816	53,768	-DITTO-

	26	13	375	475	70	520	1,440	0	28,952	24,816	53,768	SAND & SILT
	27	14	395	480	65	500	1,440	0	28,952	28,952	57,904	ALL
	28	13	355	465	70	550	1,440	0	28,952	24,816	53,768	-DITTO-
	29	14	420	460	65	495	1,440	0	37,224	20,680	57,904	SILT & CLAY
	30	13	385	470	65	520	1,440	0	28,952	24,816	53,768	ALL
	31	13	440	475	65	460	1,440	0	28,952	24,816	53,768	SILT & CLAY
JAN.	1	13	410	435	60	535	1,440	0	28,952	24,816	53,768	-DITTO-
	2	13	390	455	65	530	1,440	0	24,816	28,952	53,768	-DITTO-
	3	13	360	495	65	520	1,440	0	37,224	16,544	53,768	-DITTO-
	4	4	120	150	25	155	450	990	4,136	12,408	16,544	-DITTO-
	5	0	0	0	0	0	0	1,440	0	0	0	
	6	0	0	0	0	0	0	1,440	0	0	0	
	7	8	210	310	40	270	830	610	8,272	24,816	33,088	SILT & CLAY
	8	14	440	520	65	415	1,440	0	16,544	41,360	57,904	-DITTO-
	9	13	415	495	65	465	1,440	0	16,544	37,224	53,768	-DITTO-
	10	14	415	490	70	465	1,440	0	16,544	41,360	57,904	-DITTO-
	11	13	460	515	65	400	1,440	0	16,544	37,224	53,768	-DITTO-
	12	13	400	510	70	460	1,440	0	12,408	41,360	53,768	-DITTO-
	13	13	460	520	60	400	1,440	0	12,408	41,360	53,768	-DITTO-
	14	12	390	450	65	535	1,440	0	28,952	20,680	49,632	-DITTO-
	15	14	475	445	65	455	1,440	0	24,816	33,088	57,904	-DITTO-
	16	12	430	500	60	450	1,440	0	24,816	24,816	49,632	-DITTO-
	17	12	405	470	65	500	1,440	0	20,680	28,952	49,632	-DITTO-
	18	15	440	485	70	445	1,440	0	37,224	24,816	62,040	-DITTO-
	19	12	445	480	65	450	1,440	0	24,816	24,816	49,632	-DITTO-
	20	13	405	510	60	465	1,440	0	37,224	16,544	53,768	-DITTO-
	21	3	115	140	20	145	420	1,020	12,408	0	12,408	-DITTO-
TOTAL		1,013	28,140	37,610	5,060	35,030	105,840	22,320	1,658,368	2,549,916	4,208,284	

TOTAL NOS. OF CYCLE:	1,013	(NOS.)			
AVE. DREDGING TIME:	27.78	(MIN.)			
AVE. SAILING TIME (GOING):	37.13	(MIN.)			
AVE. DUMPING TIME:	5.00	(MIN.)			
AVE. SAILING TIME (RETURNING):	34.58	(MIN.)			
WORKING TIME PER CYCLE:	104.48	(MIN.)			
TOTAL WORKING TIME:	105,840	(MIN.)	=	1,764	(Hrs.)
TOTAL INTERMISSION TIME:	22,320	(MIN.)	=	372	(Hrs.)
DREDGING VOLUME AT LAGOON:	1,658,368	(M3)			
DREDGING VOLUME AT CHANNEL:	2,549,916	(M3)			
TOTAL DREDGING VOLUME:	4,208,284	(M3)			

DAILY REPORT OF MAINTENANCE DREDGING 1988-89

TRAILING SUCTION HOPPER DREDGER NOT VII

MONTH	DAY	NO.OF CYCLE	DREDGING TIME (MIN.)	SAILING TIME GOING (MIN.)	DUMPING TIME (MIN.)	SAILING TIME RETURNING (MIN.)	TOTAL WORKING TIME (MIN.)	INTER-MISSION TIME (MIN.)	DREDGING VOLUME AT LAGOON (M3)	DREDGING VOLUME AT CHANNEL (M3)	TOTAL DREDGING VOLUME (M3)	KIND OF SOIL
NOV.	30	9	260	325	40	380	1,005	435	18,944	23,225	42,169	SILT & CLAY
DEC.	1	8	205	385	45	470	1,105	335	17,708	17,708	35,416	-DITTO-
	2	13	365	510	60	505	1,440	0	28,524	31,822	60,346	-DITTO-
	3	12	340	475	60	565	1,440	0	33,027	26,130	59,157	-DITTO-
	4	12	380	505	60	495	1,440	0	30,975	26,295	57,270	-DITTO-
	5	12	380	450	60	550	1,440	0	30,054	26,416	56,470	-DITTO-
	6	12	400	475	60	505	1,440	0	35,236	14,370	49,606	-DITTO-
	7	12	325	460	60	595	1,440	0	8,781	43,905	52,686	-DITTO-
	8	3	85	125	20	160	390	1,050	0	13,608	13,608	-DITTO-
	9	0	0	0	0	0	0	1,440	0	0	0	
	10	0	0	0	0	0	0	1,440	0	0	0	
	11	6	215	215	25	280	735	705	4,136	25,772	29,908	SILT & CLAY
	12	9	490	380	45	420	1,335	105	12,998	25,327	38,325	-DITTO-
	13	12	430	485	60	465	1,440	0	8,239	38,033	46,272	ALL
	14	13	390	490	65	465	1,410	30	4,210	51,244	55,454	SILT & CLAY
	15	13	425	375	65	545	1,410	30	4,718	53,358	58,076	-DITTO-
	16	13	395	410	65	550	1,420	20	0	59,956	59,956	-DITTO-
	17	13	455	450	65	470	1,440	0	10,018	56,191	66,209	SAND & CLAY
	18	11	385	390	60	465	1,300	140	14,735	39,324	54,059	SILT & CLAY
	19	13	440	405	60	535	1,440	0	9,872	54,660	64,532	-DITTO-
	20	13	415	460	65	500	1,440	0	19,236	43,190	62,426	-DITTO-
	21	12	405	435	60	540	1,440	0	24,822	29,184	54,006	-DITTO-
	22	7	310	285	40	370	1,005	435	21,125	14,299	35,424	-DITTO-
	23	0	0	0	0	0	0	1,440	0	0	0	
	24	0	0	0	0	0	0	1,440	0	0	0	
	25	0	0	0	0	0	0	1,440	0	0	0	
	26	0	0	0	0	0	0	1,440	0	0	0	
	27	0	0	0	0	0	0	1,440	0	0	0	
	28	0	0	0	0	0	0	1,440	0	0	0	
	29	6	160	200	25	235	620	820	21,797	7,023	28,820	SILT & CLAY
	30	11	265	370	60	480	1,175	265	28,674	23,992	52,666	-DITTO-
	31	8	220	295	40	350	905	535	19,164	19,164	38,328	-DITTO-
JAN.	1	12	330	450	55	450	1,285	155	34,371	24,354	58,725	-DITTO-
	2	11	475	455	55	455	1,440	0	33,432	20,328	53,760	ALL
	3	11	405	470	60	505	1,440	0	37,859	20,362	58,221	SILT & CLAY
	4	11	455	400	55	510	1,420	20	25,950	30,235	56,185	-DITTO-
	5	11	380	395	55	515	1,345	95	21,164	36,085	57,249	-DITTO-
	6	12	410	435	60	530	1,435	5	30,164	31,072	61,236	-DITTO-
	7	12	425	385	55	470	1,335	105	24,682	35,574	60,256	-DITTO-
	8	13	480	435	70	455	1,440	0	14,592	48,821	63,413	-DITTO-
	9	12	525	410	55	450	1,440	0	22,581	40,072	62,653	-DITTO-
	10	12	435	445	60	500	1,440	0	14,555	44,029	58,584	-DITTO-
	11	11	430	400	60	550	1,440	0	25,590	29,254	54,844	-DITTO-
	12	10	315	295	45	405	1,060	380	29,400	19,418	48,818	-DITTO-
	13	11	405	525	60	450	1,440	0	5,045	49,908	54,953	-DITTO-
	14	10	535	430	45	430	1,440	0	25,773	24,499	50,272	-DITTO-
	15	11	480	475	55	430	1,440	0	19,891	34,629	54,520	-DITTO-
	16	3	95	165	20	170	450	990	0	15,354	15,354	-DITTO-
	17	0	0	0	0	0	0	1,440	0	0	0	
	18	0	0	0	0	0	0	1,440	0	0	0	
	19	8	315	300	35	330	980	460	12,751	16,341	29,092	SILT & CLAY
	20	13	450	410	65	490	1,415	25	10,300	37,001	47,301	-DITTO-
	21	12	460	435	60	430	1,385	55	14,800	31,235	46,035	-DITTO-
	22	14	435	435	70	500	1,440	0	14,652	38,086	52,738	-DITTO-
	23	10	325	295	50	365	1,035	405	0	43,540	43,540	-DITTO-
	24	13	450	430	65	485	1,430	10	19,954	31,636	51,590	-DITTO-
	25	12	385	505	60	490	1,440	0	18,867	27,433	46,300	-DITTO-
	26	12	410	470	60	500	1,440	0	27,902	19,774	47,676	-DITTO-
	27	14	440	455	70	475	1,440	0	24,993	28,837	53,830	-DITTO-
	28	13	420	450	65	505	1,440	0	31,746	19,591	51,337	-DITTO-
	29	12	405	500	60	475	1,440	0	45,482	1,978	47,460	-DITTO-

	30	5	180	230	30	190	630	810	7,836	11,754	19,590	
TOTAL		564	19,395	20,840	2,820	23,405	66,460	22,820	1,001,325	1,575,396	2,576,721	

TOTAL NOS. OF CYCLE:	564	(NOS.)			
AVE. DREDGING TIME:	34.39	(MIN.)			
AVE. SAILING TIME (GOING):	36.95	(MIN.)			
AVE. DUMPING TIME:	5.00	(MIN.)			
AVE. SAILING TIME (RETURNING):	41.50	(MIN.)			
WORKING TIME PER CYCLE:	117.84	(MIN.)			
TOTAL WORKING TIME:	66,460	(MIN.)	=	1,108	(Hrs.)
TOTAL INTERMISSION TIME:	22,820	(MIN.)	=	380	(Hrs.)
DREDGING VOLUME AT LAGOON:	1,001,325	(M3)			
DREDGING VOLUME AT CHANNEL:	1,575,396	(M3)			
TOTAL DREDGING VOLUME:	2,576,721	(M3)			

TRAILING SUCTION HOPPER DREDGER MOT IX

MONTH	DAY	NO.OF CYCLE	DREDGING TIME (MIN.)	SAILING TIME GOING (MIN.)	DUMPING TIME (MIN.)	SAILING TIME RETURNING (MIN.)	TOTAL WORKING TIME (MIN.)	INTER-MISSION TIME (MIN.)	DREDGING VOLUME AT LAGOON (M3)	DREDGING VOLUME AT CHANNEL (M3)	TOTAL DREDGING VOLUME (M3)	KIND OF SOIL
MAY	3	8	315	285	80	280	960	480	27,636	0	27,636	
	4	13	505	385	120	395	1,405	35	30,554	16,863	47,417	
	5	13	450	400	140	450	1,440	0	36,885	15,094	51,979	SILT & CLAY
	6	15	435	455	150	400	1,440	0	28,607	30,553	59,160	-DITTO-
	7	14	505	380	130	390	1,405	35	32,794	18,319	51,113	ALL
	8	12	475	440	130	395	1,440	0	38,033	3,591	41,624	SAND & CLAY
	9	13	480	415	130	415	1,440	0	36,676	15,918	52,594	
	10	13	375	375	120	360	1,230	210	30,681	15,458	46,139	
	11	14	485	375	150	430	1,440	0	27,818	21,364	49,182	SAND & SILT
	12	14	485	385	140	430	1,440	0	31,409	16,863	48,272	-DITTO-
	13	14	515	360	130	435	1,440	0	29,094	21,728	50,822	-DITTO-
	14	13	480	405	140	415	1,440	0	31,894	16,007	47,901	
	15	14	500	380	130	430	1,440	0	28,364	21,723	50,087	SAND & SILT
	16	14	495	380	145	420	1,440	0	29,638	22,093	51,731	-DITTO-
	17	14	510	375	135	420	1,440	0	29,640	21,728	51,368	-DITTO-
	18	5	135	75	60	200	470	970	0	17,409	17,409	-DITTO-
	19	0	0	0	0	0	0	1,440	0	0	0	
	20	0	0	0	0	0	0	1,440	0	0	0	
	21	9	355	280	80	290	1,005	435	29,638	3,591	33,229	SAND & SILT
	22	12	460	405	130	445	1,440	0	27,752	16,978	44,730	-DITTO-
	23	13	505	365	130	440	1,440	0	20,569	27,570	48,139	-DITTO-
	24	14	520	355	130	435	1,440	0	46,410	3,682	50,092	-DITTO-
	25	14	480	395	140	425	1,440	0	31,980	19,932	51,912	-DITTO-
	26	3	105	110	40	165	420	1,020	0	11,319	11,319	-DITTO-
TOTAL		268	9,570	7,780	2,680	8,465	28,495	6,065	626,072	357,783	983,855	

TOTAL NOS. OF CYCLE:	268	(NOS.)			
AVE. DREDGING TIME:	35.71	(MIN.)			
AVE. SAILING TIME (GOING):	29.03	(MIN.)			
AVE. DUMPING TIME:	10.00	(MIN.)			
AVE. SAILING TIME (RETURNING):	31.59	(MIN.)			
WORKING TIME PER CYCLE:	106.32	(MIN.)			
TOTAL WORKING TIME:	28,495	(MIN.)	=	475	(Hrs.)
TOTAL INTERMISSION TIME:	6,065	(MIN.)	=	101	(Hrs.)
DREDGING VOLUME AT LAGOON:	626,072	(M3)			
DREDGING VOLUME AT CHANNEL:	357,783	(M3)			
TOTAL DREDGING VOLUME:	983,855	(M3)			

NOTE : BESIDES THE ABOVE MENTIONED, CUTTER SUCTION DREDGER MOT VII DREDGED 14,700 M3 OF SOIL AT THE ADJACENT AREA OF IRON ORE AND OIL BERTH ON MAY 9TH.

TRAILING SUCTION HOPPER DREDGER HOT Ⅷ

MONTH	DAY	NO.OF CYCLE	DREDGING TIME (MIN.)	SAILING TIME GOING (MIN.)	DUMPING TIME (MIN.)	SAILING TIME RETURNING (MIN.)	TOTAL WORKING TIME (MIN.)	INTER-MISSION TIME (MIN.)	DREDGING VOLUME AT LAGOON (M3)	DREDGING VOLUME AT CHANNEL (M3)	TOTAL DREDGING VOLUME (M3)	KIND OF SOIL
JULY	30	0	0	0	0	0	0	1,440	0	0	0	
	31	0	0	0	0	0	0	1,440	0	0	0	
AUG.	1	0	0	0	0	0	0	1,440	0	0	0	
	2	0	0	0	0	0	0	1,440	0	0	0	
	3	0	0	0	0	0	0	1,440	0	0	0	
	4	0	0	0	0	0	0	1,440	0	0	0	
	5	3	330	80	10	75	495	945	0	12,480	12,480	SILT & CLAY
	6	8	915	250	40	235	1,440	0	0	36,154	36,154	SAND & SILT
	7	9	840	215	45	240	1,340	100	0	42,253	42,253	-DITTO-
	8	10	850	250	50	250	1,400	40	0	46,465	46,465	-DITTO-
	9	11	685	295	55	345	1,380	60	4,865	46,472	51,337	-DITTO-
	10	13	495	405	70	470	1,440	0	9,658	48,213	57,871	-DITTO-
	11	6	290	180	30	250	750	690	0	27,290	27,290	-DITTO-
	12	0	0	0	0	0	0	1,440	0	0	0	
	13	0	0	0	0	0	0	1,440	0	0	0	
	14	0	0	0	0	0	0	1,440	0	0	0	
	15	8	280	360	35	295	970	470	30,028	0	30,028	SAND & SILT
	16	9	670	290	45	300	1,305	135	10,332	21,030	31,362	-DITTO-
	17	8	815	210	40	195	1,260	180	0	26,541	26,541	-DITTO-
	18	9	920	230	45	245	1,440	0	0	32,172	32,172	-DITTO-
	19	8	905	225	40	210	1,380	60	0	26,692	26,692	-DITTO-
	20	8	935	230	45	230	1,440	0	0	27,128	27,128	-DITTO-
TOTAL		110	8,930	3,220	550	3,340	16,040	15,640	54,883	392,890	447,773	

TOTAL NOS. OF CYCLE:	110	(NOS.)			
AVE. DREDGING TIME:	81.18	(MIN.)			
AVE. SAILING TIME (GOING):	29.27	(MIN.)			
AVE. DUMPING TIME:	5.00	(MIN.)			
AVE. SAILING TIME (RETURNING):	30.36	(MIN.)			
WORKING TIME PER CYCLE:	145.82	(MIN.)			
TOTAL WORKING TIME:	16,040	(MIN.)	=	267	(Hrs.)
TOTAL INTERMISSION TIME:	15,640	(MIN.)	=	261	(Hrs.)
DREDGING VOLUME AT LAGOON:	54,883	(M3)			
DREDGING VOLUME AT CHANNEL:	392,890	(M3)			
TOTAL DREDGING VOLUME:	447,773	(M3)			

Appendix-10.1 Computational Method of the Harbour Tranquility

In deep water where the water depth is greater than about one half the wave length, waves propagate without being affected by the sea bottom. When waves enter into a region of shallower water, they transform by refraction and shoaling etc. Moreover, when water waves encounter an obstacle such as breakwaters and sea walls etc., wave diffraction and reflection take place. Most of the wave energy is ultimately lost through wave breaking before arrival at the shore line.

In the evaluation of harbour tranquillity, wave height at the entrance of harbour should be estimated at first, by a refraction calculation. After that, spatial distribution of wave height in the harbour will be evaluated by means of wave diffraction and reflection calculation.

In the calculation of the wave transformations, it is not accurate to use a monochromatic wave with a constant direction and period. Waves in the real sea are irregular; they are composed of an infinite number of components having different directions and periods. To improve the accuracy of calculation of the wave transformation, the irregularity of actual waves should be taken into account.

Methods to calculate the wave transformation, taking the wave irregularity into account, have been developed in the Port and Harbour Research Institute of the Ministry of Transport, Japan.

In the appendix, computational methods of wave transformation, namely refraction and diffraction, taking wave irregularity into account will be introduced.

(1) Refraction of waves

The refraction of random sea waves can be analyzed by numerically solving the energy conservation equation. The dependent variable in the equation is the directional spectrum of water waves. The equation is written in the form,

$$\frac{\partial}{\partial x}(SV_x) + \frac{\partial}{\partial y}(SVy) + \frac{\partial}{\partial \theta}(SV_\theta) = 0 \qquad (1)$$

where S denotes the directional wave spectral density and Vx, Vy and V_θ are given

$$\left.\begin{aligned} V_x &= C_G \cos\theta \\ V_y &= C_G \sin\theta \\ V_\theta &= \frac{C_G}{C}\left(\frac{\partial C}{\partial x}\sin\theta - \frac{\partial C}{\partial y}\cos\theta\right) . \end{aligned}\right\} \qquad (2)$$

The symbols C and C_G denote the phase and group velocities of a wave component respectively, and they are calculated with the following formulas for waves with period T and length L in water depth h:

$$\left.\begin{aligned} C &= \frac{L}{T} = \frac{g}{2\pi} T \tanh \frac{2\pi h}{L} , \\ C_G &= \frac{1}{2}\left[1 + \frac{4\pi h/L}{\sinh(4\pi h/L)}\right] C. \end{aligned}\right\} \qquad (3)$$

The symbol θ denote the propagational direction of a component wave.

Eq. (1) can be solved numerically with a appropriate boundary condition representing deep water wave condition.

(2) Diffraction of waves

When water waves encounter an obstacle such as a breakwater, they pivot about the edge of the obstacle and move into the shadow zone of the obstacle. This phenomenon is called diffraction of water waves. The spatial distribution of diffracted wave height of regular waves in uniform depth can be computed by means of the Sommerfeld solution. Conventional diagrams to get wave diffraction coefficient have been prepared for regular waves. However, direct application of such conventional diagrams to real situations is not recommended, because they can lead to erroneous results.

The diffracted heights of real sea waves should be computed as follows by introducing the directional wave spectrum:

$$(Kd)_{eff} = \left[\frac{1}{m_0}\int_0^{\infty}\int_{\theta_{min}}^{\theta_{max}} S(f,\ \theta)Kd^2(f,\ \theta)\,d\theta\,df\right]^{1/2} \qquad (4)$$

where $(Kd)_{eff}$ denotes the diffraction coefficient of random sea waves (the ratio of diffracted wave height to incident one), $Kd\ (\theta,\ f)$ is the diffraction coefficient of component (regular) waves with frequency f and direction θ, and m_0 is the integral of the directional spectrum represented as follows:

$$m_0 = \int_0^{\infty}\int_{\theta_{min}}^{\theta_{max}} S(f,\ \theta)\,d\theta\,df. \qquad (5)$$

In the practical computations, the integrations in Eq. (4) are replaced by summations over ten frequency intervals and over 20 directional intervals, and performed on a digital computer.

(3) Reflection of waves

When waves are reflected by a structure, the reflected waves cause increased agitation of the water in front of the structure and they may propagate some distance to become a source of disturbance in an otherwise calm area of water. Thus it is necessary to take wave reflection into consideration in the estimation of harbour tranquillity.

Reflected waves have a finite length along their crest line, because reflective structures such as breakwaters or quay walls have limited extent. Therefore, reflected waves disperse during propagation away from the source of reflection in a manner similar to the phenomenon of wave diffraction.

As an engineering approximation, the spatial distribution of reflected wave height can be estimated by making use of diffraction diagrams for an mouth of breakwaters. The idea is to treat the zone of wave reflection as the mouth of fictitious breakwaters and to apply a diffraction diagrams accordingly.

The practical computation of wave reflection has been performed on a digital computer similarly in the computation of wave diffraction.

(4) Composition of Waves

Where there are plural wave trains by reflection and diffraction, the wave height may be calculated by the formula,

$$H_s = \sqrt{H_1^2 + H_2^2 + \cdots\cdots + H_n^2} ,$$

where Hs denotes significant wave height as a whole of the wave trains and H_1, H_2, ..., Hn are significant wave heights of the respective wave trains.

Appendix-10.2 Annual Effective Rates of the Berths at New Mangalore Port

Reduction rates of significant wave in front of the berths can be obtained by using numerical simulation mentioned in Appendix-10.1.

Effective rate of a berth is defined as the percentage of days per annum when wave height in front of the berth is less than an allowable wave height for the operation at the berth.

Table-A.10.1 shows joint distribution of significant wave height (Hs) and direction at a depth of -10m offshore New Mangalore Port during the southwest monsoon season (June to September).

Table-A.10.1 Joint distribution of significant wave height (Hs) and direction at a depth of about -10m offshore Mangalore during the southwest monsoon season (June to September)

unit: %

② / ①	SW	WSW	W	WNW	Total
0 - 0.5	0.20	0.10	0.51	0.19	1.00
0.5 - 1.0	3.94	3.72	7.01	8.33	23.00
1.0 - 1.5	1.95	6.24	20.10	3.71	32.00
1.5 - 2.0	0.68	4.45	15.07	0.80	21.00
2.0 - 2.5	0.17	3.97	9.11	0.25	13.50
2.5 - 3.0	0.07	2.75	5.18	0.00	8.00
3.0 - 3.5	0.00	0.45	1.05	0.00	1.50
Total	7.01	21.68	58.03	13.28	100.00

① wave height range (m), ② wave direction, Based on the calculations (Figure-A.10.1 - 4) and data, effective (ineffective) rate of the each berth can be calculated as follows.

Table-A.10.2 Ineffective Rate of the Iron Ore Berth

Wave Direction	Wave Reduction Rate	Allowable Wave Height at the Berth (m)	Allowable Wave Height at Depth of -10m(m)	Ineffective Rate (%)
SW	0.29	0.5	1.7	0.6
WSW	0.25	0.5	2.0	7.2
W	0.24	0.5	2.1	13.9
WNW	0.25	0.5	2.2	0.2
Total				21.9% (June to Sep.) 7.3% (All year*)

*Assuming that the berth is always effective from Oct. to May.

Table-A.10.3 Ineffective Rate of the Crude Jetty

Wave Direction	Wave Reduction Rate	Allowable Wave Height at the Berth (m)	Allowable Wave Height at Depth of -10m(m)	Ineffective Rate (%)
SW	0.11	0.7	6.4	0.0
WSW	0.10	0.7	7.0	0.0
W	0.09	0.7	7.8	0.0
WNW	0.09	0.7	7.8	0.0
Total				0.0% (June to Sep.) 0.0% (All year*)

*Assuming that the berth is always effective from Oct. to May.

Table-A.10.4 Ineffective Rate of the Oil Products Jetty

Wave Direction	Wave Reduction Rate	Allowable Wave Height at the Berth (m)	Allowable Wave Height at Depth of -10m(m)	Ineffective Rate (%)
SW	0.08	0.5	6.3	0.0
WSW	0.07	0.5	7.1	0.0
W	0.07	0.5	7.1	0.0
WNW	0.07	0.5	7.1	0.0
Total				0.0% (June to Sep.) 0.0% (All year*)

*Assuming that the berth is always effective from Oct. to May.

Table-A.10.5 Ineffective Rate of the No.3 Berth (East Dock)

Wave Direction	Wave Reduction Rate	Allowable Wave Height at the Berth (m)	Allowable Wave Height at Depth of -10m(m)	Ineffective Rate (%)
SW	0.19	0.5	2.6	0.05
WSW	0.17	0.5	2.9	0.78
W	0.16	0.5	3.1	0.78
WNW	0.15	0.5	3.3	0.0
Total				1.6% (June to Sep.) 0.6% (All year*)

*Assuming that the berth is always effective from Oct. to May.

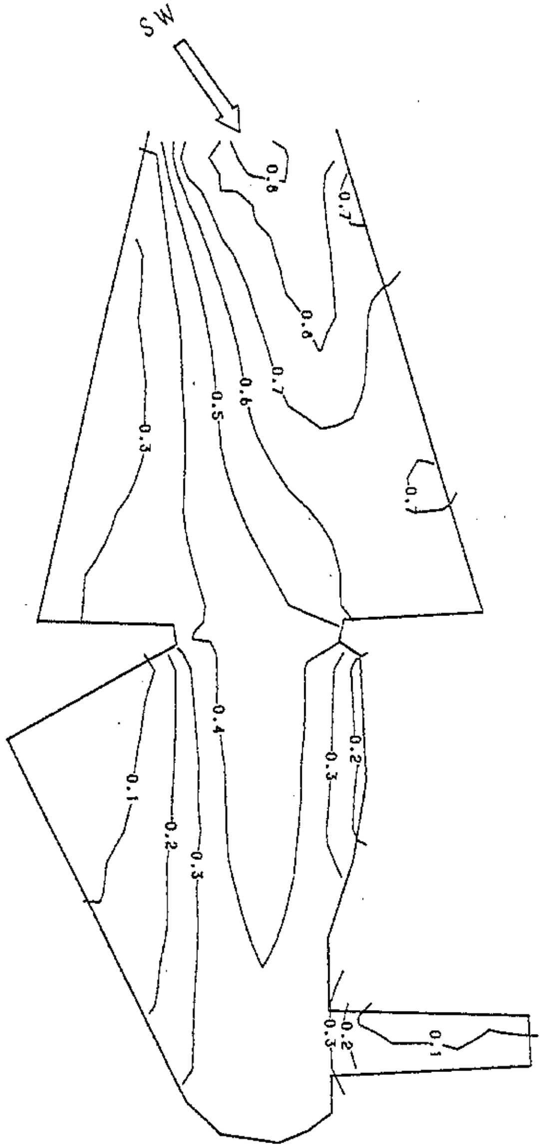


Figure-A.10.1 Wave Reduction Rate (SW)

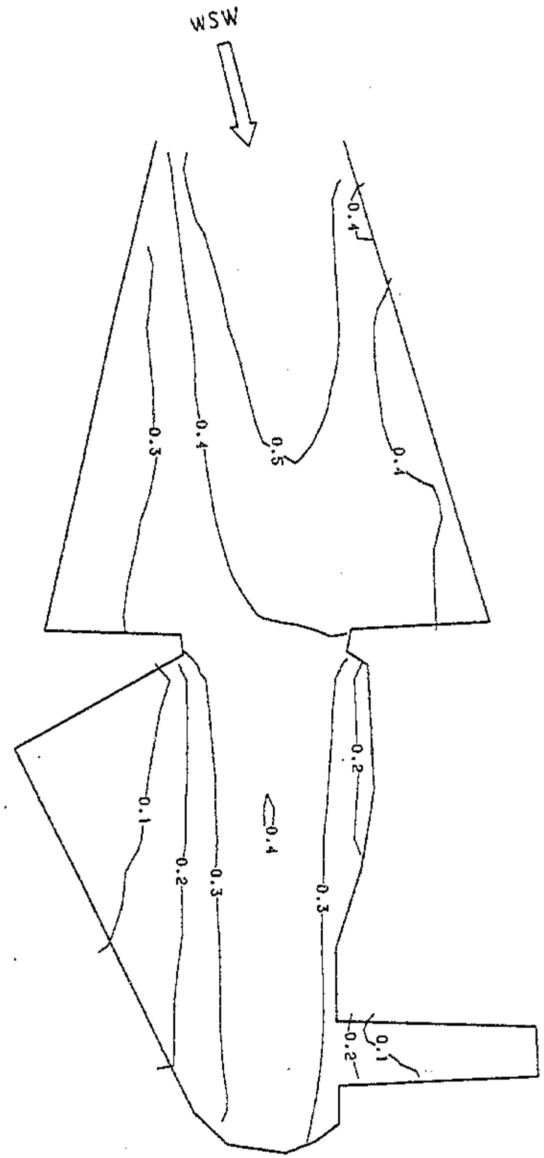


Figure-A.10.2 Wave Reduction Rate (WSW)

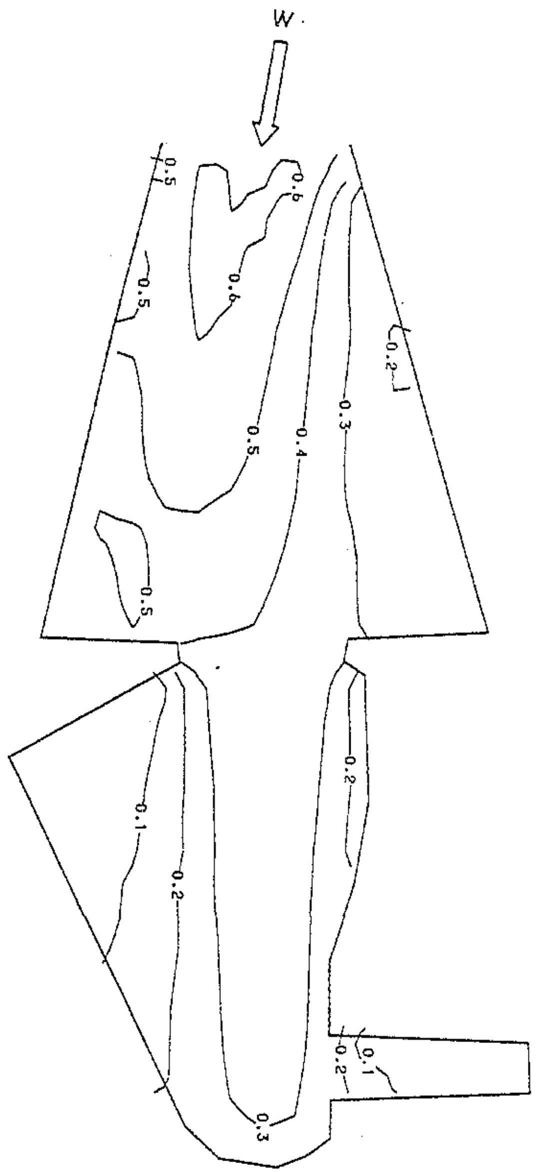


Figure-A.10.3 Wave Reduction Rate (W)

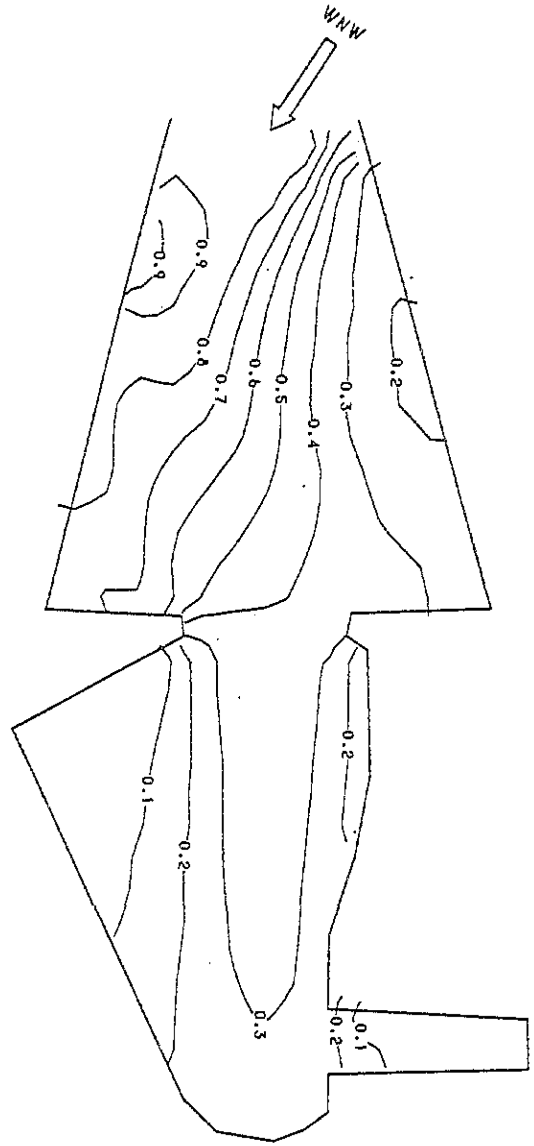


Figure-A.10.4 Wave Reduction Rate (WNW)

Appendix-10.3 Specification of Navigational Aids

Table-A.10.6 Specification of Beacon (Transponder)

1. Frequency	
X-band	: 9320-9800 MHz
2. Frequency accuracy	
Radar pulse length≦450 nsec	: 2.5 MHz
3. Receivr type	: Single conversion superheterodyne
4. Receiver sensitivity	
(at antenna flange)	
Fctory adjusted	: -35 dbm
Adjustment range	: -50 dbm to 0 dbm
(For system sensitivity, subtract antenna gain from receiver sens-itivity)	
5. Receiver noise margin	
With -35 dbm sensitivity at antenna flange	: ≧25 dbm
6. Maximum response rate	: ≧10 KHz
7. Response delay	
Radar pulsewidth 525 nsec	: 400 nsec
125 radar pulsewidth 525 nsec	: 800 nsec
525 radar pulsewidth	: 1200 nsec
8. Power supply input voltage	
Nominal	: 12 volt
Minimum	: 10 volt
Maximum	: 18 volt
(Power consuption at 50% service per)	
9. Band alternating	
(Depends on radar traffic at site)	
Without control processor module (CPM)	
Single band	: 7.5 watts
Dual band	: 15.0 watts
With control processor module(CPM)	
Idle	: 0.3 watts
Transmit (Radar in service area)	
One X	: 2.9 watts
For each additional radar in service area add.	
X-band 0.25 watts transmitter	: 0.10 watts

DIMENSIONS:
Diameter
not including lift ring: 290 mm
including lift ring: 410 mm
Height
with X-band only radome 902 mm
Weight 16 kg

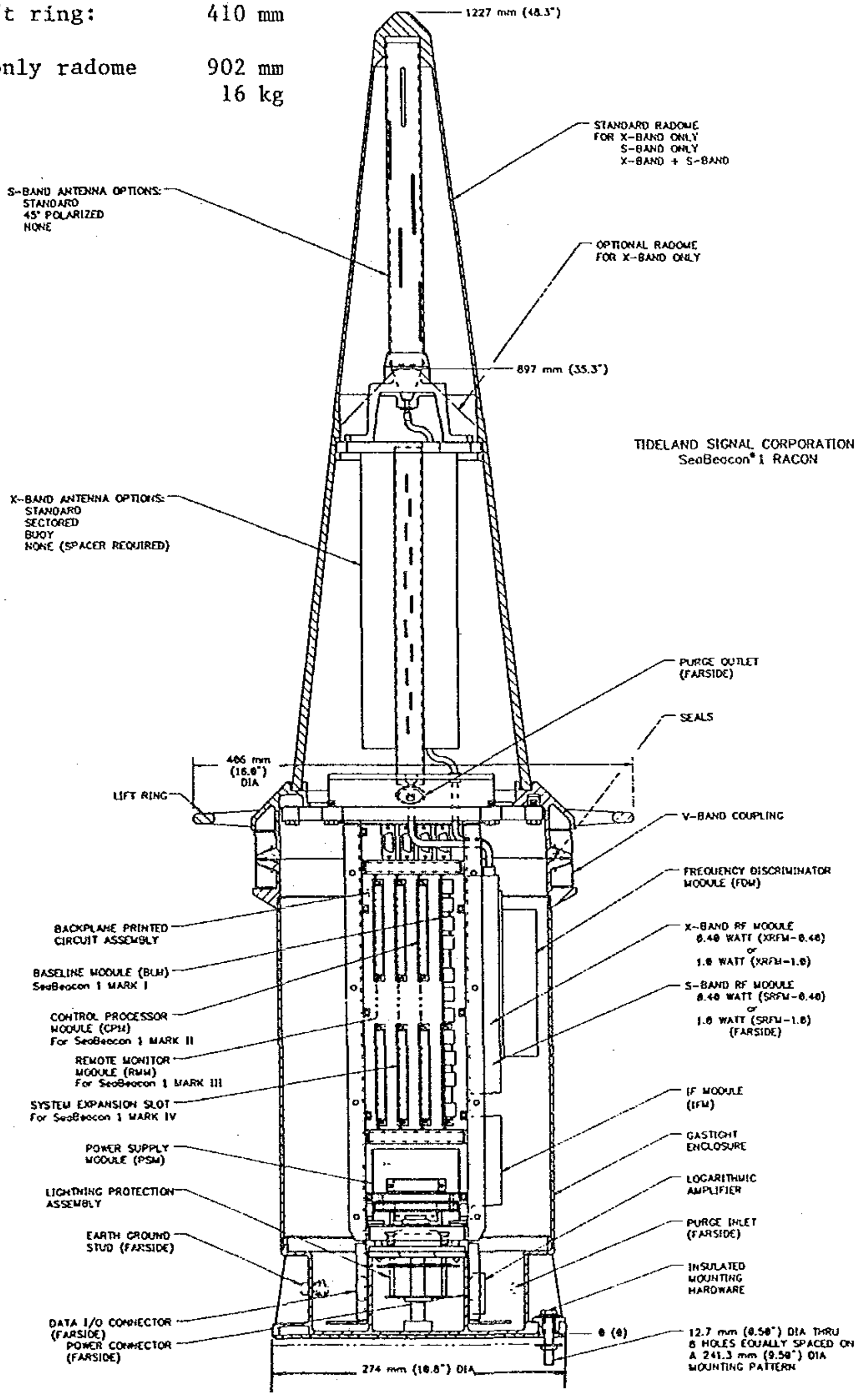


Fig-A.10.5 RADAR BEACON(TRANSPONDER)

Table-A.10.7 Specification of Leading Light Lantern

1. Height Overall	391 mm
2. Weight	6.3 kg
3. Lens	Concave lens, Condenser lens and 138mm dia. spreader lens beam
4. Lamp Size	12 V 0.55 A
5. Light Color	White, red or green
6. lamp Changer	6 lamp turret system and Automatic operation
7. Flasher	Solid State System
8. Sun Switch	Cds. photo-electric cells system
9. Light Character	One flash every 3 second (Fixed light, Quick flash, Group flash, Morse flash are available as options)
10. Pour Source	DC 12 V
11. Cabinet Material	F.R.P. resin
12. Fitting Hole Pitch	200 ϕ mm
13. Fitting Hole dia.	3-15.9mmx24.5mm or 4-15.9mmx24.5mm
14. Required Power Cable	11.8mm dia. 2 core cabtype cable

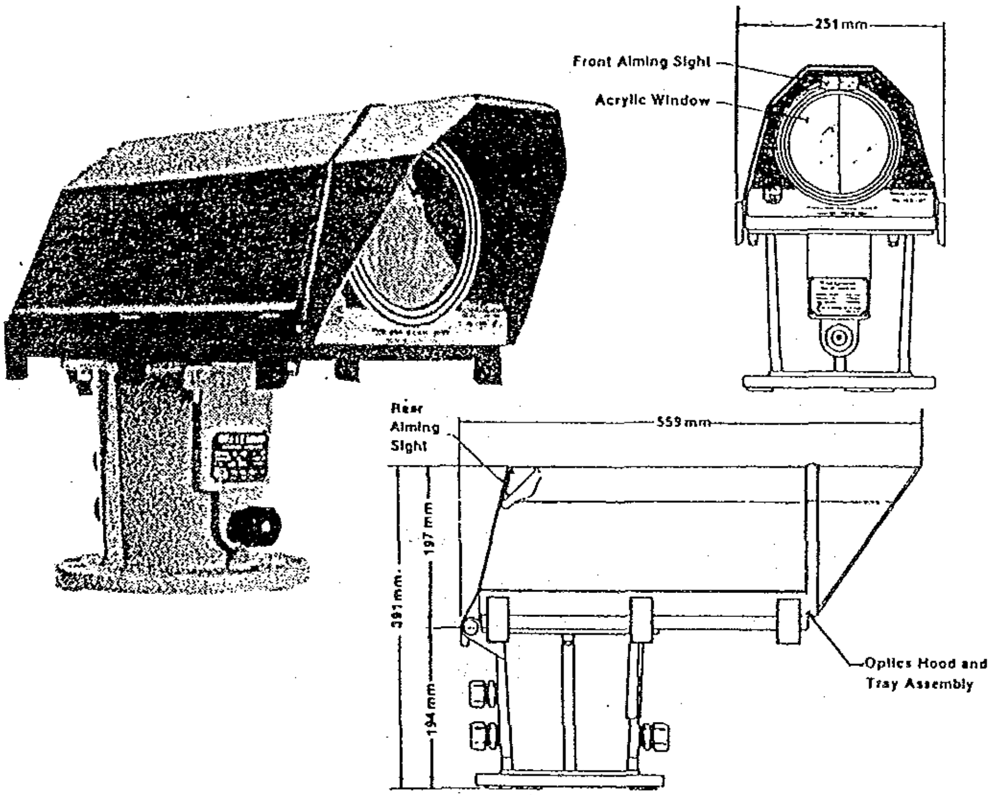


Fig-A.10.6 LEADING LIGHT

Table-A.10.8 Wave Activated Generator Specification

1. Air-turbine	Impulse turbine Anti-Corrosive Aliminum Alloy(AC7A-F)	
2. Generatoor	3-Phase A.C. generator 12V, 70W(5000 r.p.m.) D.C.	
3. Control Unit	Rectifier	: Silicon diode 3 Phase full wave rectification
	Overcharge Pro- tective Circuit	: Turn on voltage ;13.5±0.3V Turn off voltage;13.4±0.3V
	Over voltage Pro- Tective Circuit	: Turn on voltage 16V±1V Turn off voltage 16V±1V
4. Valve Body Material	F.R.P.(t-1.6 mm) Anti-Corrosive Aluminum Alloy (AC7A-F)	
5. Gross Weight	Approx. 78 kg	
6. Dimensions	Flange diameter ϕ 740mm Height Overall 875mm	

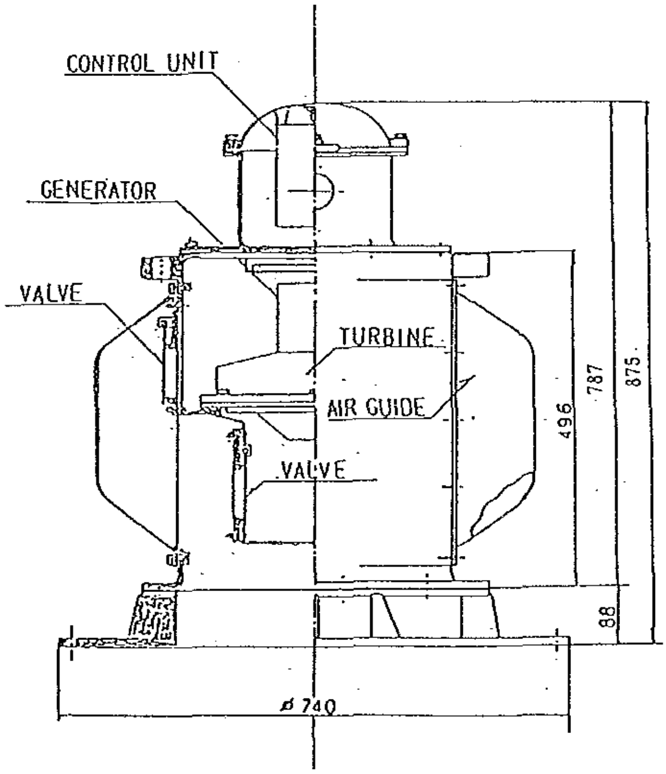


Fig-A.10.7 TG-3 TYPE WAVE ACTIVATED GENERATOR

Table-A.10.9 Specification of Light Buoy Standard

	Type - 1	Type - 2
1. Height Overall	8.84m	5.87m
2. Focal Plane height	4.59m	3.13m
3. Total Weight	5,460kg	1,150kg
4. Reserve Buoyancy	2,689kg	1,020kg
5. Maximum Current	4 knots	5 knots
6. Buoy		
1) Material	Steel plate (9mm)	Steel plate (4.5mm)
2) Superstructure	Steel angle, Bolted and Welded construction	Steel angle, Bolted and Welded construction
3) Diameter	2.60m dia.	1.50m dia.
7. Lantern		
1) Lens	155 mm dia, acrylic	155 mm dia, acrylic
2) lampchanger	6 place lampchanger	6 place lampchanger
3) Sun-switch	Photo-electric cell operation	Photo-electric cell operation
4) Standard lamp size	12 V 0.55A(6.6V)	12 V 0.55A (6.6A)
5) Effective intensity (Fixed)	130 cd.	130 cd.
6) Luminous range at T=0.74	16 km	10 km
7) Material	F.R.P.	F.R.P.
8) Color	clear, red or green	clear, red or green
8. Power Source	Wave Activated Generator Storage battery, 6 pcs. (12V 500AH)	Solar Battery system(12V 1,050AH)
9. Mooring		
1) Mooring chain	32m/m dia, chainx1 pce.	25m/m dia, chainx1 pce.
2) Bridle chain	32m/m dia, chainx5mx2 pce.	25m/m dia, chainx3mx2 pce.
3) Swivel piece	for 32m/m dia, x1 pce.	for 25m/m dia, x1 pce.
4) 3 Eyes piece	for 32m/m dia, x1 pce.	for 25m/m dia, x1 pce.
5) Joining shackle	for 32m/m dia, x7 pce.	for 25m/m dia, x7 pce.
6) Sinker	10 tons concrete sinker	5 tons concrete sinker

* Day-mark, Top-mark, Radar reflector and Rubber fender are also fitted as optional specification according to "IALA A" system.

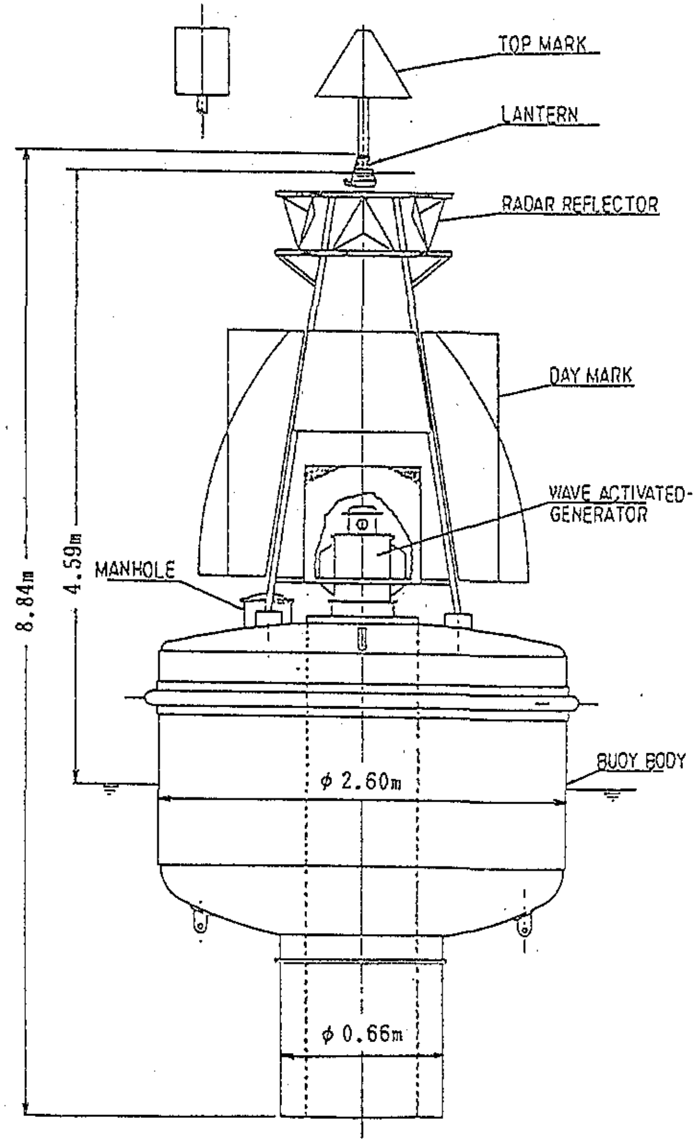


Fig-A.10.8 TYPE-1 LIGHTED BUOY (DIA. 2.6m)

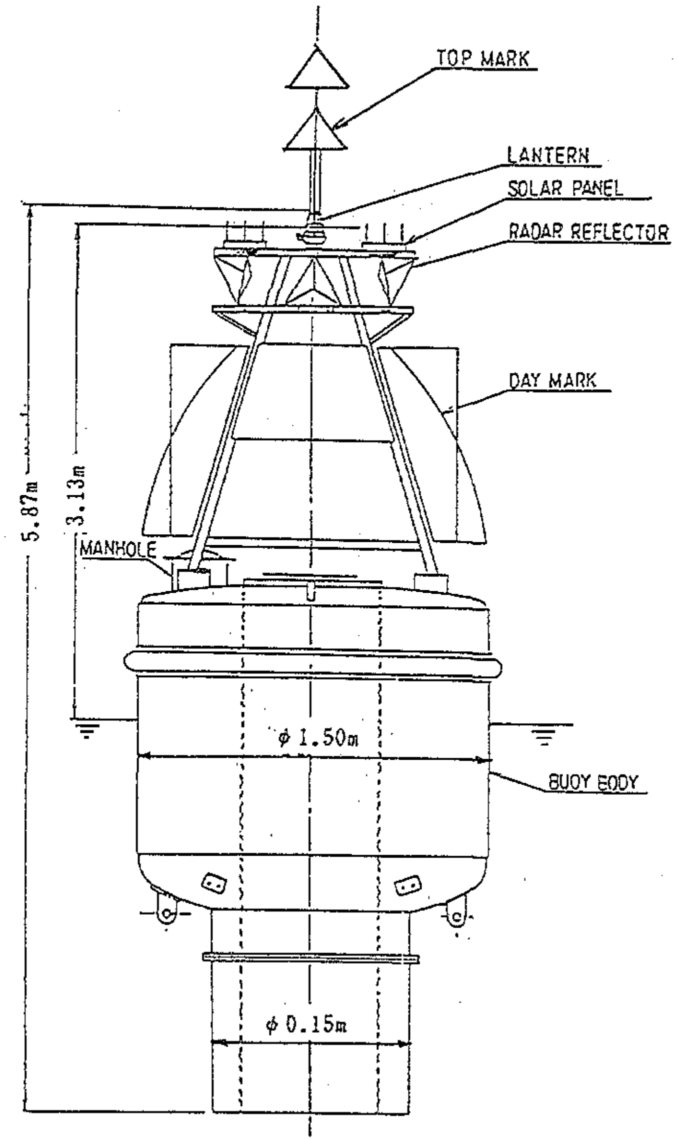


Fig-A.10.9 TYPE-2 LIGHTED BUOY (DIA. 1.5m)

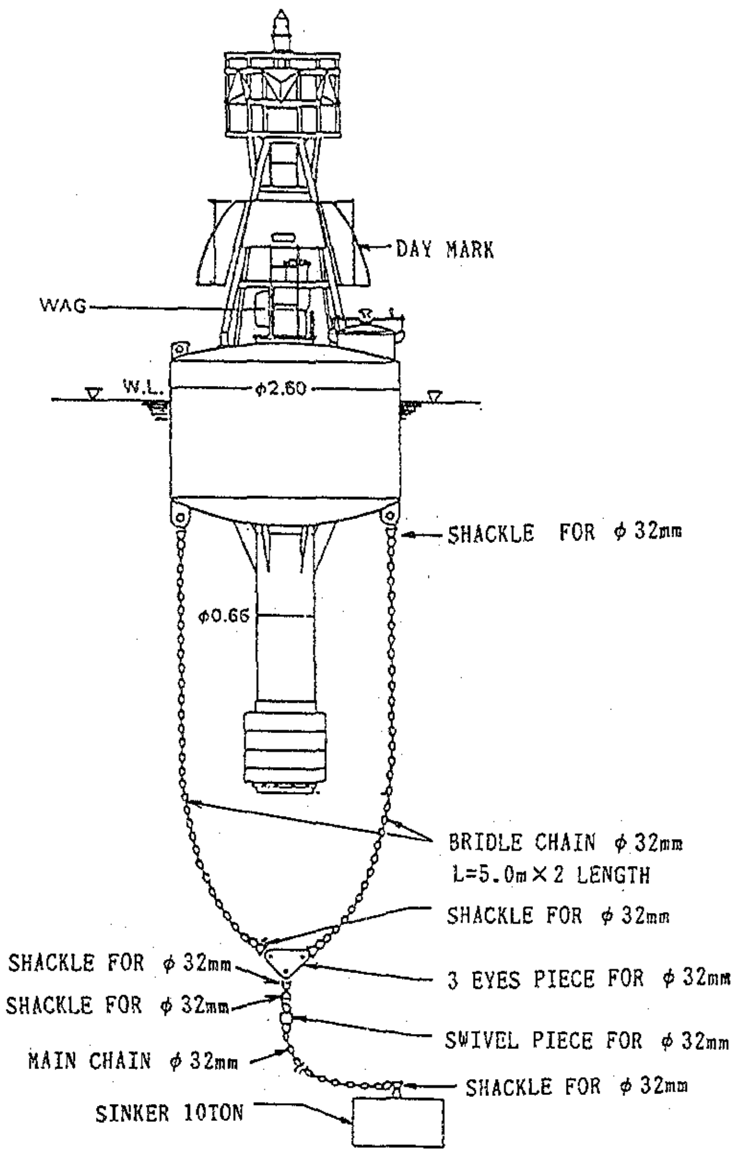


Fig-A.10.10 TYPE-1 STANDARD MOORING SYSTEM

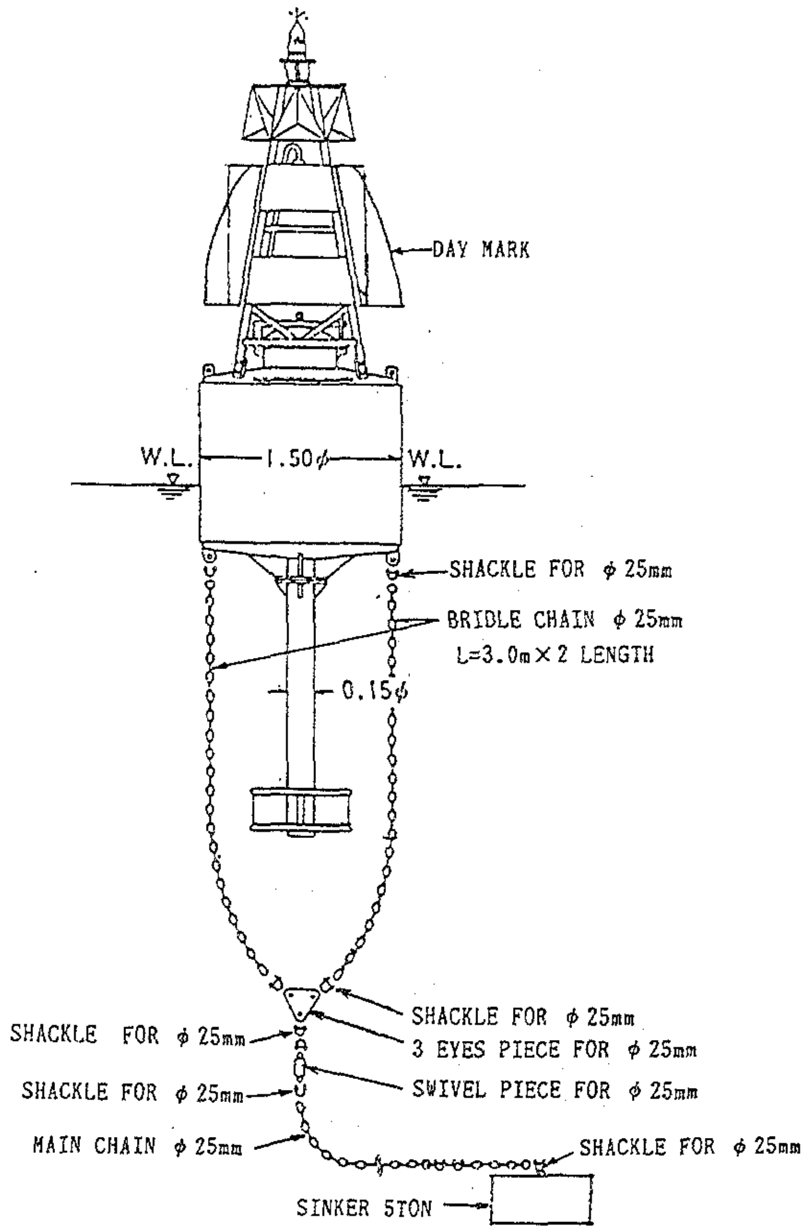


Fig-A.10.11 TYPE-2 STANDARD MOORING SYSTEM

Table-A.10.10 Specification of Light Beacon

	Type - 2	Type - 1
1. Height Overall	2.5m	5.0m
2. Material	Steel plate welded and bolted construction	Steel plate welded and bolted construction
3. Total Weight	720 kg	1300 kg
4. Lantern	ML-155	ML-155
5. Lighting Caracter	12V 0.5A 1 flashing every 4 sec.	2V 0.55A 1 flashing every 4 sec.
6. Light Color	White, red or green	White, red or green
7. Power Source	DC 12 V	DC 12 V
	Packed dry battery type KAN-100 or Layer-built air battery, Solar power type	Packed dry battery type KAN-100 or Layer-built air battery, Solar power type
8. Battery Box	Pole structure includes the box	Pole structure includes the box

* Dar-mark, Top-mark, Rader reflecter are fitted as optional specification according to "IALA'A" system

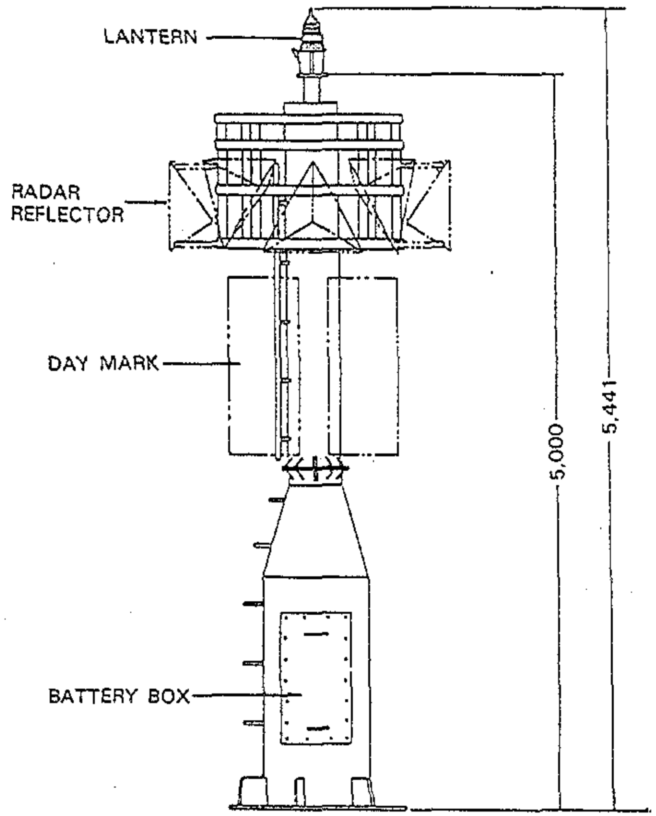


Fig-A.10.12 TYPE-1 LIGHTED BEACON

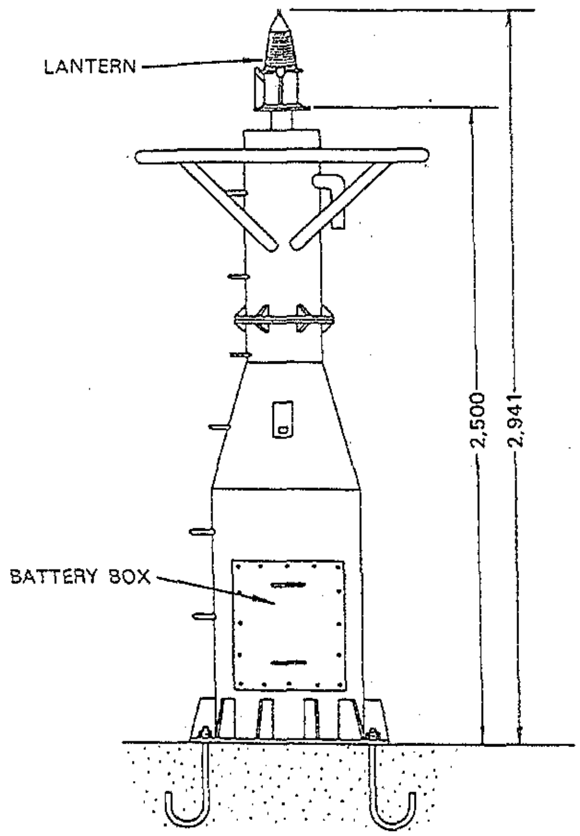


Fig-A.10.13 TYPE-2 LIGHTED BEACON

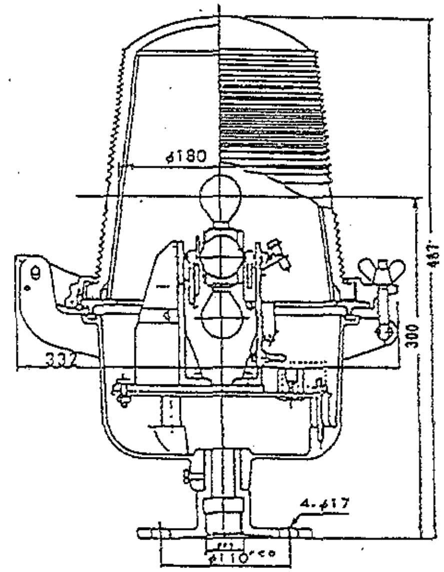


Fig-A.10.14 ML-155 TYPE LANTERN

Table-A.10.11 Specification of Syncronized Flashing

1. Master Station	
1) Effctive Control	Less than 20 km
2) Transmitter Frequency	AUAILABLE One Frequency Between 1.16 and 40MHz as required
3) Power of Transmittion antenna	Less than 1W
4) Type of emission	A2B
5) Antenna	4.04 m lemgth, vertical type
6) Power	A.C. Volts, 220V(50/60Hz)±less than 10% Consumed power: less than 7W
2. Slave Station	
1) Received frequency	AUAILABLE One Frequency Between 1.61 and 40MHz as required
2) Received radio wave type	A2B
3) Reception sensitiveivity	The station starts to operate at a an imput signal wave less than 30dB of which 70% is modulated
4) Reception system	Quartz-controled Super-Heterodyne system
5) Intermediated frequency	455 KHz
6) Antenna	2.82n length vertical type
7) Power source	D.C. Volts, 10-14.5V
8) Consumed power	Less than 0.12W at a nominal volt of 12V

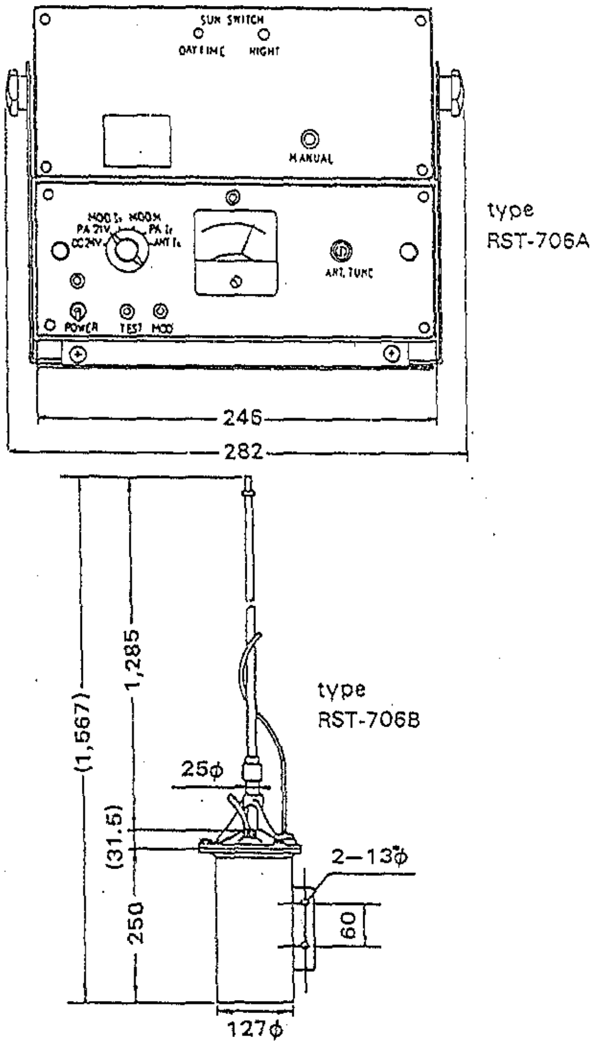


Fig-A.10.15 SYNCRONIZED FLASHING

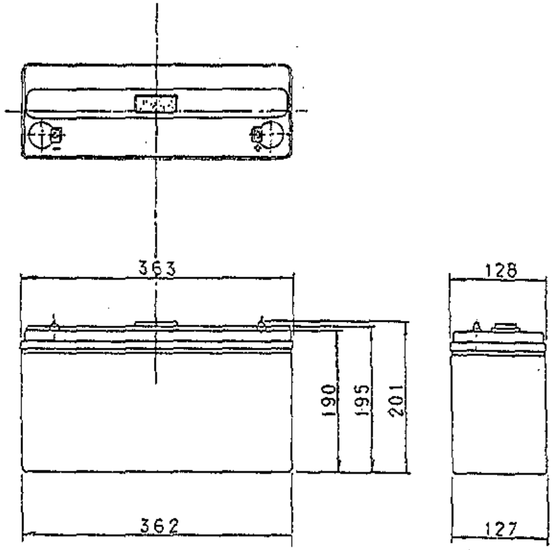


Fig-A.10.16 HSP-20 TYPE SOLAR PANEL

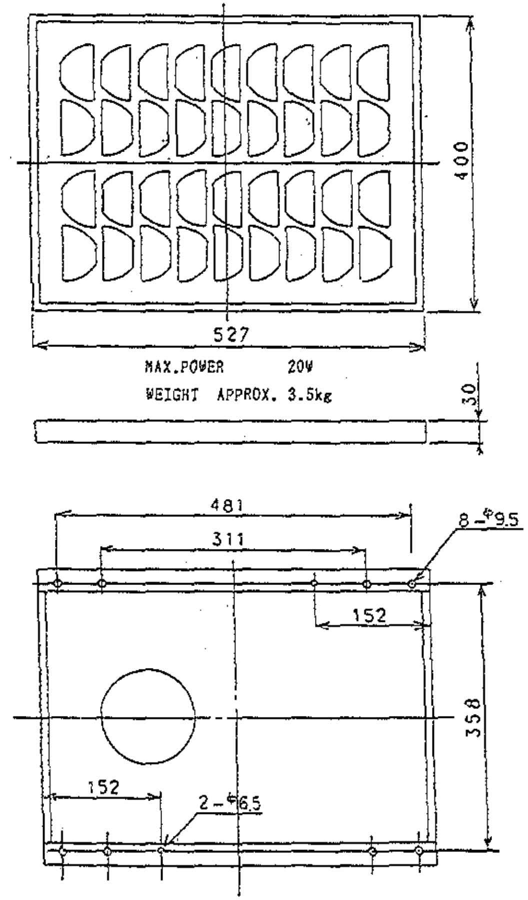


Fig-A.10.17 SE65-12 TYPE BATTERY

Appendix-10.4 Summary of Cost Estimation for the Short-term Plan for Development of Aids to Navigation System

1. Equipment			unit: YEN(¥)
(1) Electronic Aids to Navigation			20,360,000
1) Rader Beacon (Transporter)	2	set	20,360,000
(2) Visual Aids to Navigation			149,700,000
1) Leading Light	2	"	5,400,000
2) Light Buoy	15	"	115,900,000
a) Type-1	11	"	104,500,000
b) Type-2	4	"	11,400,000
3) Light Beacon	11	"	17,600,000
a) Type-1	2	"	10,000,000
b) Type-2	4	"	7,600,000
4) Lantern	2	"	3,000,000
5) Synchronized Flashing	1	"	5,000,000
6) Day Mark	2	"	2,800,000
	Sub-total		170,060,000
2. Spare parts			68,000,000
1) Spare Buoys	4	"	40,000,000
2) Spare parts	1	"	28,000,000
3. Construction Cost	1	"	38,250,000
4. Consultancy (6%)	1	"	10,300,000
5. Contingency (10%)	1	"	17,000,000
	Total		303,610,000

Appendix-10.5 Facility Plan beyond 1994/95

Handling volumes of iron ore, crude oil, oil products and coal are expected to grow after 1994/95 and reach to the amounts projected in demand forecast in 2004/05. Expansion plan of iron ore production is under consideration and the ultimate stage of the oil refinery plant and the first stage of the coal thermal power plant will be completed. Therefore, following demands for iron ore, crude oil, oil products and coal are likely to be generated between 1994/95 and 2004/05.

Iron Ore : 10.0 Million tons
Crude Oil: 6.0 Million tons
Oil Products: 3.2 million tons
Coal : 6.2 Million tons

Consequently, another iron ore berth, another oil products berth, two coal berths and an inner breakwater for protecting the new oil products berth should be constructed to meet the demands (Figure-A.10).

Construction program for the each facility are shown in Table-A.10. As when the each facility should be constructed is not clear, this program shows only the each work period.

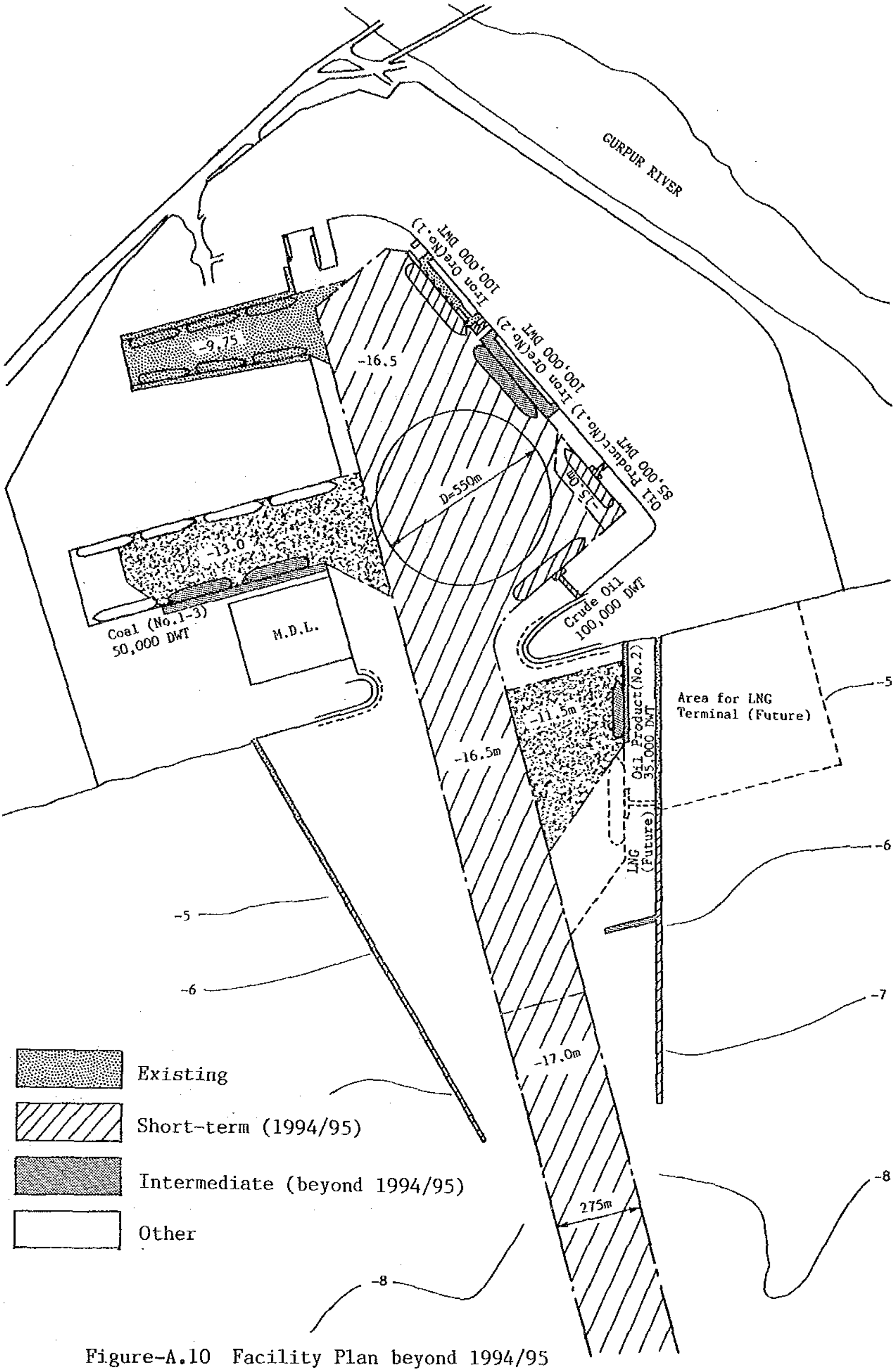


Figure-A.10 Facility Plan beyond 1994/95

Table-A.10. Work Period

Facilities	Q'ty	1 year	2 year	3 year
Iron Ore Berth for 100,000DWT	1 berth	————	——	
Iron Ore Handling Equipment	1 L.S.	————		
Oil Products Berth (No.2)for 35,000DWT	1 berth	————		
Coal Berth for 60,000 DWT	1 berth	————	————	
	1 berth	————	————	
Inner-Breakwaters	150m	——		

Note 1 Above Bar-chart does not show construction schedule but work period

2 As far as the Iron Ore Berth concerned, piling work(pile number about 284) is critical path.

3 The Coal Berths are assumed to be constructed diaphragm wall and relieving type platform

4 Inner-Breakwaters should be constructed before beginning the work of Oil Products Berth.

Table-A.11. shows the construction costs of the each facility (except a dredging cost in front of the coal berths because it is unknown how a hard rock stratum is spread there).

Table-A.11 Construction Costs of Additional Facilities

Item	Quantity	Unit	Amount (Rs. Crore)	Note
Iron Ore Berth (100,000 DWT)	1	nos.	10.3	
Iron Ore Handling Equip.	1	L.S.	61.2	Shiploader, Conveyors Reclaimer & Stockpile Shed
Oil Products Berth(No.2)	1	L.S.	5.9	Breasting Dolphin & Platform Length:60m
Jetty	(1)	(nos.)	(3.7)	
Dredging	(1.0)	(mill.m3)	(2.2)	
Coal Berths	2	nos.	14.0	Unloader & Dredging not included
Inner Breakwater	150	m	1.5	
T O T A L			92.9	