Chapter XIV Preliminary Economic Analysis

14.1 Purpose and Methodology of Economic Analysis

14.1.1 Purpose

The purpose of the economic analysis is to appraise the feasibility of the master plan for the studied port before conducting a feasibility study of the short term plan. The preliminary economic evaluation of a project should show whether the project is justifiable from the viewpoint of the national economy by assessing its contribution to the national economy.

14.1.2 Methodology

An economic analysis will be carried out according to the following method. Master plan will be defined and compared with the "Without-the-project case". All benefits and costs in market price of the difference between "With-the-project case" and "Without-the-project case" will be calculated and evaluated.

There are various methods to evaluate the feasibility of this type of development project. The economic internal rate of return (EIRR) and the benefit /cost ratio (B/C ratio) based on a cost - benefit analysis are used to appraise the feasibility of the project in this study.

The EIRR is a discount rate which makes the costs and the benefits of the project during the project life equal. The benefit /cost ratio based on the present value of benefits and costs is obtained by dividing the benefits by the costs. A ratio greater than one implies that the project is acceptable.

14.2 Prerequisites for the Economic Analysis

14.2.1 Base Year

The "Base Year" here means the standard year in the estimation of costs and benefits. Taking into consideration the base year in the estimation of construction cost, 1997 is set as the "Base Year" of the study.

14.2.2 Project Life

The period of calculation (project life) in the economic analysis is assumed to be 30 years from the time of construction.

14.2.3 Foreign Exchange Rate

The exchange rate adopted for this analysis is US$ 1.00 = Rs 35.10 = ¥ 113.80 (as of May 1997), the same rate as used in the cost estimation.

14.2.4 "With-the-project" case and "Without-the-project" Case

A cost-benefit analysis is conducted on the difference between the "With-the-project" case where investment is made and the "Without-the-project" case where no investment is made. In other words, incremental benefits and costs arising from the proposed investment are compared. In this study, the two projects, Container Terminal Project (Alternative-6) and Main Channel Deepening Project (Alternative-3) are assessed individually.

Following conditions are adopted as the "Without-the-project" case for each project.

(1) Container Terminal Project

1) No investment is made for construction of new berth in front of Indira Wall.
2) When handling volume of container cargo in Mumbai Port reaches the maximum volume of handling capacity, the container cargo which can not be handled in Mumbai Port is assumed to divert to Jawaharlal-Nehru Port.
3) The new berth for handling containers overflowing from Mumbai Port is assumed to be constructed in JNP.
4) Conventional cargo and dry bulk cargo are handled at Mumbai Port as they are at present.
5) The size of vessels and the working efficiency of cargo handling are not the same as "With-the-project" case.

(2) Main Channel Deepening Project

1) Main channel is not deepened from present level.
2) The size of vessels and the working efficiency of cargo handling are not the same as "With-the-project" case.

14.3 Benefits of the Project

14.3.1 Benefit Items

As benefits brought about by the master plan of the studied port, the following items are identified.

(1) Savings in ship waiting costs at an offshore anchorage

(2) Savings in sea transportation costs

(3) Saving in ship staying costs at a berth

(4) Savings in land transportation cost

(5) Savings in the new investment for construction of new berth for handling the container cargoes in another port

(6) Reduction of cargo damage and accidents at the port

(7) Promotion of regional economic development

(8) Increase in employment opportunities and incomes

(9) Reduction of the traffic congestion in Mumbai

Items 1), 2), 3), 4) and 5) are considered countable in this study and the monetary benefits of those items are counted.

14.3.2 Calculation of Benefits

(1) Savings in ship waiting costs

In the "With-the-project" case to implement the proposed project, the total ship staying cost at the port consisting of waiting costs at an offshore anchorage is less than that of the "Without-the -project" case. The difference of the costs between "With-the-project" case and "Without the-project" case is counted as a benefit. Savings in ship waiting costs are counted for the three projects.

In this study, it is assumed that 50 % of the benefits is assumed to return to India through the market mechanism of the world shipping.

The waiting time is estimated by using a computer simulation.

(2) Savings in sea transportation costs

Generally, larger vessels transport cargo at lower costs. Hence, in "With-the-project" case in which deeper berths are prepared sea transportation costs are less than those of "Without-the-project" case. The difference of the costs between "With-the-project" and "Without-the-project" is counted as a benefit. These benefits are counted in the Container Terminal Project and the Main Channel Deepening Project.

(3) Savings in land transportation costs

When container cargo volume reaches the maximum volume of handling capacity of Mumbai Port, the container cargo which could not be received at Mumbai Port is assumed to mainly originate from or be destined to Mumbai City and to divert to Jawaharlal-Nehru Port and detour land transport. Such incremental detour land transport costs in "Without-the-project" case are counted as the benefits generated from the proposed project. These benefits are counted in the Container Terminal Project.

(4) Savings in the new investment for construction of new berth for handling the container cargoes in another port

When the volume of containers exceeds the handling capacity of MBP, a new berth is required to be constructed at another port to receive containers over flown from MBP. The cost of construction for the berth is counted as a benefit of "Without-the-project" case.

(5) Total benefits

The results of above calculation are shown in Table 14.3.1 and 14.3.2.

Table 14.3.1 Result of Benefits Calculation of Container Terminal Project

Type of Benefit	Rs million
Savings in waiting costs of ship	30,299.5
Savings in sea transportation costs	48,620.0
Savings in land transportation costs	12,875.0
Savings in construction costs for new berth	6,965.6
Total	**98,760.1**

Table 14.3.2 Result of Benefits Calculation of Main Channel Project

Type of Benefit	Rs million
Savings in waiting costs of ship	688.0
Savings in sea transportation costs	36,297.2
Total	**36,985.2**

14.4 Costs of the Project

14.4.1 Construction costs

(1) Construction costs of container terminal project

Construction costs are divided into such categories as civil costs and mechanical costs. Main mechanical costs are purchasing of handling equipment. Construction costs are estimated in Chapter 13.3.

(2) Maintenance costs of container terminal project

The costs of maintaining the port facilities is assumed to be a fixed portion (1% for infra structures, 4 % for handling equipment) of the original construction costs excluding the costs of dredging.

(3) Total costs

The result of above calculation are shown in Table 14.4.1 and 14.4.2.

Table 14.4.1 Result of Cost Calculation of Container Terminal Project

Type of Cost	Rs million
Construction costs	14,941.6
Dredging costs	7,061.1
Maintenance costs	10,367.2
Total	**32,370.0**

Table 14.4.2 Result of Cost Calculation of Main Channel Project

Type of Cost	Rs million
Dredging costs	18,602.0
Total	**18,602.0**

14.5 Result of Economic Analysis

14.5.1 Calculation of the EIRR

The economic internal rate of return (EIRR) based on a cost -benefit analysis is used to appraise the economic feasibility of the project.

The EIRR is a discount rate which makes the costs and benefits of a project during the project life equal.

It is calculated by using the following formula.

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

where; n : Period of economic calculation (project life)

Bi : Benefit in i.- the year

Ci : Cost in i.- the year

r : Discount rate

The results of the EIRR calculation are shown in Table 14.5.1.

Table 14.5.1 Result of EIRR calculation

Project	EIRR
Container Terminal Project	17.9%
Main Channel Deepening Project	11.9%

14.5.2 Calculation of the Benefit /Cost Ratio

The benefit / cost ratio is obtained by dividing the benefit by the cost. The result of the B/C is shown in Table 14.5.2.

Table 14.5.2 Result of B/C calculation.

Project	B / C
Container Terminal Project	1.53
Main Channel Deepening Project	1.11

14.5.3 Result of Economic Analysis

It is generally considered that a project with an EIRR of more than 10% is economically feasible for infrastructure or social service projects.

As to the benefit / cost ratio, a ratio greater than one implies that the project is acceptable, while a ratio less than one implies that the project is unacceptable.

The resulting EIRRs of the three projects exceed 10 % and B /C ratio is greater than one. Therefore the proposed projects are justifiable from the viewpoint of the national economy.

Chapter XV Improvement Plan of Management and Operation System

15.1 General Principles of Port Management and Operation

Port Authorities should focus on the following three points for port management and operation to attract port users.

(1) Efficient services

High productivity of cargo handling, seamless smooth operation and speedy procedure for cargo clearance are necessary. These encourage port users to minimize the cost of transport through a port.

(2) Reliability and availability of port facilities

Port facilities and cargo handling equipment must be well maintained so that port users can make full use of facilities and equipment. Breakdown time must be minimized. Storage facilities should be well-designed to prevent cargo damages. Security measures for cargoes or countermeasures against pilferage must be taken effectively. Cargo handling operation is accurate, careful and safe.

(3) Reasonable tariff

Port charges should be competitive but must cover the cost of construction, management and maintenance of port facilities. Furthermore, tariff structure should encourage port users to use port facilities efficiently.

15.2 Future Port Management and Operation System for MBP

15.2.1 Existing Problems in MBP

(1) Open Container Terminal System

MBPT has not yet introduced a closed container terminal system. Both MBPT and the private sector are involved in container handling operations in the port. Loading/unloading,

marshaling, stacking and moving containers are fragmented, not organized or not synchronized. Nobody supervises or controls overall container handling operations in the dock area. Direct receiving from a shipper to a ship/direct delivery from a ship to a consignee is the prevailing mode of operation in the port. This results in low productivity of container handling operations and congestion in the quay side areas in the port.

(2) Inefficient cargo handling

Productivity of container loading/unloading is very low compared to other ports in Asian countries. According to MBPT's statistics, productivity is 5.6 Boxes per hour per crane in case of quay side gantry crane. Above mentioned open container terminal system results in inefficient container handling.

As for break bulk cargo handling, insufficient space and shortage of suitable equipment to handle various kind of cargoes, for example, attachments for fork lifts, result in low productivity and risk cargo damage.

Low productivity and inefficient cargo handling make turn around time of vessels long and berth occupancy rate high. Consequently, vessels have to wait for a long time in the stream before berthing.

(3) Time consuming procedures for cargo clearance

Time consuming procedures make containers at stacking yard and CFS in the port area stay for a long time. The main reason is that custom clearance needs a long time because of complicated procedures, manual documentation and high ratio of physical inspection of cargoes. In case of physical inspection for detecting bombs or arms, in particular, it is required to destuff all cargoes from a container under the customs formalities.

15.2.2 Future Port Management and Operation System

(1) Container Terminal Management

MBPT should adopt the closed container terminal system. In a closed container terminal surrounded with fences, gate clerks at the terminal gates check inflow/outflow of containers. A terminal operator controls container traffic in the terminal and takes full responsibility of

containers within its own terminal after receiving through a terminal gate till loading onto a container vessel in export and vice versa in import. It is possible to increase capacity and efficiency of container handling by adopting the closed container terminal system. In the highly competitive international shipping business of today, it is necessary to upgrade services to port users or the national economy of India will suffer.

(2) Principles of Container Terminal Operations

(a) Operation time

Container loading/discharging, container handling at CY in the Victoria Dock

24 hours operation 3 shifts

No holidays but workers can take holidays in turn. (13 days)

(b) Prohibition of direct loading/delivery at quay side

As mentioned above direct loading/delivery causes congestion of quay sides and must be prohibited.

(c) Delivering/receiving empty containers at CY in the Victoria Dock is prohibited. Empty containers may be picked up / returned only at CFS or Container depot.

(d) Principles of container movement

1) Export

a) FCL cargo stuffed at a factory

The terminal operator begins to receive export containers six days before the arrival of the vessel. Shippers have to carry loaded containers to CY in the Victoria Dock by the cut-off time, a day before the arrival of the vessel. After customs clearance the terminal operator loads them onto the ship.

In case of containers that have been cleared at an ICD, containers are carried into CY in the Victoria Dock a day before the arrival of the ship.

b) FCL cargo stuffed at CFS

Shippers have to carry cargoes to CFS two days before the arrival of the vessel. After customs clearance CFS operator stuffs the cargoes into containers. Private transporters carry the containers to CY in the Victoria Dock a day before the arrival of the vessel.

c) LCL cargo

Shippers have to carry cargoes to CFS three days before the arrival of the vessel. After customs clearance CFS operator consolidates the cargoes into a container. Private transporters carries the container to CY in the Victoria Dock a day before the arrival of the vessel.

2) Import

a) FCL cargo to be destuffed at a factory

The terminal operator stacks discharged containers at CY in the Victoria Dock. After customs clearance or getting permission of bonded transport to ICD, the containers can be brought out from the marine terminal. Free time (the period for which storage charge is not imposed) is seven days after the date of discharging. But the number of containers to be destuffed at a factory is expected to increase and it will exceed the stacking capacity of the yard in the future. The terminal operator can make the free time shorter considering the number of containers in the future.

b) FCL cargo to be destuffed at CFS and LCL cargo

Terminal operator stacks discharged containers at CY in the Victoria Dock temporarily. After finishing container loading operation terminal operator carries the discharged containers to CFS. CFS operator destuffs cargoes from the containers and stores the cargoes at CFS. After customs clearance consignees receive the cargoes.

3) Transhipment

Transhipment containers (loaded or empty) are allowed to be stacked at CY in the

Victoria Dock for a specific period.

4) Refrigerated containers

a) Export

Shippers deliver loaded containers to terminal operator at CY in the Victoria Dock.

b) Import

Terminal operator delivers cleared containers to consignees at CY in the Victoria Dock.

(e) Berth assignment

MBPT should assign new berths of Harbour Wall to shipping lines on a first come first served basis. In case of continuous berth, it is possible to berth a large ship whose LOA exceeds the length of one berth by allotting small ships to other berths. It is also possible for four small ships to berth simultaneously. Such flexible and efficient berth assignment is a merit of continuous berths.

Leasing out a berth of Harbour Wall to a specific shipping line contracting with MBPT is an option to be considered. But leasing the berth is not appropriate from the point of view of using port facilities efficiently. If MBPT allocates and leases out the berth and allows the shipping line to use the berth exclusively, the shipping line can make its own berthing plan based on the schedule of calling vessels, and control the overall operation from entry to departure of its vessels. The shipping line can use the berth efficiently, however other shipping lines not contracting with MBPT will have to use other common use berths of Ballard Pier even if the berth of Harbour Wall is idle. Consequently berth waiting time will be longer. Flexibility of berth assignment and overall efficiency of berth use will be lost if MBPT leases berths to individual shipping lines.

(f) Terminal operator

Container terminal operations include various operations; for example, loading/unloading with quay side gantry cranes, hauling containers from quay to CY in the Victoria Dock through the access bridge and vice versa, tallying loaded/discharged containers, checking containers and documents at gate posts, RTG (rubber tired gantry crane) operation at CY in the Victoria Dock, yard planning and inventory control, monitoring and maintaining the temperature of refrigerated containers. Terminal operator is required to supervise overall operation and control the container traffic within the dock area (from quay side to CY). At the Ballard Pier MBPT is the possible

terminal operator.

The candidates to serve as terminal operator of CY in the Victoria Dock are as follows:

1) MBPT

MBPT operates all the container handling from quay side to CY. MBPT provides all the cargo handling equipment (quay side gantry cranes, RTGs, tractors and chassis).

2) New company (Joint venture of MBPT and private companies)

MBPT and private sector jointly establish a new company for supervising or operating all the container handling at the new terminal. MBPT provides and leases all the container terminal facilities, such as cargo handling equipment (quay side gantry cranes, RTGs, tractors and chassis), control office, gates and CY in the Victoria Dock, to the new company. The new company pays MBPT lease fee and dividend.

MBPT can also contribute its own port facilities provided to the new company instead of investing cash at the establishment. In such case MBPT receives only dividend from the new company.

The new company employs some part of dock workers in the port as permanent workers and trains them. The agreement with the trade unions in the port of Mumbai is critical and indispensable. Therefore it is essential to persuade the trade unions to accept the workers' transfer from MBPT to the new company.

It is necessary to limit the share of the foreign company to less than 75% according to the liberalized economic policy.

3) Private companies (shipping lines/agents, transporters, stevedore companies or their joint ventures)

MBPT divides the new CY in the Victoria Dock into two portions and allocates and leases them to private companies. If MBPT leases all the container yard in the Victoria Dock to one company monopolizing container handling, there will be no competition and cargo handling charges may increase. It is advisable to divide the yard to encourage competition among the companies.

The private companies are responsible for the container handling operations from quay side to CFS. The above mentioned companies can form a joint venture.

MBPT provides container handling equipment (quay side gantry cranes and RTGs) and terminal office besides the yard. The private companies provide their own equipment including tractors and chassis. The private companies pay MBPT lease fee for CY in the Victoria Dock, container handling equipment and terminal office.

4) Private company + MBPT

This is the combination of alternative 1) and 3). The container yard in the Victoria Dock is divided into two portions. MBPT leases one of the yards to the private company and operates container handling at the other yard by itself. The aim of this alternative is to stimulate competition between MBPT and the private company and improve cargo handling efficiency of MBPT as a public authority.

5) Private company + new company

This is the combination of alternative 2) and 3). The container yard in the Victoria Dock is divided into two portions. MBPT leases one of the yards to the private company and the other to the newly established company.

Table 15.2.1 shows a summary of the alternatives.

Table 15.2.1 The Candidates of the Terminal Operator

Alternative	Victoria Dock I	Victoria Dock II	Ballard Pier
1	MBPT		MBPT
2	The New Company		MBPT
3	Private Sector	Private Sector	MBPT
4	Private Sector	MBPT	MBPT
5	Private Sector	The New Company	MBPT

Though it is assumed in these alternatives that MBPT constructs the quay, CY in the Victoria Dock, gates and office building and provide container handling equipment and leases them to the specific companies, it is possible to consider the BOT scheme as an option in case of private sector involvement. Private companies reclaim the Victoria Dock, construct the quay wall, CY, office building and gates and procure container handling equipment. The private company uses the berth exclusively as well as CY in the Victoria Dock.

Under the ordinary BOT scheme, private companies have to invest in dredging the approach channel and basin along the quay they use exclusively. The dredging cost is expected to be very high because hard rock layer may lie in a shallow part of the seabed in the proposed area and maintenance dredging may be needed at least once a year. Therefore private sector may be hesitant to participate in this BOT scheme. It is possible to exclude the dredging from the BOT scheme to encourage private sector participation. However, it is difficult for MBPT to find the rationale to invest in dredging the approach channel and the basin for specific private companies. Therefore BOT scheme is not advisable.

In comparing the five alternatives mentioned above, the following points should be considered.

a) Efficiency of container handling

b) Efficiency of land use of CY in the Victoria Dock

c) Fairness of berth assignment

d) Impact on employment of dock workers

e) Investment cost of MBPT

f) Control of container traffic inside the port area

g) Consistency with the Government policy, private participation in the port sector

Each alternative has the following advantages and disadvantages.

- If MBPT becomes the terminal operator, lack of competition and low productivity of loading/unloading containers will continue. But the container yard in the Victoria Dock would be used efficiently and flexibly according to the fluctuation of container volume and overall container traffic would be controlled within the port area. There will be no conflict with trade unions concerning employment of dock workers.

- MBPT should nominate foreign shipping lines or foreign terminal operators as joint venture partners if MBPT selects alternative 2). They have sufficient knowledge, experience and expertise in the operation and management of modern container terminals in other countries. The aim of this alternative is to train dock workers and introduce efficient container handling techniques and know-how of modern container terminal management into the port of Mumbai.

Foreign private companies are likely to use their own personnel for operations to achieve high productivity or throughput. But at present, this is not permitted. It is necessary for some part of dock workers to be transferred from MBPT to the new company. Training the dock workers to make them competent in container handling is essential even though it may take a long time.

The trade unions will probably oppose the transfer of the dock workers if their working conditions are changed unfavorably. It may be necessary to raise the wage rates or allowances as incentives subject to the profit of the new company and improvement of cargo handling efficiency.

- If private companies become terminal operators, they will compete with each other for the number of handling containers. Consequently high productivity is expected. On the other hand, dividing the container yard in the Victoria Dock into two terminals makes it impossible to use the yard flexibly according to fluctuation of containers volumes or store the maximum capacity of containers in the yard. It is expected that one terminal would be full of containers and congested, whereas the other terminal would not be crowded. In this type of operation, overall traffic within the port area can not be controlled.

- MBPT should allow the private companies to decide freely the handling charges based on the agreement with their customers, shipping lines and fix only the ceilings of the charges. If the tariff is decided by MBPT, private companies will have no incentive to increase the throughput of containers.

- In case of alternative 1) or 2), it is possible for the terminal operator to entrust private companies, stevedore companies or transporters with actual container handling operations.

15.3 Simplified Tariff System to be Proposed for MBP

15.3.1 General

As chapter 8 shows, MBPT's tariff structure is complicated compared to that of JNPT. The tariff was originally compiled for break bulk cargo, and later modified with the onset of containerization. Therefore the tariff structure does not match with the operation of container handling. MBPT should make the tariffs simple, cost related and consistent with containerization.

The percentage of demurrage fee on general cargo to the total of cargo handling and storage charges is high (32.6% in 1996-97, 34.7% in 1995-96). Inefficient cargo handling and time consuming customs clearance increase dwelling time of cargoes at the storage area. Consequently the less efficient cargo handling is, the more charges MBPT receives under the present tariff structure. If cargo handling efficiency is improved the revenue of MBPT will decrease. To avoid such a situation MBPT should change the tariff structure and induce port users to use port facilities efficiently through the new tariff system.

It is also necessary to introduce a tariff structure consistent with the closed container systems to be proposed.

15.3.2 Simplified Tariffs

To simplify the present tariffs MBPT should consider the following items.

(1) Pilotage and towage (tug assistance)

Though pilotage and towage (tug assistance) are merged at present, it is necessary to separate them into different categories. Pilotage should be charged on the GRT of the vessel and the operation time. Towage and tug assistance fee should be charged on the time of tug operation and the horse power of tugs.

(2) Berth hire fee

Berth hire fee should be charged every 12 hours for container vessels on condition that container handling efficiency is improved and berthing time of a vessel is shortened.

(3) Charges on container handling and movement

MBPT should introduce the charges for handling and movement of containers if MBPT becomes the terminal operator. For example, it is necessary to charge for the following movement of containers based on container size (20 feet, 40 feet or else) and type (normal, reefer or dangerous etc.).

a) From ship to CY or vice versa

b) From CY to CFS (container depot) or vice versa

c) From CY to railway flat or vice versa

d) From CY to truck or vice versa

It is necessary to introduce volume discount rate besides standard rate to encourage shipping lines to load/discharge containers in the port of Mumbai.

(4) Container Storage Charge (Demurrage)

At present, FCL import container's free days are seven working days following the General Landing Date (GLD) of the vessel. (The GLD is calculated as the date on which two thirds of cargo tonnage is discharged.) On the other hand, LCL import container's free days are ten days following the GLD.

On export containerized cargoes, demurrage is payable from the date of receipt up to the date of stuffing of cargoes into containers. If cargo at transit shed is stuffed within seven days, no demurrage is payable. In case of cargoes stored in open yard, free days are 10 days.

It is necessary to modify the container storage charge suitable for the closed container terminal system. By shortening the dwelling time of containers in CY, the handling capacity of container yard will increase. In case of import containers, free days should be calculated from the date of discharging rather than GLD. MBPT should shorten the free time for export containers to seven days prior to the date of shipment. The period of storage at CY in the Victoria Dock and CFS (or Container Depot) should be included in this free time.

Table 15.3.1 Other Ports' Free Times

	Export	Import	Transhipment
JNPT	7 days	3 days	30 days
Dubai	10 days	10 days	20 days
Singapore	3 days	3 days	7 days

Table 15.3.1 shows other ports' free times. Each port makes the free time of transhipment containers longer than that of import/export containers to increase the number of transhipment containers.

Demurrage should be more expensive than storage fees of warehouses outside the port. Otherwise the consignees use CY as their own storage facilities. Most consignees are likely to make efforts to pick up the containers by the expiration of free time to avoid paying demurrage.

It is expected that the number of containers handled in the Port of Mumbai will increase and that CY in the Victoria Dock will become congested in future. In such a case MBPT should shorten the period of free time and encourage consignees to pick up their containers earlier.

(5) Lease fee

If MBPT leases the container yard in the Victoria Dock and container handling equipment to private companies or the new established company, the lease fee is decided on the negotiation with the lessee. The amount of the lease fee should be high enough to cover the cost of construction, management and maintenance of the facilities. On the other hand, to encourage shipping companies to use the Port of Mumbai, lease fee should be competitive. It is necessary for MBPT to introduce the rebate system or the volume discount rate of the lease fee. If the annual throughput exceeds the minimum requirement, MBPT discounts the lease fee payable based on the exceeding part of container volume or pays back some potion of lease fee to the lessee. Figure 15.3.1 shows that if the lessee achieve the ideal annual throughput, the lease fee will became the minimum. On the other hand, the lessee must pay more lease fee as a penalty if its annual throughput is under the minimum requirement based on the agreement with MBPT.

In addition, if MBPT would like to keep the number of containers handled in the port within the maximum capacity of the port, it is also possible to raise the lease fee as described in figure 15.3.1. If the annual throughput exceeds the maximum capacity of the container terminal, the lessee have to pay more fee for the congestion caused by the incremental containers.

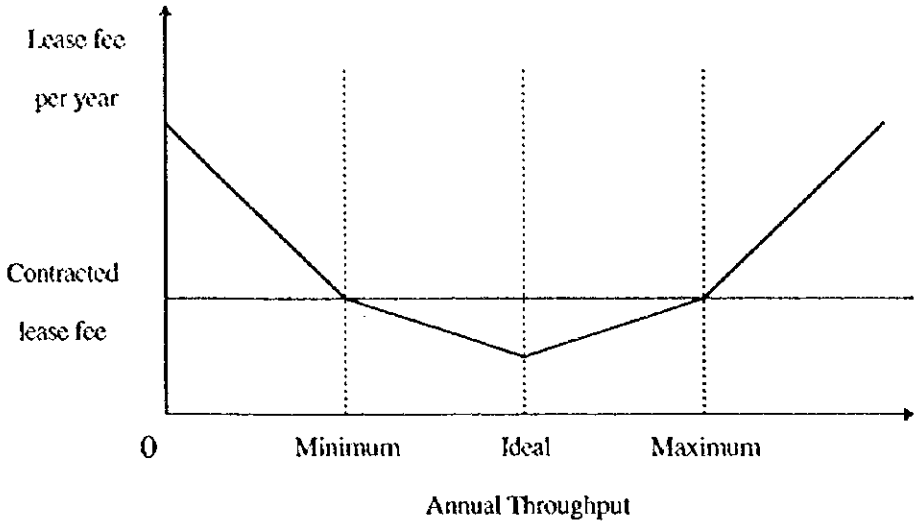


Figure 15.3.1 Structure of Lease Fee

15.4 Simplified Documentation and Information Systems

15.4.1 General

MBPT has already introduced a Management Information System. But this is a closed system used by staff of MBPT. The private sector does not participate in this system. Customs has also already introduced a computer system, which functions as a database to assist custom officers in deciding the value of import commodities. But Indian Customs is implementing EDI (Electronic Data Exchange)Systems now.

So far private companies are forced to submit many documents to MBPT or Customs to conduct trade. For example, shipping agents have to submit Import General Manifest and berth allotment application to the Port Trust where the staff of the Port Trust input the necessary data into computers. There still remains a lot of paper work between MBPT or Customs and private companies and they enter same kind of basic information into different documents repeatedly, sometimes resulting in input errors.

At present MBPT and private companies exchange a lot of documents concerning export and import procedures. Officials spend much of their time checking and verifying cargoes and documents at each stage. If computer systems were introduced, and it is possible use repeatedly the information once fed into computers, procedures could be streamlined and the time required by port users to finish necessary procedures for cargo clearance could be reduced. To simplify documentation it is necessary to introduce an open information system involving the private sector. The participants of this open information system would be shipping companies/agents, customs brokers, freight forwarders, transporters, warehouse operators and banks besides the Port Trust and Customs. Through connection with a host computer, every participant of this system can quickly input necessary data and transmit them to the host computer and receive timely responses from official organizations. The participant can then forward cargoes to the next procedure.

But the following points should be considered before introduction of new computer system.

- Amendment of relevant laws and regulations
- Consensus and cooperation among related official organizations and private sector

Introduction of a computer information system inevitably results in job losses, so it is essential to consider a method which minimizes conflicts with trade unions in the port, it is also necessary to retrain workers so that they may find work elsewhere.

15.4.2 Concept of New Systems

Following figures show the concept of the new systems.

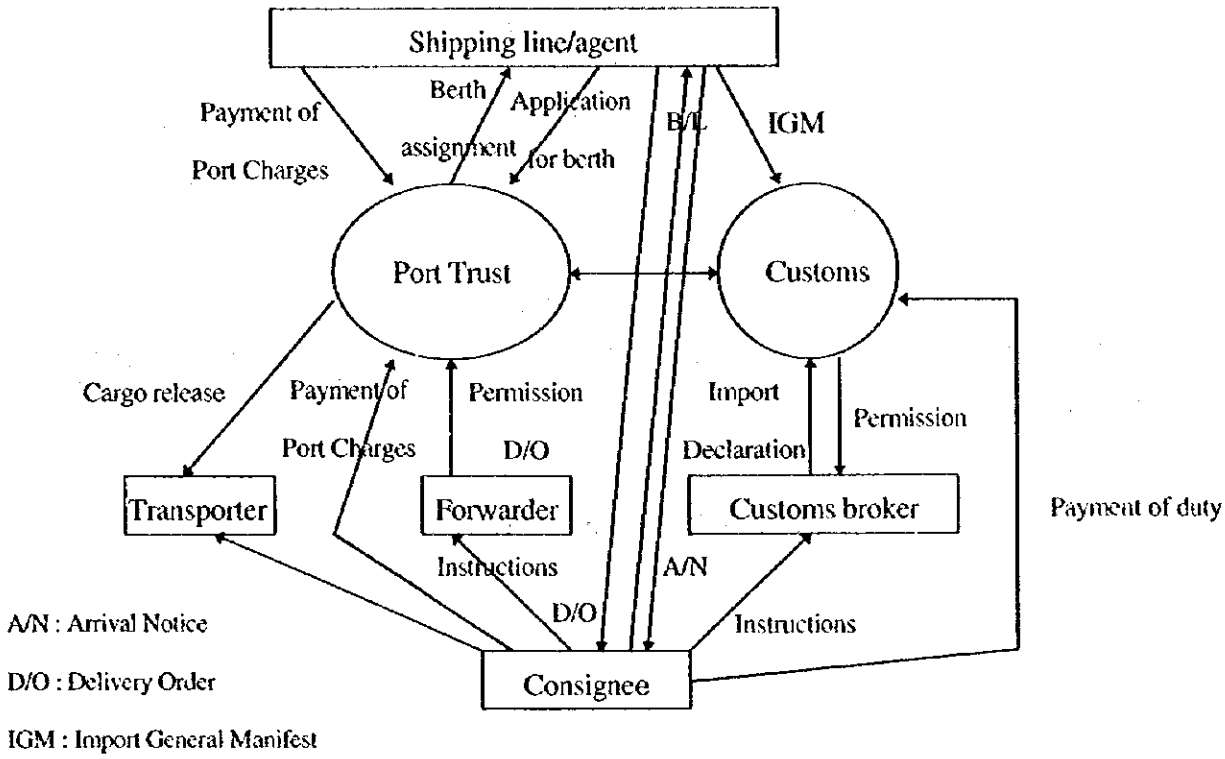


Figure 15.4.1 Import Procedures

All the transactions between the participants are settled by electronic fund transfer from one party's account to another party's account.

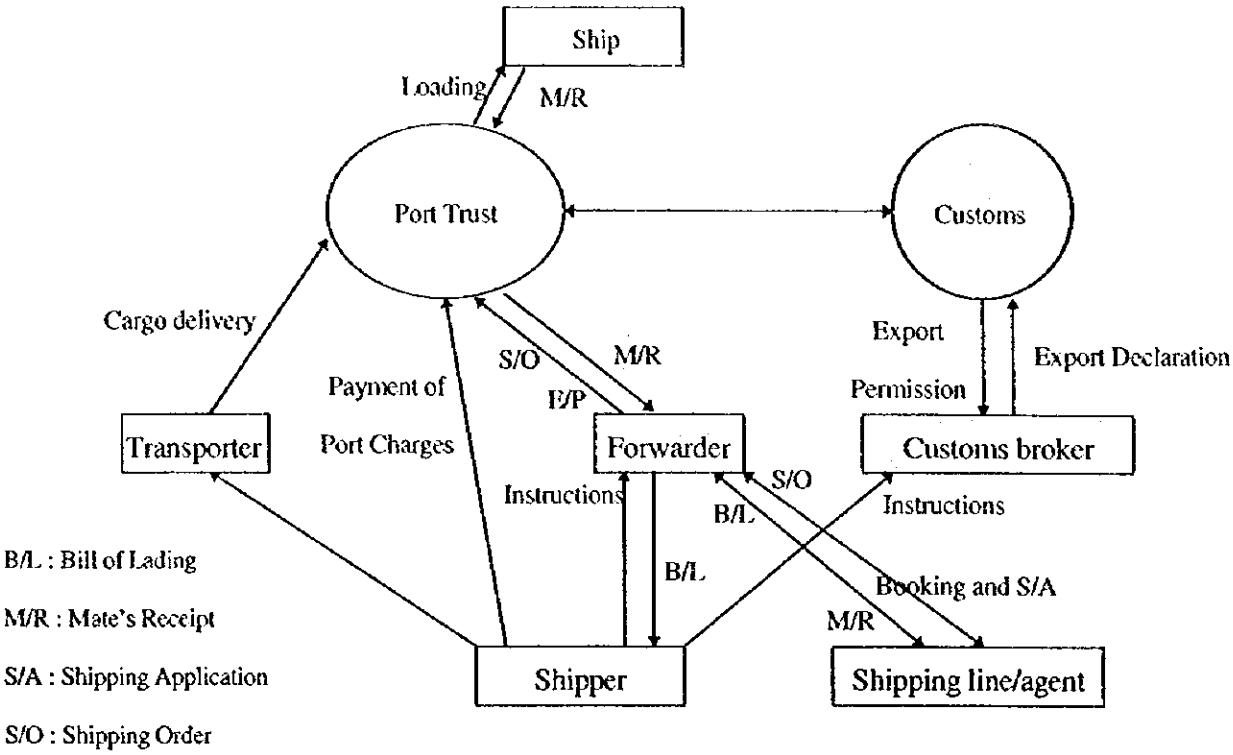


Figure 15.4.2 Export Procedures

(1) Berth assignment

A shipping line/agent inputs the following information into terminal computers in the office before arrival of the vessel.

- Vessel's information Length, breadth, draft, GRT, NRT etc.
- Import General Manifest (IGM) (This is sent to Customs, too)

A shipping line/agent also requests to MBPT to arrange pilot, tugs, cargo handling equipment and labor.

MBPT allots a suitable berth to the vessel considering the dimensions of the vessel, cargoes to be discharged/loaded and vessel's arrival order. MBPT informs the shipping line/agent of the berth allotted to the vessel through the computer network. After cargo operation is finished MBPT claims port charges (port dues, pilotage, tug assistance, berth hire, cargo handling charges etc.) to the shipping line/agent. The payment is made through electronic fund transfer from the bank account of shipping line/agent to that of MBPT.

(2) Import procedure

A shipping line/agent informs consignees of a vessel's arrival. A consignee gets D/O in exchange of B/L at the office of the shipping line/agent. The consignee instructs a customs broker to submit the import declaration to Customs to clear the cargo. The custom broker inputs necessary data for import clearance into its terminal computer. The information is transferred to the computers in Customs. After getting import permission from Customs, the consignee instructs a forwarder to submit necessary documents to MBPT to pick up the cargo from the customs (bonded) area in the Port.

MBPT has information about cargo to be discharged and exchanges information on cargoes with Customs through the network. For example, MBPT informs Customs of the location of cargoes to be examined by Customs and Customs informs MBPT whether or not cargoes are already cleared.

A forwarder inputs information of import permission and D/O into the terminal computer and transmits this information to MBPT. MBPT verifies the information from the forwarder and Customs and permits the release of cargoes from the bonded area subject to the payment of port charges. The consignee instructs a transporter to pick up the cargo. MBPT releases the

consignment after confirming the payment of port charges and inputs the data recording the lease of cargoes.

(3) Export procedure

A shipper instructs a forwarder to book space on the vessel and submits the Shipping Application to the shipping line/agent. Shipping line/agent issues Shipping Order to the forwarder. The shipper instructs a transporter to deliver cargo to the port area and instructs a customs broker to file the Export Declaration with Customs. After getting Export Permission, the forwarder transmits the data of S/O and E/P to MBPT through the computer network. After verifying the information from Customs and the forwarder, MBPT loads cargo onto the ship. After loading cargoes, Chief Officer of the vessel issues and hands over Mate's Receipt to MBPT. MBPT transmits the information of loading to forwarder and sends M/R to the forwarder. The forwarder gets Bill of Lading in exchange for M/R at the office of the shipping line/agent. The shipper gets B/L from the forwarder.

(4) Customs clearance

A customs broker inputs necessary data for clearance into terminal computers and transmits them to the host computer in customs through the network. Customs receives the data and makes risk assessment of goods based on the customs' information concerning shipper/consignee stored in the database. Customs designates the method of examination of import/export cargoes based on the result of the risk assessment. If Indian Customs introduces the self assessment system of import declaration, Customs officers have to check the importers' declared values of import goods. Computers form the price range using the import history of a specific commodity stored in the database and customs officers can easily check if the importer's declared value of cargo is proper. Computer calculates the amount of duty payable automatically. At payment of duties, importers do not need to go to banks. It is possible to withdraw the amount of duty from the importers' or customs brokers' accounts through electronic fund transfer. Another merit of introducing computers for customs clearance is that importers can not or do not need to bribe customs officers to speed up the import clearance. It is said that Customs officers are likely to demand some money to clear goods in many developing countries. (It is not certain that such a thing is done in India.)

By introducing this open system, it is possible to shorten the time from filing Bill of Entry to

receiving permits of import dramatically.

15.5 Personnel Management

15.5.1 General Principle

Modernization of port facilities is necessary for the Port of Mumbai but mechanization and computerization inevitably result in job losses for dock workers. On the other hand, it is very important for MBPT to maintain its employment and thus MBPT can not reduce the number of dock workers drastically. If it did, social unrest would occur. India is suffering from a high unemployment rate, over 40 %, and it is very difficult to find a job as a permanent worker elsewhere. MBPT is expected to sustain employment opportunities until other sectors can absorb the work force in accordance with the development of the Indian economy.

It is forecast that the total amount of personnel expenses will increase due to raises and inflation. The ratio of personnel cost to the total expenses will also rise. Though MBPT's financial situation is good now, MBPT may experience a deficit in future if the volume of cargoes decreases from the present level due to insufficient investment. Hence it is required to keep sufficient funds within the organization to invest in capital assets for the port.

From this view point, MBPT needs to attract more port traffic through strengthening competitiveness in the international shipping market. It is required to meet the increasing demand in the future without increasing the number of workers. Hence it is indispensable to increase the productivity of every worker. To increase the productivity, both training and incentives are necessary.

Introduction of the closed container terminal systems decreases the necessary number of dock workers involved in container handling at quay side, whereas it needs more operators of quay side gantry cranes and RTGs, drivers of chassis trailers, gate clerks and workers in CFSs or container depots. In the future MBPT should re-allocate surplus workers to the section in which labor shortage will occur subject to the agreement with the unions in the port and retraining programs for workers.

To generate job opportunities, establishing a joint venture company to operate new businesses related to port activities, for example, transporter, distribution center, refrigerated warehouse, is an option to be considered.

Chapter XVI Initial Environmental Examination (IEE)

16.1 Brief Project Description

Master Plan for MBP is proposed in Chapter 12 and summarized in Table 16.1.1. Proposed major facilities are the container berths. Additional three container berths are proposed as an open-sea berths of detached pier type by water-through structure.

Table 16.1.1 Summary of Projects Proposed in the M/P of MBP

	Project Name	Project Components
Long-term Plan (up to 2017)	1. Container Terminal Project	1. Additional Three Container Berths 2. Victoria Dock Container Yard 3. Off-Dock CFS and Container Depot 4. Container Handling Equipment 5. Dedicated Road for Containers
	2. Re-location of Conventional Cargo Handling Facilities	6. Re-assignment of Conventional Cargo Berths
	3. Deepening Access Channel Project	7. Deepening Access Channel

16.2 Initial Environmental Examination

The Initial Environmental Examination (IEE) has been assessed in a tabular form recommended in the publication of "Environmental Assessment Handbook for Port Development Projects", MOT, 1993. This is shown in Table 16.2.1. The degree of impacts is shown by the entries in the table; those in the left column representing no impact and those in the right column representing major impacts. The potential major impacts could be as follows:

1) Dredging Sediment
2) Disturbance due to Dredging
3) Air Pollution due to the Increased Vehicle Traffic
4) etc.

Proposed additional three container berths are to be constructed approximately 800 meters off the Indira Dock Harbour Wall. They are proposed as a detached pier type berths of water-through structure so as to minimize the adverse effect of tidal currents. Since the degree of the impact is

classified as minor, an examination is only needed in the further study.

Since the total volume of containers to be handled at MBP generates additional vehicle traffic, a certain degree of impact on air, noise and vibration pollution is anticipated especially along the road. The degree of those impacts is further examined in EIA.

16.3 IEE Overview

Initial Environmental Examination (IEE) is carried out based on the checklist of adverse effects of the Master Plan, and three major points of 1) Dredging sediments, 2) Disturbance due to dredging, and 3) Air quality due to the future traffic in and around MBP are selected and should be included in the Environmental Impact Assessment (EIA) for the Short-term Plan.

Table 16.2.1 IEE Check List for the Proposed Projects in the M/P of MBP

	Environmental Impact Factors		Environmental Impact		Countermeasures	Degree of Impact				Reason	Recommendation
						None	Small	Large	Major		
1	Impact from construction works										
1.1	Operation of working boats, construction machines	1.1.1	Air pollution	1.1.1	Management of construction process, selection of working hours, smoke prevention fence.	X					
		1.1.2	Generation of noise and vibration	1.1.2	Selection of construction methods/machines, selection of working hours, placement of sources of noise/vibration	X					
		1.1.3	Change in terrestrial ecosystem	1.1.3	Selection of construction methods/machines	X					
1.2	Dredging, stirring of bottom soil, soil dumping into water	1.2.1	Pollution of water and bottom sediments (SS, hazardous materials)	1.2.1	Settling pond, sedimentation coagulant, selection of construction method/machines, silt curtains.			X		Capital dredging of basin and channelis proposed. Dredged materials go to dumping area out of Mumbai Bay.	
		1.2.2	Offensive odor	1.2.2	Selection of construction method/machines, introduction of odor treatment methods.	X					
		1.2.3	Reduction of aquatic lives	1.2.3	Settlement pond, sedimentation coagulant, selection of construction method/machines, silt curtains, selection of construction period, monitoring of alternative habitats.	X					
		1.2.4	Pollution of marine products	1.2.4	Settlement pond, sedimentation coagulant, selection of construction methods/machines, silt curtains, selection of construction period, monitoring of pollution of fishery products.	X					
		1.2.5	Devaluation of tourism resources (water color, coral reef)	1.2.5	Settlement pond, sedimentation coagulant, selection of construction method/machines, silt curtains.	X					

1.3	Soil removal	1.3.1	Changes in topography, underground water system	1.3.1	Prior elucidation of underground water system	X					
		1.3.2	Extinction of terrestrial ecosystem	1.3.2	Transplantation of important species, vegetation.	X					
1.4	Generation of surplus soil, wastes, dumping of dredged soil on ground	1.4.1	Pollution of water/bottom sediments	1.4.1	Treatment site planning	X					
		1.4.2	Impact on terrestrial ecosystem	1.4.2	Disposal site planning	X					
1.5	Employment of laborers	1.5.1	Inflow of alien cultures	1.5.1	Employment planning, disclosure of information	X					
		1.5.2	Change in economic activities	1.5.2	Employment planning, vocational training	X					
1.6	Congestion of work vehicles and boats	1.6.1	Economic loss (traffic jam)	1.6.1	Construction of access roads			X		Roads already exist however are congested.	Required capacity need to be checked.
		1.6.2	Devaluation of fishing ground	1.6.2	Alternative fishing ground	X					
2	Impact from port facilities and site										
2.1	Emergence of site (including landfill)	2.1.1	Pollution of water and bottom sediments	2.1.1	Change of face lines, dredging sludge, promotion of seawater exchange	X					
		2.1.2	Beach erosion and accretion	2.1.2	Change of face lines, construction of breakwater against beach erosion, littoral nourishment	X					
		2.1.3	Change in coastal currents	2.1.3	Change of face lines, construction of breakwaters, selection of type of offshore structure.		X			Water-through type structure is adopted to detached pier type container terminal.	
		2.1.4	Decrease of habitats for aquatic lives	2.1.4	Transplant, discharge of seeds and saplings	X					
		2.1.5	Decrease of habitats for terrestrial lives	2.1.5	Change of face lines, designation of nature conservation areas, artificial tidal flats, transplant	X					
		2.1.6	Change in scenic beauty	2.1.6	Location of facilities, selection of color, plantation	X					

		2.1.7	Resettlement of local residents and culture	2.1.7	Transfer planning, information disclosure	X					
		2.1.8	Extinction of fishing grounds	2.1.8	Expansion of function of fishing ports, marine products transportation functions	X					
2.2	Emergence of protective facilities	2.2.1	Pollution of water and bottom sediments	2.2.1	Change of face lines, dredging sludge, promotion of sea water exchange		X			Water-through type structure is adopted to detached pier type container terminal.	
		2.2.2	Beach erosion and accretion	2.2.2	Change of face lines, construction of breakwaters against beach erosion, littoral nourishment	X					
		2.2.3	Change in coastal current	2.2.3	Change of face lines, construction of breakwaters for wave prevention, selection of type of offshore structure	X					
		2.2.4	Decrease of habitats for aquatic lives	2.2.4	Transplant, discharge of seeds and saplings	X					
		2.2.5	Change of scenic beauty	2.2.5	Changes in shape of facilities and selection of colors	X					
2.3	Emergence of waterways	2.3.1	Change in coastal currents	2.3.1	Change of face lines, construction of breakwaters for wave prevention		X			Water-through type structure is adopted to detached pier type container terminal.	
		2.3.2	Decrease of habitats for aquatic lives	2.3.2	Transplant, discharge of seeds and saplings	X					
2.4	Emergence of basins	2.4.1	Change in coastal currents	2.4.1	Change of face lines, construction of breakwaters for wave prevention, selection of type of offshore structure		X			Water-through type structure is adopted to detached pier type container terminal.	
		2.4.2	Decrease of habitats for aquatic lives	2.4.2	Transplant, discharge of seeds and saplings	X					
3	Impact from utilization of facilities in water area and anchorage										
3.1	Impact from boats	3.1.1	Air pollution	3.1.1	Reduction of stoppage time in ports, compulsory use of high quality oil	X					

		3.1.2	Water pollution (bilge)	3.1.2	Strengthening of laws and regulations		X			More vessels are expected.	Enforcement of harbour regulation
		3.1.3	Beach erosion caused by furrow wave	3.1.3	Speed limit, beach protection structure	X					
		3.1.4	Generation of wastes (dredged material included)	3.1.4	Strengthening of laws and regulations, recycling/disposal systems		X			More vessels generate more wastes.	Authorities to initiate correct waste disposal practices.
		3.1.5	Obstruction to fisheries activities	3.1.5	Alternative fishing ground and artificial fishing sites expansion of function of fishing ports and transportation of marine products	X					
4	Impact from cargo loading and utilization of storage facilities										
4.1	Cargo loading and utilization of storage facilities	4.1.1	Air pollution (dust)	4.1.1	Establishment of buffer zone, enclosure, surface treatment, selection of loading machines		X			Direct loading/unloading system of Phosphate and Sulfur is expected to cause a small impact on air quality.	
		4.1.2	Pollution of water and bottom sediments	4.1.2	Establishment of buffer zone, enclosure, surface treatment, selection of loading machines, shape of apron	X					
		4.1.3	Generation of noise	4.1.3	Zoning, sound proof fence/hood	X					
		4.1.4	Generation of offensive odor	4.1.4	Zoning, sealing of storage facilities, deodorisation facilities	X					
		4.1.5	Change in coastal ecosystem	4.1.5	Establishment of buffer zone, enclosure, surface treatment, selection of loading machines, shape of apron, monitoring of pollution of marine products	X					
		4.1.6	Generation of wastes	4.1.6	Planning for collection, treatment and disposal of wastes	X					
		4.1.7	Employment effect	4.1.7	Vocational training	X					

5	Impact from operation of facilities handling hazardous materials										
5.1	Operation of oil distribution base and facilities handling hazardous materials	5.1.1	Air pollution	5.1.1	Reduction of air pollutants (dust collection, desulphurisation, denitrification), promotion of disperation	X					
		5.1.2	Pollution of water and bottom sediments (oil)	5.1.2	Facilities for waste oil treatment, oil fence	X					
		5.1.3	Generation of offensive odor	5.1.3	Change of zoning, containment of offensive odor, deodorizer	X					
		5.1.4	Change in coastal ecosystem	5.1.4	Facilities for waste oil treatment, oil fence, monitoring of pollution of marine products	X					
		5.1.5	Change in terrestrial ecosystem	5.1.5	Facilities for waste oil treatment, oil fence, establishment of nature conservation area	X					
		5.1.6	Decrease in amount of agricultural products, fisheries products and price	5.1.6	Facilities for waste oil treatment, oil fence, monitoring of pollution of marine products.	X					
6	Impact from waste treatment and disposal										
6.1	Operation of waste treatment	6.1.1	Air pollution	6.1.1	Reduction of air pollutants (dust collection, desulphurisation, denitrification)	X					
		6.1.2	Pollution of water and bottom sediments	6.1.2	Reduction of discharge, drainage treatment facilities	X					
		6.1.3	Generation of offensive odor	6.1.3	Zoning, containment of offensive odor, deodorizer	X					
		6.1.4	Change in coastal ecosystem	6.1.4	Prevention of water pollution	X					
		6.1.5	Change in terrestrial ecosystem	6.1.5	Prevention of air/water pollution	X					
6.2	Impact from water disposal facility	6.2.1	Air pollution	6.2.1	Establishment of buffer zone, surface treatment, fence	X					
		6.2.2	Pollution of water and bottom sediments	6.2.2	Sheet cover (rain prevention) settling ponds, selection of bulkhead structure	X					

		6.2.3	Generation of offensive odor	6.2.3	Zoning	X					
		6.2.4	Change in coastal ecosystem	6.2.4	Prevention of water pollution	X					
		6.2.5	Change in terrestrial ecosystem	6.2.5	Prevention of air/water pollution	X					
		6.2.6	Formation of slums	6.2.6	Management plans for disposals site	X					
7	Impact from Traffic function										
7.1	Road Traffic	7.1.1	Air pollution	7.1.1	Improvement of transportation system routes, establishment of buffer zone, road pavement, green belt, cover on a bed of trucks			X		Additional vehicle traffic is expected.	Further study is needed.
		7.1.2	Generation of noise and vibration	7.1.2	Correction of routes, establishment of buffer zone, selection of road/trackage, structure road pavement, soundproof fence			X		Additional vehicle traffic is expected.	Further study is needed.
		7.1.3	Change in terrestrial ecosystem	7.1.3	Correction of routes, establishment of buffer zone/ nature conservation area, prevention of air pollution	X					
		7.1.4	Change in local population distribution	7.1.4	Information disclosure, enlightening the local people on the concerned project	X					
		7.1.5	Traffic jams/accidents	7.1.5	Relocation of routes/overpass		X			Container traffic is proposed to be separated from common traffic.	
8	Impact from industrial production activities										
8.1	Operation of factories and plants	8.1.1	Air pollution	8.1.1	Reduction of air pollutants (dust collection, desulphurisation, denitrification) promotion of dispersal	X					
		8.1.2	Pollution of water and bottom sediments	8.1.2	Reduction of discharge, drainage treatment facilities	X					
		8.1.3	Generation of noise and vibration	8.1.3	Zoning, establishment of buffer zone, soundproof fence/hood	X					
		8.1.4	Generation of offensive odor	8.1.4	Zoning, containment of offensive odor, deodorisation facilities	X					

		8.1.5	Ground subsidence	8.1.5	Regulation on the use of underground water	X					
		8.1.6	Change in coastal ecosystem	8.1.6	Prevention of water pollution, dredging of sludge	X					
		8.1.7	Change in terrestrial ecosystem	8.1.7	Establishment of nature conservation area	X					
		8.1.8	Generation of wastes	8.1.8	Planning for collection treatment and disposal of wastes	X					
		8.1.9	Change in local population distribution	8.1.9	Establishment of employment planning, information disclosure	X					
		8.1.10	Employment effect	8.1.10	Vocational training	X					
9	Impact from storage and distribution functions										
9.1	Storage functions (includingoutdoor storage)	9.1.1	Air pollution (dust)	9.1.1	Zoning, establishment of buffer zone, containment, sprinkling, sheet cover, surface treatment	X					
		9.1.2	Pollution of water and bottom sediments	9.1.2	Zoning, containment, sheet cover, establishment of drains, and settling ponds	X					
		9.1.3	Generation of offensive odor	9.1.3	Zoning, containment of odor, deodorizer	X					
9.2	Cargo handling	9.2.1	Generation of noise	9.2.1	Zoning, establishment of buffer zone, selection of machines, sound proof fence and sound proof hoods	X					
		9..2.2	Employment effect	9..2.2	Vocational training	X					
10	Impact from operation of recreational facilities										
10.1	Utilization of hotels, marines, artificial beaches	10.1.1	Pollution of water and bottom sediments	10.1.1	Water quality control through laws and regulations, water quality improvement in the shallow coastal area including artificial beaches	X					
		10.1.2	Change in coastal ecosystem	10.1.2	Prevention of pollution of water and bottom sediments	X					
		10.1.3	Generation of wastes	10.1.3	Planning for collection treatment and disposal of wastes	X					
		10.1.4	Inflow of alien culture	10.1.4	Selection of project location, information disclosure, enlightening the local people on the concerned project	X					

		10.1.5	Employment effect	10.1.5	Employment planning, vocational training	X					
		10.1.6	Obstruction to fishing activities	10.1.6	Securing of alternative fishing grounds	X					

Table 16.3.1 IEE Overview for the Proposed Projects in the M/P of MBP (Checklist for Scoping: Ports and Harbours)

Port:	Port of Mumbai		
	Environmental Items	Evaluation A/B/C/D	Reason
Social Environment			
1	Resettlement	D	Land site is owned by MBPT.
2	Economic Activities	A	Impact is positive.
3	Traffic/Public Facilities	C	Some increase of vehicle traffic is expected due to cargo transportation.
4	Split of Communities	D	No impact is anticipated.
5	Cultural Property	D	No impact is anticipated.
6	Water Right and Rights of Commons	D	No impact is anticipated.
7	Public Health Conditions	D	No impact is anticipated.
8	Wastes	D	No impact is anticipated.
9	Hazards (Risks)	D	No impact is anticipated.
Natural Environment			
10	Topography and Geology	C	No large scale structure is proposed.
11	Soil Erosion	D	No evidence of erosion is found at present.
12	Groundwater	D	No land change is proposed.
13	Hydrological Situation	C	No large scale structure is proposed.
14	Coastal Zone	C	No large scale structure is proposed.
15	Fauna and Flora	D	No impact is anticipated.
16	Meteorology	D	No impact is anticipated.
17	Landscape	D	No impact is anticipated.
Pollution			
18	Air Pollution	B	Some increase of road traffic is anticipated. To be examined in EIA.
19	Water Pollution	C	Water-through structure is proposed as container berths.
20	Soil Pollution	D	No impact is anticipated.
21	Noise and Vibration	B	Some increase of road traffic is anticipated. To be examined in EIA.
22	Land Subsidence	D	No impact is anticipated.
23	Offensive Odor	D	No impact is anticipated.

A: Serious impact is expected
B: Some impact is expected
C: Extent of impact is unknown. Examination is needed.
D: No impact is anticipated. IEE/EIA is not necessary.

Part III SHORT-TERM PLAN

Chapter XVII Short-term Development Plan for MBP

17.1 The Basic Concept of the Short-term Development Plan

The purpose of the Short-term Development Plan is to serve as a target and a guideline for phase plans (target year 2007). The Short-term Development Plan shall be an integrated plan covering the layout plans for additional container handling facilities, modernized existing facilities and effective management and operation systems. In making the Short-term Development Plan of container handling for MBP, the following various aspects are recognized.

(1) Insufficient Water Depth along the Existing Container Berths

Since the major container berths at MBP are located inside the docks of Indira, Victoria and Prince's connected with the open sea through the lock gates, maximum depth of those berths is only -9.8m, which means that only relatively small container vessels can be accommodated despite the recent trend to enlarge container vessel size. On the other hand, JNP started its container handling operation with new deeper berths of -13.5m deep in 1989/90. Even though a considerable volume of container cargo diverted from MBP to JNP, the number of containers discharged/loaded at the two ports increased sharply from 342,000 TEUs to 858,000 TEUs, showing an average growth rate of 16.6% per annum.

Large container vessels provide a relatively low transportation cost, especially for long distance routes such as India-Europe, India-East Asia and India-East Coast of America. Deeper container berths are required so as to reduce transportation costs to/from those countries at a long distance from India. In addition, even on short distance routes such as India-the Middle East, India-Southeast Asia and India-South Asia where containers are transported mainly by feeder services, feeder vessel size has shown an increasing trend. Thus, deeper berths are required.

(2) Excessively-low Container-Handling Productivity due to the Current Operational Manner

A marine container terminal is generally operated and controlled by a single terminal operator who takes full responsibility of containers from the gate to container vessels within the terminal in

export and vice versa in import. Containers are stacked in order on a marshaling yard behind berths according to a yard plan after being received from land side and loaded onto a container vessel according to loading sequence plan made by the terminal operator based on a vessel stowage plan in export and vice versa in import. This modernized terminal operation system enables swift, safe and economical container handling at marine container terminals and is widely adopted throughout the world. However, this system has not yet been introduced to the container terminals at MBP.

Container terminals at MBP should be managed and operated by a single terminal operator so as to increase container handling productivity and secure efficient and safe operations.

(3) Shortage of Container Handling Equipment

As to container handling machines, two quay-side gantry cranes are installed only at Ballard Pier Station and ship's cranes are used to lift containers alongside at the remaining container berths of Indira No. 1-5. The shortage of quay-side container gantry cranes is one of the major reasons of the seriously-low container handling productivity at Indira No. 1-5. Average productivity at Indira No. 1-5 is only 3.2 boxes per hour per gang, which is much less than 11.6 boxes per hour per gang at Ballard Pier Station (BPS) in 1995/96.

Moreover, only three RTGs (Rubber-Tired Gantry) are installed on the container park behind BPS. On the other hand, reach-stackers are mainly used on the remaining container parks inside the docks. Although reach-stackers are conventionally used in narrow space, they require more maneuvering space compared with RTGs. That means stacking yard is less utilized due to shortage of efficient handling machines such as RTGs.

(4) Effective Utilization of the Existing Facilities

In making the Master Plan, the effective utilization of the existing facilities to meet port requirements needs to be examined so as to save investment cost for a new project as much as possible along with improvement and operation systems of the port aiming at efficient cargo-handling.

(5) Potential Capacity of MBP in Container Handling

As mentioned in Section 12.2.2, the potential capacity in container-handling of MBP is estimated to be approximately one million TEUs if a new container terminal with off-shore jetty-typed berths is built and the existing land being used for conventional cargo at present is converted into a container stacking yard. By making the most of existing facilities, it would not be necessary to create land by open sea reclamation.

(6) Future Port Requirements and Functional Allotment of Container Handling between MBP and JNP

One million containers out of the total forecast traffic of 2.6 million TEU containers through the two ports, MBP and JNP, in the year 2007 is assigned to MBP and the remaining 1.6 million TEUs to JNP considering various factors including potential capacity of container handling, hinterlands and transport costs which would be beneficial to the Indian national economy.

(7) Economical Transportation

In making the port investment plan, it is necessary to put emphasis on economical transportation, considering both the investment cost for port facilities and ship transportation cost from the standpoint of the Indian national economy.

(8) Generation of Employment Opportunity

Considering the number of employees of MBPT and the high unemployment rate of over 40% in India at present, port activities at MBP are expected to generate employment opportunities in the future, though the modernization of the port results in job losses for the dock workers. Therefore, MBP needs to attract more port traffic through strengthening competitiveness in the international shipping market.

(9) Environmental Impact on Areas around the Port Induced by the Port Development

In the port development, environmental impact on the area both during the periods under construction and after the start of operations must be considered.

Based on the above issues, the following concept of modernizing container-handling of MBP is proposed for the purpose of achieving safe, efficient and reliable operations for the customers.

(1) Establishment of a Full-Scale New Container Terminal with Deeper Berths

To receive one million TEU containers assigned to MBP on the stage of the Master Plan, a full-scale new container terminal with deeper berths will be required.

(2) Introduction of a Closed Terminal System to the New Container Terminal

It is advisable to introduce a closed terminal system controlled by a terminal operator that takes the responsibility of receipt, storage and delivery of containers at the terminal by conducting yard planning and inventory control of containers which is indispensable for a modernized container terminal.

(3) Deepening the Approach Channel to MBP

To receive larger container vessels approaching to the new container terminal with deeper berths than the existing ones inside Indira Dock, it is necessary to deepen the existing approach channel from the currently maintained level.

(4) Preparation of the Off-Dock Container Depots within the Landed Estate of MBPT

To back up the container-handling operations at the new container terminal within a limited space, it is indispensable to prepare off-dock container depots as back-up facilities to be placed within the landed estate of MBPT. For this purpose, it is necessary to evict the leased lands which are no longer used for port-related activities within its estate.

17.2 The Short-term Development Plan for Container Handling

As mentioned in Chapter 12, Alternative-6 for container handling is proposed as Master Plan for container handling. The Short-term Plan is basically defined as a phase plan in the framework of the Master Plan. One million TEUs of container cargo is projected for MBP in 2007, out of 2.6 million TEUs for the two ports, MBP and JNP. MBP will be saturated with one million TEUs in 2007 and container traffic volume will remain in the same level up to the year 2017 due to the space limitation of the port area.

Consequently, the Short-term Development Plan for the year 2007 is defined as the same plan as Master Plan for container handling identified in Chapter 12.

Layout of the proposed plan is shown in Figure 17.2.1. On-dock layout of the proposed plan is shown in Figure 17.2.2, including 1) three new off-shore jetty-type container berths connected to Victoria Dock Container Yard by access bridge, 2) 2,930 G. slots of container marshaling yard and 802 G. slots of empty container yard on Victoria Dock Container Yard, 3) dedicated road for container traffic between on-dock container yard and off-dock CFS and empty container yard and 4) Deepening both the basin of the proposed container berths, whose berthing area is deepened to -13.5m, and the Approach Channel to -11.0m.

Dimensions of major container handling facilities are summarized in Table 17.2.1.

Table 17.2.1 Dimensions of Proposed Major Container Handling Facilities

Features	Unit	Alternative-6	
1. Existing Container Berths		Infrastructure	Equipment
1. Number of Berths		1	---
2. Berth Depth	(m)	-9.8	---
3. Berth Length	(m)	244	---
4. Berth Location		BPS	---
5. Quay-side Gantry Crane	(unit)	---	2
6. Transfer Crane	(unit)	---	3
2. Proposed Container Berths			
1. Number of Berths		3	---
2. Berth Depth	(m)	-13.5	---
3. Berth Length	(m)	300	---
4. Berth Location		800m off ID-HW	---
5. Quay-side Gantry Crane	(unit)	---	6
6. Transfer Crane	(unit)	---	19
3. Container Marshaling Yard		3,446	
1. Existing Yard	(G. Slots)	516	
2. Proposed Yard	(G. Slots)	2,930	
1. Yard Tractor-Chassis Unit	(unit)	---	97
2. Road Tractor-Chassis Unit	(unit)	---	55
3. ID-1	(G. Slots)	0	---
4. ID-2 to 5	(G. Slots)	0	---
5. ID-HW	(G. Slots)	0	---
6. VD-CY	(G. Slots)	2,930	---
7. CDW	(G. Slots)	0	---
8. TPS	(G. Slots)	0	---
9. CRS	(G. Slots)	0	---
4. Empty Container Yard	(G. Slots)	3,341	
1. Existing Yard	(G. Slots)	-	
2. Proposed Yard	(G. Slots)	3,154	
1. ID-1	(G. Slots)	240	---
2. VD-CY	(G. Slots)	802	---
3. CDW	(G. Slots)	972	---
4. TPS	(G. Slots)	1,140	---
5. CRS	(G. Slots)	0	---
3. Shortage of Yard	(G. Slots)	187	
5. Container Freight Station (CFS)	(sq. m)	67,687	
1. Existing CFS	(sq. m)	48,487	---
2. Proposed CFS	(sq. m)	19,200	---
1. CDW	(sq. m)	19,200	---
6. Dedicated Road for Containers			
1. No. of Lanes	(lanes)	4	---
2. Ground Length	(m)	1,000	---
3. Elevated Length	(m)	700	---

Remarks) BPS: Ballard Pier Station, ID-1: Indira Dock No. 1, ID-2 to 5: Indira Docks Nos. 2 to 5, ID-HW: Indira Dock Harbour Wall, VD-CY: Victoria Dock Container Yard, CDW: Cotton Depot West, TPS: Timber Pond South, CRS: Central Railway Stores

Ficilities	Unit	Alternative-6
1.Existing Container Berth		
1.Number of Berths		1
2.Berth Depth	(m)	-9.8
3.Berth Length	(m)	244
4.Berth Location		BPS
2.Proposed Container Berth		
1.Number of Berths		3
2.Berth Depth	(m)	-11 to -13.5
3.Berth Length	(m)	250 to 300
4.Berth Location		800 m off HW
3.Container Marshaling Yard	(G.slots)	3,446
1.Existing Yard	(G.slots)	516
2.Proposed Yard	(G.slots)	2,930
1.ID-1	(G.slots)	0
2.ID-2 to 5	(G.slots)	0
3.ID-HW	(G.slots)	0
4.Victoria Dock	(G.slots)	2,930
5.CDW	(G.slots)	0
6.TPS	(G.slots)	0
7.CRS	(G.slots)	0
4.Empty Container Yard	(G.slots)	3,341
1.Existing Yard	(G.slots)	0
2.Proposed Yard	(G.slots)	3,154
1.ID-1	(G.slots)	240
2.Victoria Dock	(G.slots)	802
3.CDW	(G.slots)	972
4.TPS	(G.slots)	1,140
5.CRS	(G.slots)	0
3.Shortage of Yard	(G.slots)	187
5.Container Freight Station	(sq.m)	67,687
1.Existing CFS	(sq.m)	48,487
2.Proposed CFS	(sq.m)	19,200
CDW	(sq.m)	19,200
6. Dedicated Road for Containers		
1. No. of Lanes	(lanes)	4
2. Ground Length	(m)	1,000
3. Elevated Length	(m)	700

Figure 17.2.1 Layout Plan of Major Facilities for Alternative-6

Summary of Alternative Projects for Container Handling Facilities at MBP

Timber Pond South (TPS)		
Marshaling Yard	Empty Container Yard	Container Freight Station
(G.Slots)	(G.Slots)	(sq.m)
0	1,140	-

Cotton Depot West (CDW)		
Marshaling Yard	Empty Container Yard	Container Freight Station
(G.Slots)	(G.Slots)	(sq.m)
0	972	19,200

Victoria Dock Container Yard		
Marshaling Yard	Empty Container Yard	Container Freight Station
(G.Slots)	(G.Slots)	(sq.m)
2,930	802	-

Container Berth		
800 m off ID-HW		
No.	Length	Depth
3 Berths	250 m to 300 m	-11.0m to -13.5m

Indira Dock No.1 (ID-1)	
Empty Container Yard	
240	(G.Slots)

Dedicated Road for Containers		
No. of Lanes	G. Length	E. Length
4	1,000 m	700 m

Wadala Area (WA)	
Container Freight Station(CFS)	
2,890	(sq.m)

Timber Pond (TP)	
Container Freight Station(CFS)	
14,020	(sq.m)

Cotton Depot (COD)	
Container Freight Station(CFS)	
11,003	(sq.m)

Manganese Ore Depot(MOD)	
Container Freight Station(CFS)	
10,238	(sq.m)

Frere Basin (FB)	
Container Freight Station(CFS)	
10,336	(sq.m)

Container Berth		
Ballard Pier Station (BPS)		
No.	Length	Depth
1 Berth	244 m	-9.8 m

Ballard Pier Station (BPS)	
Marshaling Yard	
516	(G.Slots)

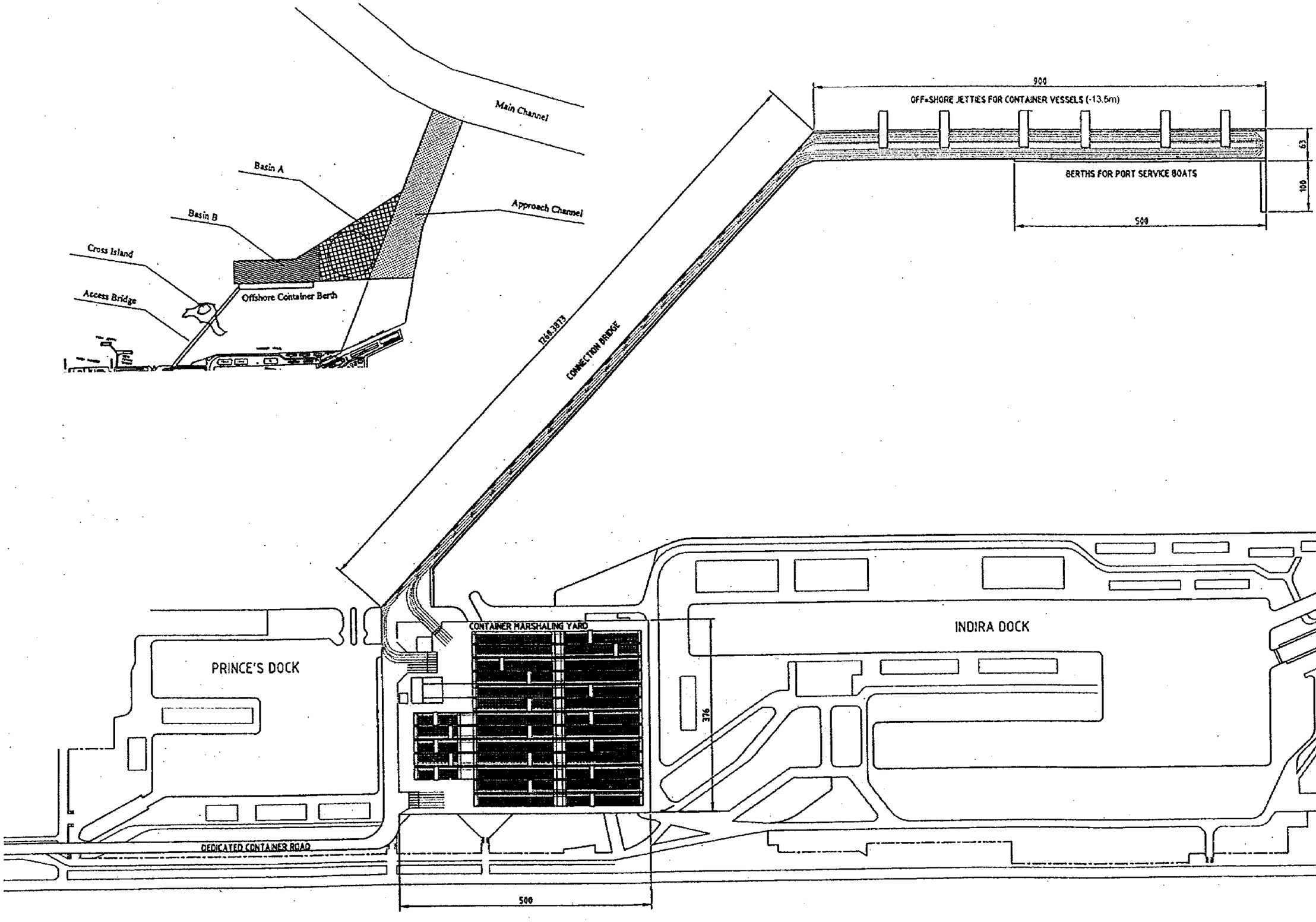


Figure 17.2.2 Layout Plan of A New Container Terminal at Victoria Dock (Alternative-6) SCALE 1:7,000

Chapter XVIII Major Facilities and Cost Estimation of Construction Work

18.1 Major Facilities for Project

As a result of the Master Plan review, a container terminal redevelopment plan focusing on the -13.5 m Offshore Container Berth and the Victoria Container Yard has been sorted out as the Short-Term Plan.

This chapter defines the scale of the structures for inclusion in the Short-Term Plan and also identifies the works associated with these structures. Figure 18.1.1 shows the locations of the structures and facilities to be included in the Short-Term Plan.

(1) Indira Dock Container Terminal

1) The depth of the Indira Dock Approach Channel is to be increased from -7.6 m to -11.0 m. The channel width of 360 m will remain unchanged.
2) A basin of -11.0 m deep and 260 m wide will be provided in front of the container berth and a turning basin will be provided between the front basin and the approach channel.
3) A new -13.5 m container berth will be built. This berth will be 900 m in length and will be a jetty type pier structure with a concrete slab system supported on concrete piles. This pier structure is planned to run parallel to the Harbour Wall. The seaward side of the pier structure will be -13.5 m in depth alongside, while the landward side will retain its present depth alongside to serve as a mooring quay for tugboats, pilot boats, dredgers and other harbor craft.

   The pier structure will be 66 m in width and provision is made for container crane installation on the pier deck with adequate spaces for hatch cover storage and truck lanes. The supporting facilities planned for the new pier type container berth will include a small workshop, office building, rest house for workers, water and power supply and lighting facilities.
4) A Inner Breakwater will be constructed at the south-west end of 900 m offshore berth to shelter the mooring quay for port crafts from the winds, gales etc.. A curtain wall type breakwater supported on concrete piles with 100 m in total length is proposed as shown in Figure 18.1.2 and figure 18.1.3.
5) when conducting the detail design of the offshore jetty, the consideration and provision of

basic facilities such as the main structure, electric supply system, anchoring positions etc., must be required to the installation of the additional quay-side gantry cranes which will be introduced in future after the opening of this container terminal

6) An access bridge will be constructed to connect the Offshore Container Berth and the Victoria Container Yard.

(2) Victoria Container Yard

1) A container yard will be built by reclamation of the Victoria Dock.

2) The planned container yard will be paved with asphalt and prestressed concrete slabs will be laid in the traveling lanes for rubber-tyred transfer cranes. The pavement of the traveling lanes for container tractors will comply with the MBPT standards for container yard pavements.

3) The Container yard will be provided with reefer container storage and lighting facilities.

4) Provision is made for construction of a dedicated substation equipped with an emergency generator system to meet the power needs of container cranes, reefers and lighting facilities during power failures.

5) Provision is also made for container gates, workshop, administration office building and rest rooms for port workers.

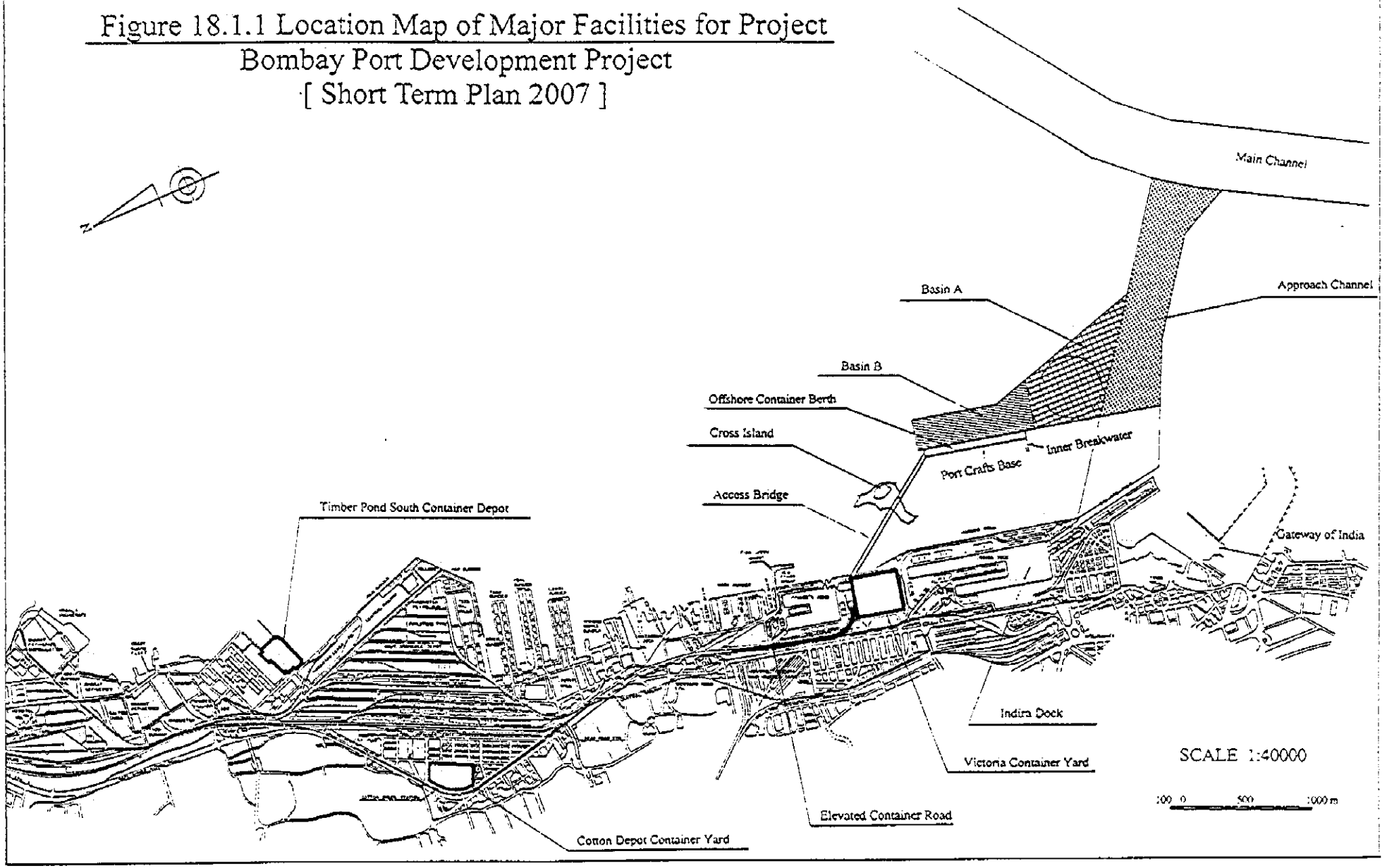
(3) Container Handling Equipment

The container handling equipment requirements of the Project include quay cranes, yard cranes and tractor chassis for yard operations and container transportation to and from inland yards.

(4) Container Traffic Road

The dock road connecting the Victoria Container Yard and the Cotton Depot Container Terminal will be improved. High priority will be given to the improvement of the intersection of the container road with the dock road and city road, especially the container road will be provided with an elevated bridge in the traffic congested area at the Malet Road Junction.

Figure 18.1.1 Location Map of Major Facilities for Project
Bombay Port Development Project
[Short Term Plan 2007]



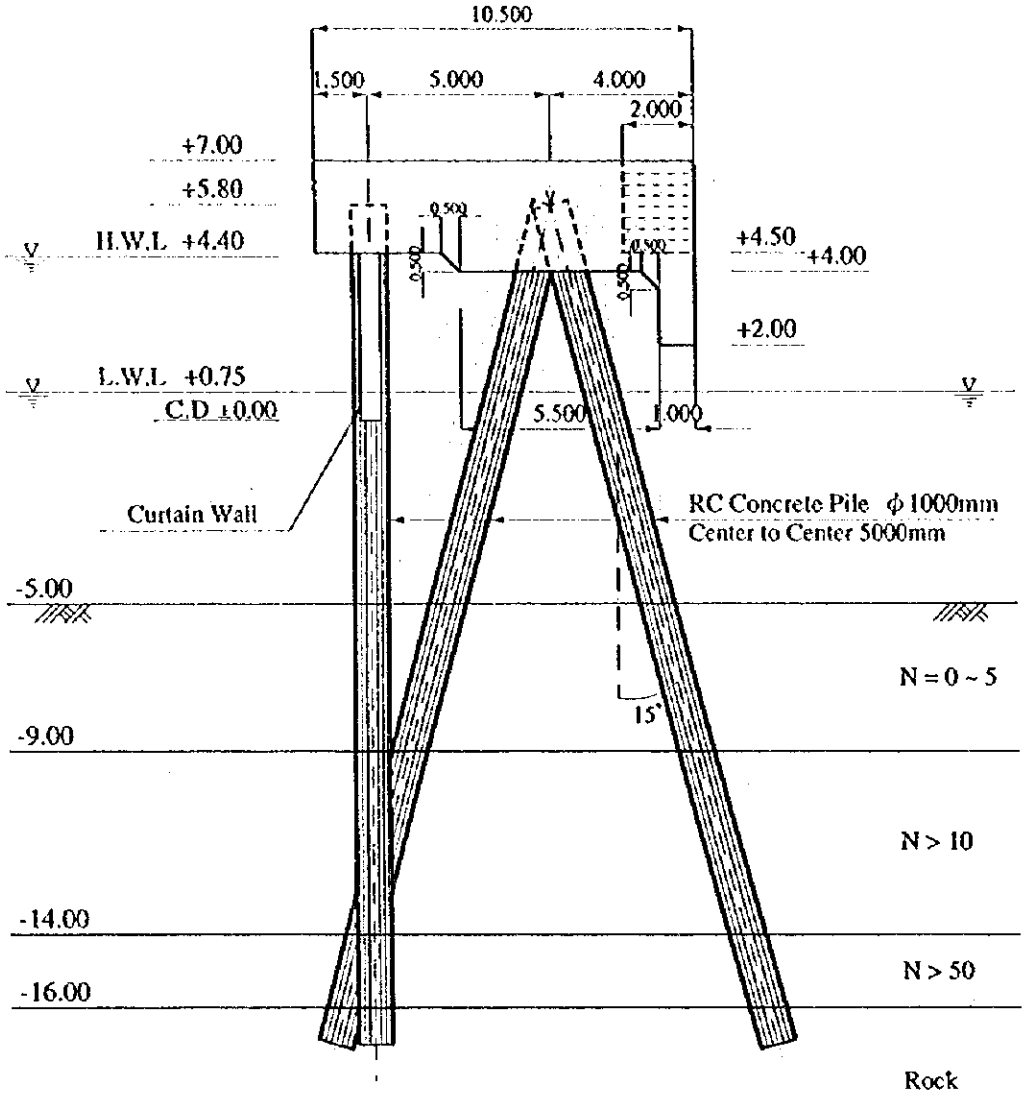
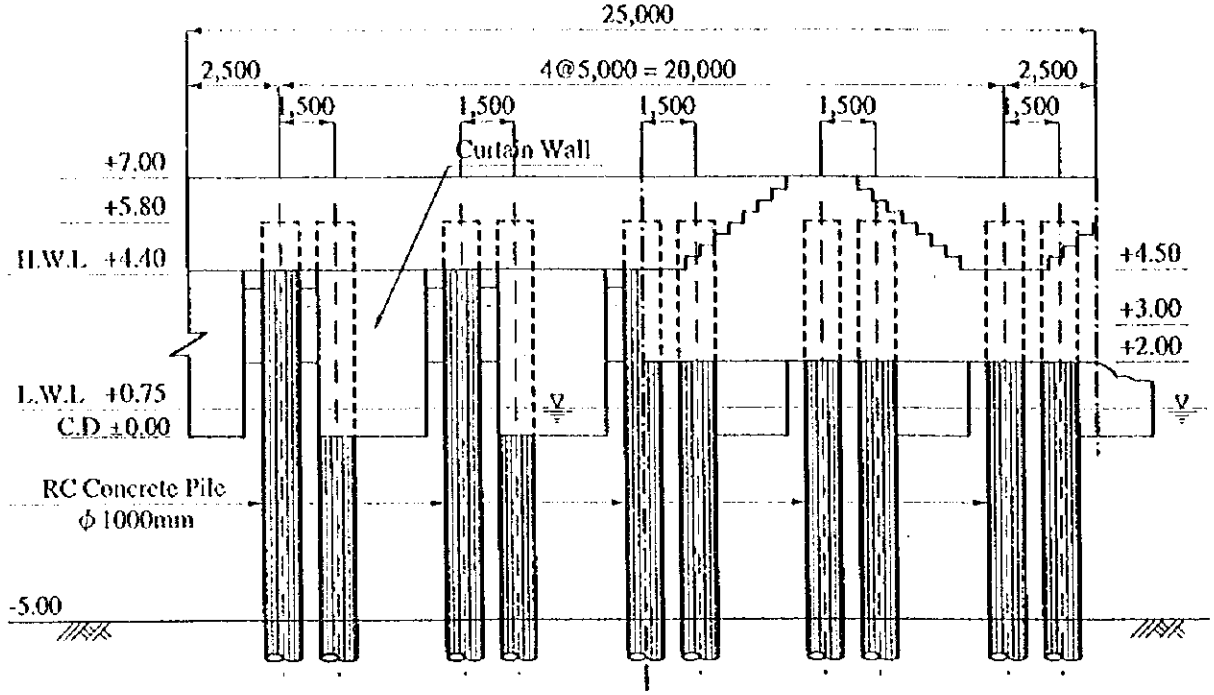
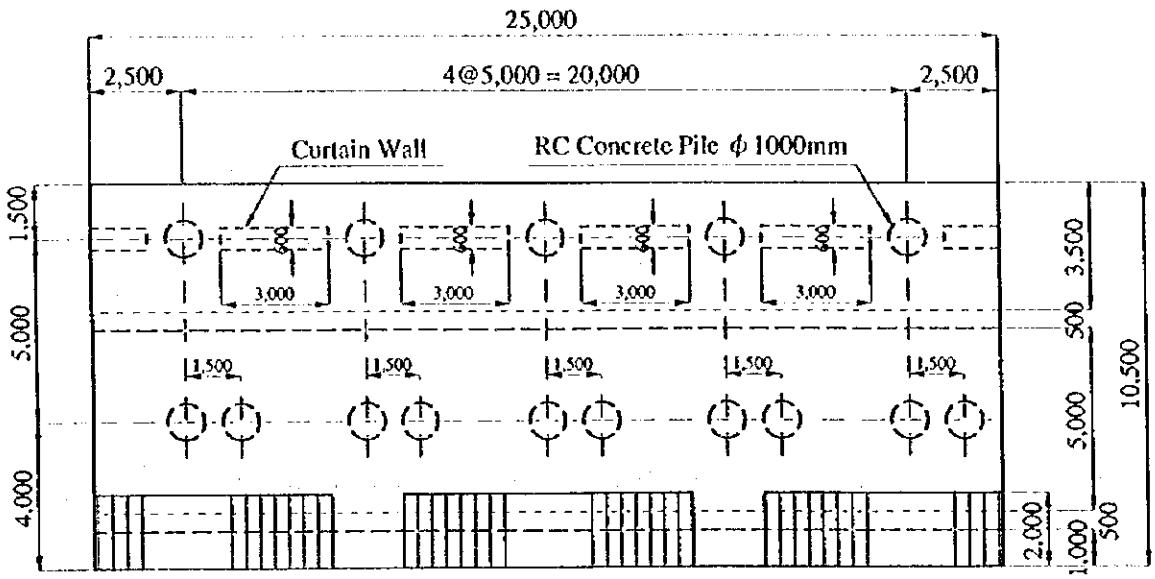


Figure 18.1.2 Typical Cross Section of Inner Breakwater
Scale 1:200, Unit meter
(Total Length 100 m of Curtain Wall Type Breakwater)



Profile of Inner Breakwater
Scale 1:200, Unit millimeter



Plan of Inner Breakwater
Scale 1:200, Unit millimeter

Figure 18.1.3 Plan and Profile of Inner Breakwater

(5) Cotton Depot Container Yard

Provision is made for construction of two CFS buildings, container stacking yard, container gates, administration office building and workshop. A dedicated substation will also be provided to serve power needs during normal time and partial power requirements during power failures.

(6) Timber Pond South Container Depot

Facilities planned for this area include a container yard, administration office building, container gates, workshop and water and power supply systems.

18.2 Cost Estimation of Construction Works

The preliminary construction cost estimates for the Short-Term Plan are based on the following preconditions:

(1) The basic prices and rates for construction plants and equipment, materials and labor applied in the cost estimation are those obtained during the Phase I Study carried out in May 1997.

(2) The exchange rates used for conversion of the local currency costs into foreign currency costs are as follows:

US$1.00 = Indian Rs.35.1 = ¥113.8 (as of May 1997)

(3) The estimated costs do not include import duties assessable on construction equipment and materials imported from overseas areas for the purpose of the Project construction.

(4) Local taxes assessable on construction equipment, materials and fuels from domestic sources are included in the cost estimates.

(5) The business tax and contract tax are excluded.

(6) Price escalation is not considered in respect of construction works, equipment procurement and engineering costs.

(7) Customes duties for the procurement of equipment is included in the cost estimates.

(8) Land acquisition and facility relocation costs are not included in the cost estimates.

(9) The ratios of foreign to local currency components by work item are as tabulated below.

Item	Foreign (%)	Local (%)
Rubble and Graded Stones	0	100
Materials of Concrete	0	100
Concrete Products	30	70
Fuel and Asphalt	0	100
Steel Material	60	40
Formwork for concrete	40	60
Floating Equipment	80	20
Construction Equipment for Land Use	0	100
Special Construction Equipment for Land Use	100	0

Table 18.2.1 shows the preliminary construction costs of the Short-Term Plan as broken down into the foreign and local currency components. Table 18.2.2 gives the annual investment requirements for the 9-year period from 1999 when the engineering services are scheduled to start up to the year 2007 when the Project construction is planned for completion.

As can be seen from Table 18.2.1, the total Project cost is estimated at Indian Rs. 20.01 billion, of which Rs. 11.33 billion represent the foreign currency portion and Rs. 8.68 billion the local currency portion.

Table 18.2.1
PROJECT COST OF SHORT TERM PLAN 2007

No.	Description		Unit	Quantity	Amount ('000Rs.)			Remarks
					Total	Foreign	Local	
I	**Indira Dock Container Terminal**							
1	**Offshore Container Berth**				**9,901,600**	**5,142,060**	**4,759,540**	
a	Dredging of Basin	Maintained at -11.0 m depth	m3	6,185,000	1,855,500	1,669,950	185,550	
b	Container Berth	-13.5 m depth & 63m wide Jetty	m	900	6,594,300	3,054,600	3,539,700	Include. berthing facility for Tug/Launch
c	Access Bridge 1	Pile foundation section	m	880	1,008,480	356,400	652,080	24 m wide of 4 lane road
d	Access Bridge 2	Causeway section	m	300	270,000	0	270,000	24 m wide of 4 lane road
e	Electric and water facilities		sum	1	61,820	30,910	30,910	
f	Inner Breakwater	Curtain wall type breakwater	m	100	111,500	30,200	81,300	
2	**Victoria Container Yard**				**1,499,643**	**515,619**	**984,024**	
a	Site Clearance		sum	1	9,400	0	9,400	
b	Revetment		m	55	25,465	0	25,465	Concrete block structure
c	Reclamation work		m3	1,300,000	416,000	326,300	89,700	
d	Paving Work	Include T/C lane & utilities	m2	190,000	593,180	0	593,180	500m by 380m
e	Building Work	office, gate, work shop, facilities	sum	1	102,597	20,519	82,078	
f	Electric and Water Supply		sum	1	337,601	168,800	168,801	Illumination, reefer, sump, tank
g	Miscellaneous	Fence, Drainage	sum	1	15,400	0	15,400	
3	**Container Handling Equipment**				**2,583,480**	**2,583,480**	**0**	
a	Container Crane		nos	6	1,099,200	1,099,200	0	
b	Transfer Crane		nos	19	763,800	763,800	0	
c	Yard Tractor and Chassis		nos	97	459,780	459,780	0	
d	Road Tractor and Chassis		nos	55	260,700	260,700	0	
4	**Sub Total**				**13,984,723**	**8,241,159**	**5,743,564**	
5	Engineering Service		sum	1	1,269,298	888,509	380,789	10% of Civil and 5% of Equip.
6	Physical Contingency		sum	1	1,217,629	852,340	365,289	10% of Civil and 3% of Equip.
7	Import Duty of Container Handling Equipment		sum	1	978,106	0	978,106	37.86% of Equip.
8	**Total**				**17,449,756**	**9,982,008**	**7,467,748**	
II	**Approach Channel**							
1	Dredging Work	Maintained at -11.0 m depth	m3	2,451,000	622,554	560,299	62,255	360 m width
2	Navigation Buoy		nos	9	30,015	30,015	0	
3	**Sub Total**				**652,569**	**590,314**	**62,255**	
4	Engineering Service		sum	1	32,628	22,840	9,788	5% of Sub Total
5	Physical Contingency		sum	1	65,257	45,680	19,577	10% of Sub Total
6	**Total**				**750,454**	**658,834**	**91,620**	
III	**Road Improvement in Dock Area**							
1	Site Clearance work		sum	1	20,300	0	20,300	
2	Container Road 1	Ground road (1000m*20m)	m2	20,000	37,540	0	37,540	20 m wide of 4 lane road
3	Container Road 2	Elevated road section	m	700	586,600	293,300	293,300	20 m wide of 4 lane road
4	Miscellaneous	Boundary wall, gate, illumination	sum	1	29,300	0	29,300	
5	Sub Total				**673,740**	**293,300**	**380,440**	
6	Engineering Service		sum	1	67,374	47,162	20,212	10% of Sub Total
7	Physical Contingency		sum	1	67,374	47,162	20,212	10% of Sub Total
8	**Total**				**808,488**	**387,624**	**420,864**	
IV	**Cotton Depot Container Yard**							
1	Civil and Building Work				613,602	103,937	509,665	
a	Container Yard		m2	95,000	178,315	0	178,315	Boundary wall, Drainage
b	Container Freight Station		m2	19,200	361,920	72,384	289,536	
c	Building Work (office, gate, work shop)		sum	1	17,100	3,420	13,680	
d	Electric and Water Supply		sum	1	56,267	28,133	28,134	Electric Sub Station
2	Container Handling Equipment				42,400	42,400	0	
a	Reach Stacker		nos	2	42,400	42,400	0	
3	**Sub Total**				**656,002**	**146,337**	**509,665**	
4	Engineering Service		sum	1	63,480	44,436	19,044	10% of Civil and 5% of Equip.
5	Physical Contingency		sum	1	62,632	43,842	18,790	10% of Civil and 3% of Equip.
6	Import Duty of Container Handling Equipment		sum	1	16,053	0	16,053	37.86% of Equip.
7	**Total**				**798,167**	**234,615**	**563,552**	
V	**Timber Pond South Container Depot**							
1	Civil and Building Work				117,143	1,749	115,394	
a	Container Yard		m2	60,000	112,620	0	112,620	Boundary wall, Drainage
b	Building Work (office, gate, work shop)		sum	1	1,710	342	1,368	
c	Electric and Water Supply		sum	1	2,813	1,407	1,406	Electric Sub Station
2	Container Handling Equipment				42,400	42,400	0	
a	Reach Stacker		nos	2	42,400	42,400	0	
3	**Sub Total**				**159,543**	**44,149**	**115,394**	
4	Engineering Service		sum	1	13,834	9,684	4,150	10% of Civil and 5% of Equip.
5	Physical Contingency		sum	1	12,985	9,090	3,895	10% of Civil and 3% of Equip.
6	Import Duty of Container Handling Equipment		sum	1	16,053	0	16,053	37.86% of Equip.
7	**Total**				**202,415**	**62,923**	**139,492**	
VI	**Grand Total**				**20,009,280**	**11,326,004**	**8,683,276**	

Note : The above costs are estimated on the premise that the construction sites such as area to be reclaimed for Victoria Container Yard, strip of land for new road and offdock yards will be transferred by MBPT to the contractors for the purpose of the Project unconditionally and without any extra costs.

Table 18.2.2
Disbursement Schedule of Short Term Plan 2007

No.	Description	Remarks	Amount (000Rs) Total Construction Cost			2000 Starting Year			2001 1st Year			2002 2nd Year			2003 3rd Year			2004 4th Year			2005 5th Year			2006 6th Year			2007 7th Year			2008 8th Year		
			Foreign	Local	Total	Foreign	Local	Total	Foreign	Local	Total	Foreign	Local	Total	Foreign	Local	Total	Foreign	Local	Total	Foreign	Local	Total	Foreign	Local	Total	Foreign	Local	Total	Foreign	Local	Total
I	Indira Dock Container Terminal		5,142,060	4,759,540	9,901,600				532,682	436,145	968,827	1,050,515	934,615	1,985,130	1,050,515	934,615	1,985,130	633,027	688,227	1,321,254	529,673	620,824	1,150,495	947,159	667,212	1,614,371	418,491	277,902	696,393			
1	Offshore Container Berth										0.13			0.25			0.25									0.25			0.12			
a	Dredging of Basin	Maintained at -11.0 m depth	1,669,950	185,550	1,855,500				217,093	24,121	241,214	417,488	46,388	463,876	417,488	46,388	463,876							417,488	46,388	463,876	200,393	22,265	222,658			
											0.08			0.17			0.17			0.17			0.17			0.17			0.07			
b	Container Berth	-13.5 m depth & 63m wide Jetty	Include. berthing facility for Tug / Launch	3,054,600	3,539,700	6,594,300			244,368	283,176	527,544	519,282	601,749	1,121,031	519,282	601,749	1,121,031	519,282	601,749	1,121,031	519,282	601,749	1,121,031	519,282	601,749	1,121,031	213,522	247,779	461,601			
											0.13			0.29			0.29			0.29												
c	Access Bridge 1	Pile foundation section	24 m wide of 4 Lane road	356,400	652,080	1,008,480			46,332	84,771	131,103	103,356	189,103	292,459	103,356	189,103	292,459	103,356	189,103	292,459												
											0.13			0.29			0.29			0.29												
d	Access Bridge 2	Causeway section	24 m wide of 4 lane road	0	270,000	270,000			0	35,100	35,100	0	78,300	78,300	0	78,300	78,300	0	78,300	78,300												
											0.08			0.17			0.17			0.17			0.17			0.17			0.07			
e	Electric and water facilities			30,910	30,910	61,820			2,473	2,473	4,946	5,255	5,254	10,509	5,255	5,254	10,509	5,255	5,254	10,509	5,255	5,254	10,509	5,255	5,254	10,509	2,162	2,167	4,329			
											0.09			0.17			0.17			0.17			0.17			0.17			0.07			
f	Inner Breakwater	Curtain wall type breakwater		30,200	81,300	111,500			2,416	6,504	8,920	5,134	13,821	18,955	5,134	13,821	18,955	5,134	13,821	18,955	5,134	13,821	18,955	5,134	13,821	18,955	2,114	5,691	7,805			
2	Victoria Container Yard			515,619	984,024	1,499,643									163,150	62,282	225,432	195,334	107,550	302,884	62,475	384,462	446,937	62,475	384,462	446,937	33,185	45,268	77,453			
																				0.50												
a	Site Clearance			0	9,400	9,400									0	4,700	4,700	0	4,700	4,700												
																	0.50			0.50												
b	Revetment		Concrete block structure	0	25,465	25,465									0	12,732	12,732	0	12,733	12,733												
																	0.50			0.50												
c	Reclamation work			326,300	89,700	416,000									163,150	44,850	208,000	163,150	44,850	208,000												
																							0.50			0.50						
d	Paving Work	Include T/C lane & utilities	450 m by 350 m	0	593,180	593,180															0	296,590	296,590	0	296,590	296,590						
																				0.17			0.33			0.33			0.17			
e	Building Work	office, gate, work shop, facilities		20,519	82,078	102,597												3,488	13,953	17,441	6,771	27,086	33,857	6,771	27,086	33,857	3,489	13,953	17,442			
																				0.17			0.33			0.33			0.17			
f	Electric and Water Supply		Illumination, reefer, sump, tank	168,800	168,801	337,601												29,696	29,696	59,392	55,704	55,704	111,408	55,704	55,704	111,408	28,696	28,697	57,393			
																				0.17			0.33			0.33			0.17			
g	Miscellaneous	Fence, Drainage		0	15,400	15,400												0	2,618	2,618	0	5,082	5,082	0	5,082	5,082	0	2,618	2,618			
3	Container Handling Equipment			2,583,480	0	2,583,480									568,366	0	568,366	568,366	0	568,366	568,366	0	568,366	568,366	0	568,366	310,016	0	310,016			
																	0.22			0.22			0.22			0.22			0.12			
a	Container Crane			1,099,200	0	1,099,200									241,824	0	241,824	241,824	0	241,824	241,824	0	241,824	241,824	0	241,824	131,904	0	131,904			
																	0.22			0.22			0.22			0.22			0.12			
b	Transfer Crane			763,800	0	763,800									168,036	0	168,036	168,036	0	168,036	168,036	0	168,036	168,036	0	168,036	91,656	0	91,656			
																	0.22			0.22			0.22			0.22			0.12			
c	Yard Tractor and Chassis			439,780	0	439,780									101,152	0	101,152	101,152	0	101,152	101,152	0	101,152	101,152	0	101,152	55,172	0	55,172			
																	0.22			0.22			0.22			0.22			0.12			
d	Road Tractor and Chassis			260,700	0	260,700									57,354	0	57,354	57,354	0	57,354	57,354	0	57,354	57,354	0	57,354	31,284	0	31,284			
4	Total			8,241,159	5,743,564	13,984,723				532,682	436,145	968,827	1,050,515	934,615	1,985,130	1,782,031	996,897	2,778,928	1,396,727	995,777	2,392,504	1,160,512	1,005,286	2,165,798	1,578,000	1,051,674	2,629,674	760,692	323,170	1,083,862			
II	Approach Channel																															
1	Dredging Work	Maintained at -11.0 m depth	360 m width	560,299	62,255	622,554															110,075	15,564	0.25 155,639	280,149	31,127	0.50 311,276	110,075	15,564	0.25 155,639			
2	Navigation Buoy			30,015	0	30,015															7,504	0	0.25 7,504	15,008	0	0.50 15,008	7,503	0	0.25 7,503			
3	Total			590,314	62,255	652,569															117,579	15,564	163,143	295,157	31,127	326,284	117,578	15,564	163,142			
III	Road Improvement in Dock Area																															
1	Site Clearance work		800 + 200 + 1000 m	0	20,300	20,300			0	2,639	0.13 2,639	0	5,887	0.29 5,887	0	5,887	0.29 5,887	0	5,887	0.29 5,887												
2	Container Road 1	Ground road (1000m*20m)	20 m wide and 4 lane road	0	37,540	37,540			0	4,879	0.13 4,879	0	10,887	0.29 10,887	0	10,887	0.29 10,887	0	10,887	0.29 10,887												
3	Container Road 2	Elevated road section	20 m wide and 4 lane road	293,300	293,300	586,600			38,129	38,129	0.13 76,258	85,057	85,057	0.29 170,114	85,057	85,057	0.29 170,114	85,057	85,057	0.29 170,114												
4	Miscellaneous	Boundary wall, gate, illumination		0	29,300	29,300			0	3,809	0.13 3,809	0	8,497	0.29 8,497	0	8,497	0.29 8,497	0	8,497	0.29 8,497												
5	Total			293,300	380,440	673,740			38,129	49,456	87,585	85,057	110,328	195,385	85,057	110,328	195,385	85,057	110,328	195,385												
IV	Cotton Depot Container Yard																															
1	Civil and Building Work			103,937	509,665	613,602									0	89,157	89,157	69,637	311,163	380,800	34,300	109,345	143,645									
																	0.50			0.50												
a	Container Yard		Boundary wall, Drainage	0	178,315	178,315									0	89,157	89,157	0	89,158	89,158												
																	0.67			0.33												
b	Container Freight Station			72,384	289,536	361,920												49,493	193,959	243,456	23,887	95,547	119,434									
																	0.67			0.33												
c	Building Work (office, gate, work shop)			3,420	13,680	17,100												2,293	9,166	11,457	1,129	4,514	5,643									
																	0.67			0.33												
d	Electric and Water Supply		Electric Sub Station	28,133	28,134	56,267												18,849	18,850	37,699	9,284	9,284	18,568									
2	Container Handling Equipment			42,400	0	42,400									42,400	0	42,400															
a	Reach Stacker			42,400	0	42,400									42,400	0	42,400															
3	Total			146,337	509,665	656,002									42,400	89,157	131,557	69,637	311,163	380,800	34,300	109,345	143,645									
V	Timber Pond South Container Depot																															
1	Civil and Building Work			3,749	113,394	117,143							0	37,165	37,165	874	76,842	77,716	875	1,387	2,262											
														0.33			0.67															
a	Container Yard		Boundary wall, Drainage	0	112,629	112,629							0	37,165	37,165	0	75,455	75,455														
																	0.50			0.50												
b	Building Work (office, gate, work shop)			342	1,368	1,710										171	684	855	171	684	855											
																	0.50			0.50												
c	Electric and Water Supply		Electric Sub Station	1,407	1,406	2,813										703	703	1,406	704	703	1,407											
2	Container Handling Equipment			42,400	0	42,400									42,400	0	42,400															
a	Reach Stacker			42,400	0	42,400									42,400	0	42,400															
3	Total			44,149	115,394	159,543							0	37,165	37,165	43,274	76,842	120,116	875	1,387	2,262											
VI	Engineering Service			1,011,631	433,983	1,446,614	202,526	86,798	0.26 289,324	153,895	65,098	0.15 216,993	101,263	43,398	0.10 144,661	101,263	43,398	0.10 144,661	101,263	43,398	0.10 144,661	101,263	43,398	0.10 144,661	101,263	43,398	0.10 144,661	101,263	43,398	0.10 144,661	50,632	21,699	0.05 72,331
VII	Physical Contingency			998,114	427,763	1,425,877				99,812	42,779	0.10 142,585	149,717	64,164	0.15 213,882	149,717	64,164	0.15 213,882	149,717	64,164	0.15 213,882	149,717	64,164	0.15 213,882	149,717	64,164	0.15 213,882	149,717	64,164	0.15 213,882			
VIII	Import Duty of Container Handling Equipment	37.86 % of Equip		0	1,010,212	1,010,212													1,010,212	1,010,212												
IX	Grand Total			11,316,004	8,683,276	20,009,280	202,526	86,798	289,324	802,518	593,478	1,395,990	1,386,552	1,189,670	2,576,223	2,203,742	1,380,786	3,584,529	1,803,276	2,536,429	4,339,706	1,593,371	1,237,757	2,831,129	2,324,837	1,190,363	3,514,501	1,159,150	446,296	1,605,547	50,632	21,699	72,331

Chapter XIX Implementation Program

19.1 Construction Works

(1) Construction of Offshore Container Berth

Because of the limited water depth of the construction site for the pier type Offshore Container Berth, the seabed of the site area will have to be dredged to required configuration. In this dredging operation, it may be necessary to excavate weathered rocks or fresh rocks which are likely to be encountered on the seabed. The pier structure will consist of cast-in-place concrete piles and cast-in-place concrete beams of the superstructure, and prestressed concrete beams for the deck slab system.

Driving of approximately 3,400 cast-in-place concrete piles would most likely be a major restrictive factor in the whole construction schedule. Because of the necessity of preparing these concrete piles in offshore locations, the total construction time of the Offshore Container Berth is estimated at approximately 5 years. Concrete in a combined quantity of nearly 180,000 m3 will be required to be cast at offshore to fabricate the concrete piles and concrete beams. For this purpose the use of a floating concrete plant is planned.

Approximately 6,000 precast prestressed concrete beams for the deck slab system will be produced in an onshore yard and delivered to the construction site in such a manner as to match the construction schedule. Cranes installed on the pier deck will be used to lay the concrete beams on the deck.

(2) Construction of Access Bridge

The main structure of the access bridge will, as in the pier structure, consist of cast-in-place concrete piles, cast-in-place concrete beams for the superstructure, and precast prestressed concrete beams for the deck slab system.

For that section of the access bridge which will be constructed in shallower water, a causeway type structure with a riprap foundation is planned with the view to accelerating early completion of the construction works.

The access bridge works will be started at the outset of the Project construction and

completed in a period of about 4 years. When completed, the access bridge will serve to facilitate the construction of pier type Offshore Container Berth.

(3) Victoria Container Yard

The Victoria Container Yard will be constructed by reclaiming the land from Victoria Dock. Sandy soil extracted from the Creek will be obtained for fill construction to provide firm filled-up ground. The use of sandy soil can be expected to contribute toward reducing water pollution in neighboring sea areas.

Prior to the reclamation works, a spillway will be built at the present location of the Lock to prevent outflow of fine-grained soil and water pollutants during the reclamation works.

It may be possible to use part of the waste produced from the demolition works on the warehouse in the Victorian Dock area for the purpose of filling up the site for the container yard.

(4) Dock Road

The main part of the dock road system will consist of cast-in-place concrete piles, cast-in place concrete beams for the superstructure, and precast prestressed concrete beams for the deck slab system.

Existing buildings in the planned road site will have to be demolished and the use of debris produced from the demolition in the reclamation area may be possible.

The road construction works will be executed in the port premises where cargo handling operations will be taking place as usual. It is necessary, therefore, for the contractors to take appropriate measures to prevent the construction activities from interfering with ordinary road traffic.

(5) Construction Base

A working yard in the port premises and a concrete production yard at outside of the port Area will be required for the purpose of the Project construction.

However, since the port premises of Mumbai Port are very limited in space, it is practically impossible to secure an adequate space for providing a working yard. It is

planned, therefore, to start the reclamation of the Victorian Dock first of all and to use the reclaimed area as a working yard as soon as the reclamation is completed. The sea area outside the Victorian Dock will be used as a construction craft basin. The work yard outside the port will accommodate the production of concrete products, asphalting and concreting plants, and other necessary construction plants and will be maintained for these purposes throughout the construction period. Therefore, provision is made for acquisition of 50,000 m2 of land lot north of the port premises for preparing the work yard required.

19.2 Construction Schedule

The engineering design by a consulting firm is to start in 2000. The construction works are estimated to take approximately six (6) years, starting in the year 2001 and ending in the early year of 2007.

Procurement of container handling equipment will be started in 2003 and completed in 2006. Table 19.2.1 shows the proposed construction schedule for the Short-Term Plan.

Table 19.2.1
Construction Schedule of Short Term Plan 2007

No.	Description	Quantity		1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	Remarks
		Year		-2	-1	0	1	2	3	4	5	6	7		
	Mile Stone			Commencement of Civil Work					Tender Announce for Procuremt. of Equipt.				Completion of Field Work		
I	**Indira Dock Container Terminal**						▼		▼				▼		
I-1	Offshore Container Berth											Final Dredging			
	1) Dredging of Basin	5,713,000	m3												
	2) Container Berth No.1, 2 and 3	900	m												
	3) Access Bridge	1,180	m												Pile foundation section = 880 m
I-2	Victoria Container Yard														Causeway section = 300 m
	1) Reclamation work	1,300,000	m3												Including revetment
	2) Paving Work	190,000	m2												
	3) Building, electric and water supply	1	sum												
I-3	Container Handling Equipment	1	sum												
II	**Approach Channel**	2,280,000	m3												Dredging and navigation buoy
III	**Road Improvement in Dock Area**	1,700	m												Elevated road section = 700 m Ground road section = 1000 m
IV	**Cotton Depot Container Yard**														
IV-1	Container Yard	95,000	m2												
VI-2	Building, electric and water supply	1	sum												
VI-3	Container Handling Equipment	1	sum												
V	**Timber Pond South Container Depot**														
V-1	Container Yard	60,000	m2												
V-2	Building, electric and water supply	1	sum												
V-3	Container Handling Equipment	1	sum												
VI	**Engineering Service**														
VI-1	Detailed Design														
VI-2	Assistance of Tender Procedure														Defect Liability Period
VI-3	Supervision of Construction Work														
VII	**Preparation of Project by GOI**														GOI : Government of India
VII-1	Detailed Project Report by MBPT														
VII-2	Clearance of Government Procedure by GOI														
VII-3	Procurement of Consultant and Contractor														

Chapter XX Economic Analysis

20. 1 Purpose and Methodology of Economic Analysis

The purpose of this chapter is to appraise the economic feasibility of the Short Term Development plan from the viewpoint of the national economy. This chapter focuses on whether the benefits of this project exceed those which could be derived from other investment opportunities in India.

All benefits and costs in the economic analysis are evaluated using economic price. There are various methods to evaluate the feasibility of those type of development. In this study, the Economic Internal Rate of Return (EIRR) and the benefit/cost ratio (B/C ratio) based on a cost-benefit analysis is used to appraise the feasibility of the proposed project in Short-term Development Plan to construct a new container terminal.

The EIRR is a discount rate which makes the costs and the benefits of the project during the project life equal. The benefit/cost ratio on the present value of benefit and costs is obtained by dividing the benefits by the costs. A ratio greater than one implies that the project is acceptable.

The procedure of the economic appraisal is summarized on Figure 20.1.1

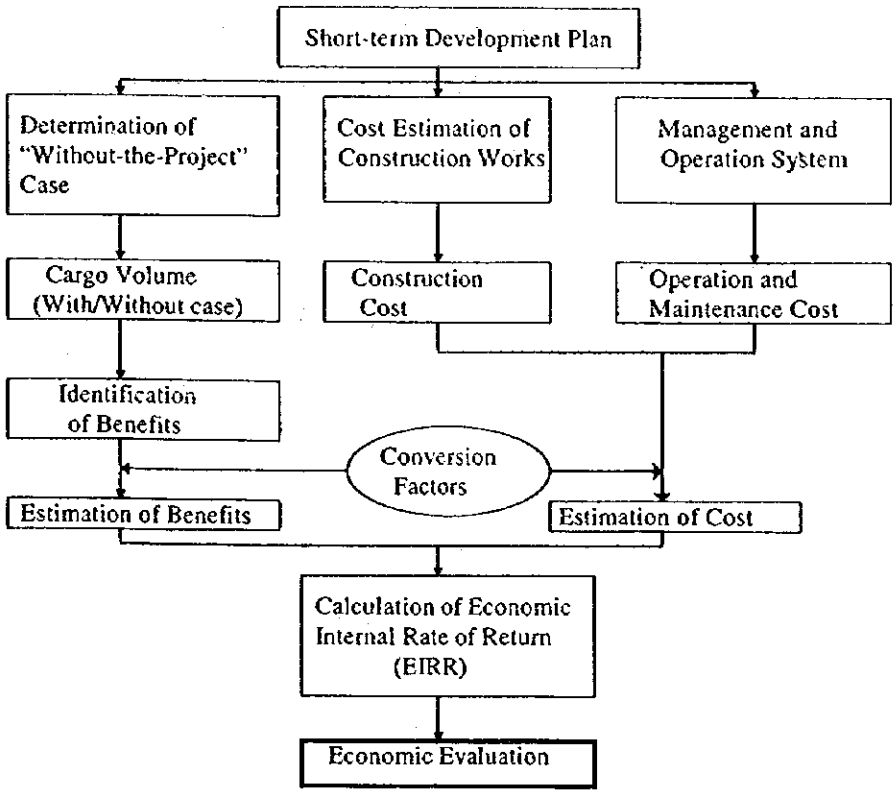


Figure 20.1.1 Process of Economic Analysis

20.2 Prerequisites for the Economic Analysis

(1) Base Year

The "Base Year" here means the standard year in the estimation of cost s and benefits. The target year of the Short-term Development Plan is 2007 and starting year of construction is assumed 7 years prior to the target year.

(2) Project life

Taking into consideration the depreciation period of the main facilities of 30 years and the construction period of 7 years, the period of calculation (Project Life) in the economic analysis is assumed to be 30 years from the beginning of construction.

(3) Foreign Exchange Rate

The exchange rate adopted for this analysis is US$ 1.00 = Rs.35.10 = ¥ 113.80, that is , the same rate as used in the cost estimation.

(4) "With-the-project" Case

A cost-benefit analysis is conducted on the difference between the "With-the-project" case in which an investment is made and the "Without-the-project" case in which no investment is made, that is, the benefit and costs arising from the proposed investment are compared.

(5) "Without-the-project" Case

No investment is made for the Short-term Development Plan.

(6) Cargo Throughput

1) "With-the-project" case

The cargo volume under "With-the-project" case at MBP and JNP during the planning period is forecast in Chapter IX. The capacity of container handling at MBP is set one million TEUs.

2) "Without-the-project" Case

In case of "Without-the-project" case, the container volume to be handled at inside the Indira Dock at MBP in 2007 is assumed to be limited to 138,000TEUs in the condition that three container vessels with a length of 190m (800-1,000TEUs capacity) each at most will simultaneously be received corresponding to the maximum possible limit of the lock and small container vessels will be diminished reflecting the continuous trend of the increase in vessel size.

On the other hand, the container volume to be handled at Ballard Pier is assumed to be 126,000TEUs referring the present productivity.

The volume of general cargoes to be handled at MBP in "Without-the-project" case is the same as that of "With-the-project" case. The excess container cargoes originating from or destined to Greater Mumbai to overflow from MBP is assumed to be handled at JNP after/before hauling to/from Greater Mumbai. The cargo throughput under the "With-the-project" case and "Without-the-project" case is shown in Figure 20.1.2.

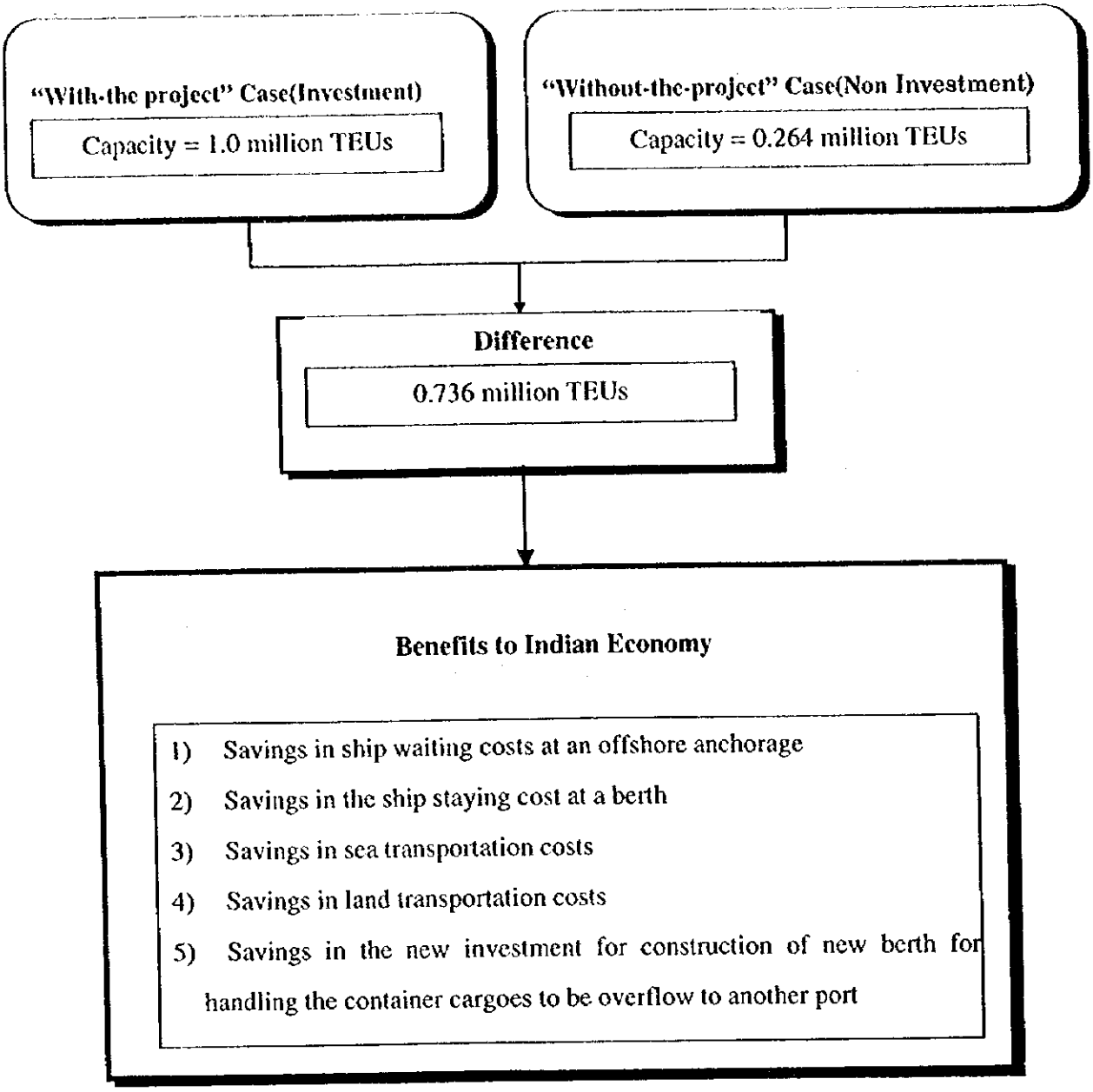


Figure 20.1.2 Cargo Throughput under the "With-the-project" Case and "Without-the-project" Case

20.3 Economic Prices

(1) General

For the economic analysis, all prices must be expressed as economic prices. In general, the construction cost, the operation cost and the maintenance cost are estimated at market prices. But in this study, for the estimation of these costs, import duties and turnover tax are excluded from trade goods, viz., the prices of traded goods are expressed as CIF prices. For non-trade goods, turnover tax, stamp duty and other duties are excluded. Therefore, these prices exclusive of personnel expenses are already expressed as economic prices, and thus require on conversion.

Labor is divided into skilled and unskilled labor. Skilled labor costs are estimated based on local market wages, and unskilled labor costs are estimated based on the value of the gross marginal product.

Economic prices for the labor costs are by multiplying these costs by the conversion factor for consumption. Since all the benefits are estimated at market prices, it is necessary to re-evaluate them from the economic point of view.

In this study, the conversion of benefits to economic prices is made using the Standard Conversion Factor (SCF) and the Conversion Factor for Consumption (CFC).

(2) Standard Conversion Factor (SCF)

Import duties and export subsidies create a price difference between the domestic market and the international market. The SCF is applied to determine the economic prices of certain non-traded goods and services that cannot be valued at border prices.

The Standard Conversion Factor makes up for this price difference. The Standard Conversion Factor is obtained by the following formula.

$$SCF = \frac{I + E}{(I + Di) + (E - De)}$$

where, I: Total value of imports (CIF)
E: Total value of exports (FOB)
Di: Total value of import duties
De: Total value of export duties and subsidies

In this report, the average SCF form 1991 to 1995 is adopted for the analysis. The Standard Conversion Factor is calculated as 0.859 (See Table 20.3.1).

Table 20.3.1 Standard Conversion Factor

Year	Total Exports (Rs.million)	Total Imports (Rs.million)	Total Export Duty Rs.million	Total Import Duty Rs. million	Standard Conversion Factor
1991	449,225	514,175	444	218,557	0.815
1992	547,620	688,629	2,054	250,229	0.833
1993	711,460	786,303	1,076	220,557	0.872
1994	843,260	999,730	1,288	259,549	0.877
1995	1,086,010	1,384,990	1,538	290,384	0.895
Average	--	--	--	--	0.859

Source) Calculated by JICA Study Team based on the data of "Reserve Bank of India" and "Union Budget, Government of India"

(3) Conversion Factor for Consumption (CFC)

This factor is used for converting the prices of consumer goods from market prices to border prices. In particular, this is required to convert labor costs from the domestic market prices to border prices.

The Conversion Factor for Consumption is usually calculated in the same manner as the Standard Conversion Factor, replacing total imports and exports by total imports and exports of consumer goods. The Conversion Factor for Consumption is calculated as 0.928 based on the data in 1995.

(4) Conversion Factor for Labor

1) Skilled Labor

For skilled labor, assuming that the market mechanism is functioning properly, the actual domestic market wages are used. But as the data are in domestic market prices, they should be converted to the border prices by multiplying by the Conversion Factor for Consumption. Conversion Factor for Skilled Labor is obtained by the following formula.

$$CFSL = \frac{Opportunity.cost}{Actual.market.wages} \times CFC$$

where, CFSL: Conversion factor for skilled labor

CFC : conversion factor for Consumption (0.928)

Conversion Factor for Skilled Labor is calculated using above formula as 0.928.

2) Unskilled labor

For unskilled labor, the economic costs are calculated based on a simplified measure of the opportunity cost. The wages paid to unskilled laborers by a project are generally above the

opportunity cost since the wage rate is controlled by a minimum wage system and other regulations despite the existence of a large amount of unskilled labors. Hence, wages should not be used for the calculation of the economic value of the unskilled labor.

In this report, the marginal productivity of an unskilled labors is assumed equal to the per capita of the agriculture, livestock and fisheries sector in Maharashtra State (hereafter referred to as the agricultural sector) on the assumption that the inflow of unskilled labors to the project is mainly from the agricultural sector.

The Conversion Factor for unskilled labor is calculated using the formula given below:

$$CFUL = \frac{Opportunity.cost.of.Unskilled.labor}{No\ min al.wage.rate.of.Unskilled.Labor} \times CFC$$

$$= \frac{Per.capita.incom.of.Agriculture.Sector.in.Maharashtra}{No\ min al.wage.rate.of.Unskilled.Labor} \times CFC$$

where, CFUL: Conversion Factor for Unskilled Labor
CFC : Conversion Factor for Consumption (0.928)

In this report, the average conversion factor for unskilled labor 1995 is adopted. The conversion factor for unskilled labor is calculated as 0.553 (See Table 20.3.2).

Table 20.3.2 Conversion Factor for Unskilled Labor

Year	GDP of Agriculture Livestock & Fisheries in Maharashtra State (Rs.million)	Population of Agriculture Sector in Maharashtra State (thousand)	Per Capita GDP of Agriculture Sector in Maharashtra State (Rs)	Wage Rate of UL (Rs)	CFUL
1995	277,990	20,979	13,251	22,244	0.553

Source) Calculated by JICA Study Team based on the data of "Economic Survey of Maharashtra 1996-97"

20.4 Benefits of Short-term Development Plan

20.4.1 Benefit Items

As benefits brought about by the short-term development plan of the study port, the following items are identified.

(1) Savings in ship waiting costs at offshore anchorage
(2) Saving in ship staying costs at a berth
(3) Saving in sea transportation costs

(4) Saving in land transportation costs

(5) Saving in the new investment for construction of new berth for handling the container cargoes in another port

(6) Reduction of cargo damage and accidents at the port

(7) Promotion of regional economic development

(8) Increase in employment opportunities and incomes

(9) Reduction of the traffic congestion in MBP

Items 1),2),3),4) and 5) are considered countable in this study and the monetary benefits of those items are counted.

20.4.2 Calculation of Benefits

(1) Savings in ship waiting costs

In the "With-the-project" case to implement the proposed project, total ship staying cost at the port consisting of waiting costs at offshore anchorages and staying costs at berths is less than that of the "Without-the-project" case owing to the proposed investment. The difference of the costs between "With-the-project" case and "Without-the-project" case is counted as a benefit of the proposed project.

In this study, it is assumed that 50% of the benefits is assumed to be attributed to India through the market mechanism of the world shipping business. Saving in ship staying costs is shown in Table 20.4.1.

Table 20.4.1 Savings in Ship Staying Costs

Year	Savings in ship waiting costs at anchorages offshore (Rs.million)	Savings in ship staying costs at berths (Rs.million)	Total (Rs.million)
2007	-289.8	608.5	318.6
2017	-33.1	752.6	748.0
2029	140.8	166.1	306.9

Source) Calculated by JICA Study team

(2) Savings in sea transportation costs

Generally, larger vessels transport cargo at lower costs. Hence, in "With-the-project" case in which deeper berths are prepared, sea transportation costs are less than those of "Without-the-project" case. On the other hand, conventional cargoes there is no difference in cost between "With-the-Project" case and "Without-the-project" case. the volume which is handled between both cases is same. The difference of the costs between "With-the-project" and "Without-the-project" is counted as a benefit. Savings in sea transportation costs is shown in Table 20.4.2.

(3) Savings in land transportation costs

In case of "Without-the-project" case, when container cargo volume will reach the container handling capacity at MBP, the excess container cargo which is assumed to mainly originate from or be destined to Mumbai City will divert to JNP and be hauled to/from the city by land. Such incremental detour land transport costs in "Without-the-project" case are counted as the benefits generated from the proposed project. Savings in land transportation costs is shown in Table 20.4.2.

Table 20.4.2 Savings in Transportation costs

Year	Savings in sea transportation costs (Rs. million)	Savings in land transportation costs (Rs. million)	Total (Rs. million)
2007	667.3	1,840.0	2,507.3
2017	667.3	1,840.0	2,507.3
2029	667.3	1,840.0	2,507.3

Source) Calculated by JICA Study team

(4) Savings in the new investment for construction of new berth for handling the container cargoes in another port

When the volume of container exceeds the container handling capacity at MBP, new berths are required to be constructed at another port to receive excess containers overflown from MBP. The cost of construction for the berth is counted as a benefit of "With-the-project" case. Construction costs of the new berth is shown in Table 20.4.3.

Table 20.4.3 Project Costs of New Berth

Year	No.	Works	Project Costs in Market Price (Rs.million)	Foreign Portion 1.000	Local Portion 0.859	Overall Conversion Factor	Project Costs in Economic Price (Rs. million)
2003	1	Offshore Container Berth	675.6	47.9%	45.0%	0.929	620.3
	2	Container Yard	307.0	92.9%	0.0%	0.929	281.9
	3	Container Handling Equipment	0.0	0.0%	0.0%	0.000	0.0
		Total	**982.6**	**41.9%**	**50.9%**	**0.929**	**902.2**
2004	1	Offshore Container Berth	1,979.3	46.9%	46.0%	0.929	1,817.5
	2	Container Yard	801.4	31.5%	73.7%	0.929	735.9
	3	Container Handling Equipment	0.0	0.0%	0.0%	0.000	0.0
		Total	**2,780.7**	**42.4%**	**54.0%**	**0.965**	**2,651.2**
2005	1	Offshore Container Berth	1,940.9	46.0%	46.9%	0.929	1,782.2
	2	Container Yard	897.6	27.1%	65.8%	0.121	824.2
	3	Container Handling Equipment	501.7	92.9%	0.0%	0.929	460.7
		Total	**3,340.1**	**47.9%**	**45.0%**	**0.929**	**3,067.0**
2006	1	Offshore Container Berth	570.9	39.7%	53.2%	0.929	524.2
	2	Container Yard	278.5	22.2%	70.7%	0.929	255.7
	3	Container Handling Equipment	1,189.7	92.9%	0.0%	0.918	1,092.4
		Total	**2,039.1**	**68.3%**	**24.5%**	**0.918**	**1,872.3**
Grand Total			**9,142.5**	**50.2%**	**43.8%**	**0.940**	**8,492.7**

(5) Total benefits

Total benefits of above items, (1), (2), (3) and (4) , in Short-term Development Plan are shown in Table 20.4.4.

Table 20.4.4 Summary of Benefits in Short-term Development Plan

(Unit: Rs. million)

No.	Year	Ship waitin costs	Transport costs	New Berth Construction costs			Total
				Construction	Maintenance	Re-Investment	
1	2000						0.0
2	2001						0.0
3	2002						0.0
4	2003			902.2			902.2
5	2004			2,651.2			2,651.2
6	2005			3,067.0		0.0	3,067.0
7	2006			1,872.4		0.0	1,872.4
8	2007	318.6	2,507.3		139.0	0.0	2,964.9
9	2008	361.6	2,507.3		139.0	0.0	3,007.8
10	2009	404.5	2,507.3		139.0	0.0	3,050.7
11	2010	447.5	2,507.3		139.0	0.0	3,093.7
12	2011	490.4	2,507.3		139.0	0.0	3,136.6
13	2012	533.3	2,507.3		139.0	0.0	3,179.6
14	2013	576.3	2,507.3		139.0	0.0	3,222.5
15	2014	619.2	2,507.3		139.0	0.0	3,265.4
16	2015	662.1	2,507.3		139.0	0.0	3,308.4
17	2016	605.1	2,507.3		139.0	0.0	3,251.3
18	2017	748.0	2,507.3		139.0	191.2	3,585.5
19	2018	701.0	2,507.3		139.0	0.0	3,347.2
20	2019	715.6	2,507.3		139.0	0.0	3,361.8
21	2020	730.2	2,507.3		139.0	0.0	3,376.4
22	2021	744.8	2,507.3		139.0	0.0	3,391.1
23	2022	1,012.7	2,507.3		139.0	1,361.9	5,020.8
24	2023	743.7	2,507.3		139.0	0.0	3,389.9
25	2024	574.7	2,507.3		139.0	0.0	3,220.9
26	2025	405.7	2,507.3		139.0	0.0	3,052.0
27	2026	236.8	2,507.3		139.0	0.0	2,883.0
28	2027	167.8	2,507.3		139.0	191.2	3,005.2
29	2028	187.4	2,507.3		139.0	0.0	2,833.6
30	2029	306.9	2,507.3		139.0	-769.4	2,183.8
Total		12,293.8	57,666.8	8,492.8	3,196.5	974.9	82,624.8

Source) Caluculated by JICA Study Team

20.5 Costs of the Short-term Development Plan

(1) Construction Cost

The construction investment (see Chapter 18.2) has to be divided into the categories of foreign currency unit and local currency unit consisting of skilled labor, unskilled labor and others.

The costs of laborers excluding foreigner is converted into economic prices using the conversion factor. Table 20.5.1 shows the economic prices for the Project Costs in Short-term Development Plan.

Table 20.5.1 Project Costs in Short-term Development Plan

Year	No.	Works	Project Costs in Market Price (Rs.million)	Foreign Portion (%)	Local Portion			Overall Conversion Factor (%)	Project Costs in Economic Price (Rs. million)
					Skilled Labor (%)	Unskilled Labor (%)	Non-Traded Material (%)		
2000	6	Engineering Service	289.3	70.0	1.2	0.2	24.3	95.8	277.0
		Total	**289.3**	**70.0**	**1.2**	**0.2**	**24.3**	**95.8**	**277.0**
2001	1	Indira Dock Container Terminal	948.8	54.0	0.6	0.4	38.3	93.3	885.6
	3	Road Improvement in Dock Area	87.6	43.5	0.7	0.4	47.2	91.8	80.4
	6	Engineering Service	217.0	70.0	1.2	0.2	24.3	95.8	207.8
	7	Physical Contingency	142.6	70.0	0.4	0.3	24.9	95.6	136.4
		Total	**1,396.0**	**57.5**	**0.7**	**0.4**	**35.3**	**93.9**	**1,310.2**
2002	1	Indira Dock Container Terminal	1,985.1	52.9	0.6	0.4	39.2	93.2	1,849.6
	3	Road Improvement in Dock Area	195.4	43.5	0.7	0.4	47.2	91.8	179.4
	5	Timber Pond South Container Dep	37.2	0.0	0.8	0.1	85.0	85.9	31.9
	6	Engineering Service	144.7	70.0	1.2	0.2	24.3	95.8	138.5
	7	Physical Contingency	213.9	70.0	0.4	0.3	24.9	95.6	204.5
		Total	**2,576.2**	**53.8**	**0.7**	**0.4**	**38.4**	**93.3**	**2,404.1**
2003	1	Indira Dock Container Terminal	2,778.9	64.1	0.5	0.3	29.9	94.8	2,634.6
	3	Road Improvement in Dock Area	195.4	43.5	0.7	0.4	47.2	91.8	179.4
	4	Cotton Depot Container Yard	131.6	32.2	0.6	0.0	57.6	90.5	119.0
	5	Timber Pond South Container Dep	120.1	36.0	0.6	0.0	54.4	91.0	109.3
	6	Engineering Service	144.7	70.0	1.2	0.2	24.3	95.8	138.5
	7	Physical Contingency	213.9	70.0	0.4	0.3	24.9	95.6	204.5
		Total	**3,584.5**	**61.5**	**0.5**	**0.3**	**32.1**	**94.4**	**3,385.4**
2004	1	Indira Dock Container Terminal	2,392.5	58.4	0.6	0.4	34.7	94.0	2,248.3
	3	Road Improvement in Dock Area	195.4	43.5	0.7	0.4	47.2	91.8	179.4
	4	Cotton Depot Container Yard	380.8	18.3	2.5	0.5	67.1	88.4	336.5
	5	Timber Pond South Container Dep	2.3	38.7	1.9	0.4	50.3	91.2	2.1
	6	Engineering Service	144.7	70.0	1.2	0.2	24.3	95.8	138.5
	7	Physical Contingency	213.9	70.0	0.4	0.3	24.9	95.6	204.5
		Total	**3,329.5**	**54.2**	**0.8**	**0.4**	**38.0**	**93.4**	**3,109.4**
2005	1	Indira Dock Container Terminal	2,165.8	53.6	0.6	0.3	38.8	93.3	2,021.1
	2	Approach Channel	163.1	90.5	0.3	0.1	7.8	98.6	160.9
	4	Cotton Depot Container Yard	143.6	23.9	3.0	0.7	61.6	89.1	128.0
	6	Engineering Service	144.7	70.0	1.2	0.2	24.3	95.8	138.5
	7	Physical Contingency	213.9	70.0	0.4	0.3	24.9	95.6	204.5
		Total	**2,831.1**	**56.3**	**0.7**	**0.3**	**36.4**	**93.7**	**2,653.1**
2006	1	Indira Dock Container Terminal	2,629.7	60.0	0.6	0.3	33.4	94.2	2,478.4
	2	Approach Channel	326.3	90.5	0.3	0.1	7.8	98.6	321.9
	6	Engineering Service	144.7	70.0	1.2	0.2	24.3	95.8	138.5
	7	Physical Contingency	213.9	70.0	0.4	0.3	24.9	95.6	204.5
		Total	**3,314.5**	**64.1**	**0.6**	**0.3**	**29.9**	**94.8**	**3,143.3**
2007	1	Indira Dock Container Terminal	1,083.9	70.2	0.5	0.3	24.7	95.7	1,037.0
	2	Approach Channel	163.1	90.5	0.3	0.1	7.8	98.6	160.9
	6	Engineering Service	144.7	70.0	1.2	0.2	24.3	95.8	138.5
	7	Physical Contingency	213.9	70.0	0.4	0.3	24.9	95.6	204.5
		Total	**1,605.5**	**72.2**	**0.5**	**0.3**	**23.0**	**96.0**	**1,541.0**
2008	6	Engineering Service	72.3	70.0	1.2	0.2	24.3	95.8	69.3
		Total	**72.3**	**70.0**	**1.2**	**0.2**	**24.3**	**95.8**	**69.3**
Grand Total			**18,999.1**	**59.6**	**0.7**	**0.3**	**33.6**	**94.2**	**17,892.8**

Source) Calculated by JICA Study Team

(2) Operation and Maintenance Costs

The main items of the operation costs of this project are personnel expenses. These costs are estimated based on the present operation at MBP (see Chapter 21.3.7).

Table 20.5.2 Operation Costs in Economic Price

	Number of personnel (person)	Annual wages (Rs)	CFSL	Operation costs (Rs.million)
Personnel expenses	790	150,000	0.928	110.0

Source) Calculated by JICA Study Team

The costs of maintaining the port facility is assumed to be a fixed portion (1% for infra structures, 4% for handling equipment) of the capital investment. The maintenance of dredging cost is estimated as 151.8 thousand Rs per year.

Table 20.5.3 Maintenance Costs for Structure and Equipment

	Original construction costs (Rs. million)	Fixed portion of original construction costs (%)	Maintenance costs (Rs. million)
Structure	11.160.6	1.0	111.6
Equipment	3,781.0	4.0	151.2
Dredging	-	-	164.4

Source) Calculated by JICA Study Team

(3) Renewal Investment Costs

The facility and equipment will be renewed according to their economic lives. As described hereunder, and cargo handling equipment will be renewed through the project life.

Table 20.5.4 Economic Life of Facility and Equipment

Facility and Equipment	Life of Asset (Years)	Renewal Investment (Rs. million)
Container Crane	15	1,336.5
Transfer Crane	15	928.7
Trailer Chassis	10	979.1
Navigation Aids	15	36.5
Electric Supply	25	—

Source) "Life Span of Port Assets in MBPT" and calculated by JICA Study Team

(4) Summary of Costs

Summary of costs above items, 1),2) and 3), in Short-term Development Plan are shown in Table 20.5.5.

Table 20.5.5 Summary of Costs in Short-term Development Plan

(unit: Rs. million)

No.	Year	Construction cost	Capital Doredging Costs	Maintenance cost			Managemc Costs	Renewal Investmen	Residual Values	Table
				Maintenance Dredging	Civil	Facility				
1	2000	277.0	0.0							277.0
2	2001	987.7	322.5							1,310.2
3	2002	1,870.7	533.4							2,404.1
4	2003	2,720.6	664.8							3,385.4
5	2004	3,109.4	0.0							3,109.4
6	2005	2,476.9	176.2							2,653.1
7	2006	2,285.6	857.7							3,143.3
8	2007	1,061.3	479.7	164.4	111.6	151.2	110.0			2,078.2
9	2008	69.3	0.0	164.4	111.6	151.2	110.0			606.5
10	2009			164.4	111.6	151.2	110.0			537.2
11	2010			164.4	111.6	151.2	110.0			537.2
12	2011			164.4	111.6	151.2	110.0			537.2
13	2012			164.4	111.6	151.2	110.0			537.2
14	2013			164.4	111.6	151.2	110.0			537.2
15	2014			164.4	111.6	151.2	110.0			537.2
16	2015			164.4	111.6	151.2	110.0			537.2
17	2016			164.4	111.6	151.2	110.0			537.2
18	2017			164.4	111.6	151.2	110.0	979.1		1,516.3
19	2018			164.4	111.6	151.2	110.0			537.2
20	2019			164.4	111.6	151.2	110.0			537.2
21	2020			164.4	111.6	151.2	110.0			537.2
22	2021			164.4	111.6	151.2	110.0			537.2
23	2022			164.4	111.6	151.2	110.0	2,301.6		2,838.8
24	2023			164.4	111.6	151.2	110.0			537.2
25	2024			164.4	111.6	151.2	110.0			537.2
26	2025			164.4	111.6	151.2	110.0			537.2
27	2026			164.4	111.6	151.2	110.0			537.2
28	2027			164.4	111.6	151.2	110.0	979.1		1,516.3
29	2028			164.4	111.6	151.2	110.0			537.2
30	2029			164.4	111.6	151.2	110.0		-1,759.5	-1,222.3
Total		14,858.5	3,034.3	3,781.2	2,566.9	3,478.6	2,529.3	4,259.8	-1,759.5	32,749.1

Source) Calculated by JICA Study Team

20.6 Evaluation of the Projects

(1) Calculation of the EIRR

The economic internal rate of return (EIRR) based on a cost-benefit analysis is used to appraise the economic feasibility of the project. The EIRR is the discount rate which makes the cost and benefit of a project during the project life equal. It is calculated using the following formula.

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

where, n : Period of economic calculation (project life)

i : Year

Bi : Benefit in i-th year

Ci : Costs in i-th year

r : Discount rate

The EIRR of Short-term Development Plan is calculated as 16.9%.

Table 20.6.1 Result of EIRR

	EIRR (%)
Short-term Development Plan	16.9

(2) Sensitivity Analysis

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

Case (A) : The costs increase by 10%

Case (B) : The benefits decrease by 10%

Case (C) : The costs decrease by 10% and the benefits decrease by 10%.

The results of the sensitivity analysis are shown in Table 20.6.2.

(3) Calculation of the Benefit / Cost Ratio

The benefit / cost ratio is obtained by dividing the benefit by cost. The result of the B/C is shown in Table 20.6.2.

shown in Table 20.6.2.

Table 20.6.2 Sensitivity Analysis for EIRR and B/C Ratio

Case	EIRR (%)	B/C
Base Case	16.9	1.39
Case (A): Increase in Costs by 10%	15.2	1.26
Case (B): Decrease in Benefit by 10%	14.5	1.27
Case (C): Increase in costs by 10% Decrease in benefits by 10%	12.5	1.12

Source) Calculated by JICA Study Team
Note: Discount rate using for calculation of B/C is adopted 10% in this study.

(4) Evaluation

The leading view is that the project is feasible if the EIRR exceeds the opportunity cost of capital. Considering the opportunity cost of capital in each country, it is generally considered that a project with an EIRR of more than 10% is economically justifiable for infrastructure or social service projects. As for this project, even though the economic calculation only takes into account the items which are easily quantified, the EIRR exceed 10%. Therefore, the proposed development project in the stage of Short-term Development Plan is viable from the viewpoint of national economy.