Part III SHORT-TERM PLAN

3.1 Short-term Development Plan for MBP

3.1.1 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) Container Handling

1) Insufficient Water Depth along the Existing Container Berths
2) Excessively-low Container-Handling Productivity due to the Current Operational Manner
3) Shortage of Container Handling Equipment
4) Effective Utilization of the Existing Facilities
5) Potential Capacity of MBP in Container Handling
6) Future Port Requirements and Functional Allotment of Container Handling between MBP and JNP
7) Economical Transportation
8) Generation of Employment Opportunity
9) Environmental Impact on Areas around the Port Induced by the Port Development

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
2) Introduction of a Closed Terminal System to the New Container Terminal
3) Deepening the Approach Channel to MBP
4) Preparation of the Off-Dock Container Depots within the Landed Estate of MBPT

3.1.2 The Short-term Development Plan for Container Handling

(1) Proposed Plan (Alternative-6) for Container Handling

The Short-term Plan is basically defined as a phase plan in the framework of the Master Plan (Alternative-6). 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.

1) Dimensions of the Proposed Plan (Alternative-6)

Major components of the proposed plan are 1) three new off-shore jetty-type container berths, whose water depth is -13.5m, connected with Victoria Dock Container Yard by access bridge, 2) 2,930 G. slots of container marshaling yard on Victoria Dock Container Yard which is created by reclamation of Victoria Dock, 3) 2,836 G. slots of empty container yard on various locations (ID-1: 240 G. slots, Victoria Dock Container Yard: 802 G. slots, CDW: 972 G. slots and TPS: 1,140 G. slots), 4) dedicated road for container traffic between on-dock container yard and off-dock CFS and container yard, 5) deepening both the basin of the proposed container berths, whose berthing area is deepened to -13.5m, and the Approach Channel to -11.0m, and 6) six quay-side gantry cranes, 19 transfer cranes, 97 yard tractor-chassis units and 55 road tractor-chassis units. Layout of the proposed plan is shown in Figure 3.1.2-1.

There would be a shortage of 187 G. slots of empty container yard in the port area. Since empty container yard is apt to be located adjacent to the factory for FCL container, however, the shortage of approximately two hundred G. slots of empty container yard in the port area would not be a crucial point for the proposed plan. Dimensions of major container handling facilities are summarized in Table 3.1.2-1.

Table 3.1.2-1 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)	19,200	---
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 3.1.2-1 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)

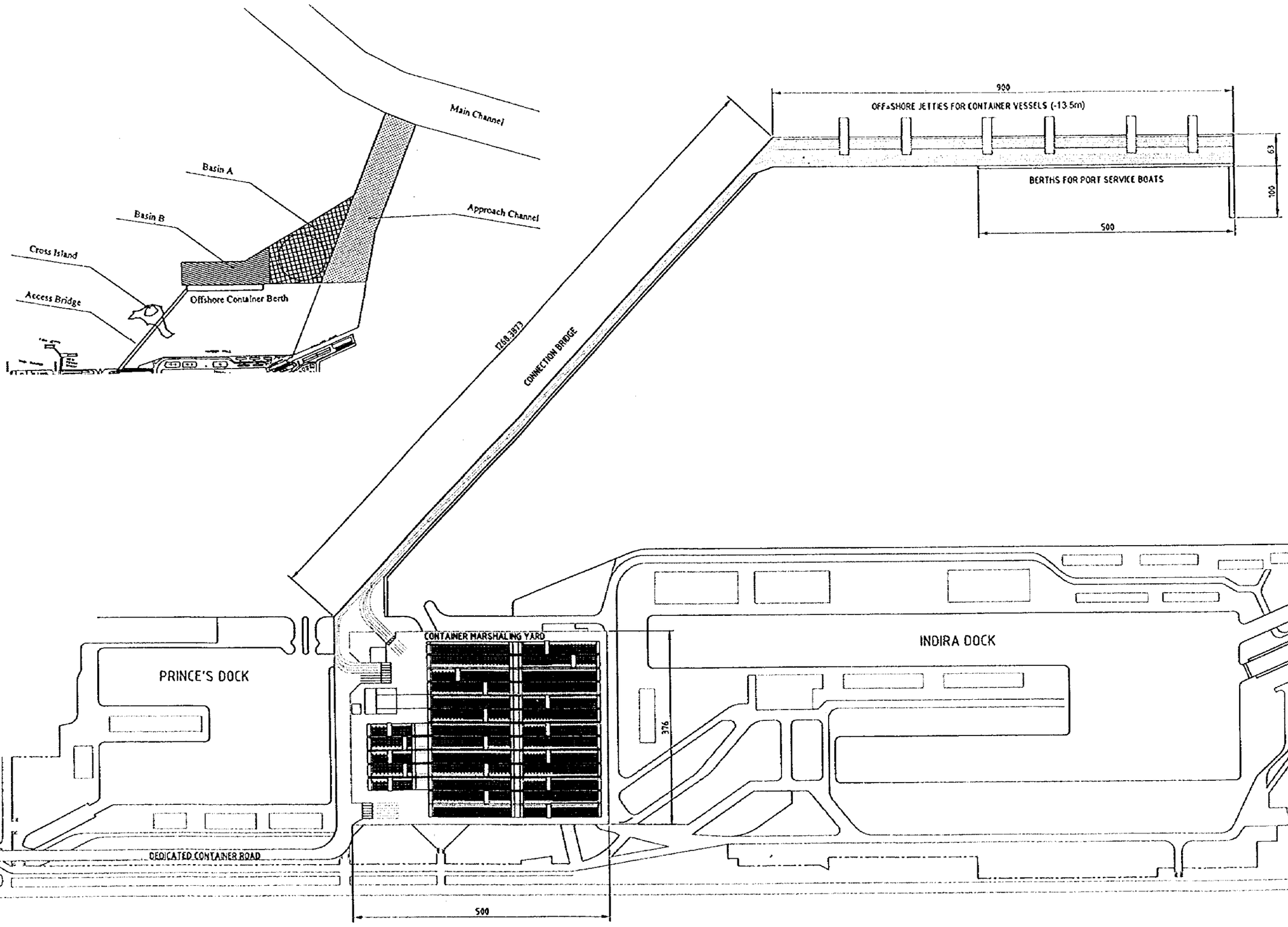

Figure 3.1.2-2 Layout Plan of A New Container Terminal at Victoria Dock (Alternative-6) SCALE1:7,000

2) Layout of the Proposed Plan (Alternative-6)

On-dock layout of the proposed plan is shown in Figure 3.1.2-2, 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.

a) Three New Container Berths

Three new off-shore jetty-type container berths are located approximately 800 meters off the Indira Dock Harbour Wall connected with Victoria Dock which is filled up as a container yard by access bridge using water-through structure such as pile-structure. Hard material lays under the seabed with a depth ranging from -4.0 to -10.0 meters within the area up to about 800 meters off the front of the Harbour Wall. Detail information of hard materials distribution is referred in Chapter 2. Berth alignment of Alternative-6 is proposed to be parallel to the Harbour Wall so as to ensure more tranquillity for mooring vessels and container-handling operations, considering the tidal flows.

In addition, the existing Ballard Pier Station (BPS) with container marshaling yard of 516 G. slots will be utilized as a container berth for the future.

The other side of the jetty facing Indira Dock Harbour Wall is planned to be used as a 500 m long berth for port service boats. This will enable ID-18, 20 and 21 berths to be fully utilized for conventional cargo handling.

b) Victoria Dock Container Yard

The container yard at Victoria Dock accommodates 2,930 G. slots of laden containers and 802 G. slots of empty containers. As to empty container yard, ID-1, Cotton Depot West (CDW) and TPS accommodate 240 G. slots, 972 G. slots and 1,140 G. slots respectively. Since the required dimension of empty container yard is 3,341 G. slots, however, the remaining required empty container yard of 187 G. slots will be in short supply and need to be prepared outside the port.

Cotton Depot West (CDW): 972 G. slots

Timber Pond South (TPS): 1,140 G. slots

Indira Dock No.1 (ID-1): 240 G. slots

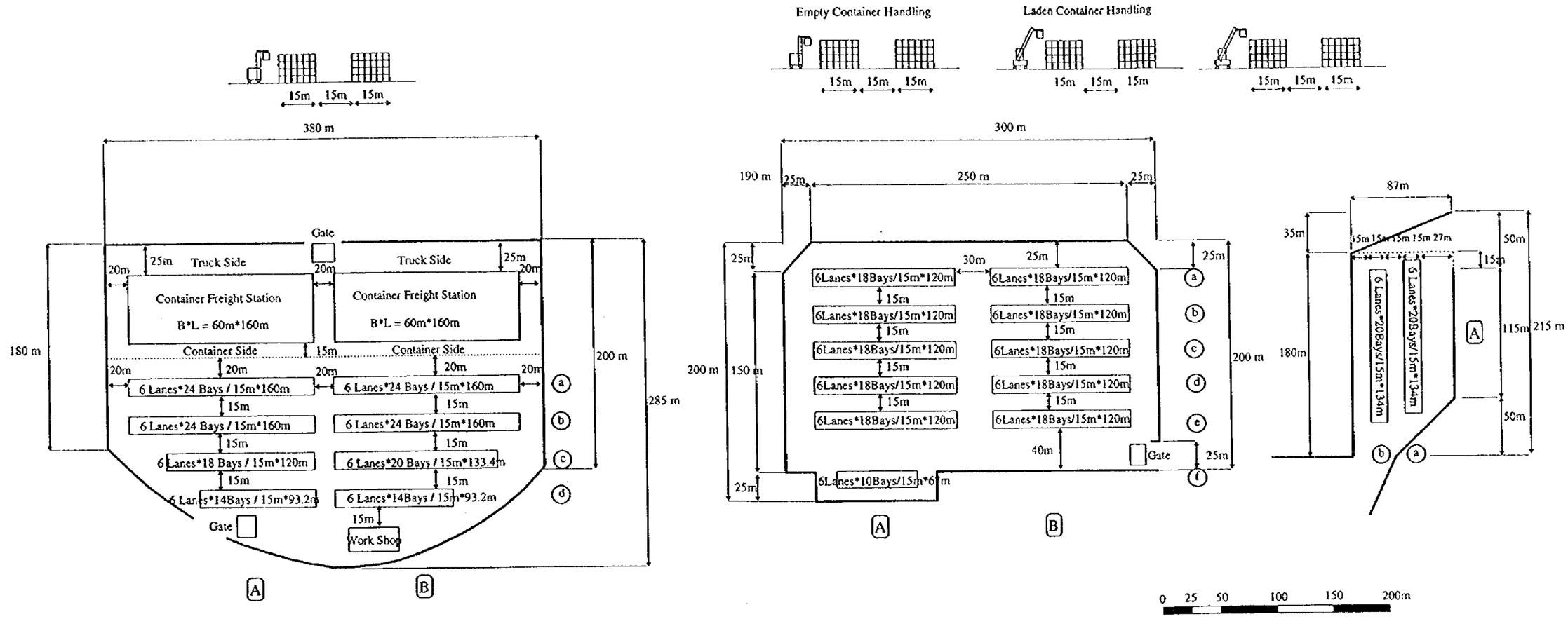

Figure 3.1.2-3 Layout Plan of Off-Dock Container Depot

c) Dedicated Road for Container Traffic

Dedicated road for container traffic would be essential to smoothly flow container traffic between on-dock container yard and off-dock CFS and empty container yard. The dedicated road starts from the gate of Victoria Dock Container Yard and extends to and connects with the Link Road. The fly-over structure is adopted for the dedicated road to cross over Malet Road so as to smoothly evacuate container out of the dock area. Heavy traffic congestion currently seen at the junction of Dock Expressway and Malet Road is expected to be reduced drastically by fly-over road.

General-purpose road along the container-dedicated road is prepared within the port area to flow port-related traffic including general cargo trucks. This could also reduce traffic congestion on P D'Mello Road where heavy congestion by both port-related traffic and city traffic is always seen currently.

However, Mumbai Metropolitan Region Development Authority (MMRDA) is planning to build "East Island Freeway" along the Link Road and Dock Expressway within the MBPT's landed estate as an extension of Eastern Express Highway to the Gateway of India. "East Island Freeway" is planned basically to flow city traffic rather than port-related traffic. Since the above-mentioned container-dedicated road could reduce city traffic congestion and MBPT's landed estate have to be utilized basically for dealing port-related activities, precious space for the container-dedicated road should be reserved for this Master Plan.

d) Deepening both the Basin and the Approach Channel to -11.0m

Indira Dock and the Approach Channel were designed to be deepened at -9.8m and -7.6m respectively. Since the tidal range of MBP is 5.2m, the Approach Channel was designed at a depth of -7.6m by utilizing tide for ship's entering/departing Indira Dock so as to minimize capital and maintenance dredging costs. Both the basin of the proposed container berths, whose berthing pocket area is deepened to -13.5m, and the Approach Channel are planned to be deepened up to -11.0m.

In addition, the layout of the off-dock container depots are shown in Figure 3.1.2-3. 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.

802 G. slots and 240 G. slots of empty container yards are planned in Victoria Dock Container Yard and at ID-1 within the dock area. Although 2,299 G. slots of off-dock empty container yard are required to be prepared in off-dock area, 972 G. slots in CDW and 1,140 G. slots in TPS can only be planned within the off-dock area whereas 187 G. slots are in short supply.

3) Operational Conditions for Cargo Handling along the Proposed Container Berths

During the monsoon season from the middle June to the end of September, the significant waves generated by the SW monsoon winds enter the Mumbai Harbour. On the other hand, during the remaining monsoon season from October to June, the harbour is calm due to prevailing wind direction of NE, namely land wind. In this regard, it is necessary to assess whether the critical wave height of 0.5m for cargo handling along the proposed container berths would be maintained on the required level generally adopted in the range of 90 to 95% of the year.

The non-excess probability of the critical wave height for cargo handling is estimated at approximately 90% in the SW monsoon and 97% throughout the year, which satisfy the above criteria[1].

4) Ship Maneuvering

Turning circle for the container vessels departing from the proposed container berths is designed for 2,500 TEU-size container vessels with a diameter of 520m which is equal to twice as long as LOA of 2,500 TEU-size container vessel. This turning circle is located a little apart from the corner of the Approach Channel and the basin. Designed depth of the Approach Channel and the basin is planned as -11.0m, taking into account the tidal range of 5.2m at MBP as mentioned above.

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[1] Master Plan Study by Bertlin and Partners (India)

3.1.3 The Short-term Development Plan for Port Traffic Facilities

(1) Present Port-related Cargo Traffic in and around MBP

The present port-related cargo traffic in and around MBP is presented in Figure 3.1.3-1. Average daily traffic volume of vehicles at each monitoring points is summarized in Table 3.1.3-1.

Table 3.1.3-1 Average Daily Traffic (Two-Directional) of Port-related Cargo by Vehicle Type

(unit: vehicles/day)

Monitoring Point	Trucks + Lorries	Containers	Tempos	Cars + Taxi	Auto Rikshaw	Two-Wheelers	Buses	Grand Total
1. P D'Mello Road	**11,616**	**2,157**	4,703	10,020	594	5,478	907	35,475
2. Link Road	**2,064**	**4,898**	49	5,272	0	3,865	4	16,152
3. Cotton Green	**11,461**	**966**	3,277	3,277	155	4,390	52	23,578
4. Wadala Flyover*	**5,901***	**2,131***	1,143*	10,123*	235*	4,241*	1,344*	25,118*
5. Everard Nagar Jnc. (Cembur Point)	**22,697**	**3,308**	8,570	26,424	10,833	9,763	12,270	93,865

Remarks) * represent data on 29th of September, 1997, because data on 13th of October seems outlier.

(2) Forecast Port-related Cargo Traffic and Flow Assignment in and around MBP

Peaking daily traffic volume of port-related cargo in 2007 is estimated by using computer simulation based on the future volume of container cargo, break and dry bulk cargo to be handled at MBP taking account of modal split between road and rail, and assigned to each roads. All the port-related cargo traffic is assigned to container-dedicated road, Link Road and Anik-Everard Nagar Road up to Everard Nagar Junction without merging city traffic (Figure 3.1.3-2). Estimated results are summarized and compared with the counted daily traffic volume in Table 3.1.3-2.

(3) Dedicated Road to Evacuate Containers from Dock Area

Dedicated road for container traffic would be essential to smoothly flow container traffic between on-dock container yard and off-dock CFS and empty container yard. The dedicated road

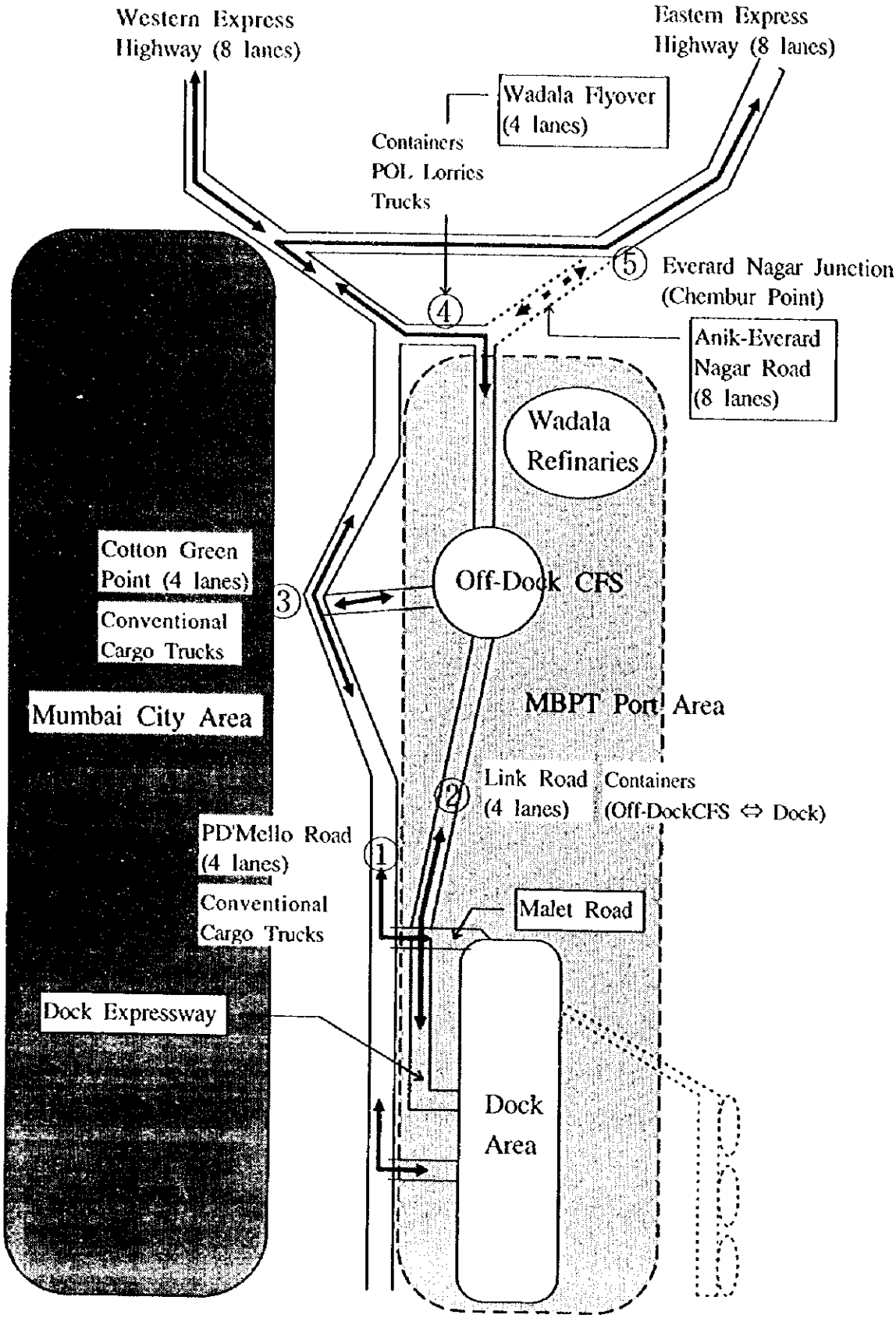


Figure 3.1.3-1 Present Port-related Cargo Traffic Flow Pattern in and around MBP

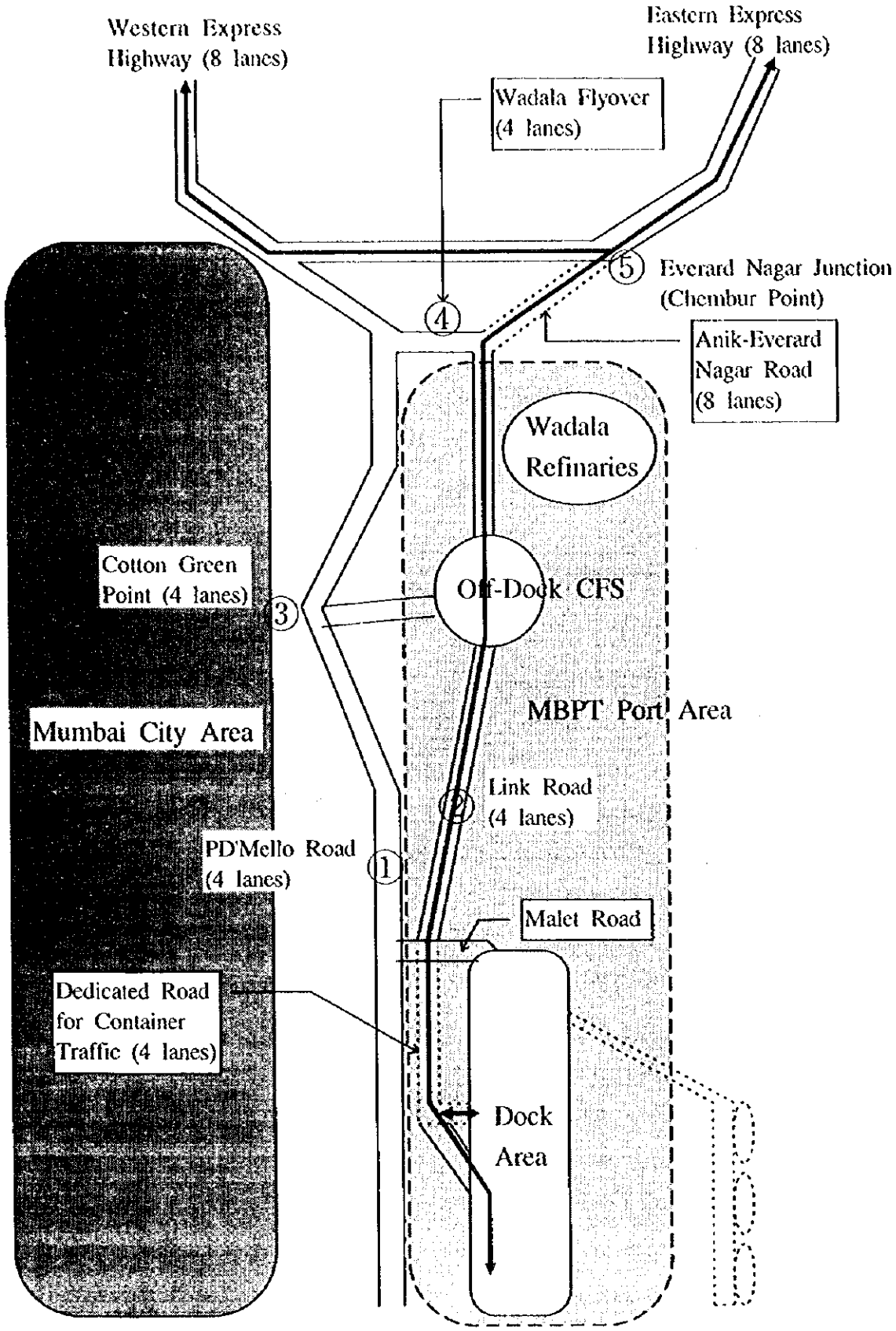


Figure 3.1.3-2 Port-related Cargo Traffic Flow Assignment Plan in and around MBP

starts from the gate of Victoria Dock Container Yard and extends to and connects with the Link Road. The fly-over structure is adopted for the dedicated road to cross over Malet Road so as to smoothly evacuate containers out of the dock area. Heavy traffic congestion currently seen at the junction of Dock Expressway and Malet Road is expected to be reduced drastically by fly-over road.

Table 3.1.3-2 Estimated Peaking Daily Traffic (Two-directional) in 2007 in and around MBP

(unit: vehicles/day)

	Estimated Volume	① PD'Mello	② Link Road	③ Cotton Green	④ Wadala Fly-over	⑤ Everard Nagar Junction (Chembur)
1. Container-trailer (LCL) (Off-dock CFS⇔Docks)	4,206	-	4,206	-	-	-
2. Container-trailer (FCL) (Out-of-port⇔Docks)	3,744	-	3,744	-	-	3,744
3. Loose Cargo Trucks to/from CFS (Out-of-port⇔Off-dock CFS)	4,214	-	-	-	-	4,214
4. Break and Dry Bulk Cargo Trucks (Out-of-port⇔Docks)	8,056		8,056	-	-	8,056
5. POL Lorries (Out-of-Port⇔Wadala)	3,328	-	-	-	-	3,328
Number of Containers in 2007		-	7,950	-	0	3,744
Number of Containers in 1995-96		-	4,898	-	2,131	0
Number of Trucks and Lorries in 2007		0	8,056	0	0	15,598
Number of Trucks and Lorries in 1995-96		11,616	2,064	11,461	5,901	0
Number of Port-related Traffic in 2007			16,006	-	-	19,343
Number of Port-related Traffic in 1995-96		-	6,962	-	-	0

Dedicated road for ordinary port-related traffic along the container-dedicated road is planned within the port area to flow port-related traffic including general cargo trucks. This could also reduce traffic congestion on P D'Mello Road where heavy congestion by both port-related traffic and city traffic is always seen currently.

However, Mumbai Metropolitan Region Development Authority (MMRDA) is planning to build "East Island Freeway" along the Link Road and Dock Expressway within the MBPT's landed estate as an extension of Eastern Express Highway to the Gateway of India. "East Island Freeway" is planned basically to flow city traffic rather than port-related traffic. Since the above-mentioned container-dedicated road could reduce city traffic congestion and MBPT's landed estate has to be utilized basically for dealing port-related activities, precious space for the container-dedicated road should be reserved for this Master Plan.

Additionally, the numbers of lanes of container-dedicated road, Link Road and Anik-Everard Nagar Road are examined to be adequate for serving the projected traffic volume for the year 2007.

3.2 Major Facilities and Cost Estimation of Construction Work

3.2.1 Major Facilities for Project

As a result of the Master Plan study, a container terminal redevelopment plan focusing on the -13.5m offshore container berth, the Victoria Container Yard and related offdock container yards with dedicated container road has been sorted out as the Short-Term Plan. Figure 3.2.1-1 shows the locations of the structures and facilities to be included in the Short-Term Plan.

3.2.2 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) Customs duties for the procurement of container handling equipment are included in the cost estimation.

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

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

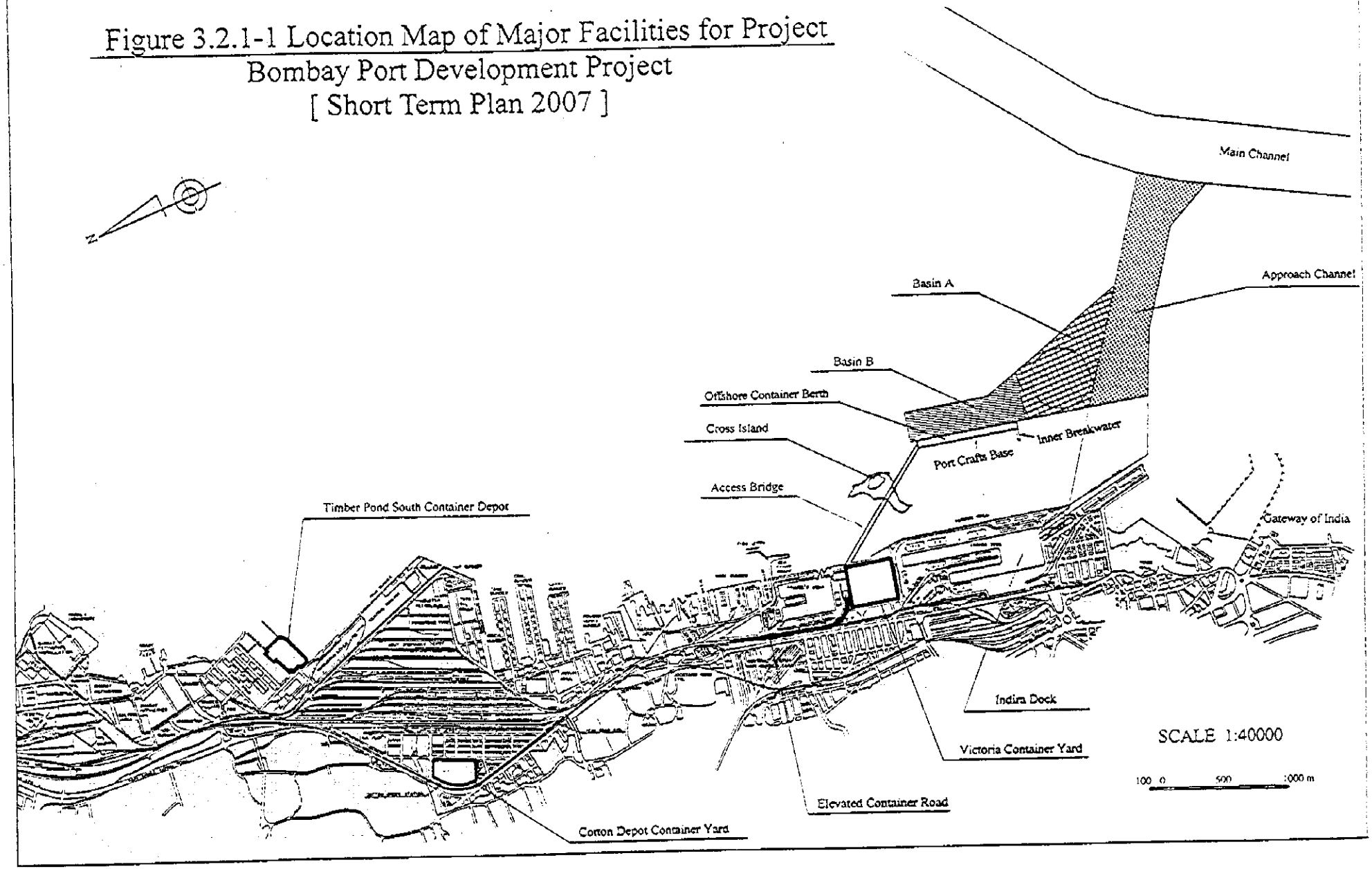
Table 3.2.2-1 shows the preliminary construction costs of the Short-Term Plan as broken down into the foreign and local currency components. As can be seen from Table 3.2.2-1, the total Project cost is estimated at Indian Rs. 20.00 billion, of which Rs. 11.32 billion represent the foreign currency portion and Rs. 8.68 billion the local currency portion.

Table 3.2.2-1 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	585,600	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

Figure 3.2.1-1 Location Map of Major Facilities for Project
Bombay Port Development Project
[Short Term Plan 2007]



3.3 Implementation Program

3.3.1 Construction Works

(1) Construction of Offshore Container Berth

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.

(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.

(4) 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.

3.3.2 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 year early year of 2007.

Procurement of container handling equipment will be started in 2003 and completed in 2006. Table 3.3.2-1 shows the proposed construction schedule for the Short-Term Plan.

Table 3.3.2-1
Construction Schedule of Short Term Plan 2007

No.	Description	Quantity		Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	Remarks
					-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 Causeway section = 300 m
I-2	Victoria Container Yard															
	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															

3.4 Economic Analysis

3.4.1 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 opportunity in India.

All benefits and costs in the economic analysis are evaluated using economic price. 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.

3.4.2 Prerequisites for the Economic Analysis

(1) Base Year

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

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 "With-the-project" case, the container volume to be handled at MBP in 2007 and 2028 be limited to 886,000 TEUs and 677,000 TEUs respectively in the condition of the usage of dock facility together with general cargoes. The volume of general cargoes to be handled at MBP in "With-the-project" case is the same as that of "Without-the-project" case.

3.4.3 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.

(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 divert valued at border prices.

The Standard Conversion Factor makes up for this price difference.

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

(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 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 calculated 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 count rolled 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 agricultural sector in Maharashtra State 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 as 0.553.

3.4.4 Benefits of Short-term Development Plan

(1) Benefits Items

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

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

(2) Calculation of Benefits

The total benefits above items in Short-term Development Plan are shown in Table 3.4.4-1.

Table 3.4.4-1 Summary of Benefits in Short-term Development Plan

(Unit: Rs. million)

No.	Year	Ship waiti costs	Transport costs	New Berth Construction costs			Total
				Constructi	Maintenan	Re-Investn	
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

3.4.5 Costs of Short-term Development Plan

Following items are identified as Costs of Short-term Development Plan.

1) Construction costs of offshore container terminal

2) Operation and maintenance costs

3) Renewal investment costs

Summary of costs above items in Short-term Development Plan are shown in Table 3.4.5-1.

Table 3.4.5-1 Summary of Costs in Short-term Development Plan

(unit: Rs. million)

No.	Year	Construction cost	Capital Doredging Costs	Maintenance cost			Management Costs	Renewal Investment	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

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

(2) Sensitivity Analysis

In order to see if the project is still feasible when some factor are varied, several cases are examined. The results of the sensitivity analysis are shown in Table 3.4.5-1.

(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 3.4.5-1.

Table 3.4.5-1 Summary of 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.

3.5 Financial Analysis

3.5.1 Purpose and Methodology

Purpose of the financial analysis is to examine the viability of the project in the short-term plan and the financial soundness of the terminal management entity during the project life.

Figure 3.5.1-1 shows a flowchart of the financial analysis.

(1) Viability of the Project

The viability of the project is analyzed using the Financial Internal Rate of Return (FIRR) by means of the discount cash flow method.

When FIRR exceeds the weighted average interest rate of the total funds for investments of the project, the project is regarded as financially feasible.

(2) Financial Soundness of the Terminal Management Entity

Financial soundness of the terminal management entity is appraised with its projected financial statements (income statement, cash flow statement and balance sheet). The appraisal is made from the viewpoints of profitability, loan repayment capacity and operational efficiency.

3.5.2 Prerequisites of the Financial Analysis for the Container Terminal

(1) Scope of the Financial Analysis

Scope of this financial analysis is as follows:

1) All the construction work of the new container terminal including offshore container berth, access bridge, Victoria dock CY, container handling equipment, control office and gates.
2) Dredging of basin, approach channel and navigation buoys
3) Road improvement in dock area
4) Cotton Depot CY and Timber Pond South CY and container handling equipment

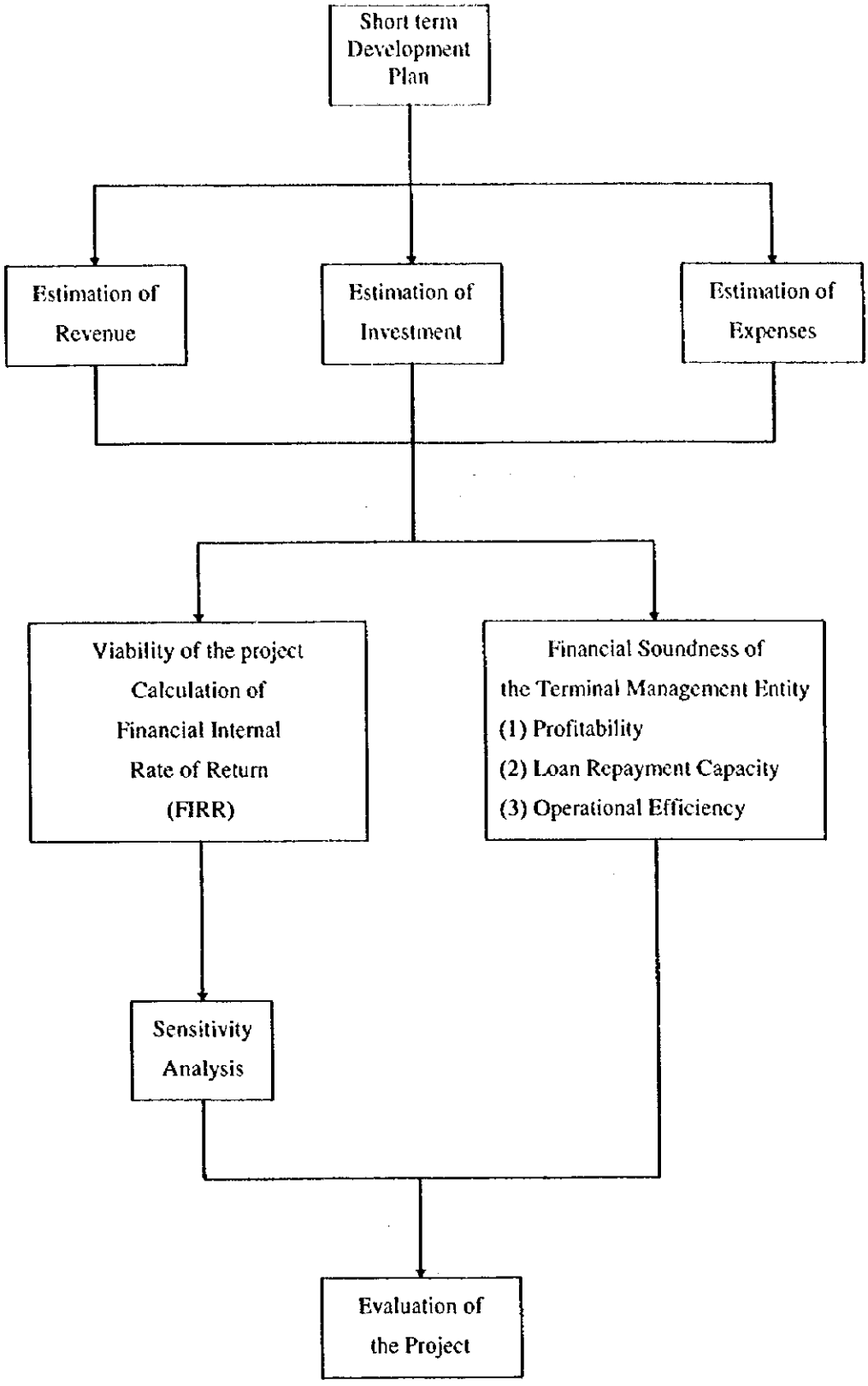


Figure 3.5.1-1 Flowchart of the Financial Analysis

(2) Project Life

Project life is 30 years from the beginning of the project. It includes eight years of detailed design and construction work of the above mentioned port facilities.

(3) Base Year

All costs, expenditure and revenues are indicated in prices as of 1997, when the price survey was conducted. Neither inflation nor an increase in nominal wages are considered during the project life.

(4) Fund Raising

Fund raising is divided into two kinds, foreign and domestic funds. In the projects, all costs of foreign procurement are assumed to be raised by foreign funds (soft loan) and the domestic procurement costs are assumed to be raised by domestic funds in principle. The required money for domestic funds is financed by the nationalized banks. Conditions of loans are as follows:

1) Foreign Funds

Loan period	: 30 years, including a grace period of 10 years
Interest rate	: 1.8 %
Repayment	: Fixed amount repayment of principal

These are OECF's in 1998. Its upper limit of finance is the total amount of foreign procurement or 85% of the total project, whichever is higher.

2) Domestic Funds

Loan period	: 10 years
Interest rate	: 14% (prime lending rate)
Repayment	: Fixed amount repayment of principal

3) Weighted Average Interest Rate

3.63% (1.8%*0.85+14%*0.15)

(5) Cargo Handling Volume

The cargo handling volume that will be handled in the new container terminal and Ballard Pier will reach the upper limit (one million TEUs) in 2008. Annual container traffic at the new container terminal is assumed to be 830,000TEUs. It is assumed that operation of the new

container terminal will start in May 2007. Therefore the throughput in 2007 is assumed to be 553,333 TEUs.

In case of "Without-the-project" case, the number of containers handled in the Port of Mumbai is assumed to decrease to 264,000 TEUs in 2007. Incremental traffic is 490,666 TEUs in 2007 and 736,000 TEUs from 2008.

(6) Revenues

Calculation of revenues from port activities is based on the present and revised tariff system and future cargo handling volume. Charges obtained from the operation of the new container terminal are as follows:

1) Charges from Vessels (the present tariff is used)

1) Port due	US$ 0.17 per GRT
2) Fees for pilotage and towage	US$ 0.24 per GRT
3) Berth hire charge	US$ 0.14 per GRT

Incremental revenues from container vessels are the difference between "With-the-project" case and "without-the-project" case. In "Without-the-project" case, it is assumed that the average size of calling vessels is 17,000 GRT (Loading capacity is 800 TEUs.) and the number of calling is 339.

2) Container handling and movement fee

Port of Mumbai does not adopt a tariff system consistent with closed container terminal system, therefore the following tariff is used.

Per TEU	Loaded	Empty
1) From ship to CY or vice versa	Rs.2,600	Rs.2,100
2) From CY to truck or vice versa	Rs.400	Rs.400

3) Stuffing/destuffing charge

20 feet	Rs. 600
40 feet	Rs. 1,200

4) Container Storage Fee

It is assumed that all the import (export) containers are received by consignees (loaded into vessels) within seven days. Container storage charges or demurrage are not considered.

5) Wharfage

a) Export (Factory stuffed container)

20 feet	Rs.1,000 per unit
40 feet	Rs.2,000 per unit

b) Export (CFS stuffed)

20 feet	Rs.832 per unit
40 feet	Rs.1,664 per unit

c) Import (Factory/CFS destuffed)

20 feet	Rs.1,365 per unit
40 feet	Rs.2,730 per unit

d) To/from ICD by rail

20 feet	Rs.1,300 per unit
40 feet	Rs.1,950 per unit

(7) Expenses

1) Investment in capital assets

According to the construction schedule, investment will be done. Cargo handling equipment will be replaced after service life with internal fund. Service lives are as follows:

Quay side gantry crane, RTG	: 15 years
Vehicles, trailers, fork lift truck, top lift truck	: 10 years

The annual depreciation of the container handling equipment is calculated by the straight line method. In this analysis, residual values at the end of the project life are not considered.

2) Dredging cost

The following maintenance dredging cost is included in the maintenance cost.

Approach channel	Rs.124,131,000
Basin	Rs.40,245,975
Total	Rs.164,376,975

3) Maintenance and repair cost

Annual maintenance costs for the port facilities are calculated as follows:

Infrastructure	: 1% of the construction cost
Equipment	: 4% of the procurement cost

4) Personnel and administration cost

Estimation of annual personnel cost is based on the required number of employees and future average pay scales. The future average pay scale is assumed to be 20 % higher than the current average pay scales of MBPT considering the future raise and welfare costs.

Administration cost (material cost) is assumed as 25% of total personnel cost considering increase of administrative cost and modernized management system in the target year.

Assumed numbers of personnel at the New container terminal and new CFSs are as follows:

- Container Terminal	594
-Cotton Depot	98
- Timber Pond South Depot	98
Grand total of personnel	790

Personnel cost per capita per annum	Rs.120,000
Administration cost per capita per annum	Rs.30,000
Total cost of personnel and administration	Rs.118,500,000

3.5.3 Evaluation of the Project

(1) Viability of the Project

1) FIRR

The calculation results of FIRR are 10.23 %(Total traffic) and 8.51 % (Incremental traffic). Both exceed the weighted average interest of the funds. (3.63%)

2) Sensitivity Analysis

Sensitivity analysis is conducted to examine the impact of unexpected future changes. (For example, cargo volume, construction cost, inflation or exchange rate)

The following cases are envisioned.

Case	Total traffic	Incremental traffic
a) Revenue decreases by 10%	8.85%	7.16%
b) Investment cost increases by 10%	9.17%	7.50%
c) Revenue down 10% and cost up 10%	7.83%	6.18%

In all the cases, FIRR exceeds the weighted average interest ratio of the funds.

3) Evaluation

Judging from the above results of analysis, this project is regarded as financially feasible under the assumptions in chapter 3.5.2.

(2) Financial Soundness of the Terminal Management Entity

1) Profitability

The rate of return on net fixed assets exceeds the weighted average interest rate of funds from 2007, the beginning of the operation.

2) Loan Repayment Capacity

Throughout the project life, the debt service coverage ratio exceeds 1.0. This means that there will be no difficulty in repaying long-term loans from the annual operating revenues.

3) Operational Efficiency

Both the operating and working ratios maintain favorable levels. It shows that the operation will be efficient.

(3) Conclusion

Judging from the above analysis, the base case projects are regarded as financially feasible. However, the terminal operator should make continuous efforts to secure forecast cargo volume, to improve cargo handling efficiency and to reduce operating expenses, especially personnel cost.

3.6 Improvement Plan of Management and Operation System for the Short-term Plan

3.6.1 Future Port Management and Operation System for MBP

(1) Organization of the New Container Terminal

The terminal operator of the new container terminal needs to establish the organization having the following divisions to manage a full-fledged container terminal.

1) Loading/unloading Division
   - Planning and operating loading/discharging
   - Receiving relevant information from shipping lines/agents
   - Providing information on vessels' arrival for related parties

2) Yard Control Division
   - Arranging necessary cargo handling equipment, operators and workers
   - Supervising the container handling operation in CY, controlling the flow of tractor trailers from outside the gates
   - Controlling inventory of containers stored in the container terminal
   - Compiling the data of storage fee and statistics

3) Gate Operation Division
   - Delivering/receiving containers at the terminal gates
   - Checking the document to be exchanged with trailer drivers
   - Checking container numbers and seal numbers
   - Checking the exterior of containers and damage of containers

4) Documentation Division

   a) Export section
      - Checking the booking of shipping lines/agents
      - Checking the permission of Customs
      - Compiling the data concerning detention charge

   b) Import section
      - Checking the data of cargo manifest
      - Checking the schedule of the container delivery by transporters or shipping lines

/agents

- Checking the permission of Customs
- Compiling the data concerning demurrage

5) Maintenance Division

- Maintenance of cargo handling equipment
- Maintenance of terminal facilities (e.g. a substation at CY, lighting facilities and electrical system of the refrigerated containers)
- Plugging/unplugging refrigerated containers
- Monitoring temperature of refrigerated containers

(2) Flow of Containers through the New Container Terminal

1) Export Containers

Terminal operator begins to receive export containers from a week before the arrival of the vessel. Shippers arrange tractor trailers and bring loaded containers to the Container terminal. At the gate of terminal, gate clerks check the exterior and seal of the containers. (In case of refrigerated containers, they also check the temperature of containers.) Then they weigh the containers on the scales. They input necessary data (container number, name of shipping company, name of vessel, port of discharge, size of container, weight, cargo description, customs clearance is done or not) into a terminal computers at gate house. Gate clerks instruct the stacking location of containers. At the same time, this information is transmitted to operators of RTGs via Yard Operator from Gate clerks. The driver of tractor trailer goes to the designated place of CY and waits for an RTG. An RTG moves to the place where the tractor stays. Then the RTG picks up the container from the trailer and stacked in the designated slot. After arrival of a vessel, RTGs pick up containers and load them onto yard trailers according to the working schedule prepared by the ship loading planner. Yard trailers carry the containers to the place below the designated quay side gantry crane. According to the working schedule, quay side gantry cranes pick up the containers from yard trailers and load the containers into the designated slot in hold or on deck of a vessel.

2) Import Containers

The ship planner receives documents related to the import containers (bay plan of vessel,

cargo manifest, hazardous cargo list, information on refrigerated containers and special cargoes) at least three days before the arrival of the vessel from the shipping line/agent. The ship planner considers above mentioned information very carefully and prepares the unloading schedule to make operation time shortest. After the berthing of the vessel, operators of quay side gantry cranes unload containers from the vessel to yard trailers according to the unloading schedule. Yard trailers move containers from quay side to the designated place in CY. RTGs pick up the containers from yard trailers and put them on the designated locations. After finishing unloading containers, a shipping line/agent notices the arrival of the vessel to each consignee. At the shipping line/agent office, consignees get D/O in exchange of B/L. Then the consignee inform the documentation division of the container terminal when to pick up the container. Documentation division of the terminal checks D/O and permission of Customs clearance or bonded transportation. Demurrage or other charges are recovered at the release of the containers, if necessary. Then documentation division sends the delivery application to yard control division. Yard control division checks the yard plan with the delivery application by consignees and makes the list of containers for delivery. Drivers of container trailers arranged by consignees presents D/O to the gate clerks at the gate house. The gate clerks check D/O against the list of containers for delivery. If the container is on the list, the clerk let the driver go to the designated location for receiving the container. Yard operator instructs a operator of RTG to pick up the container for delivery. The operator of RTG checks the number of the container and RTG picks up the container from the stack of containers and loads it onto the trailer. The driver of trailer stops at the out lane of the gate where the gate clerk checks the exterior and seal of the container.

3.6.2 Training Methods for Port Employees

In the opening of the new container terminals under the closed terminal operation system at the port of Mumbai, it will be necessary to train employees to acquire operational know-how and skills to control containers within the terminals.

For the personnel at a control office, it is necessary to invite several foreign experts specializing in yard planning, stowage planning and documentation, to assist in on-the-job training.

For the operators of newly introduced machines such as quay side gantry cranes and RTGs, machine manufacturers generally dispatch operational instructors in the beginning of the operations. They will transfer operational skills mainly by on-the-job training using machines newly procured at the actual container yard.

A modern container terminal must have its own maintenance shop for container-handling machines within the terminal. It is also expected that manufacturers of newly introduced machines dispatch maintenance engineers to give on-the-job training to ports' engineers/mechanics at the work shops in the beginning of the operations.

Prior to on-the-job training, it is advisable to have theoretical training the newly introduced technology in the various fields. This would include lectures by the respective experts.

Once personnel of the new terminal obtains the above technology of container-handling operations from foreign experts, in turn, some of them could become instructors for new comers who will be recruited or transferred from other sections.

3.6.3 Other Improvement Plans

(1) Simplified Procedure for Disposal of Uncleared Cargoes

To shorten the period to finish the required procedures, amendment of the Customs Act and Major Port Trust Act is necessary, but this may be difficult. By introducing the computer system, it is possible to simplify and speed up, to some extent, the procedures for disposal of uncleared cargoes without the amendment of the Acts. It will not be necessary to enter same information on uncleared cargoes in documents repeatedly once necessary information is inputted into a terminal computer before discharging of cargoes. Based on the clearance information from Customs computer system, computer can extract the necessary information on uncleared cargoes and compile and output the list of them. Computer can store the information on valuation and compile the data base of valuation of cargoes by category. Staff can refer to this data system when they decide the minimum bidding price for the public auction. This is another merit of the computer system. Since the minimum bidding price is based on the market price (retail price), the price may not be attractive for potential bidders. It is recommended that the wholesale price should be used at the valuation of uncleared cargoes

to attract potential bidders.

(2) Simplified Procedure for Bonded Transport

It is recommended that comprehensive permission of bonded transport system should be introduced in case of containerized cargo. If a shipping line or a transporter nominated by a shipping line/agent transports containers in bond continuously from the dock to the specific container depots(CFSs)/ICDs in the country and vice versa, authority should give them comprehensive permission within a certain period. Once getting this permission, the shipping line/agent or the transporter does not need to get the permission of bonded transport individually during the period.

Besides the comprehensive permission, it is advisable to use the computer system to simplify and shorten the time of processing for bonded transport of containers.

3.7 Environmental Impact Assessment

3.7.1 General

(1)Environmental Quality Standards in India

The standards for several environmental parameters are briefly reviewed, i.e. effluents discharge to marine coastal area, other marine water quality, the ambient primary and secondary standards for gaseous pollutants, and the ambient air quality standards in respect of noise. All standards are being followed as per "The Environment Protection acts/Rules, 1986" and subsequent amendments by MOE&F and standards prescribed by MPCB. The international standards for gaseous pollutants and noise impacts are also reviewed.

(2)Overview of Existing Environmental Situation in India

1) Introduction

The Govt. of India is emphasising conservation, protection and preservation of the environment to maintain the Indian ethos, culture and traditions. The Indian Constitutions enjoin the "Status to take measures to protect and improve the environment and to safeguard the forests, lakes, rivers and wild life of the country."

2) EIA capability

The Ministry of Environment and Forest (MOE&F) is assigned the Environmental Impact Assessment study for development of projects prior to any investment decision.

3) EIA Procedures

EIAs are generally carried out as per Environmental Procedure and Guidelines issued by MOE&F, 1994. The Port and Harbour Project is one of the projects listed in schedule in the EIA Notification, 1994. It is intended that the suitable procedure will be followed along the guidelines given in the following documents:

- Environmental Guidelines for Port and Harbour Project, MOE&F, Govt. of India, 1989.
- World Bank Environmental Assessment Source Book, Volume II - Sectoral Guidelines, Environment Department.
- Environmental Guidelines for selected Infrastructure Projects, Asian Development Bank.

The Environmental Appraisal Committee will scrutinise the documents submitted by the investors with help of multi-disciplinary staff complement functioning in the MOE&F.

4) Existing environmental quality in India

a) Water pollution

Water pollution is becoming acute in many regions of India due to direct discharge of wastewater to the water courses. Investigation by the Central and State Boards for the Prevention and Control of Water Pollution shows that the major sources of pollution of natural water courses including coastal waters are the discharge of community waters from human settlements. Most of the community and industrial waste water are discharged off into water courses, rendering it unfit for drinking water sources.

b) Air pollution

The problems of air pollution are becoming severe in major cities in India. A high background dust level during certain period/season aggravates the problematic situation. The level of sulphur dioxide, oxides of nitrogen and particulate matter in certain major cities exceed the permissible limits specified by organisations like World Health Organisation (WHO).

c) Noise pollution

In major cities and big towns, the noise pollution is very much serious. There are few laws to control noise but not sufficient.

d) Land pollution

Pollution of land causes recently largely from unproper disposal of solid waste and irregular solid waste management technique. Open dumping is common process in India for solid waste treatment. This serves serious breeding ground for pests and disease carrying vector.

e) Environmental problems and actions in India

The environmental problems in India are classified into two broad categories: Problems arising from conditions of poverty and underdevelopment, and Problems arising as negative effects of the very process of development.

Current various environmental problems and Indian Government's actions against them are briefly mentioned.

3.7.2 Description of the Short-term Development Plan

Project components of the Short-term Development Plan for the year 2007 are 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. The project components are summarized in Table 3.7.5-1.

3.7.3 Description of the Existing Environment

(1)Coastal Environmental Setting in Mumbai

As coastal environmental setting, the following basic subjects were briefly summarised., i.e. geology and geomorphology, soils, ground water, flooding spots, climate, agriculture, forest (vegetation and wet lands), land use, socio-economics, wet land, fisheries, marine ecology, fresh water supply and quality, coastal water quality and beach water quality (waterfronts quality), waste water and water reuse, historical interest and tourism, industrial areas, and transport.

(2)Overview on Existing Environmental Quality in and around The Port of Mumbai

a) Baseline environmental conditions

In order to establish the existing environmental conditions in and around Mumbai Port, base line studies, including field survey, have been carried out, which covered the existing environmental attributes, i.e. water quality, air quality, noise, marine ecology, etc.

b) Water quality

The data of water quality, monitored for 26 parameters at various locations in the harbour region of MBP, were summarised. National Institute of Oceanography (NIO) has studied the marine water quality within the port limits in Nov/Dec, 1996. The followings are a part of their findings:

Table 3.7.2-1 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)	19,200	---
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

- pH value of the bay ranged from 7.8 to 8.0, which is fairly constant.
- Dissolved oxygen ranged from 0.6 mg/l to 8.3 mg/l in the main bay and average value was above 3.5 mg/l. DO values in the Docks and Bunders were less than 2.5 mg/l, which indicates the organic pollution, and DO value in Timber Pond area was of 7.9 to 8.1 mg/l, which appears high due to algal photosynthesis in the water.
- Nitrate, Phosphate, Nitrite and Ammonia values were high with respect to standards for natural coastal water. This may be due to the indiscriminate discharge of waste water from fertilizer industries and spillage during unloading operations of fertilizers.
- Concentration of nutrients was high in most of the docks and Bunders. A maximum phosphate value of 1361µg/l was abnormally high in Lakdi Bunder, Haji Bunder, Timber pond and Sewri mud flat area.
- Petroleum Hydrocarbon values in the bay were higher (17.4 µg/l) than standards for clean coastal waters, and the values were high in most of the docks and Bunders (34 µg/l), but in the fishery jetty the value was 49.1 µg/l.

c) Air quality

The previous data of ambient air quality at 12 locations in MBP premise were reviewed with respect to SO_2, Nox, NH_3, and SPM. The air quality status '96-97' of various locations of 10 km radius area was collected to ascertain the surrounding air quality pollution in Mumbai Port.

The Air quality of most of locations is polluted with Suspended Particulate Matter (SPM), which shows concentration beyond permissible limits but SO_2 and NOx concentrations are within prescribed standards in all locations except Khar area.

d) Noise pollution

Noise survey has been carried out by MCGB. Although observations on noise levels in Mumbai were limited to day time only, they indicated that noise level was in the range of 70 to 88 dB(A) during peak traffic hours, 55-85 dB(A) in residential areas and 62-86 dB(A) in commercial areas. Traffic was the major contributor to the noise pollution in the city near the airport, where the noise level was in the ranges of 90-94 dB(A).

e) Marine flora and fauna

The average concentration of phytoplankton pigments inside the docks (Indira, Prince's

and Victoria) was 2.0 mg/m^3, whereas 22.3 mg/m^3 average concentration in other docks/ bunders. An information on zooplankton biomass and zooplankton with macrobenthic was reviewed briefly.

f) Fisheries

The fisheries potential is moderate in the Mumbai harbour area and the average value of catch rate was 53 kg/hr. The catch rate near Butcher island (Jawahar Dweep) in Nov., 1996 was 45.4 kg/hr, whereas in Harbour area the rate was 60.3 kg/hr.

There is no fishery production zone /capture zone along the coast line of Mumbai region.

g) Environmental status identification

Present environmental problems, involving 16 subjects, were summarised with such items as area where the problem occurs, nature of activity, major environmental problems, mitigative measures, and some remarks.

3.7.4 Baseline Environment Quality Survey

(1) Air Quality

To establish the baseline conditions, the present study carried out the ambient air quality survey in and around the Port of Mumbai. The survey was conducted once each weekday and holiday during the wet season and the dry season. As sampling points, the following five stations were selected:

- P.D'Mello Road (AQ-1)
- Link Road (AQ-2)
- Cotton Green Stations (AQ-3)
- Wadala Flyover (AQ-4)
- Chembur - Near Priyadarshini (AQ-5):

At each station, monitoring was carried out continuously for 24 hours using High Volume Sampler(HVS). Samples for CO were collected by using instantaneous sampling method. The result of survey for the ambient air quality was briefly summarized as follows:

a) Suspended Particulate Matter(SPM)

The concentration of SPM in the wet season was found high at all locations, having a maximum value of 1112 μg/m^3 on weekday at the station AQ-3, while a minimum value of

273.7 $\mu g/m^3$ on holiday at the station AQ-2. In the dry season, the high concentration of SPM was found at all locations, having a maximum concentration of 863 $\mu g/m^3$ at the station AQ-3, while a minimum concentration of 313.5 $\mu g/m^3$ at the station AQ- 2.

It is apparent from these results that the concentration of SPM exceeds the limits of 200 $\mu g/m^3$ stipulated by CPCB.

b) Sulfur Dioxide(SO_2)

In the wet season, a maximum concentration of SO_2 was found 51.9 $\mu g/m^3$ at the station AQ-1 and AQ-5, while a minimum concentration of 29.5 $\mu g/m^3$ at the station AQ-2. In the dry season, a maximum concentration of SO_2 was found 64.2 $\mu g/m^3$ at the station AQ-3 on weekday, while a minimum concentration 30 $\mu g/m^3$ at the station AQ-2 on holiday.

It is apparent that the concentration of SO_2 is below the limit of 80 $\mu g/m^3$ prescribed by CPCB.

c) Oxides of Nitrogen (NOx)

In the wet season, the concentration of NOx ranged from 11 $\mu g/m^3$ to 26 $\mu g/m^3$. In the dry season, the concentration of NOx ranged from 16 $\mu g/m^3$ to 33 $\mu g/m^3$. The Concentration of NOx for both wet and dry seasons was found to be below the limit of 80 $\mu g/m^3$ prescribed by CPCB.

(2) Noise

The noise quality survey was conducted once during the wet and dry seasons at the same location where the air quality monitoring survey was carried out. The survey was carried out continuously for 24 hours by using a portable sound level meter.

In the wet season, noise levels ranged from 80 dB(A) to 96 dB(A), while a maximum instantaneous noise level was 106 dB(A) at the station NQ-5. In the dry season, noise levels varied from 81 dB(A) to 88 dB(A) at the station NQ-4. High noise levels were observed at all the monitoring stations, which may be attributed to the high traffic density and heavy traffic congestion at all locations. The noise levels exceeds the limit prescribed by CPCB.

(3) Vibration

Field survey pertaining to the vibrations was done on both weekday and holiday for both dry

and wet seasons during the course of air quality monitoring. The vibration was measured at the same locations where the air quality survey was carried out. The vibration was recorded at 15 minutes intervals continuously for 24 hours.

In the wet season, a maximum instantaneous vibration was found to be 186 μ at the station VQ-5, while a minimum instantaneous vibration level 4 μ at the station VQ-4. In the dry season, a maximum instantaneous vibration was found to be 169 μ at VQ-5.

It is apparent from these results that the vibration levels are high at VQ-5 during both wet and dry seasons, resulting from the high traffic density there.

(4) Water Quality

The water quality survey including sea bottom material (sediment) was carried out for consecutive 7 days for both wet and dry seasons. The sampling was done for both low tide and high tide time. Five following sampling points were selected:

- Pir Pau (At Trombay) : WQ - 1
- Butcher Island : WQ - 2
- Cross Island : WQ - 3
- Indira Dock : WQ - 4
- Naval Dock : WQ - 5

Sea bottom material samples were collected by using the Eckman Dredge sampler. The samples were collected in the wet season and the dry season.

a) Water quality

In the wet season, pH of water samples ranged from 7.5 to 7.8. Water temperature was reported to be between 29°C and 31°C at all sampling stations. DO varied from 5 mg/l to 6.4 mg/l. BOD was found to be between 2 mg/l and 22 mg/l. COD varied from 8 mg/l to 183 mg/l. The concentrations of pH, temperature, COD, phenolic compounds, ammonical nitrogen, Cd, Cu, Cr^{6+}, Zn, Ni, Pb, and Fe were found to be less than the tolerance limit for harbour waters. In the wet season, pH of the water samples ranged from 8.0 to 8.5. Water temperature varied from 30°C to 31°C at all locations. DO was found to be between 6.2 mg/l and 6.8 mg/l. BOD varied from 3mg/l to 8.0 mg/l. COD, phenolic compounds, ammonical nitrogen, Cd, Cu, Cr^{6+}, Zn, Ni, Pb, and Fe were found to be less than tolerance limit for harbour waters.

b) Sediment quality

Data pertaining to the sediment analysis indicated that the clay and silt particles were more than the fine sand in the wet season. At all locations, the density of the sediment samples varied from 1.019 gm/ml to 1.207 gm/ml in the wet season, while between 1.211 gm/ml and 1.342 gm/ml in the dry season. COD was found to be between 0.40mg/g and 0.85mg/g in the wet season as well as in the dry season. Cd and Hg were reported to be nil at all sampling stations.

3.7.5 Identification, Forecast and Assessment of Environmental Impacts

Major components of the Short-term Development Plan are 1) off-shore jetty-type container berths, 2) Victoria Dock Container Yard, 3) dedicate road for container traffic, and 4) Deepening both basin and approach channel.

Since off-shore jetty-type container berths and its access bridge are designed as water-through structure, no significant adverse effect is anticipated on tidal current. Victoria Dock Container Yard is planned to be built on reclaimed Victoria Dock. Since reclamation of the dock may not cause any significant adverse effect on open-sea. Dedicated road for container traffic will change traffic flow in and around MBP. All the port-related cargo traffic is assigned to container-dedicated road, Link Road and Anik-Everard Nagar Road up to Everard Nagar Junction without merging city traffic. Reduction of the port-related cargo traffic is anticipated on P D'Mello Road, Cotton Green and Wadala Flyover, while an increase of the port-related traffic is anticipated on Link Road and Anik-Everard Nagar Road. Therefore, vehicle emission along those points will be further studied in the following Section. Since heavy metals of Cd and Hg, and Arsenic were not detected in the bottom sediments during the field survey, handling of dredged materials does not pose a potential impact from heavy metals.

3.7.6 Environmental Protection Measures

(1)Reclamation Work of Victoria Dock

Soil quantity required for reclamation of Victria Dock is estimated as 1.3 million cu. meters. At the first stage of the land reclamation works, the filling-in soils will be carried by hopper barges and dumped directly into the basin, as the barges can enter the basin through the existing dock gate. After construction of closing structure at the place of the existing dock gate, filling-in materials will be unloaded through the Victoria Dock harbour walls and conveyed by bulldozers. The following countermeasures shall be considered when designing the reclamation method.

1) During the period of dumping soils by hopper barges, a line of movable flexible curtain type turbidity diffusion protector shall be installed around the entrance of the dock gate.
2) At the final stage of dumping solids, hopper barges with shallow water depth shall be selected to promote reclamation works.
3) When the water depth becomes too shallow to dump the solids directly, the existing dock gate shall be closed with a suitable structure. After construction of the wall there, one waste way shall be provided at a seaside corner of the dock.
4) Lower the water level in the dock as low as possible to reduce the volume of spillage to be treated.
5) To reclaim the basin from seaside toward land side to secure enough distance to an outlet gate.
6) To provide a flexible curtain type turbidity diffusion protector around the outlet gate.

(2)Dredging Work of both Basin and Approach Channel

Drag suction dredgers generally perform overflow dredging, that is, muddy water overflows through the weir of her hopper during dredging in order to increase dredged soils in the hopper. This overflow of muddy water causes diffusion of turbidity over the dredging area widely. The most simple and reliable method to prevent such disadvantage is to stop loading mixtures in the hopper at the overflow level of the hopper.

It is difficult to prevent turbidity during grab dredging. However, a flexible curtain type turbidity diffusion protector is provided these days around the excavation area, particularly in

front of the bow of the grab dredger. Such kind of protector installed from the water surface level to near the seabed may be effective for reduction of diffusion of turbidity.

At the time of designing the protector, tidal current at the site, maintenance of the protector and anchoring system, and additional time required for shifting the protector in accordance with movement of dredging area shall be considered.

3.7.7 Conclusions of Environmental Impact Assessment

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.

Concerning dredging, since heavy metals of Cd and Hg, and Arsenic were not detected in the bottom sediments during the field survey, handling of dredged materials does not pose a potential impact from heavy metals. A flexible curtain type turbidity protector is recommended to be provided around the excavation area for grab dredging so as to minimize the impact on the ambient marine environment.. Concerning ambient air quality, no significant increase of SO_2 and NO_X are found and SO_2 and NO_X remains far below the tolerance limit (80 μ g/m^3) at selected five points along the roads in and around MBP for the year 2007. No significant increases of SPM are also found at those points for the year 2007, while the baseline concentration of SPM is exceeding the tolerance limit (200 μ g/m^3). Apart from these impacts which can be controlled to acceptable levels there are no environmental reasons against the project proceeding of the Short-term Development Plan.

CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

1. Necessity of Development of the Port of Mumbai

The Port of Mumbai (MBP) is the largest port in India in traffic volume and serve a wide hinterland, conspicuous in handling containers and petroleum.

1. The Port of Mumbai(MBP), administrated and managed by MBPT has been the largest port in India in terms of cargo volume handled. In 1995/96, MBP handled cargo of 34.0 million tons (16% of the total volume through the major ports in India) including container cargo of 6.7 million tons (518,000 TEUs, 40% of the total containers through the major ports), break-bulk/dry bulk cargoes of 5.7 million tons and 21.0 million tons of petroleum (22% of the total petroleum through the major ports) contributing to the economic activities in its hinterland, covering not only the Mumbai Metropolis composed of Greater Mumbai and New Mumbai and the remaining areas of Maharashtra State but also the west India including Gujarat State and the north India including the states of Delhi, Haryana and Punjab.

   Since the last major development which dates back to the early 1970s except for the construction of marine oil jetties, the volume of cargo passing through MBP has increased continuously along with the economic growth of India, and that has resulted in serious port congestion.

2. The major berths which accommodate sea-going vessels at present are placed inside the docks of Indira, Victoria and Prince's connected with the open sea through lock gates or pairs of miter gates and at Ballard Pier facing the open sea. The construction of these facilities dates back to the 1870s - 1910s. Indira Dock and Ballarad Pier were extended in the 1970s, which represented the last major development of the port apart from the installation of the marine oil terminals at Butcher Island and Pir Pau. Since the last major development in the 1970s, the volume of cargo passing through the port has increased continuously along with the economic growth of India, and that resulted in serious port congestion.

The Port of Jawaharlal Nehru (JNP) was constructed at Sheva Island in the Mumbai harbour and opened in 1989 as a deep-sea port specialized for handling containers and dry bulk cargo so as to receive overflowed cargo from the congested MBP.

3. To meet both the ever-increasing port demand and the requirement of deep sea berths to accommodate large-sized container vessels for direct shipping services or dry bulk carriers, the construction of new port facilities was proposed, and eventually, the construction of a new port at Sheva Island was decided upon (extension plan of MBP was another option). MBP is situated close to the densely-populated urban areas of Mumbai City (Greater Mumbai) and has a constraint of space limitation for extension on land, and it was considered that the depth of the surface of hard materials under the sea bed in front of the docks was insufficient in elevation for economical deepening by dredging in the light of the technical level at that time. The new port was named as Jawaharlal Nehru (JNP) and was opened in 1989. JNP has been developed as a port specialized for handling containers and dry bulk cargo which has berths of 13.5m deep, spacious yards and equipment designed for above-mentioned specific cargoes.

Even after the opening of JNP to where a considerable volume of dry cargo shifted from congested MBP, the volume of cargo handled at MBP showed a continuous and steady increase in dry cargo containing containers, break-bulk and bulk cargoes ,resulting in port congestion getting more serious year by year.

4. Even after the opening of JNP to which a considerable volume of dry cargo shifted from congested MBP as mentioned above, the volume of cargo handled at MBP located in Mumbai City with a population of around 12 million as a commercial and industrial center in India, however, showed a continuous and steady increase from 8.9 to 11.5 million tons in dry cargo containing containers, break-bulk and bulk cargoes from 1989/90 to1995/96. This represent an average growth rate of 4.3% per annum. The number of containers passing through MBP in the same period increased from 309,000 to 518,000 TEUs showing a high average growth rate of. 9.0% per annuin. Thus, port congestion has been getting more serious year by year in MBP as evidenced by an excessively-long berth waiting time of 4.5 days per calling vessel on average in 1995/96. Even container vessels, which are generally operated to provide regular

services, are often forced to wait for berthing off-shore; average berth waiting time of 2.5 days per vessel was recorded in the same year.

It is necessary to develop MBP to resolve the present problems and to meet increasing demand for the port.

5. Thus, to resolve the present problems and meet increasing demand for the port in the foreseeable future, development of MBP is necessary. To survive in the competitive atmosphere of today's international shipping and port business, major investment and improved business practices on the part of private sectors are required.

(1) Handling of Container

Water depths along the existing container berths are insufficient at MBP.

6. 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 water depth of those berths is only 9.8m, which can accommodate relatively small container vessels in the recent growing trend of container vessel size. Large container vessels provide a relatively low transportation cost especially on long distance routes such as India-Europe, India-East Asia and India-East Coast of America compared with medium-sized or small-sized container vessels. On the other hand, even on short distance routes such as India-the Middle East, India-Southeast Asia, India-East Coast of Africa and India-South Asia where containers are transported mainly by feeder services, feeder vessel size has shown an increasing trend. Thus, deeper container berths are required so as to reduce transportation costs to/from the trade partners of India without distinction of route distances.

There is a shortage of container-handling equipment, especially in quay-side container gantry cranes, contributing to low-container-handling productivity alongside.

7. As to container-handling machines, two quay-side container gantry cranes are installed only at

Ballard Pier and at the remaining container berths, Indira Nos.1-5, ship's gears are used to lift containers alongside. The shortage of quay-side container gantry cranes is a reason of low-container-handling productivity alongside. The average productivity at Indira Nos.1-5 is only 3.2 boxes per hour per gang in 1995/96, whereas 11.6 boxes per hour per gang was achieved at the container berth of Ballard Pier in the same year. On the container marshaling yard allocated behind the Bllarad Pier berth, three RTGs (Rubber-Tired Gantry) are installed, and on the remaining container yards inside the docks, reach-stackers are mainly used. Although reach-stackers are conveniently used in narrow space, they need more maneuvering space compared with other yard machines such as RTGs and straddle cranes, and therefore container stacking capacity is less.

The modern container terminal operation system is not yet introduced into MBP, resulting in excessively-low container-handling productivity and consequent long berthing times

8. At present, nobody controls the whole container-handling operations comprising stevedoring, hauling and stacking of containers without adopting the modern container operation system wholly controlled by a terminal operator that takes full responsibility for handling and storing containers after receipt or before delivery at the gate (referred to as "the closed terminal operation system"). Thus, container-handling operations alongside are done in chaotic conditions, resulting in excessively-low container-handling productivity and consequent long berthing times and long berth-waiting times.

Intricate on-chassis container traffic is found within the dock area due to scattered container stacking yards designated transporter-wise.

9. Within the dock area, the use of container stacking yards are permitted to shipping agents/lines by each operation, but actually designated and fixed in transporter-wise. Currently, over ten transporters are in operations and hence not so spacious "container parks" inside the docks are further divided into small yards and scattered inside the docks. In some container-handling operations alongside, transporter-wise designated container yards are not necessarily allocated adjacent to the operation site alongside, and hence on-chassis containers are hauled intricately

to the respective container yards by individual transporters within the narrow dock area.

It is necessary to allocate one million TEU containers per annum to MBP from the stage of the Short-Term Plan taking account of adequate functional allotment between MBP and JNP determined from various factors including potential capacity of container-handling, hinterlands and transport costs from the standpoint of the national economy.

10. To handle a large amount of containers through the two ports, MBP and JNP in the future, the amount needs to be allocated to MBP and JNP adequately considering various factors including potential capacity of container-handling, hinterlands and transport costs from the standpoint of the national economy. As to potential capacity in container-handling, the capacity of MBP is estimated to be approximately one million TEUs in the condition of preparing a new container terminal with a container marshaling yard prepared by converting the existing dock facilities without creating additional land off the docks and with jetty-typed off-shore berths connected to the marshaling yard by a bridge.

11. Currently, approximately one third of the total container cargoes through MBP and JNP originates from or is destined to Mumbai City. In case of short shipping distance routes as defined above where the container traffic volume accounts for approximately 50% of the total container traffic through the two ports at present, economical feeder vessel size is estimated to be in the range of 1,500 - 2,000 TEUs in lading capacity which could be received by MBP given the implementation of the proposed development. Hence, there is no difference in sea transport cost for containers on the short distance routes between MBP and JNP, and the total transport cost through JNP is higher than through MBP by land transport cost between JNP and Mumbai City. On the other hand, if water depths of JNP's container berths are kept intact, the maximum permissible limit to vessel drafts at MBP is the same as at JNP and the total transport cost through JNP is higher than through MBP by land transport cost between JNP and Mumbai City. In case when deeper berths are constructed at JNP and post-panamax typed vessels of 4,500 TEUs in loading capacity call at JNP, sea transport cost reduction exceeds the land transport cost between JNP and Mumbai City. In this case, however, costs for deepening the main channel from the present level and subsequent maintenance dredging must

be burdened to deploy post-panamax typed vessels, resulting no decisive difference between the total container transport costs through MBP and through JNP.

12. To reduce the detour transport of containers originating from or destined to Mumbai City through JNP by land, it is necessary to receive such containers at MBP as much as possible for the purpose of avoiding excessive road traffic congestion and consequent air and noise pollution caused by intricate hauling of container cargoes. In addition, not only in environmental but also in economical point of view as mentioned above, it is justified to make the most of MBP in container-handling. Currently, the hinterland of MBP in container transport widely covers not only Mumbai City but the areas of remaining Maharashtra State and the other states in the west and the north India, and in the future, the demand for container-handling at MBP is expected to be continuously generated from the latter areas, especially on the short distance routes showing no decisive difference between the sea transport costs through MBP and through JNP.

13. Although potential needs for handling container at MBP in the future is very large, one million TEU containers out of the total demand of 2.6 million TEUs in 2007 and 5.9 million TEUs in 2017 at MBP and JNP, are allocated to MBP due to its capacity limitation.

It is necessary to establish a full-scale new container terminal with deep berths and container-handling capacity of one million TEUs per annum at MBP by 2007.

14. Thus, to resolve the present problems mentioned above, meet a continuously increasing demand in container-handling and achieve economical container transport from the standpoint of the national economy, it is necessary to establish a full-scale new container terminal with deep berths and container-handling capacity of one million TEUs per annum at MBP by 2007.

(2) Handling of Conventional Cargo

In conventional cargo handling, adequate berth allocation appropriate to individual cargo package types is not done.

15. In conventional cargo handling in Indira, Victoria and Prince's Docks,, adequate berth allocation appropriate to individual cargo package types is not done, resulting in chaotic cargo-handling.

Conventional cargo is handled inefficiently and at the risk of cargo damage due to shortage of equipment, machines and slings appropriate to individual operations.

16. In loading/discharging bagged cargo such as rice and oil cakes onto/from vessels by ship gears, net slings are used at the risk of bag damage and subsequent cargo spill. In handling break-bulk cargo of other package types, net slings are also used at the same risk mentioned above. In handling long or/and heavy cargo such as coils, pipes and plates of steel products on dock-side, the shortage of forklift trucks is found in number and lifting capacity. In addition, attachments of forklift trucks designed to lift specified cargo efficiently and safely are not sufficiently prepared. In discharging dry bulk cargo such as phosphate rocks, sulfur and food-grains from vessels using ship cranes with grabs, hoppers placed alongside are used and their valves are not well maintained, resulting in cargo spill after trucks leave from hoppers.

It is necessary to improve conventional cargo handling operations by allocating specific berths by cargo type, viz. bag, dry bulk and long/heavy material, and preparing cargo-handling equipment, machines and slings appropriate to individual operations.

17. Thus, to resolve the present problems mentioned above, it is necessary to improve conventional cargo handling operations by allocating specific berths by cargo type, viz. bag, dry bulk and long/heavy material, and preparing cargo-handling equipment, machines and slings appropriate to individual operations.

18. The volume of conventional cargo is not expected to increase vigorously in the future, due to the anticipated shift of conventional cargo to container cargo through the progress of containerization. Given the construction of off-shore container berths, the existing berths inside the docks will be utilized exclusively for conventional cargoes.

(3) Handling of Petroleum

The shortage of the discharging capacity of the existing pipelines connected to the JD Nos.1-3 oil jetties is a bottleneck in handling petroleum, resulting in excessively long berth waiting times of tankers. The high increase in the volume of refined petroleum handled at MBP aggravates the congestion.

19. The shortage of the discharge capacity of pipelines connecting the Jawaharlal Dweep (JD) oil jetties Nos.1-3 at Butcher Island and the refineries at Trombay is a present bottleneck in discharging and loading petroleum through the jetties, resulting in excessively long berth waiting times of petroleum tankers, 5.2 days per vessel on average in 1995/96. These pipelines were designed to meet the original refinement capacity of 3.5 million tons per annum and have been left without replacement even after the expansion of refinement capacity up to 12 million tons per annum. The high increase in the volume of refined petroleum whose handling needs much longer berthing times than that of crude petroleum aggravates the congestion.

20. MBPT is proceeding with a project to replace the existing pipelines of 12 - 24 inches in diameter by larger-sized pipelines of 30-42 inches along with the renovation of discharging/loading facilities at the JD Nos.1-3 jetties (referred to as "the pipeline replacement project"). The project will be completed by the year 2003. It is said that additional storage tanks for petroleum could be installed on reserved land within the compound of the above refineries if required.

(4) Landed Estate of MBPT

Despite the effort of eviction of land which fell out of use or was no longer used for port-related activities for the recovery of port-related use and growing needs for more land for off-dock container depots, considerable portion of land is still left in non-port-related use.

21. The total area of landed estate under MBPT's control is about 753 ha most of which was created by reclamation from 1873 to 1907 and the part of land outside the docks was leased to private sectors on a long-term basis and was used for depots of port cargo such as raw cotton, grains, coal, timbers in log and manganese ore or sites for port-related manufacturers which imported raw materials or exported finished goods through MBP. Since then, the composition of port cargo commodity and package styles has changed drastically reflecting the progress of industrialization in India and the subsequent increase in containerized cargo. The dramatic progress of containerization in international shipping has accelerated the containerization at MBP.

22. To cope with the dramatic progress of containerization, MBPT has converted some areas under its control outside the docks which fell out of use or were no longer used for port-related activities into off-dock container depots after evicting the land from the former lessees. Despite such efforts and growing needs for more land for off-dock container depots, considerable portion of the landed estate of MBPT is still left in non-port-related use.

It is necessary to continue the effort of eviction of the leased land within the landed estate of MBPT so as to meet growing needs for more land for off-dock container depots to backup dockside operations done within limited space.

23. Thus, it is necessary to continue the effort of eviction of the leases land within the landed estate of MBPT so as to meet growing needs for more land for off-dock container depots, viz. container storage yards and CFS sites, to backup dockside operations done within limited space.

(5) Traffic within Landed Estate of MBPT

Presently, there is serious congestion in road traffic within the landed estate of MBPT and merging points with city roads due to insufficient port roads.

24. Presently, there is serious congestion in road traffic within the landed estate of MBPT and

merging points with city roads due to insufficient port roads. Though the traffic of tractor-trailer units for containers is partly separated from that of ordinary trucks by dedicated container roads, there is no fly-over and no elevated road, inducing congestion at plain cross sections. Within the landed estate of MBPT, city common roads run along the dock fences, and ordinary trucks are forced to use these roads together with city traffic in chaotic conditions to access dock areas. In addition, port roads merge with city roads at urban areas, causing congestion there. Presently, a new road with eight lanes which starts at the north end of the landed estate of MBPT and merges with the city road at Everard Nagar at the north outskirts of Mumbai City is being developed. From the merging point, the road is near the Eastern and Western Express Highways in the direction of the northern and eastern states and will be usable for port traffic.

It is necessary to improve the existing port roads so as to haul port cargoes smoothly within the port..

25. It is necessary to improve the existing port roads so as to haul port cargoes smoothly within the port.

(6) Main Channel

A project to deepen the main channel ("the main channel deepening project") is envisaged so as to save ship costs for waiting for high tide or reduce sea transport costs by deploying larger vessels such as post-panamax typed container vessels and crude petroleum tankers with deep draft.

26. The controlled water depths of Main Channel including Jawaharlal Nehru Channel extending from the entrance to JNP are in the range of 10.8 - 11m below CD. The deep-water berths, viz. JD No.4 oil jetty (14.3m) and JNP berths (13.5m) are located along and the end of the channel,, respectively. Within the channel, sedimentation occurs and therefore these water depths are maintained by maintenance dredging implemented from time to time. When a vessel with a deep draft approaches to or departs from these deep-water berths, she uses high

such situation, a project to deepen the main channel is envisaged so as to save ship costs for waiting for high tide or reduce sea transport costs by deploying larger vessels such as post-panamax typed container vessels and crude petroleum tankers with deep draft.

2. Master Plan (Target Year: 2017)

(1) Handling of Container

It is proposed to establish a full-scale new container terminal with off-shore jetties with a water depth of 13.5m at MBP, which can accommodate container vessels of the third generation in the range of 2,500 – 3,000 TEU lading capacity.

27. In the target year of the Master Plan, 2017, one million TEU of containers is planned to be allocated to MBP. To handle the allocated containers, it is proposed to establish a full-scale new container terminal with off-shore jetties with a deep water depth of 13.5m, which can accommodate container vessels of the third generation in the range of 2,500 – 3,000 TEU capacity.

It is proposed to introduce a closed terminal operation system in the planned container terminal.

28. It is proposed to introduce a closed terminal operation system in which a container terminal is wholly controlled by a terminal operator who takes the full responsibility of receipt, storage and delivery of containers at the terminal by conducting yard planning for container stacking and inventory control of containers within the terminal. This type of system is indispensable for a modernized container terminal.

It is proposed to deepen the existing access channel to Indira Dock to 11.0m to receive larger container vessels to approach the off-shore jetties of the proposed new container terminal.

29. It is proposed to deepen the existing access channel to Indira Dock from the present level to

receive larger container vessels to approach the off-shore jetties of the proposed new container terminal. The water depth of the deepened channel is proposed as 11.0m below CD based on dredging costs and benefits generated from reduction of ship waiting for high tide.

It is proposed to prepare additional off-dock container depots to be placed within the landed estate of MBPT by evicting the leased lands which are no longer used for port-related activities within its estate.

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

(2) Handling of Conventional Cargo

It is considered that the forecast volume of conventional cargo excluding petroleum to be handled at MBP will be able to be handled by using the existing dock berths even in the stage of the Master Plan

31. In the year 2017, the volume of conventional cargo excluding petroleum to be handled at MBP is estimated as 7.92 million tons (6.08 million in import and 1.84 million tons in export). It is considered that the forecast volume of conventional cargo will be able to be handled by using the existing dock berths even in the stage of the Master Plan.

(3) Handling of Petroleum

It is considered that the forecast volume of petroleum and liquid chemical products will be able to be handled at the existing marine oil jetties even in the stage of the Master Plan by the completion of the pipeline replacement project under progress.

32. In the year 2017, the volume of petroleum comprising crude oil and refined oil to be handled

at marine oil terminals at MBP is estimated as 36.50 million tons with 18.89 million of crude oil and 17.61 million tons of refined oil. In addition to these petroleum oils, liquid chemical products of 386,000 tons will be handled at the New Pir Pau Jetty together with refined oil in the same year. It is considered that the forecast volume of petroleum and liquid chemical products will be able to be handled at the existing marine oil jetties even in the stage of the Master Plan by the completion of the pipeline replacement project under progress by MBPT.

(4) Traffic within Landed Estate of MBPT

It is proposed to prepare a new dedicated container road with a fly-over bridge connecting the proposed new container terminal and off-dock container depots. It is also proposed to prepare a dedicated ordinary truck road along the existing dock fences by converting the existing dedicated container road so as to enable ordinary trucks to have an access to the dock gates without using the congested common roads.

33. It is proposed to prepare a new dedicated container road with a fly-over bridge connecting the proposed new container terminal to be placed within the existing dock area and off-dock container depots within the landed estate of MBPT. It is also proposed to prepare a dedicated ordinary truck road along the existing dock fences by converting the existing dedicated container road so as to enable ordinary trucks to have an access to the dock gates without using the congested common roads.

(5) Main Channel

It is proposed to deepen the existing main channel to 12m below CD to attract post-panamax typed container vessels to JNP.

34. Main channel deepening project is essential to attract post-panamax-typed mainline container vessels to JNP. The economic viability of the project and the optimum water depth were accessed from the comparison of costs comprising capital and maintenance dredging and benefits estimated by taking account of various factors including forecast cargo volume and

predicted tidal fluctuation. According to the assessment, it is considered that the main beneficiary is container transport through JNP by using post-panamax typed container vessels rather than crude petroleum transport through JD No.4 jetty. It must be noted that the viability of the project depends on whether a large amount of containers will be handled at JNP, and therefore the project seems to become viable from the stage of the Master Plan. The water depth of the channel is proposed to be deepened to 12m below CD which is considered to be an economical water depth based on dredging costs and benefits generated from reduction of sea transport costs by using larger vessels.

(6) Project Cost

35. The total project cost of the Master Plan is roughly estimated as 23.9 billion Rs.

(7) Initial Environmental Examination

As Initial Environmental Examination (IEE) is carried out, dredging sediments within planned area, disturbance due to dredging and air pollution due to the future port-related traffic are selected and should be included in the Environmental Impact Assessment (EIA) for the Short-term Plan.

36. As Initial Environmental Examination (IEE) is carried out, three points of 1) dredging sediments within planned area, 2) disturbance due to dredging, and 3) air pollution due to the future port-related traffic in and around MBP are selected and should be included in the Environmental Impact Assessment (EIA) for the Short-term Plan.

(8) Management, Operations and Institutional Matters

It is proposed that the new container terminal should be wholly controlled by a terminal operator to achieve efficient operation.

37. It is proposed that the new container terminal should be wholly controlled by a terminal

operator. The terminal operator should take the full responsibility of receipt, storage and delivery of the containers at the terminal. The terminal operator should supervise the overall container handling operation at the terminal by conducting yard planning and inventory control of containers. As for the organization of the terminal operator, the followings are considered:

- one department of MBPT
- establishing a new organization that is financially independent of MBPT
- private sector as a lessee of the terminal facility and cargo handling equipment

The terminal operator needs to have the necessary number of personnel to handle containers efficiently and to manage the organization efficiently. It is necessary to select and transfer highly motivated workers or staff of MBPT on condition that trade unions of MBP agree. The terminal operator needs to invite foreign experts to assist in on-the-job training for terminal employees. It is necessary to raise the wage rate or allowance as incentives if workers gain skill and expertise through the training and consequently improve the efficiency of container handling. In the long run, it is necessary to consider the establishment of joint ventures with foreign companies for further improvement of the operation and management if private sector involvement develops in the port.

(9) Potential Capacity for Container Handling Capacity at MBP

MBP could have the total container handling capacity of 2 million TEUs and more per annum.

38. In the Master Plan proposed in this study, the capacity of the proposed container terminal is estimated as one million TEUs per annum on the assumption that the existing facilities at the Indira Dock will be converted into a new container marshaling yard by filling the dock waters. However, the potential demand for handling containers at MBP would become much higher than that in the future. Hence, due to the space constraint, there would still be a large gap between the demand and the capacity for container handling at MBP, even after the creation of

the proposed new container terminal

39. However, the total container handling capacity of MBP could be increased to 2 million TEUs and more in the condition of constructing additional off-shore berths next to the berths proposed in the Master Plan., converting the existing facilities at Prince's Dock into another container marshaling yard. The second phase container terminal project at the Prince's Dock, so to speak, has a great advantage because the access channel, the connection bridge and the dedicated container road to be prepared in the first phase project would be usable as common infra-structures. The timing of the start of the second phase container terminal project needs be carefully determined after confirming satisfactory progress of the first phase project. In this meaning, the second phase container terminal project would be started beyond the target year of the Master Plan, 2017, and excluded in the Master Plan.

40. In this study, containers of one million TEUs are allocated to MBP, and the remaining volume is allocated to JNP out of the total demand for container handling on the assumption that JNPT has a sufficient potential container handling capacity to compensate for the conservative allocation to MBP. However, it must be noted that JNP's container handling capacity is not limitless. According to the conceptual plan made by JNPT, the total container handling capacity per annum does not seem to exceed 4 million TEUs. In this view, the possibility of starting the second phase project at MBP before 2017 should not be completely ruled out.

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 1 Master Plan for Development of the Port of Mumbai

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)

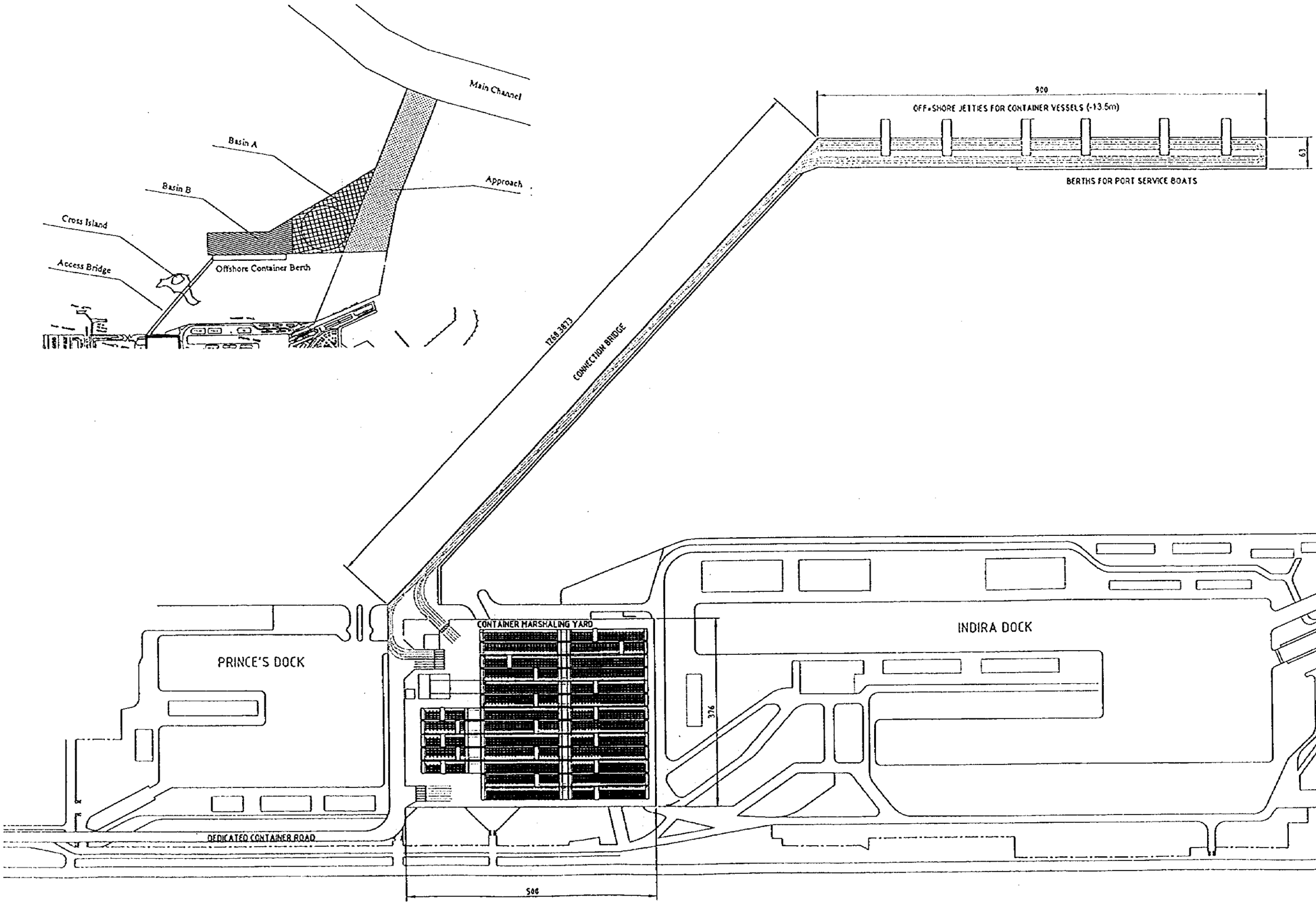


Figure 2 Layout of Master Plan for Container Handling

3. Short-Term Plan (Target Year: 2007)

(1) Handling of Container

It is proposed to establish a full-scale new container terminal with off-shore jetties with a deep water depth of 13.5m at MBP.

41. In the target year of the Short-Term Plan, 2007, one million TEUs of containers are allocated to MBP. To handle the allocated containers, it is proposed to establish a full-scale new container terminal with off-shore jetties with a deep water depth of 13.5m at MBP.

It is proposed to introduce a closed terminal operation system in the planned container terminal.

42. It is proposed to introduce a closed terminal operation system in which a container terminal is wholly controlled by a terminal operator that who the full responsibility of receipt, storage and delivery of containers at the terminal.

It is proposed to deepen the existing access channel to Indira Dock to 11.0m to receive larger container vessels approaching the proposed off-shore jetties.

43. It is proposed to deepen the existing access channel to Indira Dock to 11.0m to receive larger container vessels approaching the proposed off-shore jetties.

It is proposed to prepare additional off-dock container depots as back-up facilities to be placed within the landed estate of MBPT by evicting the leased lands which are no longer used for port-related activities within its estate.

44. It is proposed to prepare additional off-dock container depots as back-up facilities to be placed within the landed estate of MBPT to back up the container-handling operations at the proposed new container terminal to be operated within a limited space. For this purpose, it is

necessary to evict the leased lands which are no longer used for port-related activities within its estate.

(2) Handling of Conventional Cargo

It is considered that the forecast volume of conventional cargo excluding petroleum to be handled at MBP will be able to be handled by using the existing dock berths in the stage of the Short-Term Plan

45. In the year 2007, the volume of conventional cargo excluding petroleum to be handled at MBP is estimated as 6.25 million tons with 4.65 million in import and 1.60 million tons in export. It is considered that the forecast volume of conventional cargo will be able to be handled by using the existing dock berths

(3) Handling of Petroleum

It is considered that the forecast volume of petroleum and liquid chemical products will be able to be handled at the existing marine oil jetties in the stage of the Short-Term Plan by the completion of the pipeline replacement project under progress.

46. In the year 2007, the volume of petroleum comprising crude oil and refined oil to be handled at marine oil terminals at MBP is estimated as 28.68 million tons with 18.89 million of crude oil and 9.79 million tons of refined oil. In addition to these petroleum oils, liquid chemical products of 200,000 tons will be handled at the New Pir Pau Jetty together with refined oil at the same year. It is considered that the forecast volume of petroleum and liquid chemical products will be able to be handled at the existing marine oil jetties in the stage of the Short-Term Plan by the completion of the pipeline replacement project under progress by MBPT.

(4) Traffic within Landed Estate of MBPT

It is proposed to prepare a new dedicated container road with a fly-over bridge connecting the

proposed new container terminal and off-dock container depots It is also proposed to prepare a dedicated ordinary truck road along the existing dock fences by converting the existing dedicated container road.

47. It is proposed to prepare a new dedicated container road with a fly-over bridge connecting the proposed new container terminal and off-dock container depots as back-up facilities. It is also proposed to prepare a dedicated ordinary truck road along the existing dock fences by converting the existing dedicated container road.

(5) Construction Cost

48. The total construction cost of the Short-Term Plan is estimated as20.0 billion Rs.

(6) Economic Analysis

The proposed project with the EIRR of 16.9% is considered to be economically justifiable.

49. A comparison between the "Without-Project" case and the "With-Project" case was carried out to evaluate the feasibility of the project for construction of a new container terminal including deepening of the access channel, preparation of off-dock container depots and construction of a new dedicated container road with a fly-over bridge at MBP proposed in the Short-Term Plan from the viewpoint of the national economy of India. The main economic benefits of the project are savings on sea transport costs for containers through MBP, port staying and off-shore waiting costs of container vessels calling at the port generated from the project. The resulting economic rate of return (EIRR) of the project is estimated as 16.9%, exceeding the general criterion to assess the economic justifiability.

(7) Financial Analysis

The proposed project with the FIRR of 10.2% is considered to be financially feasible.

50. The financial revenues are generated from port charges based on the tariff proposed to cover capital investment and operational costs by referring to the current tariff level and that of the neighboring port. The resulting financial rate of return (FIRR) of the project is estimated as 10.2 % which exceeds the weighted average interest rates of assumed fund raising plans and hence the project is considered to be financially feasible.

(8) Environmental Consideration

As Environmental Impact Assessment (EIA) was conducted concerning items selected through Initial Environmental Examination (IEE), there are no environmental reasons against the project proceeding of the Short-term Development Project.

51. Environmental Impact Assessment (EIA) was conducted. Since heavy metals of Cd and Hg, and Arsenic were not detected in the bottom sediments within the planned area during the field survey. It is possible to control environmental impact of dredging on ambient marine environment within an insignificant range by using a flexible curtain type turbidity protector around the excavation area for grab dredging. Concerning ambient air quality, no significant increase of SO_2 and NO_X are forecast, while SO_2 and NO_X currently remain far below the tolerance limit (80 μ g/m^3) in and around MBP for the year 2007. No significant increase of SPM are also forecast for the year 2007, while the baseline concentration of SPM is exceeding the tolerance limit (200 μ g/m^3). Consequently, there are no environmental reasons against the project proceeding of the Short-term Development Project.

(9) Management, Operations and Institutional Matters

It is proposed that the new container terminal should be wholly controlled by a terminal operator to achieve efficient operation.

52. It is proposed that the new container terminal should be wholly controlled by a full-fledged terminal operator. The terminal operator should take the full responsibility of receipt, storage and delivery of the containers at the terminal. The terminal operator should supervise the

overall container handling operation at the terminal by conducting yard planning and inventory control of containers. As for the organization of the terminal operator, the followings are considered.

- one department of MBPT
- establishing a new organization that is financially independent of MBPT
- private sector as a lessee of the terminal facility and cargo handling equipment

The terminal operator needs to have the necessary number of personnel to handle containers efficiently and to manage the organization efficiently.

It is proposed to transfer some part of workers or staff to the new organization from MBPT.

53. As for the recruitment of the new organization, it is necessary to select and transfer highly motivated workers or staff to the new organization from MBPT on condition that the trade unions of MBP agree. The new organization needs to invite foreign experts to assist in on-the-job training for terminal employees.

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 3 Short-Term Plan for Development of the Port of Mumbai

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)

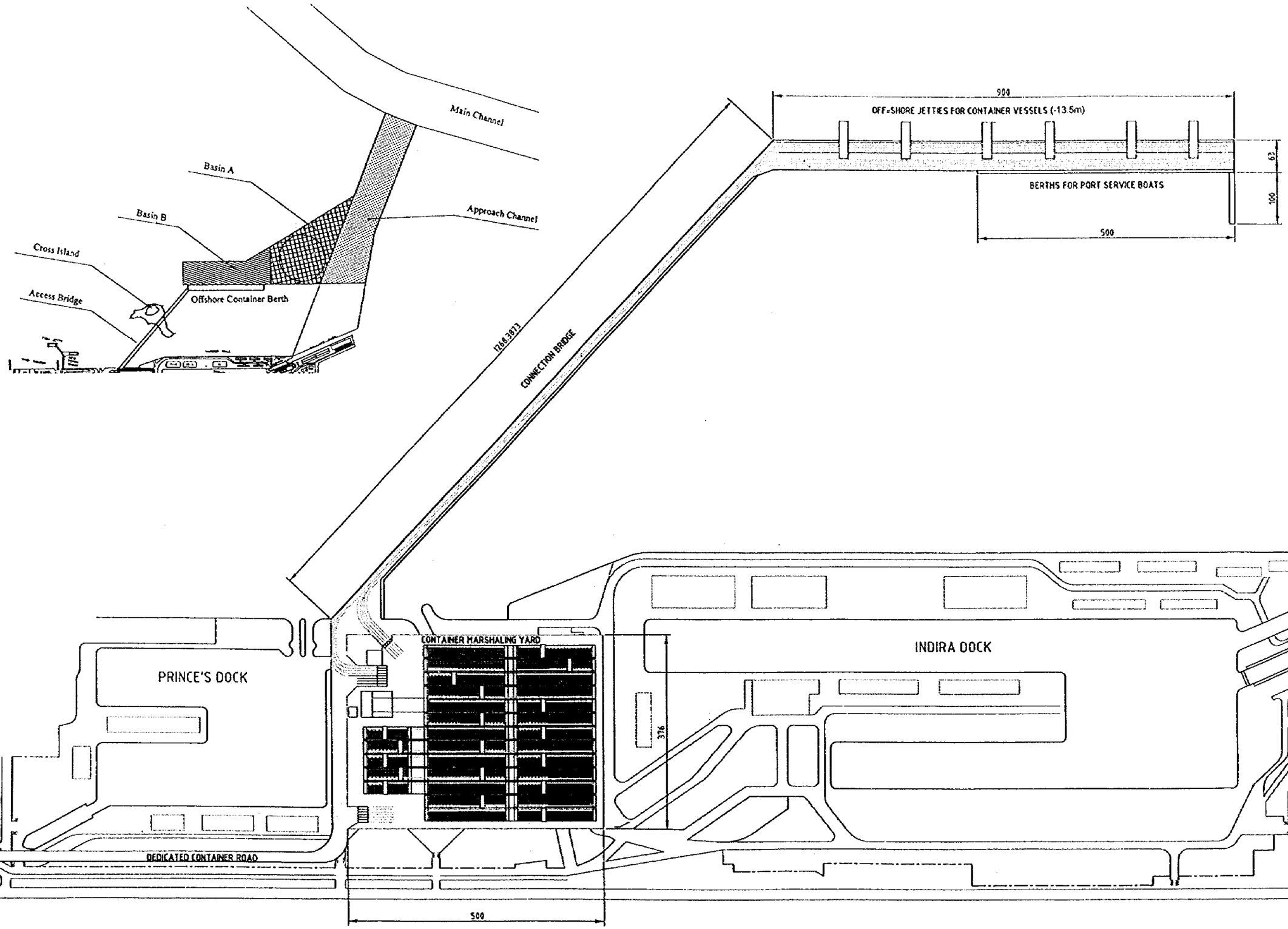


Figure 4 Layout of Short-term Plan for Container Handling

SCALE1:7,000

RECOMMENDATIONS

In accordance with the results of the study, it is recommended that the Government of India implement the development project of the Port of Mumbai and the improvement project of the Main Channel to contribute to the Indian economy. The former project is the first phase project to be completed by 2007, the target year of Short-Term Plan, and the latter project is the second phase project to be completed from 2007 to 2017, the target year of the Master Plan.

1. The First Phase Project

The main components of the development project of the Port of Mumbai as the first phase project are summarized as follows:

1.1 Establishment of a New Full-scale Container Terminal

(1) Construction of infra-structures

1) Off-shore berths with a total length of 900 m and water depth of 13.5m below CD
2) Connection bridge with 4 lanes and length of 1,180m
3) Marshaling yard with area of 19.0 ha and total storage capacity of 11,196 TEUs(3,732 ground slots)
4) Dedicated container road with a fly-over bridge: length of 700m
5) Off-dock container depots with area of 15.5 ha and total storage capacity of 6,336 TEUs(2,112 ground slots)
6) Supplementary jetty to prevent waves for port service crafts: length of 100m

(2) Construction of super-structures

1) 2 CFSs (Container Freight Station) with a total floor space of 19,200sq. m
2) Terminal control office
3) Gate house
4) Repair shop

(3) Preparation of water facilities

1) Deepening the existing approach channel with water depth of 11.0m below CD

2) Creation of turning basin with diameter of 520m and water depth of 11.0m below CD

3) Navigational aids

(4) Procurement of container-handling equipment

1) 6 quay-side container gantry cranes

2) 18 RTGs (Rubber Tyred Gantry Crane)(6 rows + 1 lane)

3) 4 Reach stackers

4) 97 Yard tractor-trailer units

5) 55 Road tractor-trailer units

(5) Introduction of a closed terminal operation system

(6) Engineering matters at the implementation stage

1) In conducting detail design of ancillary equipment of quay-side cranes such as cable guides on off-shore berth structures, it is necessary to take account of the possible installation of additional cranes after the opening of the terminal.

2) It is recommended that an experimental test be conducted at the implementation stage to confirm tranquillity of the proposed off-shore berthss for mooring vessels and container-handling operations.

1.2 Improvement of Conventional Cargo Handling Operations

(1) Allocation of specific berths by cargo type

(2) Preparation of necessary cargo-handling equipment

(3) Preparation of a dedicated ordinary truck road outside the dock areas

1.3 Management, Operations and Institutional Matters

(1) Comprehensive management by a terminal operator at the new container terminal

(2) Transfer of some personnel from MBPT

(3) Development of human resources through on-the-job training by foreign experts

2. The Second Phase Project

The main components of the improvement project of the Main Channel as the second phase project are summarized as follows.

2.1 Improvement of the Main Channel

(1) Deepening the present water depth to 12 m deep below CD in terms of the controlled depth

(2) Widening of channel at the narrow places to 500 m wide

(3) Others

1) It should be noted that the main beneficiary of the project is JNP.

2) It is recommended that the commencement timing of the project be periodically reviewed in the future due to the actual increasing trend of future container traffic.