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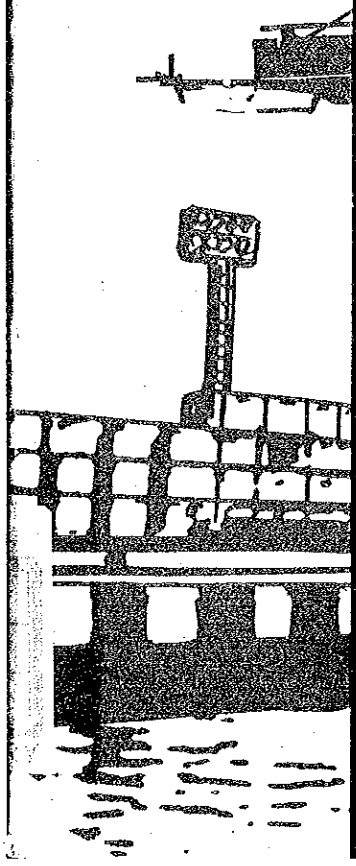
FINAL REPORT APPENDIX

MARCH 1982



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APPENDIX

Appendix II-1 Average Transport Distance by System

Multimodel Transport

1. Railway Karachi ⟷ Lahore 1220 km

2. Road

Lahore	Distance (km)	Cargo Volume	Ton km
CFS ⟷ Lahore	20	273	5,460
⟷ Faisalabad	145	130	18,850
⟷ Sargoda	170	61	10,370
⟷ Gujranwala	95	143	13,585
⟷ Rawalpindi	275	112	30,800
⟷ Hazara	390	7	2,730
⟷ Malakand	465	5	2,325
⟷ Peshawar	440	79	34,760
⟷ DI Khan	410	8	3,280
		818	122,160

Average Road Distance = $\frac{122,160}{818}$ = 149 km

Road Transport

	Distance (km)	Cargo Volume 1000 tonne)	Ton km
Karachi ⟷ Lahore	1,290	273	352,170
⟷ Faisalabad	1,180	130	153,400
⟷ Sargoda	1,225	61	74,725
⟷ Gujranwala	1,320	143	188,760
⟷ Rawalpindi	1,570	112	175,840
⟷ Hazara	1,680	7	11,760
⟷ Malakand	1,755	5	8,775
⟷ Peshawar	1,735	79	137,065
⟷ DI Khan	1,245	8	9,960
		818	1,112,455

Average Road Distance = $\frac{1,112,455}{818}$ = 1,360 km

Appendix II-2 Capital Costs by Transport System

Unit: 1000 US$

				Years of Service
Case; Multimodel Transport				
Total			46,586	
1. Port Terminal	See Next Page		7,086	
2. Railway Equipment		Unit Price		
Wagon; 72,284 TEU ÷ 300 days x 1.25 ÷ 3 TEU/Wagon x 2 days = 200 Wagons		x 57 =	11,400	50
Engine; 200 Wagons ÷ 25 Wagons/Train = 8 Engines		x 1200 =	9,600	20
Shunting Loco;	2 Engines	x 700 =	1,400	20
3. Inland CFS	See Next Page		12,250	
4. Road Transport Equipment				
40' trailer;	73 (40' Trailer)	x 50 =	3,650	7
8 ton truck;	100 (8 ton truck)	x 12 =	1,200	7
Case; Road Transport				
Total			42,464	
1. Port Terminal	See Next Page		5,164	
2. Road Transport Equipment				
40' trailer;	590 (40' Trailer)	x 50 =	29,500	7
8 ton truck;	650 (8 ton truck)	x 12 =	7,800	7

Appendix II-3 Capital Cost of Terminal

Description of Equipment	Years of Service	Unit Price	Port Terminal Multi modal Q'ty	Port Terminal Multi modal Cost	Port Terminal Road Q'ty	Port Terminal Road Cost	Inland CFS Multi modal Q'ty	Inland CFS Multi modal Cost
(Unit train operation)								
Rail mounted transfer cranes	12	2,381	2	4,762	-	-	2	4,762
Yard tractor	7	37	8	296	-	-	8	296
Yard chassis 40'(20' x 2)	7	13	8	104	-	-	8	104
Rubber tired transfer crane	12	952	2	1,904	-	-	2	1,904
(Container yard operation)								
Rubbre tired transfer crane	12	952	-	-	4	3,808	4	3,808
(Gate operation)								
Weighing scale	50	143	-	-	1	143	1	143
(Maintenance)								
Forklift truck								
3.0 tons	7	17	-	-	1	17	1	17
15.0 tons with telescopic side spreader	7	126	-	-	1	126	1	126
(CFS operation)								
Forklift truck								
3.0 tons	7	17	-	-	13	221	13	221
6.0 tons	7	35	-	-	2	70	2	70
Yard tractor	7	37	-	-	4	148	4	148
Yard chassis 20 footer	7	10	-	-	12	120	12	120
40 footer	7	10	-	-	6	60	6	60
Pallet	3	0.04	-	-	2,350	94	2,350	94
(Multipurpose)								
Forklift truck								
3.0 tons	7	17	-	-	2	34	2	34
15.0 tons	7	105	-	-	1	105	1	105
Mobile crane for emergency use and CFS operation 30 tons	7	190	-	-	1	190	1	190
(Communication)								
Wireless telephone (VHF)	10	2	10	20	14	28	24	48
			Total	2,086	Total	5,164	Total	12,250

Appendix II-4 Working Expenses for Inland Transportation

Unit; 1000 US$

Case; Multimodal Transport

1. Port Terminal			1,075.8
2. Railway Expenses	152,453 x 0.101 x 0.8 ≒ 12,500		12,500
	*Figure is extracted from Table of Expenditure for Working CNTR Train in Financial Analysis.		
3. Inland CFS			2,753.1
4. Truck Operating Cost			
40' Trailer;	73 Trailer x 300 Km x 300 days x 3.5 Rs/Km x 0.101	=	2,322
8 ton truck;	100 Truck x 300 Km x 300 days x 1.9 Rs/Km x 0.101	=	1,727
		Sub Total	4,049

Case; Road Transport

1. Port Terminal			1,677.3
2. Truck Operating Cost			
40' Trailer;	590 Trailer x 340 Km x 300 days x 3.5 Rs/Km x 0.101	=	21,274
8 ton Truck;	650 Truck x 340 Km x 300 days x 1.9 Rs/Km x 0.101	=	12,723
		Sub Total	33,997

Appendix II-5 Working Expenses at Terminal

1,000 US$/Year

Multimodal Transport

o Port Terminal			
Energy Consumption			76.3
Maintenance		7,086 x 0.04 =	283.4
Labour	skilled	23 x 18,000 x 0.101 ÷ 1000 =	42.0
"	unskilled	6 x 9,000 x 0.101 ÷ 1000 =	5.0
			406.7
o Inland CFS			
Energy Consumption			211.3
Maintenance		12,250 x 0.04 =	490.0
Labour	skilled	261 x 18,000 x 0.101 ÷ 1000 =	474.0
"	unskilled	109 x 9,000 x 0.101 ÷ 1000 =	99.0
			1,274.3

Road Transport

Port Terminal			
Energy Consumption			135.0
Maintenance		5,164 x 0.04 =	206.6
Labour	skilled	238 x 18,000 x 0.101 ÷ 1000 =	433.0
"	unskilled	103 x 9,000 x 0.101 ÷ 1000 =	94.0
			868.6

Appendix II-6 Energy Consumption Cost at Terminal

Unit: 000 US$

	Energy Consumption Rate	Working Hour/ No. of TEU Per Year	Working Efficiency	Consumption Volume	Unit Price	Consumption Cost/Unit 000 US$	Actual Required No. of Equipment	Total Cost
(Unit Train Operation)								
Rail mounted transfer crane	3.2 Kwh/TEU	56,472 TEU	-	180,710 Kwh	0.05 US$/Kwh	9.0	1.28	11.5
Road tractor (400 ps)	15.1 Kg/hr	1,980 hrs	0.5	14.9 Kt	426.5 US$/Kt	6.4	8.00	51.2
Rubber tired transfer crane(260 ps)	46.8 Kg/hr	1,060 hrs	0.5	24.8 Kt	"	10.6	1.28	13.6
							Total	(76.3)
(Container yard operation)	46.8 Kg/hr	1,980 hrs	0.5	46.3 Kt	"	19.7	0.50	9.9
Rubber tired transfer crane (260 ps)	46.8 Kg/hr	860 hrs	0.5	20.1 Kt	"	8.6	2.30	19.8
(Maintenance)								
Forklift truck 3.0 tons (42 ps)	8.4 Kg/hr	660 hrs	0.5	2.8 Kt	"	1.2	1.00	1.2
15.0 tons (110 ps)	24.2 Kg/hr	660 hrs	0.5	8.0 Kt	"	3.4	1.00	3.4
(CFS operation)								
Forklift truck 3.0 tons(42 ps)	8.4 Kg/hr	1,980 hrs	0.5	8.3 Kt	"	3.5	9.20	32.2
6.0 tons(85 ps)	17.9 Kg/hr	1,980 hrs	0.5	17.7 Kt	"	7.5	1.00	7.5
Road tractor (400 ps)	15.1 Kg/hr	1,980 hrs	0.5	14.9 Kt	"	6.4	4.00	25.6
(Multipurpose)								
Forklift truck 3.0 tons(42 ps)	8.4 Kg/hr	1,980 hrs	0.5	8.3 Kt	"	3.5	2.00	7.0
15.0 tons(110ps)	24.2 Kg/hr	1,980 hrs	0.5	24.0 Kt	"	10.2	1.00	10.2
Mobile crane 30.0 tons	40.0 Kg/hr	200 hrs	0.5	4.0 Kt	"	1.7	1.00	1.7
Toplifter 35.0 tons(212ps)	39.2 Kg/hr	1,980 hrs	0.5	38.8 Kt	"	16.5	1.00	16.5
				(232.9 Kt)				(135.0)
							G. Total	211.3

Appendix II-7 Road Cost

The present average structural number of the Karachi-Lahore road is 1.25, which is considerably smaller than the value of requiring repaving of SN = 2.5. The roads should be repaved to be able to handle heavy seaborne containers.

In order to make a conservative estimation on repaving cost, SN = 2.5 is adopted as the value of SN after repaving.

The design thickness of repaiving is the wearing course of 5 cm and the base course of 8 cm.

Under the Third IBRD Highway Project, load and axle load conditions for different types of vehicles are indicated as follows:

	Load	Front axle weight	Rear axle weight
Loaded truck	14 tons	28%	72%
Empty truck	6 tons	28%	72%
Bus	10 tons	40%	60%

Under the same project, the direction factor of 0.5 and the lane factor of 0.9 are adopted.

Accumulated number of 8-ton single-axle-load repetitions in 1987 on typical section of the Karachi-Lahore main road will be 3000 axles a day.

The number of vehicles per day is 75 units –40′ container trailers to be introduced in 1987 and 80 units 8-ton truckes to be also introduced. Assuming that the loaded vehicle rate at this point is 60% for 40′ trailers and 85% for 8-ton trucks, on the road the number of 8-ton-single-axle-load repetitions is about 600 under the load conditions indicated in Fig.

Therefore, the cost to be shared by the container trailers is 20% of the repaving cost. The per-km repaving cost of 67,000 U.S. dollars adopted that for the road width is 7 m. In this case, the assumed service life is 10 years.

The bridges and other structures of the Karachi-Lahore section are totally adequate for container transport because they are designed using the IRC 'A' load (40 tons).

The present road maintenance cost is 3 Rs per m^2.

Appendix II-8 Railway Cost

The following railway facilities for railway cost will be required if the multimodal transportation system is adopted:

	Truck	Unit cost		
Port terminal	2,000 m	x 143$	=	286,000
Access line	3,000 m	x 286$	=	858,000
Inland CFS	2,000 m	x 143$	=	286,000
				1,430,000$

The assumed service life of railway tracks is 20 years.
The per-km maintenance cost of these is 100,000 Rs/year.

Appendix II-9 Required Number of Equipment for Container Terminal (1987/88)

I. Equipments for unit Train Operation

$$NE = \frac{NC \times p}{WD \times GH \times w \times AP}$$

where:

NE : Number of equipment at peak hour (units)
NC : Number of CNTR movement per year (units)
WD : Annual working days, 365 - 65 = 300 days
P : Peak day factor
GH : Gross working hours per day
w : Net working ratio
AP : Average productivity per equipment hour.

(A) Rail mount transfer crane for unit train

$$NE = \frac{54,213 \times 1.25}{300 \times 22 \times 0.4 \times 20} = 1.28 = \underline{2 \text{ units}}$$

$$^{x}NC = (DS + LS) \times U \times t$$

DS : Number of CNTR discharged from ship per year (TEU)
LS : Number of CNTR loaded to ship per year (TEU)
u : Ratio of transportation by unit train, 42.7%
t : Exchange rate from TEU to units of CNTR, 0.75

$$NC = (84,642 + 84,642) \times 0.427 \times 0.75 = 54,213 \text{ units}$$

(B) Rubber tired transfer crane for unit train

$$NE = \frac{54,213 \times 1.25}{300 \times 22 \times 0.4 \times 20} = 1.28 = 2 \text{ units}$$

(C) Yard tractor & chassis 40' (20' x 2) for unit train operation

4 sets of tractor & chassis per crane x 2 = 8 sets

(D) Wireless telephone (VHF)

a. Rail mount transfer crane for unit train operation	2 units
b. Yard tractor for unit train operation	8 units
	10 units

II. Equipment for CNTR yard Operation

(A) Rubber tired transfer crane

1. LCL by road $NE = \frac{39,656 \times 1.25}{300 \times 22 \times 0.75 \times 20} = 0.50 = \underline{1 \text{ unit}}$

$^{x}NC = (IF + EF) \times \ell \times (1 + e) \times t$

IF : Number of import CNTR carried from the new port terminal (TEU)

EF : Number of export CNTR carried to the new port terminal (TEU)

ℓ : Percentage of LCL CNTR, 40%

e : Empty CNTR ratio to full CNTR, 1

t : Exchange rate from TEU to units of CNTR, 0.75

$NC = (36,142 + 29,952) \times 0.4 \times (1 + 1) \times 0.75 = 39,656$ units

2. FCL by road $NE = \frac{59,485 \times 1.25}{300 \times 8 \times 0.9 \times 15} = 2.3 = \underline{3 \text{ units}}$

$^{x}NC = (IF + EF) \times f \times (1 + e) \times t$

f : Percentage of FCL CNTR, 60%

$NC = (36,142 + 29,952) \times 0.6 \times (1 + 1) \times 0.75 = 59,485$ units

Remark : The miscellaneous operations regarding inspection, repair and adjustment of CNTR are manage at other working hours than the peak ones.

(B) Weighing scale used by export FCL CNTR

$$NS = \frac{13,478 \times 1.25}{300 \times 8 \times 0.9 \times 15} = 0.5 = \underline{1 \text{ unit}}$$

*NC - EF x f x t

NS : Number of weighing scales

EF : Number of export ECL CNTR carried to the new port terminal (TEU)

f : Percentage of FCL CNTR, 60%

t : Exchange rate from TEU to units of CNTR, 0.75

NC = 29,952 x 0.6 x 0.75 = 13,478 units

(C) Equipment and pallets for CFS Operation

1. 3 Tons fork lift trucks

$$NE = \frac{NC \times p \times AW}{WD \times GH \times w}$$

where :

NE : Number of equipment at peak hour (units)

NC : Number of LCL CNTR per year (units)

p : Peak day factor

AW : Average working hours per CNTR

Import 20 footer = 1.0 hour

Import 40 footer = 1.5 hours

Export 20 footer = 0.5 hour

Export 40 footer = 0.75 hour

WD : Annual working days, 365 - 65 = 300 days

GH : Gross working hours per day

w : Net working hour ratio

a. Unstuffing import 20' $NE = \frac{7,228 \times 1.25 \times 1.0}{300 \times 22 \times 0.75} = 1.8 = \underline{2 \text{ units}}$

$X_{NC} = IF \times \ell \times d$

IF : Number of import CNTR carried from the new port terminal (TEU)

ℓ : Percentage of LCL CNTR, 40%

d : Exchange rate from TEU to units of 20' or 40' CNTR

NC = 36,142 x 0.4 x 0.5 = 7,228 units

b. Unstuffing import 40' $NE = \frac{3,614 \times 1.25 \times 1.5}{300 \times 22 \times 0.75} = 1.4 = \underline{2 \text{ units}}$

NC = 36,142 x 0.4 x 0.25 = 3,614 units

c. Stuffing export 20' $NE = \frac{5,990 \times 1.25 \times 0.5}{300 \times 22 \times 0.75} = 0.8 = \underline{1 \text{ unit}}$

NC = EF x ℓ x d

EF : Number of export CNTR carried to the new port terminal (TEU)

NC = 29,952 x 0.4 x 0.5 = 5,990 units

d. Stuffing export 40' $NE = \frac{2,995 \times 1.25 \times 0.75}{300 \times 22 \times 0.75} = 0.6 = \underline{1 \text{ unit}}$

NC = 29,952 x 0.4 x 0.25 = 2,995 units

Total number of fork lift truck for unstuffing & stuffing cargo from/to containers; $NE_t = NE_a + NE_b + NE_c + NE_d = \underline{6 \text{ units}}$

e. The same number of equipment to the above mentioned ones (NE_t) are required to remove/feed cargo between CNTR and stack place, and receive/deliver cargo from/to consignee; $NE_e = NE_t = 6$ units

Grand total : $NE_t + NE_e = \underline{12 \text{ units}}$

(D) 6 Tons fork lift truck for handling heavy cargo

One unit every 10 units of 3 tons fork lift truck; NE = 2 units

(E) Yard tractor

4 units per transfer crane for handling LCL CNTR x 1; NE = 4 units

(F) Yard chassis : NE_2 = 12 units of 20' chassis
NE_4 = 6 units of 40' chassis
NE_t = 18 units

* Number of chassis are required three times as many as continer handled at the peak hour.

Pallets with 1.8m x 1.2m two-way reversible winged type

$$NP = \frac{FS \times r \times t}{(WP + W) \times (LP + 1)}$$

where :

NP = Number of pallets (sheets)
FS = Floor space of CFS (m^2)
r = Floor utilization ratio of cargo stacking space, 45%
t = Stacking tier, 1
WP = Width of pallet 1.8m
w = Width wise clearance between pallets, 0.2m
LP = Length of pallets, 1.2m
1 = Length wise clearance, 0.1m

$$NP = \frac{13,580 \times 0.45 \times 1}{(1.8 + 0.2) \times (1.2 + 0.1)} = 2,350 \text{ sheets}$$

(G) Equipments for the repair shop

a. 3 Tons fork lift truck for lifting damage CNTR on stands;
NE = 1 unit

b. 15 Tons fork lift truck with telescopic side spreader;
NE = 1 unit

(H) Multipurpose equipment

a. Mobile crane with 35 tons capacity for emergency measures at CNTR yard and CFS operation; NE = 1 unit

b. 3 Tons fork lift truck for carrying cargo gears and others; NE = 2 units

c. 15 Tons fork lift truck with telescopic side spreader for handling heavy cargo and empty CNTR; NE = 1 unit

(I) Wireless telephone (VHF)

Rubber tired transfer crane	6
Yard tractor for CFS operation	4
Terminal office	1
Maintenance shop	1
CFS	1
Spare	1
Total	14 units

Appendix II-10 Unit Operating Cost of 8-ton truck
Speed : 64 km/hr

(Unit : RS/1000km)

	Consumption	Economic Cost	Financial Cost
Fuel Consumption (lit)	300.00	1,062	915
Engine Oil Consumption (lit)	4.60	37	46
Tyre wear (Tyre)	0.07	26	53
Interest %(veh)	0.07	84	140
Maintenance			
Labour (hrs)	20.00	150	150
Parts %(veh)	0.09	108	180
Driver (hrs)	16.00	160	160
Assistant (hrs)	16.00	96	96
Subtotal		1,723	1,740
Overhead	10% of above Total	172	174
Total		1,895	1,914

Source : Economic Analysis for Highways

Unit Price (Unit : Rp)

	Economic Price	Financial Price
Truck	120,000.00	200,000.00
H.S.D. (lit)	3.54	3.05
Oil (lit)	8.00	10.00
Tyre	375.00	750.00
Labour (hr)	7.50	7.50
Driver (hr)	10.00	10.00
Assistant (hr)	6.00	6.00

Appendix II-11 Unit Operating Cost of Truck-Semitrailer for 40' Container
Speed : 64 km/hr

(Unit : Rs/1000km)

	Consumption	Economic Cost	Financial Cost
Fuel Consumption (lit)	500.00	1,770	1,525
Engine Oil Consumption (lit)	8.00	64	80
Tyre Wear (Tyre)	0.14	105	210
Interest %(veh)	0.07	350	490
Maintenance			
Labour (hrs)	23.00	173	173
Parts %(veh)	0.09	450	630
Driver (hrs)	16.00	160	160
Assistant (hrs)	16.00	96	96
Subtotal		3,168	3,364
Overhead	10% of above Total	317	336
Total		3,485	3,700

Source : Economic Analysis for Highways

(Unit : Rp)

	Unit Price	
	Economic Price	Financial Price
Truck	500,000.00	700,000.00
H.S.D. (lit)	3.54	3.05
Oil (lit)	8.00	10.00
Tyre	750.00	1,500.00
Labour (hr)	7.50	7.50
Driver (hr)	10.00	10.00
Assistant (hr)	6.00	6.00

Appendix II-12 Required No. of Railway Equipment in 1987/88, 1999/2000

Round Trip : 4 days
Distance : 1,220 km

1987/88

Wagons : CT ÷ WD x p ÷ CC x RT

CT : Annual throughput of CNTRS (TEU) transported to and from new port CNTR terminal by unit train

WD : Annual Working days = 300 days

p : Peak day factor

CC : No. of TEU carried by Wagon = 3 TEU

RT : Round Trip Time = 4 days

72,284 ÷ 2 ÷ 300 x 1.25 ÷ 3 x 4 = 200 Wagons

Engines : 200 Wagons ÷ 25 Wagons/unit Train = 8 Engines

Shunting Loco : 2 Engines

1999/2000

Wagons : 288,658 ÷ 2 ÷ 300 x 1.25 ÷ 3 x 4 = 800 Wagons

Engine : 800 Wagons ÷ 25 = 32 Engines

Shunting Loco : 2 Engines

Appendix III-1

Calculation Method of Containerized Cargo Quantity (MT) by Commodity:

1) Rice, Sugar, Cotton, Iron :

$$a \times \frac{b}{c}$$

a Total containerized cargo (1988/2000 x Import/Export)

b Rice/Sugar/Cotton/Iron (1988/2000 x Import/Export)

c Total containerizable cargo (1988/2000 x Import/Export)

2) Other dry cargo by commodity:

$$a \times \frac{b}{c} \times \frac{d}{e}$$

a Total containerized cargo (1988/2000 x Import/Export)

b Other dry cargo (1988/2000 x Import/Export)

c Total containerizable cargo (1988/2000 x Import/Export)

d Ultimately containerized quantity by commodity (1974 x Import/Export)

e Total ultimately containerized quantity (1974 x Import/Export)

Cargo weight (MT) per TEU

(IMPORT 1987 - 1988)

No.	Commodity	Containerized cargo by commodity a	x	b	÷	c	x	d	÷	e	Total (1000MT)	Cargo weight (MT) per TEU	Total TEU
0	(FOOD/LIVE ANIMALS)												
01	MEAT/PREPS	857		2,820		2,820		0.04		788.30	0.04	10	4.0
02	DAIRY/PRODUCTS/EGGS							33.85		788.30	36.79	15	2,452.7
03	FISH/PREPS							0.47		788.30	0.51	7	72.9
04	CEREALS/PREPS												
	OTHERS							4.14		788.30	4.50	16	281.3
05	FRUITS/VEGETABLES							71.71		788.30	77.95	8	9,743.8
06	SUGAR/PREPS/HONEY												
	SUGAR							44.10		788.30	47.94	18	2,663.3
	OTHERS							0.16		788.30	0.17	17	10.0
07	COFFEE/TEA/COCOA/SPICES							10.64		788.30	11.57	16	723.1
08	ANIMAL FEEDING STUFF							0.14		788.30	0.15	5	30.0
09	MISC. FOOD PREPS							0.66		788.30	0.72	10	72.0
1	(BEVERAGES/TOBACO)												
11	BEVERAGES							1.47		788.30	1.60	18	88.9
12	TOBACO							0.02		788.30	0.02	8	2.5
2	(CRUDE MATERIALS EXCL. FUELS)												
21	HIDES/SKINS/FURS UNDRSSD							3.21		788.30	3.49	18	193.9

No.	Commodity	Containerized cargo by commodity a	x	b	÷	c	x	d	÷	e	Total (1000MT)	Cargo weight (MT) per TEU	Total TEU
22	OIL SEEDS/NUTS/KERNELS	857		2,820		2,820		3.61		788.30	3.92	13	301.5
23	RUBBER CRUDE/SYNTHETIC							22.23		788.30	24.16	6	4,026.7
24	WOOD/LUMBER/CORK												
	OTHERS							10.68		788.30	11.61	13	893.1
25	PULP/WASTE PAPERS							6.87		788.30	7.47	17	439.4
26	TEXTILE FIBRES							91.62		788.30	99.59	10	9,959.0
29	CRUDE ANIMAL/VEGETABLES, NES							8.26		788.30	8.98	10	898.0
5	(CHEMICALS)												
51	CHEM. ELEMENT COMPOUNDS							63.72		788.30	69.26	12	5,771.7
52	COAL/PETROLEUM, ETC. CHEM.							0.22		788.30	0.24	18	13.3
53	DYES/TANNING/COLOUR PROD.							13.12		788.30	14.26	18	792.2
54	MEDICAL, ETC. PROD.							40.58		788.30	44.11	8	5,513.8
55	PERFUME/CLEANING, ETC. PROD.							1.11		788.30	1.21	10	121.0
57	EXPLOSIVES/PYROTECH.PROD.							0.06		788.30	0.07	18	3.9
58	PLASTIC MATERIALS, ETC.							25.30		788.30	27.50	8	3,437.5
59	CHEMICALS, NES							9.89		788.30	10.75	13	826.9
6	(BASIC MANUFACTURES)												
61	LEATHER DRESSED/FUR, ETC.							0.28		788.30	0.30	10	30.0

No.	Commodity	Containerized cargo by commodity a x b ÷ c x d ÷ e					Total (1000MT)	Cargo weight (MT) per TEU	Total TEU
62	RUBBER MANUFACTRS, NES	857	2,820	2,820	4.54	788.30	4.93	10	493.0
63	WOOD/CORK MANFCTRS, NES				0.79	788.30	0.86	7	122.9
64	PAPER/PAPER BOARD MFRS.				78.11	788.30	84.91	12	7,075.8
65	TEXTILE YARN/FABRIC, ETC.				26.87	788.30	29.21	10	2,921.0
66	NONMETAL MINRL MFRS., NES				7.65	788.30	8.32	15	554.7
67	IRON/STEEL	-	-	-	-	-			
68	NON FERROUS METALS				28.94	788.30	31.46	15	2,097.3
69	METAL MFRS, NES				21.18	788.30	23.02	17	1,354.1
7	(MACHINES/TRANSPORT EQUIP.)								
71	MACHINERY NON-ELECTRIC				38.86	788.30	42.24	8	5,280.0
72	ELECTRIC MACHINERY				32.59	788.30	35.43	5	7,086.0
73	TRANSPORT EQUIPMENT								
	CARS				41.95	788.30	45.60	3	15,200.0
	PARTS				23.42	788.30	25.46	8	3,182.5
8	(MISC. MANUFACTURED GOODS)								
81	PLUMBG/HEATING/LIGHTNG EQUIP.				0.47	788.30	0.51	6	85.0
86	INSTRUMENT/WATCHES/CLOCKS				4.43	788.30	4.82	10	482.0
89	MISC. MANFCTRD GOODS, NES				10.34	788.30	11.24	8	1,405.0
	GRAND TOTAL				788.30		856.89	8.9	96,705.7

Cargo weight (MT) per TEU (EXPORT 1987 - 1988)

No.	Commodity	Containerized cargo by commodity a	x	b	÷	c	x	d	÷	e	Total (1000MT)	Cargo weight (MT) per TEU	Total TEU
0	(FOOD/LIVE ANIMALS)												
01	MEAT/PREPS	890		1,210		2,175		0.04		696.71	0.03	10	3.0
03	FISH/PREPS	890		1,210		2,175		16.97		696.71	12.07	7	1,724.3
04	CEREALS/PREPS												
	RICE	890		465		2,175		-		-	190.28	18	10,571.1
	OTHERS	890		1,210		2,175		8.89		696.71	6.32	16	395.0
05	FRUITS/VEGETABLES	890		1,210		2,175		31.62		696.71	22.48	8	2,810.0
06	SUGAR/PREPS/HONEY												
	SUGAR	890		200		2,175		-		-	81.84	18	4,546.7
	OTHERS	890		1,210		2,175		0.86		696.71	0.61	17	35.9
07	COFFEE/TEA/COCOA/SPICES	890		1,210		2,175		6.77		696.71	4.81	16	300.6
08	ANIMAL FEEDING STUFF	890		1,210		2,175		80.28		696.71	57.08	5	11,416.0
09	MISC. FOOD PREPS	890		1,210		2,175		1.03		696.71	0.73	10	73.0
1	(BEVERAGES/TOBACO)												
11	BEVERAGES	890		1,210		2,175		1.44		696.71	1.02	18	56.7
12	TOBACO	890		1,210		2,175		4.85		696.71	3.45	8	431.3
2	(CRUDE MATERIALS EXCL. FUELS)												
21	HIDES/SKINS/FURS UNDRSSD.	890		1,210		2,175		0.14		696.71	0.10	18	5.6

No.	Commodity	Containerized cargo by commodity a	x	b	÷	c	x	d	÷	e	Total (1000MT)	Cargo weight (MT) per TEU	Total TEU
22	OIL SEEDS/NUTS/KERNELS	890		1,210		2,175		12.52		696.71	8.90	13	684.6
25	PULPS/WASTE PAPERS	890		1,210		2,175		0.20		696.71	0.14	17	8.2
26	TEXTILE FIBRES	890		1,210		2,175		67.33		696.71	47.87	10	4,787.0
	COTTON	890		300		2,175		-		-	122.76	10	12,276.0
29	CRUDE ANIMAL/VEGETABLES, NES	890		1,210		2,175		76.15		696.71	54.14	10	5,414.0
6	(BASIC MANUFACTURES)												
61	LEATHER DRESSED/FUR, ETC.	890		1,210		2,175		25.50		696.71	18.13	10	1,813.0
62	RUBBER MANFACTUR, NES	890		1,210		2,175		0.83		696.71	0.59	10	59.0
63	WOOD/CORK MANUFACTURES, NES	890		1,210		2,175		0.42		696.71	0.30	7	42.9
64	PAPER/PAPER BOARD MFRS.	890		1,210		2,175		0.89		696.71	0.63	12	52.5
65	TEXTILE YARN/FABRIC, ETC.	890		1,210		2,175		235.59		696.71	167.50	10	16,750.0
66	NONMETAL MINERAL MFRS, NES												
	OTHERS	890		1,210		2,175		53.80		696.71	38.25	15	2,550.0
67	IRON/STEEL	890		1,210		2,175		5.50		696.71	3.91	18	217.2
68	NON FERROUS METALS	890		1,210		2,175		0.20		696.71	0.14	15	9.3
69	METAL MFRS, NES	890		1,210		2,175		24.27		696.71	17.26	17	1,015.3

No.	Commodity	Containerized cargo by commodity a	x	b	÷	c	x	d	÷	e	Total (1000MT)	Cargo weight (MT) per TEU	Total TEU
7	(MACHINES/TRANSPORT EQUIP)												
71	MACHINERY NON ELECTRIC	890		1,210		2,175		3.50		696.71	2.49	8	311.3
72	ELECTRIC MACHINERY	890		1,210		2,175		1.79		696.71	1.27	5	254.0
73	TRANSPORT EQUIPMENT												
	CARS	890		1,210		2,175		0.50		696.71	0.36	3	120.0
	PARTS	890		1,210		2,175		0.37		696.71	0.26	8	32.5
8	(MISC. MANUFACTURED GOOD)												
81	PLUMBG/HEATING/LIGHTING EQUIP.	890		1,210		2,175		1.02		696.71	0.73	6	121.7
84	CLOTHING	890		1,210		2,175		6.88		696.71	4.89	5	978.0
85	FOOT WEAR	890		1,210		2,175		5.26		696.71	3.74	7	534.3
89	MISC. MANUFACTURED GOODS, NES	890		1,210		2,175		21.30		696.71	15.14	8	1,892.5
	GRAND TOTAL							696.71			890.22	10.8	82,292.5

Cargo weight (MT) per TEU (IMPORT 1999 - 2000)

No.	Commodity	Containerized cargo by commodity a	x	b	÷	c	x	d	÷	e	Total (1000MT)	Cargo weight (MT) per TEU	Total TEU
0	(FOOD/LIVE ANIMALS)												
01	MEAT/PREPS	3,221		4,945		5,495		0.04		788.30	0.15	10	15.0
02	DAIRY PRODUCTS/EGGS							33.85		788.30	124.47	15	8,298.0
03	FISH/PREPS							0.47		788.30	1.73	7	247.1
04	CEREALS/PREPS												
	OTHERS							4.14		788.30	15.22	16	951.3
05	FRUITS/VEGETABLES							71.71		788.30	263.68	8	32,960.0
06	SUGAR/PREPS/HONEY												
	SUGAR							44.10		788.30	162.16	18	9,008.9
	OTHERS							0.16		788.30	0.59	17	34.7
07	COFFEE/TEA/COCOA/SPICES							10.64		788.30	39.12	16	2,445.0
08	ANIMAL FEEDING STUFF							0.14		788.30	0.51	5	102.0
09	MISC. FOOD PREPS							0.66		788.30	2.43	10	243.0
1	(BEVERAGES/TOBACO)												
11	BEVERAGES							1.47		788.30	5.41	18	300.6
12	TOBACO							0.02		788.30	0.07	8	8.8
2	(CRUDE MATERIALS EXCL. FUELS)												
21	HIDES/SKINS/FURS UNDRSSD							3.21		788.30	11.80	18	655.6
22	OIL SEEDS/NUTS/KERNELS							3.61		788.30	13.27	13	1,020.8

No.	Commodity	Containerized cargo by commodity a x b ÷ c x d ÷ e	Total (1000MT)	Cargo weight (MT) per TEU	Total TEU
23	RUBBER CRUDE/SYNTHETIC	3,221 4,945 5,495 22.23 788.30	81.74	6	13,623.3
24	WOOD/LUMBER/CORK				
	OTHERS	10.68 788.30	39.27	13	3,020.8
25	PULP/WASTE PAPERS	6.87 788.30	25.26	17	1,485.9
26	TEXTILE FIBRES	91.62 788.30	336.89	10	33,689.0
29	CRUDE ANIMAL/VEGETABLES, NES	8.26 788.30	30.37	10	3,037.0
5	(CHEMICALS)				
51	CHEM. ELEMENT COMPOUNDS	63.72 788.30	234.30	12	19,525.0
52	COAL/PETROLEUM, ETC.CHEM.	0.22 788.30	0.81	18	45.0
53	DYES/TANNING/COLOUR PROD.	13.12 788.30	48.24	18	2,680.0
54	MEDICAL, ETC. PROD.	40.58 788.30	149.21	8	18,651.3
55	PERFUME/CLEANING, ETC. PROD.	1.11 788.30	4.08	10	408.0
57	EXPLOSIVES/PYROTECH PROD.	0.06 788.30	0.22	18	12.2
58	PLASTIC MATERIALS, ETC.	25.30 788.30	93.03	8	11,628.8
59	CHEMICALS, NES	9.89 788.30	36.37	13	2,797.7
6	(BASIC MANUFACTURES)				
61	LEATHER DRESSED/FUR, ETC.	0.28 788.30	1.03	10	103.0
62	RUBBER MANUFACTURES,NES	4.54 788.30	16.69	10	1,669.0

No.	Commodity	Containerized cargo by commodity a	x	b	÷	c	x	d	÷	e	Total (1000MT)	Cargo weight (MT) per TEU	Total TEU
63	WOOD/CORK MANFCTRS, NES.	3,221		4,945		5,495		0.79		788.30	2.90	7	414.3
64	PAPER/PAPER BOARD MFRS.							78.11		788.30	287.21	12	23,934.2
65	TEXTILE YARN/FABRIC, ETC.							26.87		788.30	98.80	10	9,880.0
66	NONMETAL MINRL MFRS. NES	3,221		4,945		5,495		7.65		788.30	28.13	15	1,875.3
67	IRON/STEEL	3,221		550		5,495		-		-	322.39	18	17,910.6
68	NONFERROUS METALS	3,221		4,945		5,495		28.94		788.30	106.41	15	7,094.0
69	METAL MFRS, NES							21.18		788.30	77.88	17	4,581.2
7	(MACHINES/TRANSPORT EQUIP)												
71	MACHINERY NON ELECTRIC							38.86		788.30	142.89	8	17,861.3
72	ELECTRIC MACHINERY							32.59		788.30	119.83	5	23,966.0
73	TRANSPORT EQUIPMENT												
	CARS							41.95		788.30	154.25	3	51,416.7
	PARTS							23.42		788.30	86.12	8	10,765.0
8	(MISC. MANUFACTURED GOODS)												
81	PLUMBG/HEATING/LIGHTING EQUIP.							0.47		788.30	1.73	6	288.3
86	INSTRUMENT/WATCHES/CLOCKS							4.43		788.30	16.29	10	1,629.0
89	MISC. MANFCTRD GOODS,NES							10.34		788.30	38.02	8	4,752.5
	GRAND TOTAL							788.30			3,220.97	9.3	345,035.2

Cargo weight (MT) per TEU (EXPORT 1999 - 2000)

No.	Commodity	Containerized cargo by commodity a	x	b	÷	c	x	d	÷	e	Total (1000MT)	Cargo weight (MT) per TEU	Total TEU
0	(FOOD/LIVE ANIMALS)												
01	MEAT/PREPS	2,655		2,120		3,270		0.04		696.71	0.10	10	10.0
03	FISH/PREPS	2,655		2,120		3,270		16.97		696.71	41.92	7	5,988.6
04	CEREALS/PREPS												
	RICE	2,655		650		3,270		-		-	527.75	18	29,319.4
	OTHERS	2,655		2,120		3,270		8.89		696.71	21.96	16	1,372.5
05	FRUITS/VEGETABLES	2,655		2,120		3,270		31.62		696.71	78.10	8	9,762.5
06	SUGAR/PREPS/HONEY												
	SUGAR	2,655		200		3,270		-		-	162.39	18	9,021.7
	OTHERS	2,655		2,120		3,270		0.86		696.71	2.12	17	124.7
07	COFFEE/TEA/COCOA/SPICES	2,655		2,120		3,270		6.77		696.71	16.72	16	1,045.0
08	ANIMAL FEEDING STUFF	2,655		2,120		3,270		80.28		696.71	198.29	5	39,658.0
09	MISC. FOOD PREPS	2,655		2,120		3,270		1.03		696.71	2.54	10	254.0
1	(BEVERAGES/TOBACO)												
11	BEVERAGES	2,655		2,120		3,270		1.44		696.71	3.56	18	197.8
12	TOBACO	2,655		2,120		3,270		4.85		696.71	11.98	8	1,479.5
2	(CRUDE MATERIALS EXCL. FUELS)												
21	HIDES/SKINS/FURS UNDRSSD	2,655		2,120		3,270		0.14		696.71	0.35	18	19.4

No.	Commodity	Containerized cargo by commodity a	x b	÷ c	x d	÷ e	Total (1000MT)	Cargo weight (MT) per TEU	Total TEU
22	OIL SEEDS/NUTS/KERNELS	2,655	2,120	3,270	12.52	696.71	30.92	13	2,378.5
25	PULPS/WASTE PAPERS	2,655	2,120	3,270	0.20	696.71	0.49	17	28.8
26	TEXTILE FIBRES	2,655	2,120	3,270	67.33	696.71	166.31	10	16,631.0
	COTTON	2,655	300	3,270	-	-	243.58	10	24,358.0
29	CRUDE ANIMAL/VEGETABLES, NES	2,655	2,120	3,270	76.15	696.71	188.09	10	18,809.0
6	(BASIC MANUFACTURES)								
61	LEATHER DRESSED/FUR,ETC.	2,655	2,120	3,270	25.50	696.71	62.99	10	6,299.0
62	RUBBER MANFACTURES, NES	2,655	2,120	3,270	0.83	696.71	2.05	10	205.0
63	WOOD/CORK MANFACTURES, NES	2,655	2,120	3,270	0.42	696.71	1.04	7	148.6
64	PAPER/PAPER BOARD MFRS.	2,655	2,120	3,270	0.89	696.71	2.20	12	183.3
65	TEXTILE YARN/FABRIC, ETC.	2,655	2,120	3,270	235.59	696.71	581.91	10	58,191.0
66	NONMETAL MINERAL MFRS,NES								
	OTHERS	2,655	2,120	3,270	53.80	696.71	132.89	15	8,859.3
67	IRON/STEEL	2,655	2,120	3,270	5.50	696.71	13.59	18	755.0
68	NON FERROUS METALS	2,655	2,120	3,270	0.20	696.71	0.49	15	32.7
69	METAL MFRS, NES	2,655	2,120	3,270	24.27	696.71	59.95	17	3,526.5
7	(MACHINES/TRANSPORT EQUIP.)								
71	MACHINERY NONELECTRIC	2,655	2,120	3,270	3.50	696.71	8.65	8	1,081.3
72	ELECTRIC MACHINERY	2,655	2,120	3,270	1.79	696.71	4.42	5	884.0

No.	Commodity	Containerized cargo by commodity a	x b	÷ c	x d	÷ e	Total (1000MT)	Cargo weight (MT) per TEU	Total TEU
73	TRANSPORT EQUIPMENT								
	CARS	2,655	2,120	3,270	0.50	696.71	1.24	3	413.3
	PARTS	2,655	2,120	3,270	0.37	696.71	0.91	8	113.8
8	(MISC. MANUFACTURED GOOD)								
81	PLUMBG/HEATING/LIGHTING EQUIP.	2,655	2,120	3,270	1.02	696.71	2.52	6	420.0
84	CLOTHING	2,655	2,120	3,270	6.88	696.71	16.99	5	3,398.0
85	FOOT WEAR	2,655	2,120	3,270	5.26	696.71	12.99	7	1,855.7
89	MISC. MANUFACTURED GOODS, NES	2,655	2,120	3,270	21.30	696.71	52.61	8	6,576.3
	GRAND TOTAL				696.71	696.71	2,654.61	10.5	253,401.2

Appendix III-2

Necessary Ground Slots of CNTR at Port Terminal

The required ground slots of CNTR can be calculated using the following formula:

$$GS = \frac{NC \times CS}{t \times n \times WD}$$

Where, GS : Number of ground slots of CNTR (TEU)
NC : Number of CNTR handled per year (TEU)
CS : Days of CNTR's stay (dwell time) in terminal
t : Number of stacking tiers of CNTR (stacking height) for rubber tired transfer crane
n : Net stacking CNTR ratio exclusive of operational allowance for slot availavility due to reservation, shifting or congestion
WD : Annual working days, 365 - 65 = 300 days.

	Handling mode of CNTR	CS	t	n
a	Import FCL dry CNTR by rail	4	3	0.9
b	Import FCL special CNTR by rail	4	1	0.9
c	Import FCL dry CNTR by road	14	2	0.7
d	Import FCL special CNTR by road	14	1	0.9
e	Import LCL dry CNTR by rail & road	4	3	0.9
f	Import LCL special CNTR by rail & road	4	1	0.9
g	Export FCL dry CNTR by rail	7	3	0.5
h	Export FCL special CNTR by rail	7	1	0.9
i	Export FCL dry CNTR by road	7	3	0.5
j	Export FCL special CNTR by road	7	1	0.9
k	Export LCL dry CNTR by rail & road	5	3	0.5
l	Export LCL special CNTR by rail & road	5	1	0.9
m	Empty CNTR for stuffing export cargo	14	3	0.9
n	Export empty CNTR	7	3	0.9
o	Tranship dry & empty CNTR	14	3	0.7
p	Tranship special CNTR	14	1	0.9

1. **Master plan (1999–2000)**

a. Import FCL dry CNTR by rail; $GSa = \frac{129,896 \times 4}{3 \times 0.9 \times 300} = \underline{642 \text{ TEU}}$

* NC = IFR x d

IFR : Number of import FCL CNTR carried by rail per year (TEU)
d : Dry CNTR ratio of FCL CNTR by rail, 90%

NC = 144,329 x 0.9 = 129,896 TEU

b. Import FCL special CNTR by rail; $GSb = \frac{14,433 \times 4}{1 \times 0.9 \times 300} = \underline{214 \text{ TEU}}$

* NC = IFR x c

c : Special CNTR ratio of FCL CNTR by rail, 10%

NC = 144,329 x 0.1 = 14,433 TEU

c. Import FCL dry CNTR by road; $GSc = \frac{63,275 \times 14}{2 \times 0.7 \times 300} = \underline{2,110 \text{ TEU}}$

* NC = IFD x d

IFD : Number of import FCL CNTR carried by road per year (TEU)
NC = 70,305 x 0.9 = 63,275 TEU

d. Import FCL special CNTR by road; $GSd = \frac{7,031 \times 14}{1 \times 0.9 \times 300} = \underline{365 \text{ TEU}}$

* NC = IFD x c

NC = 70,305 x 0.1 = 7,031 TEU

e. Import LCL dry CNTR by rail & road; $GSe = \frac{80,615 \times 4}{3 \times 0.9 \times 300} = \underline{398 \text{ TEU}}$

* NC = (ILR + ILD) x d

ILR : Number of import LCL CNTR carried by rail per year (TEU)
ILD : Number of import LCL CNTR carried by road per year (TEU)

NC = (18,590 + 70,982) x 0.9 = 80,615 TEU

f. Import LCL special CNTR by rail & road; $GSf = \frac{8,957 \times 4}{1 \times 0.9 \times 300} = \underline{133 \text{ TEU}}$

* NC = (ILR + ILD) x c

NC = (18,590 + 70,982) x 0.1 = 8,957 TEU

g. Export FCL dry CNTR by rail; $GSg = \frac{86,390 \times 7}{3 \times 0.5 \times 300} = \underline{1,344 \text{ TEU}}$

* NC = EFR x d

EFR : Number of export FCL CNTR carried by rail per year (TEU)

NC = 95,989 x 0.9 = 86,390 TEU

h. Export FCL special CNTR by rail; $GSh = \frac{9,599 \times 7}{1 \times 0.9 \times 300} = \underline{249 \text{ TEU}}$

* NC = EFR x c

NC = 95,989 x 0.1 = 9,599 TEU

i. Export FCL dry CNTR by road; $GSi = \frac{39,848 \times 7}{3 \times 0.5 \times 300} = \underline{620 \text{ TEU}}$

* NC = EFD x d

EFD: Number of export FCL CNTR carried by road per year (TEU)

NC = 44,276 x 0.9 = 39,848 TEU

j. Export FCL special CNTR by road; $GSj = \frac{4,428 \times 7}{1 \times 0.9 \times 300} = \underline{115 \text{ TEU}}$

* NC = EFD x c

NC = 44,276 x 0.1 = 4,428 TEU

k. Export LCL dry CNTR by rail & road; $GSk = \frac{58,405 \times 5}{3 \times 0.5 \times 300} = \underline{650 \text{ TEU}}$

* NC = (ELR + ELD) x d

ELR : Number of export LCL CNTR carried by rail per year (TEU)

ELD : Number of export LCL CNTR carried by road per year (TEU)

NC = (9,801 + 55,093) x 0.9 = 58,405 TEU

l. Export LCL special CNTR by rail & road; $GS_1 = \frac{6,489 \times 5}{1 \times 0.9 \times 300} = \underline{121 \text{ TEU}}$

* NC = (ELR + ELD) x c

NC = (9,801 + 55,093) x 0.1 = 6,489 TEU

m. Empty CNTR for stuffing export cargo; $GSm = \frac{87,032 \times 14}{3 \times 0.9 \times 300} = \underline{1,505 \text{ TEU}}$

* NC = EFD x e + (FLR + FLD)

e : Percentage of empty CNTR stored at terminal, 50%

NC = 44,276 x 0.5 + 9,801 + 55,093 = 87,032 TEU

n. Export empty CNTR; $GSn = \frac{99,047 \times 7}{3 \times 0.9 \times 300} = \underline{856 \text{ TEU}}$

* NC = (IFR + ILR + IFD + ILD) - (EFR + ELR + EFD + ELD)
= (144,329 + 18,590 + 70,305 + 70,982) - (95,989 + 9,801 + 44,276 + 55,093) = 99,047 TEU

o. Tranship dry & empty CNTR; $GSo = \frac{32,111 \times 14}{3 \times 0.7 \times 300} = \underline{714 \text{ TEU}}$

* $NC = IF \left\{ \left(\frac{tf}{100-tf-te}\right) \times d + \left(\frac{te}{100-tf-te}\right) \right\}$

IF : Number of import full CNTR discharged per year (TEU)

tf : Percentage of tranship full CNTR, 5%

te : Percentage of tranship empty CNTR, 5%

$NC = 304,206 \left\{ \left(\frac{5}{100-10}\right) \times 0.9 + \left(\frac{5}{100-10}\right) \right\} = 32,111 \text{ TEU}$

p. Tranship special CNTR; $GSp = \frac{1,690 \times 14}{1 \times 0.9 \times 300} = \underline{88 \text{ TEU}}$

* $NC = IF \times \left(\frac{tf}{100-tf-te}\right) \times c$

$NC = 304,206 \left(\frac{5}{100-10}\right) \times 0.1 = 1,690 \text{ TEU}$

Total ground slots: GSt = GSa + - - - - - - + GSp = 10,124 TEU

* Reference No.1: The same number of chassis (TEU) to the total stacking slots, exclusive of operational margin for the rubber-tired transfer crane system, are required for the all chassis system.

Total stacking slots:

642 (GSa)	x 0.9	x 3	= 1,734	TEU
214 (GSb)	x 0.9	x 1	= 193	"
2,110 (GSc)	x 0.7	x 2	= 2,954	"
365 (GSd)	x 0.9	x 1	= 329	"
398 (GSe)	x 0.9	x 3	= 1,075	"
133 (GSf)	x 0.9	x 1	= 120	"
1,344 (GSg)	x 0.5	x 3	= 2,016	"
249 (GSh)	x 0.9	x 1	= 224	"
620 (GSi)	x 0.5	x 3	= 930	"
115 (GSj)	x 0.9	x 1	= 104	"
650 (GSk)	x 0.5	x 3	= 975	"
121 (GSl)	x 0.9	x 1	= 109	"
1,505 (GSm)	x 0.9	x 3	= 4,064	"
856 (GSn)	x 0.9	x 3	= 2,311	"
714 (GSo)	x 0.7	x 3	= 1,499	"
88 (GSp)	x 0.9	x 1	= 79	TEU
			18,716	TEU

∴ The necessary number of chassis

20 footer : 18,716 x 0.5 = 9,358 units

40 footer : 18,716 x 0.25 = 4,679 units

* Reference No.2: The required ground slots of refrigerated CNTR at CNTR yard are calculated as follows:

$$GSr = (GSb + GSd + GSf + GSh + GSj + GSl + GSp) \times \gamma + GSq$$

GSr : Ground slots of refrigerated CNTR

γ : Refrigerated CNTR ratio to all special ones, 0.3

GSq : Ground slots of empty refrigerated CNTR for pretrip (cooling)

$$GSq = \frac{2,611 \times 3}{1 \times 0.9 \times 300} = \underline{29 \text{ TEU}}$$

CS : Days of CNTR's stay, 3 days

$$NC = EFD \times c \times e \times \gamma + (FLR + FLD) \times c \times \gamma$$

$$= 44,276 \times 0.1 \times 0.5 \times 0.3 + (9,801 + 55,093) \times 0.1 \times 0.3 = 2,611 \text{ TEU}$$

$$\therefore GSr = (214 + 365 + 133 + 249 + 115 + 121 + 88) \times 0.3 + 29 = \underline{\underline{415 \text{ TEU}}}$$

2. Urgent plan (1987–1988)

a. Import FCL dry CNTR by rail; $GSa = \frac{32,528 \times 4}{3 \times 0.9 \times 300} = \underline{161 \text{ TEU}}$

* NC = IFR x d

IFR : Number of import FCL CNTR carried by rail per year (TEU)

d : Dry CNTR ratio of FCL CNTR by rail, 90%

NC : 36,142 x 0.9 = 32,528 TEU

b. Import FCL special CNTR by rail; $GSb = \frac{3,614 \times 4}{1 \times 0.9 \times 300} = \underline{54 \text{ TEU}}$

* NC = IFR x c

c : Special CNTR ratio of FCL CNTR by rail, 10%

NC = 36,142 x 0.1 = 3,614 TEU

c. Import FCL dry CNTR by road; $GSc = \frac{15.845 \times 14}{2 \times 0.7 \times 300} = \underline{529 \text{ TEU}}$

* NC = IFD x d

IFD : Number of import FCL CNTR carried by road per year (TEU)

NC = 17,606 x 0.9 = 15,845 TEU

d. Import FCL special CNTR by road; $GSd = \frac{1,761 \times 14}{1 \times 0.9 \times 300} = \underline{92 \text{ TEU}}$

* NC = IFD x c

NC = 17,606 x 0.1 = 1,761

e. Import LCL dry CNTR by rail & road; $GSe = \frac{20,187 \times 4}{3 \times 0.9 \times 300} = \underline{100 \text{ TEU}}$

* NC = (ILR + ILD) x d

ILR : Number of import LCL CNTR carried by rail per year (TEU)

ILD : Number of import LCL CNTR carried by road per year (TEU)

NC = (4,740 + 17,690) x 0.9 = 20,187 TEU

f. Import LCL special CNTR by rail & road; $GSf = \frac{2.243 \times 4}{1 \times 0.9 \times 300} = \underline{34 \text{ TEU}}$

* NC = (ILR + ILD) x c

NC = (4,740 + 17,690) x 0.1 = 2,243 TEU

g. Export FCL dry CNTR by rail; $GSg = \frac{26,957 \times 7}{3 \times 0.5 \times 300} = \underline{420 \text{ TEU}}$

* NC = EFR x d

EFR : Number of export FCL CNTR carried by rail per year (TEU)

NC = 29,952 x 0.9 = 26,957 TEU

h. Export FCL special CNTR by rail; $GSh = \frac{2,995 \times 7}{1 \times 0.9 \times 300} = \underline{78 \text{ TEU}}$

* NC = EFR x c

NC = 29,952 x 0.1 = 2,995 TEU

i. Export FCL dry CNTR by road; $GSi = \frac{11,804 \times 7}{3 \times 0.5 \times 300} = \underline{184 \text{ TEU}}$

* NC = EFD x d

EFD : Number of export FCL CNTR carried by road per year (TEU)

NC : 13,115 x 0.9 = 11,804 TEU

j. Export FCL special CNTR by road; $GSj = \frac{1,312 \times 7}{1 \times 0.9 \times 300} = \underline{34 \text{ TEU}}$

* NC = EFD x c

NC = 13,115 x 0.1 = 1,312 TEU

k. Export LCL dry CNTR by rail & road; $GSk = \frac{19,494 \times 5}{3 \times 0.5 \times 300} = \underline{217 \text{ TEU}}$

* NC = (ELR + ELD) x d

ELR : Number of export LCL CNTR carried by rail per year (TEU)

ELD : Number of export LCL CNTR carried by road per year (TEU)

NC = (3,554 + 18,106) x 0.9 = 19,494 TEU

l. Export LCL special CNTR by rail & road; $GSe = \frac{2,166 \times 5}{1 \times 0.9 \times 300} = \underline{41 \text{ TEU}}$

* NC = (ELR + ELD) x c

NC = (3,554 + 18,106) x 0.1 = 2,166 TEU

m. Empty CNTR for stuffing export cargo; $GSm = \frac{28,218 \times 14}{3 \times 0.9 \times 300} = \underline{488 \text{ TEU}}$

* NC = EFD x e + (FLR + FLD)

e : Percentage of empty CNTR stored at terminal, 50%

NC = 13,115 x 0.5 + (3,554 + 18,106) = 28,218 TEU

n. Export empty CNTR; $GSn = \frac{11,451 \times 7}{3 \times 0.9 \times 300} = \underline{99 \text{ TEU}}$

* NC = (IFR + ILR + IFD + ILD) - (EFR + ELR + EFD + ELD)
= (36,142 + 4,740 + 17,606 + 17,690) - (29,952 + 3,554 + 13,115 + 18,106) = 11,451 TEU

o. Tranship dry & empty CNTR; $GSo = \frac{8,041 \times 14}{3 \times 0.7 \times 300} = \underline{179 \text{ TEU}}$

* $NC = IF \left\{ \left(\frac{tf}{100-tf-te}\right) \times d + \left(\frac{te}{100-tf-te}\right) \right\}$

IF : Number of import full CNTR discharged per year (TEU)
tf : Percentage of tranship full CNTR, 5%
te : Percentage of tranship empty CNTR, 5%

$NC = 76,178 \left\{ \left(\frac{5}{100-10}\right) \times 0.9 + \left(\frac{5}{100-10}\right) \right\} = 8,041 \text{ TEU}$

p. Tranship special CNTR; $GSp = \frac{423 \times 14}{1 \times 0.9 \times 300} = \underline{22 \text{ TEU}}$

* $NC = IF \times \left(\frac{tf}{100-tf-te}\right) \times c$

$NC = 76,178 \times \left(\frac{5}{100-10}\right) \times 0.1 = 423 \text{ TEU}$

Total ground slots: GSt = GSa + - - - - + GSp = 2,732 TEU

* Reference : The required ground slots of refrigerated CNTR at CNTR yard are calculated as follows:

$$GSr = (GSb + GSd + GSf + GSh + GSj + GSl + GSp) \times \gamma + GSq$$

GSr : Ground slots of refrigerated CNTR

γ : Refrigerated NCTR ratio to all special ones, 0.3

GSq : Ground slots of empty refrigerated CNTR for pretrip (cooling)

$$GSq = \frac{847 \times 3}{1 \times 0.9 \times 300} = \underline{10 \text{ TEU}}$$

CS : Days of CNTR's stay, 3 days

NC = EFD x c x e x γ + (FLR + FLD) x c x γ

= 13,115 x 0.1 x 0.5 x 0.3 + (3,554 + 18,106) x 0.1 x 0.3 = 847 TEU

$\therefore$ GSr = (54 + 92 + 34 + 78 + 34 + 41 + 22) x 0.3 + 10 = 117 TEU

Appendix III-3

Necessary Floor Space of Container Freight Station at Port Terminal

The floor space of CFS is calculated by the following equation:

$$FS = \frac{(IR + ID + ER + ED) \times DS}{\omega \times \gamma \times WD}$$

Where;

FS : Floor space of CFS (m^2)
IR : Import LCL cargo volume by rail (MT)
ID : Import LCL cargo volume by road (MT)
ER : Export LCL cargo volume by rail (MT)
ED : Export LCL cargo volume by road (MT)
DS : Days of cargo stay in CFS, 7 days
ω : Average weight of cargo stacked in storage space, 1.0 MT/m^2
γ : Coefficient of floor utilization for storing cargo, 0.45
WD : Annual working days, 365 - 65 = 300 days

a. Urgent plan

$$FS = \frac{(42,507 + 159,745 + 39,160 + 198,648) \times 7}{1 \times 0.45 \times 300} = 22,818 \text{ m}^2$$

LCL by rail = 4,235 m^2
LCL by road = 18,583 m^2

b. Master plan

$$FS = \frac{(169,747 + 637,919 + 106,067 + 607,066) \times 7}{1 \times 0.45 \times 300} = 78,856 \text{ m}^2$$

LCL by rail = 14,301 m^2
LCL by road = 64,555 m^2

Appendix III-4(1)

Number of Equipment in Port Terminal (1,999–2,000)

The necessary number of equipment is calculated as follows:

(1) Container cranes: 2 units per berth
(12 units per terminal)

Average productivity per crane hour = 20 movements (units)
Gross working hour per day = 22 hours
Net working hour ratio = 0.75
Ordinary productivity per berth day = 20 x 22 x 0.75 x 2 = 660 movements

(2) Equipment for unit train and CNTR yard operation

$$NE = \frac{NC \times P}{WD \times GH \times w \times AP}$$

Where:

NE : Number of equipment at peak hour (units)
NC : Number of CNTR movements per year (units)
WD : Annual working days, 365 - 65 = 300 days
P : Peak day factor
GH : Gross working hours per day
w : Net working hours ratio
AP : Average productivity per equipment hour

(A)-1 Rail-mounted transfer cranes for unit train

$$NE = \frac{36,082 \times 1.25}{300 \times 22 \times 0.4 \times 20} = 0.9 = 1 \text{ unit per berth (6 units per terminal)}$$

* $NC = (DS + LS) \times u \times t \div NB$

DS : Number of CNTR discharged from ship per year (TEU)
LS : Number of CNTR loaded to ship per year (TEU)
u : Ratio of transportation by unit train, 0.427
t : Exchange rate from TEU to units of CNTR, 0.75
NB : Number of berths, 6

NC = (338,007 + 338,007) x 0.427 x 0.75 ÷ 6 = 36,082 units per berth

(A)-2 Top lifter for unit train

$$NE = \frac{36,082 \times 1.25}{300 \times 22 \times 0.4 \times 14} = 1.2 = 2 \text{ units per berth (12 units per terminal)}$$

(B)-1 Rail-mounted / Rubber-tired) transfer cranes at CNTR yard.

a. Ship's operation : $NE_a = \frac{PB}{GH \times w \times AP}$

PB : Ordinary productivity per berth day (units)
GH : Gross working hours per day
w : Net working hour ratio, 0.75
AP : Average productivity per equipment hour, 20

$$NE_a = \frac{660}{22 \times 0.75 \times 20} = 2 \text{ units}$$

b. Unit train : $NE_b = \frac{36,082 \times 1.25}{300 \times 22 \times 0.4 \times 20} = 0.9 = 1$ unit

c. LCL by rail & road: $NE_c = \frac{38,617 \times 2.5}{300 \times 22 \times 0.75 \times 20} = 1$ unit

* $NC = (IL + EL) \times t \div NB \times (1 + e)$

IL : Number of import LCL CNTR by rail & road (TEU)
EL : Number of export LCL CNTR (TEU)
t : Exchange rate from TEU to units of CNTR, 0.75
NB : Number of berths, 6
e : Percentage of empty CNTR stored at terminal, 100%

$NC = (89,572 + 64,894) \times 0.75 \div 6 \times (1 + 1) = 38,617$ units

d. FCL by road : $NE_d = \frac{23,111 \times 1.5}{300 \times 8 \times 0.9 \times 12} = 1.3 = 2$ units

* $NC = 2(IF + e \times EF) \times t \div NB$

IF : Number of import FCL CNTR by road (TEU)
EF : Number of export FCL CNTR (TEU)
e : Percentage of empty CNTR stored at terminal, 50%

$NC = 2(70,305 + 0.5 \times 44,276) \times 0.75 \div 6 = 23,111$ units

Total number of transfer cranes : $NE_t = NE_a + NE_b + NE_c + NE_d$
= 6 units per berth
(36 units per terminal)

Remark : The miscellaneous operations regarding inspection, repair and adjustment of CNTR are managed at other working hours than the peak ones.

e. Tractors & chassis 40' (20' x 2) for ship's operation

4 sets of tractors & chassis per crane x 2 = 8 sets per berth
(48 sets per terminal)

f. Tractors & chassis 40' (20' x 2) for unit train operation

4 sets of tractors & chassis per crane x 1 = 4 sets per berth
(24 sets per terminal)

(B)-2 All straddle carrier

a. Ship's operation : $NE_a = \frac{660}{22 \times 0.75 \times 12} = 3.3 = 4$ units

b. Unit train : $NE_b = \frac{36,082 \times 1.25}{300 \times 22 \times 0.4 \times 12} = 14 = 2$ units

c. LCL by rail & road: $NE_c = \frac{38,617 \times 2.5}{300 \times 22 \times 0.75 \times 12} = 1.6 = 2$ units

d. FCL by road : $NE_d = \frac{23,111 \times 1.5}{300 \times 8 \times 0.9 \times 12} = 1.3 = 2$ units

e. Spare : NE_e = 1 unit

Total number of straddle carriers: $NE_t = NE_a + NE_b + NE_c + NE_d + NE_e$
= 11 units per berth
(66 units per terminal)

f. Tractors & chassis 40' (20' x 2) for unit train operation

4 sets per crane x 1 = 4 sets per berth
(24 sets per terminal)

(B)-3 Combined system of rubber tired transfer cranes and straddle carriers

	Transfer cranes	Straddle carriers
a. Ship's operation	2 units	2 units
b. Unit train	1	1
c. Delivery of import FCL	1	1
d. Spare	0	1
Total	4 units and 5 units per berth (24 units and 30 units per terminal)	

The above number of equipment are required at least when most operations are concentrated in a service area of the transfer crane or the straddle carrier.

e. Tractors & chassis 40' (20' x 2) for ship's operation

4 sets per crane x 2 = 8 sets per berth
(48 sets per terminal)

f. Tractors & chassis 40' (20' x 2) for unit train operation

4 sets per crane x 1 = 4 sets per berth
(24 sets per terminal)

(B)-4 All chassis and shifters

a. Chassis : 592 units of 20 footer and 296 units of 40 footer chassis per berth.

3,552 units of 20 footer and 1,776 units of 40 footer chassis per terminal.

b. Tractors

Ship's operation : 4 units per CNTR crane x 2 = 8 units
Unit train " : 4 units per crane x 1 = 4 units
Gate operation : 4 units per shifter x 2 = 8 units

Total : 20 units
(120 units per terminal)

c. Shifters: $NE_c = \frac{23,111 \times 1.5}{300 \times 8 \times 0.9 \times 15} = 1.1 = 2$ units per berth
(12 units per terminal)

(B)-5 Top lifters and chassis feed

a. Ship's operation : $NE_a = \frac{660}{22 \times 0.75 \times 14} = 2.9 = 3$ units

b. Unit train : $NE_b = \frac{36,082 \times 1.25}{300 \times 22 \times 0.4 \times 14} = 1.2 = 2$ units

c. LCL by rail & road: $NE_c = \frac{38,617 \times 2.5}{300 \times 22 \times 0.75 \times 14} = 1.4 = 2$ units

d. FCL by road : $NE_d = \frac{23,111 \times 1.5}{300 \times 8 \times 0.9 \times 7} = 2.3 = 3$ units

e. Spare : $NE_e = 1$ unit

Total number of top lifters = $NE_a + NE_b + NE_c + NE_d + NE_e$
= 11 units per berth
(66 units per terminal)

f. Tractors & chassis 40' (20' x 2) for ship's operation

4 sets per crane x 2 = 8 sets per berth
(48 sets per terminal)

g. Tractors & chassis 40' (20' x 2) for unit train operation

4 sets per crane x 1 = 4 sets per berth
(24 sets per terminal)

(3) Gate operation

(A) Lanes (NL : Number of lanes)

a. Unit train : $NL_a = \frac{36,082 \times 1.25}{300 \times 22 \times 0.4 \times 20} = 0.9 = 1$ lane

b. LCL by rail & road : $NL_b = \frac{38,617 \times 2.5}{300 \times 22 \times 0.75 \times 20} = 1$ lane

c. FCL by road : $NL_c = \frac{23,111 \times 1.5}{300 \times 8 \times 0.9 \times 15} = 1.1 = 2$ lanes

Total number of lanes : $NL_t = NL_a + NL_b + NL_c$ = 4 lanes per berth
(24 lanes per terminal)

(B) Booths

One booth between two lanes ------ 2 booths per berth
(12 booths per terminal)

(C) Weighing scales used by export FCL CNTR

$$NS = \frac{5,535 \times 3.0}{300 \times 8 \times 0.9 \times 15} = 0.5 = 1 \text{ unit per berth}$$
(6 units per terminal)

* NC = EF x t ÷ NB

NS : Number of weighing scales
EF : Number of export FCL CNTR by road (TEU)
t : Exchange rate from TEU to units of CNTR, 0.75
NB : Number of berths, 6

NC = 44,276 x 0.75 ÷ 6 = 5,535 units

(4) Equipments and pallets for CFS operation

(A) 3 Ton fork lift trucks

$$NE = \frac{NC \times p \times AW}{WD \times GH \times w}$$

Where :

NE : Number of equipment at peak hour (units)
NC : Number of LCL CNTR per year (units)
p : Peak day factor
AW : Average working hours per CNTR
Import 20 footer = 1.0 hour
Import 40 footer = 1.5 hours
Export 20 footer = 0.5 hour
Export 40 footer = 0.75 hour
WD : Annual working days, 365 - 65 = 300 days
GH : Gross working hours per day
w : Net working hour ratio

a. Unstuffing import 20' : $NE_a = \frac{7,464 \times 1.5 \times 1.0}{300 \times 22 \times 0.75} = 2.3 = 3$ units

* NC = IL x d ÷ NB

IL : Number of import LCL by rail and road (TEU)
d : Exchange rate from TEU to units of 20' or 40' CNTR
NB : Number of berths, 6

NC = 89,572 x 0.5 ÷ 6 = 7,464 units

b. Unstuffing import 40' : $NE_b = \frac{3,732 \times 1.5 \times 1.5}{300 \times 22 \times 0.75} = 1.7 = 2$ units

* NC = 89,572 x 0.25 ÷ 6 = 3,732 units

c. Stuffing export 20' : $NE_c = \frac{5,408 \times 4.0 \times 0.5}{300 \times 22 \times 0.75} = 2.2 = 3$ units

* NC = 64,894 x 0.5 ÷ 6 = 5,408 units

d. Stuffing export 40' : $NE_d = \frac{2,704 \times 4.0 \times 0.75}{300 \times 22 \times 0.75} = 1.6 = 2$ units

* NC = 64,894 x 0.25 ÷ 6 = 2,704 units

Total number of fork lift trucks for unstuffing and stuffing LCL cargo from/to containers; $NE_t = NE_a + NE_b + NE_c + NE_d = 10$ units per berth.

e. The same number of equipment for the above mentioned ones (NE_t) are required to remove/feed cargo between CNTR and stack place, and receive/deliver cargo from/to consignor; $NE_e = NE_t = 10$ units per berth.

Grand total; $NE_t + NE_e = 20$ units per berth
(120 units per terminal)

(B) Fork lift trucks with 6 ton capacity for handling heavy cargo;

NE = 2 units per berth
(12 units per terminal)

(C) Tractors

4 units per transfer crane x 1 = 4 units per berth
(24 units per terminal)

(D) Chassis

NE_2 = 20 units of 20' chassis

NE_4 = 10 units of 40' chassis

NE_t = 30 units per berth

(180 units per terminal)

* Required number of chassis are three times as many as number of containers stuffed and unstuffed at the peak hour.

(E) Pallets with 1.8 m x 1.2 m two-way reversible winged type

$$NP = \frac{FS \times \gamma \times t}{(WP + w) \times (LP + \ell)}$$

Where :

NP : Number of pallets (sheets)

FS : Floor space of CFS (m^2)

γ : Floor utilization ratio of cargo stacking space, 45%

t : Number of stacking tires of pallet, 1

WP : Width of pallet, 1.8 m

w : Widthwise clearance between pallets, 0.2 m

LP : Length of pallet, 1.2 m

ℓ : Lengthwise clearance, 0.1 m

$$NP = \frac{13,143 \times 0.45 \times 1}{(1.8 + 0.2) \times (1.2 + 0.1)} = 2,275 \text{ sheets per berth}$$

(13,650 sheets per terminal)

* FS = 78,856 ÷ 6 = 13,143 m^2 per berth

(5) Equipment for the repair shop

(A) 3 ton fork lift truck for lifting CNTR on the repair stand

One unit per berth

(6 units per terminal)

(B) 15 ton fork lift truck with telescopic side spreader

One unit per berth

(6 units per terminal)

(6) Multipurpose equipment

(A) Mobile crane with 35 ton capacity for emergency

Measures at CNTR yard and CFS operation : One unit every 2 berth
(3 units per terminal)

(B) 3 ton fork lift trucks for carrying cargo gears and others

3 units every 2 berths
(9 units per terminal)

(C) 15 ton fork lift trucks with telescopic side spreader for handling heavy cargo and empty CNTR

One unit every two berths
(3 units per terminal)

(D) 35 ton top lifters with telescopic spreader for transferring full CNTR at CFS and CNTR yard

One unit every two berths
(3 units per terminal)

(7) Terminal office

(A) Computer for inventory control of CNTR in terminal

One set every two berths
(3 units per terminal)

(B) Wireless telephone (VHF)

	Main equipment	Office, CFS & maintenance	Total per terminal
a. Transfer crane	153	12	165
b. Straddle carrier	135	12	147
c. Combined system	171	12	183
d. All chassis	177	12	189
e. Top lifter	183 units	12 units	195 units

Appendix III-4(2)

Number of Equipments in Port Terminal (1987–1988)

The necessary number of equipment is calculated as follows:

(1) Container cranes: 2 units per berth
(4 units per terminal)

Average productivity per crane hour = 20 movements (units)
Gross working hour per day = 22 hours
Net working hour ratio = 0.75
Ordinary productivity per berth day = 20 x 22 x 0.75 x 2 = 660 movements

(2) Equipments for unit train and CNTR yard operation

$$NE = \frac{NC \times p}{WD \times GH \times w \times AP}$$

Where :

NE : Number of equipment at peak hour (units)
NC : Number of CNTR movements per year (units)
WD : Annual working days, 365 - 65 = 300 days
p : Peak day factor
GH : Gross working hours per day
w : Net working hour ratio
AP : Average productivity per equipment hour

(A) Rail mount transfer cranes for unit train

$$NE = \frac{27,107 \times 1.25}{300 \times 22 \times 0.4 \times 20} = 0.6 = 1 \text{ unit per berth}$$

(2 units per terminal)

* NC = (DS + LS) x u x t ÷ NB

DS : Number of CNTR discharged from ship per year (TEU)
LS : Number of CNTR loaded to ship per year (TEU)
u : Ratio of transportation by unit train, 0.427
t : Exchange rate from TEU to units of CNTR, 0.75
NB : Number of berths, 2

NC = (84,642 + 84,642) x 0.427 x 0.75 ÷ 2 = 27,107 units

(B) Rubber tired transfer cranes for CNTR yard operation

a. Ship's operation : $NE_a = \frac{PB}{GH \times w \times AP}$

PB : Ordinary productivity per berth day (units)
GH : Gross working hours per day
w : Net working hours ratio, 0.75
AP : Average productivity per equipment hour, 20

$$NE_a = \frac{660}{22 \times 0.75 \times 20} = 2 \text{ units}$$

b. Unit train : $NE_b = \frac{27,107 \times 1.25}{300 \times 22 \times 0.4 \times 20} = 0.6 = 1 \text{ unit}$

c. LCL by rail & road : $NE_c = \frac{33,068 \times 2.5}{300 \times 22 \times 0.75 \times 20} = 0.8 = 1 \text{ unit}$

* $NC = (IL + EL) \times t \div NB \times (1 + e)$

IL : Number of import LCL CNTR by rail & road (TEU)
EL : Number of export LCL CNTR (TEU)
t : Exchange rate from TEU to units of CNTR, 0.75
NB : Number of berths, 2
e : Percentage of empty CNTR stored at terminal, 100%

$NC = (22,430 + 21,660) \times 0.75 \div 2 \times 2 = 33,068$ units

d. FCL by road : $NE_d = \frac{18,123 \times 1.5}{300 \times 8 \times 0.9 \times 12} = 1 \text{ unit}$

* $NC = 2 (IF + e \times EF) \times t \div NB$
IF : Number of import FCL CNTR by road (TEU)
EF : Number of export FCL CNTR by road (TEU)
e : Percentage of empty CNTR stored at terminal, 50%

$NC = 2 (17,606 + 0.5 \times 13,115) \times 0.75 \div 2 = 18,123$ unit.

Total number of transfer cranes : $NE_t = NE_a + NE_b + NE_c + NE_d$
= 5 units per berth
(10 units per terminal)

Remark : The miscellaneous operations regarding inspection, repair and adjustment of CNTR are managed at other working hours than the peak ones.

(C) Tractors and chassis 40' (20' x 2) for ship's operation

4 sets of tractor & chassis per crane x 2 = 8 sets per berth
(16 sets per terminal)

(D) Tractors and chassis 40' (20' x 2) for unit train operation

4 sets of tractors & chassis per crane x 1 = 4 sets per berth
(8 sets per terminal)

(3) Gate operation

(A) Lanes (NL : Number of lanes)

a. Unit train : $NL_a = \frac{27,107 \times 1.25}{300 \times 22 \times 0.4 \times 20} = 0.6 = 1$ lane

b. LCL by rail & road : $NL_b = \frac{33,068 \times 2.5}{300 \times 22 \times 0.75 \times 20} = 0.8 = 1$ lane

c. FCL by road : $NL_c = \frac{18,123 \times 1.5}{300 \times 8 \times 0.9 \times 15} = 0.8 = 1$ lane

Total number of lanes: $NL_t = NL_a + NL_b + NL_c = 3$ lanes per berth
(6 lanes per terminal)

(B) Booths

One booth between two lanes ----- 2 booths per berth
(3 booths per terminal)

(C) Weighing scale used by export FCL CNTR

$NS = \frac{4,918 \times 3.0}{300 \times 8 \times 0.9 \times 15} = 0.5 = 1$ unit per berth
(2 units per terminal)

* NC = EF x t ÷ NB

NS : Number of weighing scales
EF : Number of export FCL CNTR by road (TEU)
t : Exchange rate from TEU to units of CNTR, 0.75
NB : Number of berths, 2

NC = 13,115 x 0.75 ÷ 2 = 4,918

(4) Equipment and pallets for CFS operation

(A) 3 ton fork lift trucks

$$NE = \frac{NC \times p \times AW}{WD \times GH \times w}$$

Where :

NE : Number of equipment at peak hour (units)
NC : Number of LCL CNTR per year (units)
p : Peak day factor
AW : Average working hours per CNTR
Import 20 footer = 1.0 hour
Import 40 footer = 1.5 hours
Export 20 footer = 0.5 hour
Export 40 footer = 0.75 hour
WD : Annual working days, 365 - 65 = 300 days
GH : Gross working hours per day
w : Net working hour ratio

a. Unstuffing import 20'; $NE_a = \frac{5,608 \times 1.5 \times 1.0}{300 \times 22 \times 0.75} = 1.7 = 2$ units

* NC = IL x d ÷ NB

IL : Number of import LCL by rail and road (TEU)
d : Exchange rate from TEU to units of 20' or 40'
NB : Number of berths, 2

NC = 22,430 x 0.5 ÷ 2 = 5,608

b. Unstuffing import 40'; $NE_b = \frac{2,804 \times 1.5 \times 1.5}{300 \times 22 \times 0.75} = 1.3 = 2$ units

* NC = 22,430 x 0.25 ÷ 2 = 2,804 units

c. Stuffing export 20'; $NE_c = \frac{5,415 \times 4.0 \times 0.5}{300 \times 22 \times 0.75} = 2.2 = 3$ units

* NC = 21,660 x 0.5 ÷ 2 = 5,415 units

d. Stuffing export 40'; $NE_d = \frac{2,708 \times 4.0 \times 0.75}{300 \times 22 \times 0.75} = 1.6 = 2$ units

* NC = 21,660 x 0.25 ÷ 2 = 2,708 units

Total number of fork lift trucks for unstuffing and stuffing LCL cargo from/to CNTR; $NE_t = NE_a + NE_b + NE_c + NE_d = 9$ units.

e. The same number of equipment for the above mentioned ones (NT_t) are required to remove/feed cargo between CNTR and stack place, and receive/deliver cargo from/to consignor; $NE_e = NE_t = 9$ units.

Grand total : $NE_t + NE_e = 18$ units per berth
(36 units per terminal)

(B) 6 ton fork lift trucks for handling heavy cargo : NE = 2 units per berth
(4 units per terminal)

(C) Road tractor

4 units per transfer crane for CFS operation x 1 = 4 units per berth
(8 units per terminal)

(D) Chassis

NE_2 = 18 units of 20' chassis
NE_4 = 9 units of 40' chassis
NE_t = 27 units per berth
(54 units per terminal)

* Required number of chassis are three times as many as number of containers stuffed and unstuffed at the peak hour.

(E) Pallets with 1.8 m x 1.2 m two-way reversible winged type

$$NP = \frac{FS \times \gamma \times t}{(WP + w) \times (LP + \ell)}$$

Where :

NP : Number of pallets (sheets)
FS : Floor space of CFS (m^2)
γ : Floor utilization ratio of cargo stacking space, 45%
t : Number of stacking tires of pallet, 1
WP : Width of pallet, 1.8 m
w : Widthwise clearance between pallets, 0.2 m
LP : Length of pallets, 1.2 m
ℓ : Lengthwise clearance, 0.1 m

$$NP = \frac{11,409 \times 0.45 \times 1}{(1.8 + 0.2) \times (1.2 + 0.1)} = 1,975 \text{ sheets per berth}$$

(3,950 sheets per terminal)

* FS = 22,818 ÷ 2 = 11,409 m^2 per berth

(5) Equipment for the repair shop

(A) 3 ton fork lift truck for lifting CNTR on the repair stands

One unit per berth
(2 units per terminal)

(B) 15 ton fork lift truck with telescopic side spreader

One unit per berth
(2 units per terminal)

(6) Multipurpose equipment

(A) Mobile crane with 35 ton capacity for emergency

measures at CNTR yard and CFS operation : One unit every 2 berths
(1 unit per terminal)

(B) 3 ton fork lift truck for carrying cargo gears and others

3 units every 2 berths
(3 units per terminal)

(C) 15 ton fork lift truck with telescopic side spreader for handling heavy cargo and empty CNTR : One unit every 2 berths
(One unit per terminal)

(D) 35 ton top lifter with telescopic spreader for transferring full CNTR at CFS and CNTR yard : One unit every 2 berths
(One unit per terminal)

(7) Terminal office

(A) Computer for inventory control of CNTR in terminal

One set every two berths
(One set per terminal)

(B) Wireless telephone (VHF)

Container crane	4 units
Yard tractor for ship's operation	16 "
Rail-mounted transfer crane for unit train operation	2 "
Tractor for unit train operation	8 "
Rubber tired-transfer crane	10 "
Tractor for CFS operation	8 units
Top lifter	1 unit
Terminal office	1 "
Maintenance shop	1 "
CFS	1 "
Spare	1 unit

(53 units per terminal)

Appendix IV-1 Ship waiting time for the alternative

Table A-IV-1(a) Cargo Volume for Karachi Port ("Without" Case)

YEAR	WHEAT	RICE	FERT.P/S	CEMENT	G.CARGO	P.I./COKE	TOTAL	%
1979.80	672.1	1,106	1,426.	6 .	3,494.		7,308.	100.
1980.81	308.	1,257.	1,530.	444.	3,650.		7,189.	98.
1981.82	280.	1,399.	1,490.	300.	3,520.		6,990.	96
1982.83	250.	1,500.	1,499.	150.	3,189.		6,538.	89.
1983.84	180.	1,575.	2,078.	150.	3,339.		7,322.	100.
1984.85	0.	150.	570.	150.	3,499.		4,369.	60
1985.86	0.	150.	570.	0.	3,537.		4,257.	58.
1986.87	0.	150.	570.	0.	3,751.		4,471.	61.
1987.88	0.	150	570.	0.	3,964.		4,684.	64.
1988.89	0.	150.	570.	0.	4,217.		4,937.	68.
1989.90	0.	150.	570.	0.	4,557.		5,277.	72.
1990.91	0.	160.	570.	0.	4,860.		5,590.	76.
1991.92	0.	178.	570.	0.	5,075		5,815.	80.
1992.93	0.	180.	570.	0.	5,290		6,040.	83.
1993.94	0.	190.	570.	0.	5,505.		6,265.	86.
1994.95	0.	200.	570.	0.	5,720.		6,490.	89.
1995.96	0.	210.	570.	0.	6,039.		6,819.	93.
1996.97	0.	220.	570.	0.	6,358.		7,148.	98.
1997.98	0.	230.	570.	0.	6,677.		7,477.	102.
1998.99	0.	240.	570.	0.	6,996.		7,806.	107.
1999.00	0.	250.	570.	0.	7,315.		8,135.	111.

(Cargo allocation proposed by SWANCO)

Table A-IV-1(b) No. of ship call for Karachi Port ("Without" case)

YEAR	WHEAT	RICE	FERT.P/S	CEMENT	G.CARGO	P.I./COKE	TOTAL	Ship/day
1979.80	45.	178.	110.	51.	998.		1,374.	4.04.
1980.81	21.	193.	118.	37.	1,043.		1,411.	4.15.
1981.82	19.	215.	115.	25.	1,006.		1,279.	4.06.
1982.83	17.	231.	111.	13.	911.		1,283.	3.77.
1983.84	12.	242.	160.	13.	954.		1,381.	4.06.
1984.85	0.	23.	44.	13.	1,000.		1,079.	3.17.
1985.86	0.	23.	44.	0.	1,011.		1,077.	3.17.
1986.87	0.	23.	44	0.	1,072.		1,139.	3.35.
1987.88	0.	23.	44.	0.	1,133.		1,199.	3.53.
1988.89	0.	23.	44.	0.	1,205.		1,272.	3.74
1989.90	0.	23.	44.	0.	1,302.		1,369.	4.03.
1990.91	0.	25.	44.	0.	1,389.		1,457.	4.29.
1991.92	0.	26.	44.	0.	1,450.		1,520.	4.47.
1992.93	0.	28.	44.	0.	1,511.		1,583.	4.66.
1993.94	0.	29.	44.	0.	1,573.		1,646.	4.84.
1994.95	0.	31.	44.	0.	1,634.		1,709.	5.03.
1995.96	0.	32.	44.	0.	1,725.		1,802.	5.30.
1996.97	0.	34.	44.	0.	1,817.		1,894.	5.57.
1997.98	0.	35.	44.	0.	1,908.		1,987.	5.84.
1998.99	0.	37.	44.	0.	1,999.		2,080.	6.12.
1999.00	0.	38.	44.	0.	2,090.		2,172.	6.39.

Table A-IV-1(c) Ship Day & Waiting Time for Karachi Port ("Without" Case)

YEAR	WHEAT	RICE	FERT. P/S	CEMENT	G.CARGO	P.I./COKE	TOTAL	Berth No.	B.NO	W.TIME	W.TIME(5%)
1979.88	192.	691.	891.	382.	6,353		8,509.	189.	23.		
1980.81	88.	786.	956.	278.	6,636		8,744.	112.	23.		
1981.82	80.	875.	931.	188.	6,400		8,474.	200.	25.	1.24.	4.26
1982.83	71.	938.	906.	94.	5,798		7,806.	85.	27.	0.15	0.33
1983.84	51.	984.	1,299.	94.	6,071		8,499.	93.	27.	0.69	1.87
1984.85	0.	94.	356.	94.	6,362		6,906.	75.	27.	0.07	0.15
1985.86	0.	94.	356.	0.	6,431		6,881.	75.	27.	0.08	0.16
1986.87	0.	94.	356.	0.	6,820		7,270.	79.	27.	0.16	0.36
1987.88	0.	94.	356.	0.	7,207		7,657.	83.	27.	0.33	0.76
1988.89	0.	94.	356.	0.	7,667		8,117.	88.	27.	0.74	2.05
1989.90	0.	94.	356.	0.	8,285		8,735.	95.	27.	2.70	
1990.91	0.	100.	356.	0.	8,836		9,293.	101.	27.		
1991.92	0.	106.	356.	0.	9,227		9,690.	106.	27.		
1992.93	0.	113.	356.	0.	9,618		10,087.	110.	27.		
1993.94	0.	119.	356.	0.	10,009		10,484.	113.	27.		
1994.95	0.	125.	356.	0.	10,400		10,881.	119.	27.		
1995.96	0.	131.	356.	0.	10,980		11,468.	125.	27.		
1996.97	0.	138.	356.	0.	11,560		12,054.	131.	27.		
1997.98	0.	144.	356.	0.	12,148		12,648.	138.	27.		
1998.99	0.	150.	356.	0.	12,720		13,226.	144.	27.		
1999.00	0.	156.	356.	0.	13,300		13,813.	150.	27.		

Table A-IV-2(a) Cargo Volume for Karachi Port ("With" Case)

YEAR	WHEAT	RICE	FERT. P/S	CEMENT	G.CARGO	P.I./COKE	TOTAL	%
1979.80	671.	1,106.	1,426.	611.	3,494.		7,308.	100.
1980.81	308.	1,257.	1,530.	444.	3,650		7,189.	98.
1981.82	280.	1,400.	1,490.	300.	3,520.		6,990.	96.
1982.83	250.	1,500.	1,449.	150.	3,189.		6,538.	89.
1983.84	180.	1,575.	2,078.	150.	3,339.		7,322.	100.
1984.85	0.	1,650.	570.	150.	3,499.		5,869.	80.
1985.86	0.	1,720.	570.	0.	3,537.		5,827.	80.
1986.87	0.	1,790.	570.	0.	3,751.		6,111.	84.
1987.88	0.	1,799.	570.	0.	3,466.		5,835.	80
1988.89	0.	1,824.	570.	0.	3,351.		5,745.	79.
1989.90	0.	1,839.	570.	0.	3,197.		5,606.	77.
1990.91	0.	1,860.	570.	0.	3,060.		5,490.	75.
1991.92	0.	1,920.	570.	0.	3,275.		5,765.	79.
1992.93	0.	1,980.	570.	0.	3,490		6,040.	83.
1993.94	0.	2,040.	570.	0.	3,705.		6,315	86.
1994.95	0.	2,100.	570.	0.	3,920.		6,590.	90.
1995.96	0.	2,158.	570.	0.	4,239.		6,967.	95.
1996.97	0.	2,216.	570.	0.	4,558		7,344.	100.
1997.98	0.	2,274.	570.	0.	4,877.		7,721.	106.
1998.99	0.	2,332.	570.	0.	5,196.		8,098.	111.
1999.00	0.	2,390.	570.	0.	5,515.		8,475.	116.

(rice is handled in Karachi Port)

Table A-IV-2(b) No. of Ship Call for Karachi Port ("With" Case)

YEAR	WHEAT	RICE	FERT. P/S	CEMENT	G.CARGO	P.I./COKE	TOTAL	Ship/day
1979.80	45.	170.	110.	51.	998.		1,374.	4.04
1980.81	21.	193.	118.	37.	1,043.		1,411.	4.15
1981.82	19.	215.	115.	25.	1,006.		1,379.	4.06
1982.83	17.	231.	111.	13.	911.		1,283.	3.77
1983.84	12.	242.	160.	13.	954.		1,381.	4.06
1934.85	.	254.	44.	13.	1,000.		1,310.	3.85
1985.86	0.	265.	44.	0.	1,011.		1,319.	3.88
1986.87	0.	275.	44.	0.	1,072.		1,391.	4.09
1987.88	0.	277.	44.	0.	990.		1,311.	3.86
1988.89	0.	281.	44.	0.	957.		1,282.	3.77
1989.90	0.	283.	44.	0.	913.		1,240.	3.65
1990.91	0.	286.	44.	0.	874.		1,204.	3.54
1991.92	0.	295.	44.	0.	936.		1,275.	3.75
1992.93	0.	305.	44.	0.	997.		1,346.	3.96
1993.94	0.	314.	44.	0.	1,059.		1,416.	4.17
1994.95	0.	323.	44.	0.	1,120.		1,487.	4.37
1995.96	0.	332.	44.	0.	1,211.		1,587.	4.67
1996.97	0.	341.	44.	0.	1,302.		1,687.	4.96
1997.98	0.	350.	44.	0.	1,393.		1,787.	5.26
1998.99	0.	359.	44.	0.	1,485.		1,887.	5.55
1999.00	0.	368.	44.	0.	1,576.		1,987.	5.84

Table A-IV-2(c) Ship Day & Waiting Time for Karachi Port ("With" Case)

YEAR	WHEAT	RICE	FERT. P/S	CEMENT	G.CARGO	P.I./COKE	TOTAL	Berth No.	W.TIME	W. TIME(5%)
1979.80	192.	691.	891.	382.	6,353.		8,509.	23.		
1980.81	88.	786.	956.	278.	6,675.		8,744.	23.		
1981.82	88.	875.	931.	188.	6,400.		8,474.	25.	1.24	4.26
1982.83	71.	938.	906.	94.	5,798.		7,806.	27.	0.15	0.33
1983.84	51.	984.	1,299.	94.	6,071.		8,499.	27.	0.69	1.87
1984.85	0.	1,031.	356.	94.	6,362.		7,843.	27.	0.31	0.72
1985.86	0.	1,075.	356.	0.	6,431.		7,862.	27.	0.39.	0.91
1986.87	0.	1,119.	356.	0.	6,820.		8,295.	27.	0.90	2.79
1987.88	0.	1,124.	356.	0.	6,302.		7,782.	27.	0.38	0.90
1988.89	0.	1,140.	356.	0.	6,093.		7,589.	27.	0.28	0.63
1989.90	0.	1,149.	356.	0.	5,813.		7,318.	27.	0.18	0.38
1990.91	0.	1,163.	356.	0.	5,564.		7,082.	27.	0.12	0.25
1991.92	0.	1,200.	356.	0.	5,955.		7,511.	27.	0.25	0.55
1992.93	0.	1,238.	356.	0.	6,345.		7,939.	27.	0.51	1.29
1993.94	0.	1,275.	356.	0.	6,736.		8,368.	27.	1.12	4.09
1994.95	0.	1,313.	356.	0.	7,127.		8,796.	27.	3.02	
1995.96	0.	1,349.	356.	0.	7,707.		9,412	27.		
1996.97	0.	1,385.	356.	0.	8,287.		10,029.	27.		
1997.98	0.	1,421.	356.	0.	8,867.		10,645	27.		
1998.99	0.	1,458.	356.	0.	9,447.		11,261.	27.		
1999.00	0.	1,494.	356.	0.	10,027.		11,877.	27.		

Table A-IV-3(a) Cargo Volume for Karachi Port ("With" Case)

YEAR	WHEAT	RICE	FERT. P/S	CEMENT	G.CARGO	P.I./COKE	TOTAL	%
1979.80	671.	1,106.	1,426.	611.	3,494.		7,308.	100.
1980.81	308.	1,257.	1,530.	444.	3,650.		7,189.	98.
1981.82	280.	1,400.	1,490.	300.	3,520		6,990.	96.
1982.83	250.	1,500.	1,449.	150.	3,289.		6,638.	91.
1983.84	180.	1,575.	2,078.	150.	3,439.		7,422.	102.
1984.85	200.	1,650	2,180.	150.	3,599.		7,779.	106.
1985.86	256.	1,698.	2,158.	0.	3,469.		7,581.	104.
1986.87	312.	1,738.	2,136.	0.	3,441.		7,627.	104.
1987.88	368.	1,769.	2,120.	0.	3,316.		7,573.	104.
1988.89	424.	1,790.	2,102.	0.	3,162.		7,478	102.
1989.90	480.	1,800.	2,070.	0.	2,957		7,307.	100.
1990.91	546.	1,860.	1,924.	0.	3,160.		7,490.	102.
1991.92	612.	1,920.	2,018.	0.	3,375.		7,925.	108.
1992.93	678.	1,980.	2,112.	0.	3,590.		8,360.	114.
1993.94	744.	2,040.	2,206.	0.	3,805.		8,795.	120.
1994.95	810.	2,100.	2,300.	0.	4,020.		9,230.	126.
1995.96	872.	2,158.	2,382.	0.	4,339.		9,751.	133.
1996.97	934.	2,216.	2,464.	0.	4,658.		10,272.	141.
1997.98	996.	2,274.	2,546.	0.	4,977.		10,793.	148.
1998.99	1,058.	2,332.	2,628.	0.	5,296.		11,314.	155.
1999.00	1,120.	2,390.	2,710.	0.	5,615.		11,835	162.

(Marginal Wharf berth No. 5-7 converted to container berths)

Table A-IV-3(b) No. of Ship Call for Karachi Port ("With" Case)

YEAR	WHERT	RICE	FERT. P/S	CEMENT	G.CARGO	P.I./COKE	TOTAL	Ship/day
1979.80	45.	170.	118.	51.	998		1,374.	4.04
1980.81	21.	193.	118.	37.	1,043.		1,411.	4.15
1981.82	19.	215.	115.	25.	1,006.		1,379.	4.06
1982.83	17.	231.	111.	13.	940.		1,311.	3.86
1983.84	12.	242.	160.	13.	983.		1,409.	4.14
1984.85	13.	254.	168.	13.	1,028.		1,476.	4.34
1985.86	17.	261.	166.	0.	991.		1,435.	4.22
1986.87	21.	267.	164.	0.	983.		1,436.	4.22
1987.88	25.	272.	163.	0.	947.		1,407.	4.14
1988.89	28.	275.	162.	0.	903.		1,369.	4.03
1989.90	32.	277.	159.	0.	845.		1,313.	3.86
1990.91	36.	286.	148.	0.	903.		1,373.	4.04
1991.92	41.	295.	155.	0.	964.		1,456.	4.28
1992.93	45.	305.	162.	0.	1,026.		1,538.	4.52
1993.94	50.	314.	170.	0.	1,087.		1,620.	4.77
1994.95	54.	323.	177.	0.	1,149.		1,703.	5.01
1995.96	58.	332.	183.	0.	1,240.		1,813.	5.33
1996.97	62.	341.	190.	0.	1,331.		1,924.	5.66
1997.98	66.	350.	196.	0.	1,422.		2,034.	5.98
1998.99	71.	359.	202.	0.	1,513.		2,145.	6.31
1999.00	75.	368.	208.	0.	1,604.		2,255.	6.63

Table A-IV-3(c) Ship Day & Waiting Time for Karachi Port ("With" Case)

YEAR	WHEAT	RICE	FERT. P/S	CEMENT	G.CARGO	P.I./COKE	TOTAL	Berth No.	W.TIME	W. TIME(5%)
1979.80	192.	691.	891.	382.	6,353.		8,509.	23.		
1980.81	88.	786.	956.	278.	6,675.		8,744.	23.		
1981.82	80.	875.	931.	188.	6,400.		8,474.	25.	1.24	4.26
1982.83	71.	938.	906.	94.	5,980.		7,988.	27.	0.21	0.45
1983.84	51.	984.	1,299.	94.	6,253.		8,681.	27.	0.94	2.96
1984.85	57.	1,031.	1,363.	94.	6,544.		9,088.	27.	3.79	-16.32
1985.86	73.	1,061.	1,349.	0.	6,307.		8,790.	27.	2.32	47.17
1986.87	89.	1,086.	1,335.	0.	6,256.		8,767.	27.	2.50	193.14
1987.88	105.	1,106.	1,325.	0.	6,029.		8,565.	27.	1.65	9.22
1988.89	121.	1,119.	1,314.	0.	5,749.		8,303.	27.	0.99	3.23
1989.90	137.	1,125.	1,294.	0.	5,376.		7,932.	27.	0.51	1.29
1990.91	156.	1,163.	1,203.	0.	5,745.		8,266.	27.	0.93	2.96
1991.92	175.	1,200.	1,261.	0.	6,136.		8,772.	27.	2.86	
1992.93	194.	1,238.	1,328.	0.	6,527.		9,278.	27.		
1993.94	213.	1,275.	1,379.	0.	6,918.		9,785.	27.		
1994.95	231.	1,313.	1,438.	0.	7,309.		10,291.	27.		
1995.96	249.	1,349.	1,489.	0.	7,889.		10,976.	27.		
1996.97	267.	1,385.	1,540.	0.	8,469.		11,661.	27.		
1997.98	285.	1,421.	1,591.	0.	9,049.		12,346.	27.		
1998.99	302.	1,458.	1,643.	0.	9,629.		13,031.	27.		
1999.00	320.	1,494.	1,694.	0.	10,209.		13,717.	27.		

Table A-IV-4(a) Cargo Volume for Karachi Port ("Without" Case)

YEAR	WHEAT	RICE	FERT. P/S	CEMENT	G.CARGO	P.I./COKE	TOTAL	%
1979.80	671.	1,106.	1,426.	611.	3,494.		7,308.	100.
1980.81	308.	1,257.	1,530.	444.	3,650.		7,189.	98.
1981.82	280.	1,400.	1,490.	300.	3,520.		6,990.	96.
1982.83	250.	1,500.	1,449.	150.	3,189.		6,538.	89.
1983.84	180.	1,575.	2,078.	150.	3,339.		7,322.	100.
1984.85	0.	1,650.	570.	150.	3,499.		5,869.	80.
1985.86	0.	1,720.	570.	0.	3,537.		5,827.	80.
1986.87	0.	1,790.	570.	0.	3,751.		6,111.	84.
1987.88	0.	1,860.	570.	0.	3,964.		6,394.	87.
1988.89	0.	1,930.	570.	0.	4,217.		6,717.	92.
1989.90	0.	2,000.	570.	0.	4,557.		7,127.	98.
1990.91	0.	2,060.	570.	0.	4,860.		7,490.	102.
1991.92	0.	2,120.	570.	0.	5,075.		7,765.	106.
1992.93	0.	2,180.	570.	0.	5,290.		8,040.	110.
1993.94	0.	2,240.	570.	0.	5,505.		8,315.	114.
1994.95	0.	2,300.	570.	0.	5,720.		8,590.	118.
1995.96	0.	2,358.	570.	0.	6,039.		8,967.	123.
1996.97	0.	2,416.	570.	0.	6,358.		9,344.	128.
1997.98	0.	2,474.	570.	0.	6,677.		9,721.	133.
1998.99	0.	2,532.	570.	0.	6,996.		10,098.	138.
1999.00	0.	2,590.	570.	0.	7,315.		10,475.	143.

(rice is handled in Karachi Port)

Table A-IV-4(b) No. of Ship Call for Karachi Port ("Without" Case)

YEAR	WHEAT	RICE	FERT. P/S	CEMENT	G.CARGO	P.I./COKE	TOTAL	Ship/day
1979.80	45.	170	110.	51.	998.		1,374.	4.04
1980.81	21.	193.	118.	37.	1,043.		1,411.	4.15
1981.82	19.	215.	115.	25.	1,006.		1,379.	4.06
1982.83	17.	231.	111.	13.	911.		1,283.	3.77
1983.84	12.	242.	160.	13.	954.		1,381.	4.06
1984.85	0.	254.	44.	13.	1,000.		1,310.	3.85
1985.86	0.	265.	44.	0.	1,011.		1,319.	3.88
1986.87	0.	275.	44.	0.	1,072.		1,391.	4.09
1987.88	0.	286.	44.	0.	1,133.		1,463.	4.30
1988.89	0.	297.	44.	0.	1,205.		1,546.	4.55
1989.90	0.	308.	44.	0.	1,302.		1,654.	4.86
1990.91	0.	317.	44.	0.	1,389.		1,749.	5.15
1991.92	0.	326.	44.	0.	1,450.		1,820.	5.35
1992.93	0.	335.	44.	0.	1,511.		1,891.	5.56
1993.94	0.	345.	44.	0.	1,573.		1,961.	5.77
1994.95	0.	354.	44.	0.	1,634.		2,032.	5.98
1995.96	0.	363.	44.	0.	1,725.		2,132.	6.27
1996.97	0.	372.	44.	0.	1,817.		2,232.	6.57
1997.98	0.	381.	44.	0.	1,908.		2,332.	6.86
1998.99	0.	390.	44.	0.	1,999.		2,432.	7.15
1999.00	0.	398.	44.	0.	2,090.		2,532.	7.45

Table A-IV-4(c) Ship Day & Waiting Time for Karachi Port ("without" Case) ("Without" Case)

YEAR	WHEAT	RICE	FERT. P/S	CEMENT	G.CARGO	P.I./COKE	TOTAL	Berth No.	W.TIME	W.TIME 5%
1979.80	192.	691.	891.	382.	6,353.		8,509.	23.		
1980.81	88.	786.	956.	278.	6,675.		8,744.	23.		
1981.82	80.	875.	931.	188	6,400.		8,474.	25.	1.24	4.26
1982.83	71.	938.	906.	94.	5,798.		7,806.	27.	0.15	0.33
1983.84	51.	984.	1,299.	94.	6,071.		8,499.	27.	0.69	1.87
1984.85	0.	1,031.	356.	94.	6,362.		7,843.	27.	0.31	0.72
1985.86	0.	1,075.	356.	0.	6,431.		7,862.	27.	0.39	0.91
1986.87	0.	1,119.	356.	0.	6,820.		8,295.	27.	0.90	2.79
1987.88	0.	1,163.	356.	0.	7,207.		8,726.	27.	2.35	74.21
1988.89	0.	1,206.	356.	0.	7,667.		9,230.	27.	32.90	
1989.90	0.	1,250.	356.	0.	8,285.		9,892.	27.		
1990.91	0.	1,288.	356.	0.	8,836.		10,480.	27.		
1991.92	0.	1,325.	356.	0.	9,227.		10,909.	27.		
1992.93	0.	1,363.	356.	0.	9,618.		11,337.	27.		
1993.94	0.	1,400.	356.	0.	10,009.		11,765.	27.		
1994.95	0.	1,438.	356.	0.	10,400.		12,194.	27.		
1995.96	0.	1,474.	356.	0.	10,980.		12,810.	27.		
1996.97	0.	1,510.	356.	0.	11,560.		13,426.	27.		
1997.98	0.	1,546.	356.	0.	12,140.		14,043.	27.		
1998.99	0.	1,583.	356.	0.	12,720.		14,659.	27.		
1999.00	0.	1,619.	356.	0.	13,300.		15,275.	27.		

Table A-IV-5(a) Cargo Volume for Karachi Port ("Without" Case)

YEAR	WHEAT	RICE	FERT. P/S	CEMENT	G.CARGO	P.I./COKE	TOTAL	%
1979.80	671.	1,106.	1,426.	611.	3,494.		7,308.	100.
1980.81	308.	1,257.	1,530.	444.	3,650.		7,189.	98.
1981.82	280.	1,400.	1,490.	300.	3,520.		6,990.	96.
1982.83	250.	1,500.	1,449.	150.	3,289.		6,638.	91.
1983.84	180.	1,575.	2,078.	150.	3,439.		7,422.	102.
1984.85	200.	1,650.	2,180.	150.	3,599.		7,779.	106.
1985.86	256.	1,698.	2,158.	0.	3,637.		7,749.	106.
1986.87	312.	1,738.	2,136.	0.	3,851.		8,037.	110.
1987.88	368.	1,769.	2,120.	0.	4,064.		8,321.	114.
1988.89	424.	1,790.	2,102.	0.	4,317.		8,633.	118.
1989.90	480.	1,800.	2,070.	0.	4,657.		9,007.	123.
1990.91	546.	1,860.	1,924.	0.	4,960.		9,290.	127.
1991.92	612	1,920.	2,018.	0.	5,175.		9,725.	133.
1992.93	678.	1,980.	2,112.	0.	5,390.		10,160.	139.
1993.94	744.	2,040.	2,206.	0.	5,605.		10,595.	145.
1994.95	810.	2,100.	2,300.	0.	5,820.		11,030.	151.
1995.96	872.	2,158.	2,382.	0.	6,139.		11,551.	158.
1996.97	934.	2,216.	2,464.	0.	6,458.		12,072.	165.
1997.98	996.	2,274.	2,546.	0.	6,777.		12,593.	172.
1998.99	1,058.	2,332.	2,628.	0.	7,096.		13,114.	179.
1999.00	1,120.	2,390.	2,710.	0.	7,415.		13,635.	187.

(Marginal Wharf Berth No.5-7 converted to container berths)

Table A-IV-5(b) No. of Ship Call for Karachi Port ("Without" Case)

YEAR	WHEAT	RICE	FERT. P/S	CEMENT	G.CARGO	P.I./COKE	TOTAL	Ship/day
1979.80	45.	170.	110.	51.	998.		1,374.	4.04
1980.81	21.	193.	118.	37.	1,043.		1,411.	4.15
1981.82	19.	215.	115.	25.	1,006.		1,379.	4.06
1982.83	17.	231.	111.	13.	940.		1,311.	3.86
1983.84	12.	242.	160.	13.	983.		1,409.	4.14
1984.85	13.	254.	168.	13.	1,028.		1,476.	4.34
1985.86	17.	261.	166.	0.	1,039.		1,483.	4.36
1986.87	21.	267.	164.	0.	1,100.		1,353.	4.57
1987.88	25.	272.	163.	0.	1,161.		1,621.	4.77
1988.89	28.	275.	162.	0.	1,233.		1,699.	5.00
1989.90	32.	277.	159.	0.	1,331.		1,799.	5.29
1990.91	36.	286.	148.	0.	1,417.		1,888.	5.55
1991.92	41.	195.	155.	0.	1,479.		1,970.	5.79
1992.93	45.	305.	162.	0.	1,540.		2,052	6.04
1993.94	50.	314.	170.	0.	1,601.		2,135.	6.28
1994.95	54.	323.	177.	0.	1,663.		2,217.	6.52
1995.96	58	332.	182.	0.	1,754.		2,327.	6.85
1996.97	62	341.	190.	0.	1,845		2,438.	7.17
1997.98	66.	350.	196.	0.	1,936.		2,548.	7.50
1998.99	71.	359.	202.	0.	2,027.		2,659.	7.82
1999.00	75.	368.	208.	0.	2,119.		2,769.	8.15

Table A-IV-5(c) Ship Day & Waiting Time for Karachi Port ("Without" Case)

YEAR	WHEAT	RICE	FERT. P/S	CEMENT	G.CARGO	P.I./COKE	TOTAL	Berth No.	W.TIME
1979.80	192.	691.	891.	382.	6,353.		8,509.	23.	
1980.81	88.	786.	956.	278.	6,636.		8,744.	23.	
1981.82	80.	875.	931.	188.	6,400.		8,474.	25.	1.24
1982.83	71.	938.	906.	94.	5,980.		7,988.	27.	0.21
1983.84	51.	984.	1,299.	94.	6,253.		8,681.	27.	0.94
1984.85	57.	1,031.	1,363.	94.	6,544.		9,088.	27.	3.79
1985.86	73.	1,061.	1,349.	0.	6,613.		9,096.	27.	5.97
1986.87	89.	1,086.	1,335.	0.	7,002.		9,512.	27.	
1987.88	105.	1,106.	1,325.	0.	7,389.		9,925.	27.	
1988.89	121.	1,119.	1,314.	0.	7,849.		10,403.	27.	
1989.90	137.	1,125.	1,294.	0.	8,467.		11,023.	27.	
1990.91	156.	1,163.	1,203.	0.	9,018.		11,539.	27.	
1991.92	175.	1,200.	1,261.	0.	9,409.		12,045.	27.	
1992.93	194.	1,238.	1,320.	0.	9,800.		12,551.	27.	
1993.94	213.	1,275.	1,379.	0.	10,191.		13,057.	27.	
1994.95	231.	1,313.	1,438.	0.	10,582.		13,563.	27.	
1995.96	249.	1,349.	1,489	0.	11,162.		14,248.	27.	
1996.97	267.	1,385.	1,540.	0.	11,742.		14,934.	27.	
1997.98	285.	1,421.	1,591.	0.	12,322.		15,619.	27.	
1998.99	302.	1,458.	1,643.	0.	12,902.		16,304.	27.	
1999.00	320.	1,494.	1,694.	0.	13,482.		16,989.	27.	

Table A-IV-6(a) Cargo Volume for Qasim Port ("Without" Case)

YEAR	WHEAT	RICE	FERT. P/S	CEMENT	G.CARGO	P.I./COKE	TOTAL	%
1979.80	0.	0.	0.	0.	0.	0.	0.	0.
1980.81	0.	0.	0.	0.	0.	0.	0.	0.
1981.82	0.	0.	0.	0.	0.	0.	0.	0.
1982.83	0.	0.	0.	150.	300.	176.	626.	100.
1983.84	0.	0.	0.	150.	300.	176.	626.	100.
1984.85	200.	1,500.	1,610.	150.	300.	176.	3,936.	629.
1985.86	256.	1,570.	1,588.	0.	330.	176.	3,920.	626.
1986.87	312.	1,640.	1,566.	0.	360.	176.	4,054.	648.
1987.88	368.	1,710.	1,550.	0	390.	176.	4,194.	670.
1988.89	424.	1,780.	1,522.	0.	420.	176.	4,322.	690.
1989.90	480.	1,850.	1,500.	0.	450.	88.	4,368.	698.
1990.91	546.	1,900.	1,354.	0.	480.	0.	4,280.	684.
1991.92	612.	1,950.	1,448.	0.	510.	0.	4,520.	722.
1992.93	678.	2,000.	1,240.	0.	540.	0.	4,760.	760.
1993.94	744.	2,050.	1,636.	0.	570.	0.	5,000.	799.
1994.95	810.	2,100.	1,730.	0.	600.	0.	5,240.	837.
1995.96	872.	2,148.	1,812	0.	640.	0.	5,472.	874.
1996.97	934.	2,196.	1,894.	0.	680.	0.	5,704.	911.
1997.98	996.	2,244.	1,976.	0.	720.	0.	5,936.	948.
1998.99	1,058.	2,292.	2,058.	0.	760.	0.	6,168.	985.
1999.00	1,128.	2,340.	2,140.	0.	800.	0.	6,400.	1,022.

(cargo allocation proposed by SWANCO)

Table A-IV-6(b) No. of Ship Call for Qasim Port ("Without" Case)

YEAR	WHEAT	RICE	FERT. P/S	CEMENT	G.CARGO	P.I./COKE	TOTAL	Ship/day
1979.80	0.	0.	0.	0.	0.	0.	0.	0.00
1980.81	0.	0.	0.	0.	0.	0.	0.	0.00
1981.82	0.	0.	0.	0.	0.	0.	0.	0.00
1982.83	0.	0.	0.	13.	53.	20.	86.	0.25
1983.84	0.	0.	0.	13.	53.	20.	86.	0.25
1984.85	8.	179.	124.	13.	53.	20.	397.	1.17
1985.86	11.	188.	122.	0.	58.	20.	399.	1.17
1986.87	13.	196.	120.	0.	64.	20.	413.	1.22
1987.88	15.	204.	119.	0.	69.	20.	428.	1.26
1988.89	18.	213.	117.	0.	74.	20.	442.	1.30
1989.90	20.	221.	115.	0.	80.	10.	446.	1.31
1990.91	23	227.	104.	0.	85.	0.	439.	1.29
1991.92	26.	233.	111.	0.	90.	0.	460.	1.35
1992.93	28.	239.	119.	0.	96.	0.	481.	1.42
1993.94	31.	245.	126.	0.	101.	0.	503.	1.48
1994.95	34.	251.	133.	0.	106.	0.	524.	1.54
1995.96	36.	257.	139.	0.	113.	0.	546.	1.60
1996.97	39.	262.	146.	0.	120.	0.	567.	1.67
1997.98	42.	268.	152.	0.	127.	0.	589.	1.73
1998.99	44.	274.	158.	0.	135.	0.	611.	1.80
1999.00	47.	280.	165.	0.	142.	0.	632.	1.86

Table A-IV-6(c) Ship Day & Waiting Time for Qasim Port ("Without" Case)

YEAR	WHEAT	RICE	FERT. P/S	CEMENT	G.CARGO	P.I./COKE	TOTAL	Berth No.	W.TIME
1979.80	0.	0.	0.	0.	0.	0.	0.	0.	
1980.81	0.	0.	0.	0.	0.	0.	0.	0.	
1981.82	0.	0.	0.	0.	0.	0.	0.	0.	0.00
1982.83	0.	0.	0.	86.	500.	207.	793.	4.	1.47
1983.84	0.	0.	0.	86.	500.	207.	793.	4.	1.47
1984.85	57.	857.	920.	86.	500.	207.	2,627.	8.	21.59
1985.86	73.	897.	907.	0.	550.	207.	2,635.	8.	23.74
1986.87	89.	937.	895.	0.	600.	207.	2,728.	8.	
1987.88	105.	977.	886.	0.	650.	207.	2,825.	8.	
1988.89	121.	1,017.	870.	0.	700.	207.	2,915.	8.	
1989.90	137.	1,057.	857.	0.	750.	104.	2,905.	8.	
1990.91	156.	1,086.	774.	0.	800.	0.	2,815.	8.	
1991.92	175.	1,114.	827.	0.	850.	0.	2,967.	8.	
1992.93	194.	1,143.	881.	0.	900.	0.	3,118.	8.	
1993.94	213.	1,171.	935.	0.	950.	0.	3,269.	8.	
1994.95	231.	1,200.	989	0.	1,000.	0.	3,420.	8.	
1995.96	249.	1,227.	1,035.	0.	1,067.	0.	3,579.	8.	
1996.97	267.	1,255.	1,082	0.	1,133.	0.	3,737.	8.	
1997.98	285.	1,282.	1,129.	0.	1,200.	0.	3,896.	8.	
1998.99	302.	1,310	1,176.	0.	1,267.	0.	4,055.	8.	
1999.00	320.	1,337.	1,223.	0.	1,333.	0.	4,213.	8.	

Table A-IV-7(a) Cargo Volume for Qasim Port ("With" Case)

YEAR	WHEAT	RICE	FERT. P/S	CEMENT	G.CARGO	P.I./COKE	TOTAL	%
1979.80	0.	0.	0.	0.	0.	0.	0.	0.
1980.81	0.	0.	0.	0.	0.	0.	0.	0.
1981.82	0.	0.	0.	0.	0.	0.	0.	0.
1982.83	0.	0.	0.	150.	300.	176.	626.	100.
1983.84	0.	0.	0.	150.	300.	176.	626.	100.
1984.85	200.		1,610.	150.	300.	176.	2,436.	389.
1985.86	256.	0.	1,588.	0.	330.	176.	2,350.	375.
1986.87	312.	0.	1,566.	0.	360.	176.	2,414.	386.
1987.88	368.	0.	1,550.	0.	390.	176.	2,484.	397.
1988.89	424.	0.	1,522.	0.	420.	176.	2,542.	406.
1989.90	480.	0.	1,500.	0.	450.	88.	2,518.	402.
1990.91	546.	0.	1,354.	0.	480.	0.	2,380.	380.
1991.92	612.	0.	1,448.	0.	510.	0.	2,570.	411.
1992.93	678.	0.	1,240.	0.	540.	0.	2,760.	441.
1993.94	744.	0.	1,636.	0.	570.	0.	2,950.	471.
1994.95	810.	0.	1,730.	0.	600.	0.	3,140.	502.
1995.96	872.	0.	1,812.	0.	640.	0.	3,324.	531.
1996.97	934.	0.	1,894.	0.	680.	0.	3,508.	560.
1997.98	996.	0.	1,976.	0.	720.	0.	3,692.	590.
1998.99	1,058.	0.	2,058.	0.	760.	0.	3,876.	619.
1999.00	1,120.	0.	2,140.	0.	800.	0.	4,060.	649.

(rice is handled in Karachi Port)

Table A-IV-7(b) No. of Ship Call for Qasim Port ("With" Case)

YEAR	WHEAT	RICE	FERT.P/S	CEMENT	G.CARGO	P.I./COKE	TOTAL	Ship/day
1979.80	0.	0.	0.	0.	0.	0.	0.	0.00
1980.81	0.	0.	0.	0.	0.	0.	0.	0.00
1981.82	0.	0.	0.	0.	0.	0.	0.	0.00
1982.83	0.	0.	0.	13.	53.	20.	86.	0.25
1983.84	0.	0.	0.	13.	53.	20.	86.	0.25
1984.85	0.	0.	124.	13.	53.	20.	218.	0.64
1985.86	11.	0.	122.	0.	58.	20.	211.	0.62
1986.87	13.	0.	120.	0.	64.	20.	217.	0.64
1987.88	15.	0.	119.	0.	69.	20.	224.	0.66
1988.89	18.	0.	117.	0.	74.	20.	229.	0.67
1989.90	20.	0.	115.	0.	80.	10.	225.	0.66
1990.91	23.	0.	104.	0.	85.	0.	212.	0.62
1991.92	26.	0.	111.	0.	90.	0.	227.	0.67
1992.93	28.	0.	119.	0.	96.	0.	242.	0.71
1993.94	31.	0.	126.	0.	101.	0.	258.	0.76
1994.95	34.	0.	133.	0.	106.	0.	273.	0.80
1995.96	36.	0.	139.	0.	113.	0.	289.	0.85
1996.97	39.	0.	146.	0.	120.	0.	305.	0.90
1997.98	42.	0.	152.	0.	127	0.	321.	0.94
1998.99	44.	0.	158.	0.	135.	0.	337.	0.99
1999.00	47.	0.	165.	0.	142.	0.	353.	1.04

Table A-IV-7(c) Ship Day & Waiting Time for Qasim Port ("With" Case)

YEAR	WHEAT	RICE	FERT.P/S	CEMENT	G.CARGO	P.I./COKE	TOTAL	Berth No.	W.TIME
1979.80	0.	0.	0.	0.	0.	0.	0.	0.	
1980.81	0.	0.	0.	0.	0.	0.	0.	0.	
1981.82	0.	0.	0.	0.	0.	0.	0.	0.	0.00
1982.83	0.	0.	0.	86.	500.	207.	793.	4.	1.47
1983.84	0.	0.	0.	86.	500.	207.	793.	4.	1.47
1984.85	57.	0.	920.	86.	500.	207.	1,770.	8.	0.58
1985.86	73.	0.	907.	0.	550.	207.	1,738.	8.	0.52
1986.87	89.	0.	895.	0.	600.	207.	1,791.	8.	0.63
1987.88	105.	0.	886.	0.	650.	207.	1,848.	8.	0.77
1988.89	121.	0.	870.	0.	700.	207.	1,898.	8.	0.91
1989.90	137.	0.	857.	0.	750.	104.	1,848.	8.	0.76
1990.91	156.	0.	774.	0.	800.	0.	1,730.	8.	0.51
1991.92	175.	0.	827.	0.	850.	0.	1,852.	8.	0.77
1992.93	194.	0.	881.	0.	900.	0.	1,975.	8.	1.17
1992.94	213.	0.	935.	0.	950.	0.	2,097.	8.	1.77
1994.95	231.	0.	989.	0.	1,000.	0.	2,220.	8.	2.73
1995.96	249.	0.	1,035.	0.	1,067.	0.	2,351.	8.	4.56
1996.97	267.	0.	1,082.	0.	1,133.	0.	2,482.	8.	8.58
1997.98	285.	0.	1,129.	0.	1,200.	0.	2,614.	8.	22.85
1998.99	302.	0.	1,176.	0.	1,267.	0.	2,745.	8.	
1999.00	320.	0.	1,223.	0.	1,333	0.	2,876.	8.	

Table A-IV-8(a) Cargo Volume for Qasim Port ("With" Case)

YEAR	WHEAT	RICE	FERT.P/S	CEMENT	G.CARGO	P.I./COKE	TOTAL	%
1979.80				0.	0.	0.	0.	0.00
1980.81				0.	0.	0.	0.	0.00
1981.82				0.	0.	0.	0.	0.00
1982.83				13.	35.	20.	68.	0.20
1983.84				13.	35.	20.	68.	0.20
1984.85				13.	35.	20.	68.	0.20
1985.86				0.	41.	20.	61.	0.18
1986.87				0.	46.	20.	66.	0.19
1987.88				0.	51.	20.	71.	0.21
1988.89				0.	57.	20.	77.	0.23
1989.90				0.	62.	10.	72.	0.21
1990.91				0.	67.	0.	67.	0.20
1991.92				0.	73.	0.	73.	0.21
1992.93				0.	78.	0.	78.	0.23
1993.94				0.	83.	0.	83.	0.24
1994.95				0.	88.	0.	88.	0.26
1995.96				0.	96.	0.	96.	0.28
1996.97				0.	103.	0.	103.	0.30
1997.98				0.	110.	0.	110.	0.32
1998.99				0.	117.	0.	117.	0.34
1999.00				0.	124.	0.	124.	0.36

(Marginal Wharf Berth No.5-7 converted to container berths)

Table A-IV-8(b) No. of Ship Call for Qasim Port ("With" Case)

YEAR	WHEAT	RICE	FERT.P/S	CEMENT	G.CARGO	P.I./COKE	TOTAL	Ship/day
1979.80				0.	0.	0.	0.	0.
1980.81				0.	0.	0.	0.	0.
1981.82				0.	0.	0.	0.	0.
1982.83				150.	200.	176.	526.	100.
1983.84				150.	200.	176.	526.	100.
1984.85				150.	200.	176.	526.	100.
1985.86				0.	230.	176.	406.	77.
1986.87				0.	260.	176.	436.	83.
1987.88				0.	290.	176.	466.	89.
1988.89				0.	320.	176.	496.	94.
1989.90				0.	350.	88.	438.	83.
1990.91				0.	380.	0.	380.	72.
1991.92				0.	410.	0.	410.	78.
1992.93				0.	440.	0.	440.	84.
1993.94				0.	470.	0.	470.	89.
1994.95				0.	500.	0.	500.	95.
1995.96				0.	540.	0.	540.	103.
1996.97				0.	580.	0.	580.	110.
1997.98				0.	620.	0.	620.	118.
1998.99				0.	660.	0.	660.	125.
1999.00				0.	700.	0.	700.	133.

Table A-IV-8(c) Ship Day & Waiting Time for Qasim Port ("With" Case)

YEAR	WHEAT	RICE	FERT.P/S	CEMENT	G.CARGO	P.I./COKE	TOTAL	Berth No.	W.TIME
1979.80				0.	0.	0.	0	0.	
1980.81				0.	0.	0.	0.	0.	
1981.82				0.	0.	0.	0.	0.	0.00
1982.83				86.	333.	207.	626.	4.	0.59
1983.84				86.	333.	207.	626.	4.	0.59
1984.85				86.	333.	207.	626.	4.	0.59
1985.86				0.	383.	207.	590.	4.	0.50
1986.87				0.	433.	207.	640.	4.	0.67
1987.88				0.	483.	207.	690.	4.	0.89
1988.89				0.	533.	207.	740.	4.	1.17
1989.90				0.	583.	104.	687.	4.	0.86
1990.91				0.	633.	0.	633.	4.	0.63
1991.92				0.	683.	0.	683.	4.	0.83
1992.93				0.	733.	0.	733.	4.	1.10
1993.94				0.	783.	0.	783.	4.	1.43
1994.95				0.	833.	0.	833.	4.	1.85
1995.96				0.	900.	0.	900.	4.	2.58
1996.97				0.	967.	0.	967.	4.	3.63
1997.98				0.	1,033.	0.	1,033.	4.	5.16
1998.99				0.	1,100.	0.	1,100.	4.	7.54
1999.00				0.	1,167.	0.	1,167.	4.	11.67

Appendix V-1

Necessary Ground Slots of CNTR at Inland Container Freight Station

The required ground slots of CNTR can be calculated using the following formula;

$$GS = \frac{NC \times CS}{t \times n \times WD}$$

Where:
- GS : Number of ground slots of CNTR (TEU)
- NC : Number of CNTR handled per year (TEU)
- CS : Days of CNTR's stay (dwell time) in terminal
- t : Number of stacking tiers of CNTR (stacking height) for rubber tired transfer crane
- n : Net stacking CNTR ratio exclusive of operational allowance for slot availability due to reservation, shifting or congestion.
- WD : Annual working days, 365 - 65 = 300 days

	Handling mode of CNTR	CS		t	n
		2000	1988		
a	Import FCL dry CNTR	8	10	2	0.7
b	Import FCL special CNTR	7	9	1	0.9
c	Import LCL dry CNTR	3	3	3	0.9
d	Import LCL special CNTR	3	3	1	0.9
e	Export FCL dry CNTR	6	8	3	0.9
f	Export FCL special CNTR	5	7	1	0.9
g	Export LCL dry CNTR	3	3	3	0.9
h	Export LCL special CNTR	3	3	1	0.9
i	Empty CNTR for stuffing export cargo	12	14	3	0.9
j	Export empty CNTR	5	5	3	0.9

1. Master plan (1999–2000)

a. Import FCL dry CNTR; $GSa = \frac{91,691 \times 8}{2 \times 0.7 \times 300} = \underline{1,747 \text{ TEU}}$

* $NC = IF \times (1 + \frac{s}{100-s}) \times f \times d$

IF: Number of import CNTR carried from the new port terminal to the inland container freight station per year (TEU)

s : Percentage of CNTR discharged and loaded by the semi and RORO CNTR ship at the present Karachi port, 15%

f : Percentage of FCL CNTR at inland terminal, 60%

d : Dry CNTR ratio of import full CNTR, 90%

$NC = 144,329 \times (1 + \frac{15}{85}) \times 0.6 \times 0.9 = 91,691 \text{ TEU}$

b. Import FCL special CNTR: $GSb = \frac{10,188 \times 7}{1 \times 0.9 \times 300} = \underline{265 \text{ TEU}}$

* $NC = IF \times (1 + \frac{s}{100-s}) \times f \times c$

c : Special CNTR ratio of import full CNTR, 10%

$NC = 144,329 \times (1 + \frac{15}{85}) \times 0.6 \times 0.1 = 10,188 \text{ TEU}$

c. Import LCL dry CNTR; $GSc = \frac{61,128 \times 3}{3 \times 0.9 \times 300} = \underline{227 \text{ TEU}}$

* $NC = IF \times (1 + \frac{s}{100-s}) \times \ell \times d$

ℓ : Percentage of LCL CNTR at inland CFS, 40%

$NC = 144,329 (1 + \frac{15}{85}) \times 0.4 \times 0.9 = 61,128 \text{ TEU}$

d. Import LCL special CNTR; $GSd = \frac{6,792 \times 3}{1 \times 0.9 \times 300} = \underline{76 \text{ TEU}}$

* $NC = IF \times (1 + \frac{s}{100-s}) \times \ell \times c$

$NC = 144,329 (1 + \frac{15}{85}) \times 0.4 \times 0.1 = 6,792 \text{ TEU}$

e. Export FCL dry CNTR; $GSe = \frac{60,981 \times 6}{3 \times 0.9 \times 300} = \underline{452 \text{ TEU}}$

* $NC = EF \times (1 + \frac{s}{100-s}) \times f \times d$

EF: Number of export CNTR carried from the inland container freight station to the new port terminal per year (TEU)

$NC = 95,989 \ (1 + \frac{15}{85}) \times 0.6 \times 0.9 = 60,981$ TEU

f. Export FCL special CNTR; $GSf = \frac{6,776 \times 5}{1 \times 0.9 \times 300} = \underline{126 \text{ TEU}}$

* $NC = 95,989 \ (1 + \frac{15}{85}) \times 0.6 \times 0.1 = 6,776$ TEU

g. Export LCL dry CNTR; $GSg = \frac{40,654 \times 3}{3 \times 0.9 \times 300} = \underline{151 \text{ TEU}}$

* $NC = 95,989 \ (1 + \frac{15}{85}) \times 0.4 \times 0.9 = 40,654$ TEU

h. Export LCL special CNTR; $GSh = \frac{4,517 \times 3}{1 \times 0.9 \times 300} = \underline{51 \text{ TEU}}$

* $NC = 95,989 \ (1 + \frac{15}{85}) \times 0.4 \times 0.1 = 4,517$ TEU

i. Empty CNTR for stuffing export LCL cargo; $GSi = \frac{79,050 \times 12}{3 \times 0.9 \times 300}$

$= \underline{1,172 \text{ TEU}}$

* $NC = EF \ (1 + \frac{s}{100-s}) \times (f \times e + \ell)$

e : Percentage of empty CNTR stored at terminal, 50%

$NC = 95,989 \ (1 + \frac{15}{85}) \times (0.6 \times 0.5 + 0.4) = 79,050$ TEU

j. Export empty CNTR; $GSj = \frac{56,871 \times 5}{3 \times 0.9 \times 300} = \underline{351 \text{ TEU}}$

* $NC = (IF - EF) \times (1 + \frac{s}{100-s})$

$= (144,329 - 95,989) \times (1 + \frac{15}{85}) = 56,871$ TEU

Total ground slots: GSt = GSa + - - - - - - - + GSj = 4,618 TEU

* Reference No. 1: The same number of chassis (TEU) to the total stacking slots, exclussive of operational margin for the rubber tired transfer crane system, are required for the all chassis system.

Total stacking slots:

1,747	(GSa)	x 0.7 x 2 =	2,446	TEU
265	(GSb)	x 0.9 x 1 =	239	"
227	(GSc)	x 0.9 x 3 =	613	"
76	(GSd)	x 0.9 x 1 =	69	"
452	(GSe)	x 0.9 x 3 =	1,221	"
126	(GSf)	x 0.9 x 1 =	114	"
151	(GSg)	x 0.9 x 3 =	408	"
51	(GSh)	x 0.9 x 1 =	46	"
1,172	(GSi)	x 0.9 x 3 =	3,165	"
351	(GSj)	x 0.9 x 3 =	948	TEU
			9,269	TEU

The necessary number of chassis

20 footer : 9,269 x 0.5 = 4,634.5 = 4,635 units

40 footer : 9,269 x 0.25 = 2,317.3 = 2,318 units

* Reference No. 2: The required ground slots of refrigerated CNTR at CNTR yard are calculated as follows;

$$GSr = (GSe + GSd + GSf + GSh) \times \gamma + GSk$$

GSr : Ground slots of refrigerated CNTR

γ : Refrigerated CNTR ratio to all special ones, 0.3

GSq : Ground slots of empty refrigerated CNTR for pretrep (cooling)

$$GSq = \frac{2,372 \times 3}{1 \times 0.9 \times 300} = \underline{27 \text{ TEU}}$$

CS : Days of CNTRs stay, 3 days

NC = EFS x e x γ + ELS x γ = 6,776 x 0.5 x 0.3 + 4,517 x 0.3 = 2,372 TEU

EFS: Number of export FCL special CNTR handled per year

ELS: Number of export LCL special CNTR handled per year

$$GSr = (265 + 76 + 126 + 51) \times 0.3 + 27 = \underline{\underline{183 \text{ TEU}}}$$

2. Urgent plan (1987–1988)

a. Import FCL dry CNTR; $GSa = \frac{24,396 \times 10}{2 \times 0.7 \times 300} = \underline{581 \text{ TEU}}$

* $NC = IF \times (1 + \frac{s}{100-s}) \times f \times d$

IF: Number of import CNTR carried from the new port terminal to the inland container freight station per year (TEU)

s : Percentage of CNTR discharged and loaded by the semi and RORO CNTR ship at the present Karachi port, 20%

f : Percentage of FCL CNTR at inland terminal, 60%

d : Dry CNTR ratio of import full CNTR, 90%

$NC = 36,142 \times (1 + \frac{20}{80}) \times 0.6 \times 0.9 = 24,396 \text{ TEU}$

b. Import FCL special CNTR; $GSb = \frac{2,711 \times 9}{1 \times 0.9 \times 300} = \underline{91 \text{ TEU}}$

* $NC = IF \times (1 + \frac{s}{100-s}) \times f \times c$

c : Special CNTR ratio of import full CNTR, 10%

$NC = 36,142 \times (1 + \frac{20}{80}) \times 0.6 \times 0.1 = 2,711 \text{ TEU}$

c. Import LCL dry CNTR; $GSc = \frac{16,264 \times 3}{3 \times 0.9 \times 300} = \underline{61 \text{ TEU}}$

* $NC = IF \times (1 + \frac{s}{100-s}) \times \ell \times d$

ℓ : Percentage of LCL CNTR at inland CFS, 40%

$NC = 36,142 (1 + \frac{20}{80}) \times 0.4 \times 0.9 = 16,264 \text{ TEU}$

d. Import LCL special CNTR; $GSd = \frac{1,807 \times 3}{1 \times 0.9 \times 300} = \underline{20 \text{ TEU}}$

* $NC = IF \times (1 + \frac{s}{100-s}) \times \ell \times c$

$NC = 36,142 (1 + \frac{20}{80}) \times 0.4 \times 0.1 = 1,807 \text{ TEU}$

e. Export FCL dry CNTR; $GSe = \frac{20,218 \times 8}{3 \times 0.9 \times 300} = \underline{200 \text{ TEU}}$

* $NC = EF \times (1 + \frac{s}{100-s}) \times f \times d$

EF: Number of export CNTR carried from the inland container freight station to the new port terminal per year (TEU)

$NC = 29,952 \ (1 + \frac{20}{80}) \times 0.6 \times 0.9 = 20,218$ TEU

f. Export FCL special CNTR; $GSf = \frac{2,246 \times 7}{1 \times 0.9 \times 300} = \underline{59 \text{ TEU}}$

* $NC = 29,952 \ (1 + \frac{20}{80}) \times 0.6 \times 0.1 = 2,246$ TEU

g. Export LCL dry CNTR; $GSg = \frac{13,478 \times 3}{3 \times 0.9 \times 300} = \underline{50 \text{ TEU}}$

* $NC = 29,952 \ (1 + \frac{20}{80}) \times 0.4 \times 0.9 = 13,478$ TEU

h. Export LCL special CNTR; $GSh = \frac{1,498 \times 3}{1 \times 0.9 \times 300} = \underline{17 \text{ TEU}}$

* $NC = 29,952 \ (1 + \frac{20}{80}) \times 0.4 \times 0.1 = 1,498$

i. Empty CNTR for stuffing export cargo; $GSi = \frac{31,824 \times 14}{3 \times 0.9 \times 300} = \underline{550 \text{ TEU}}$

* $NC = EF \ (1 + \frac{s}{100-s}) \ (f \times e + \ell)$

e : Percentage of empty CNTR stored at terminal, 75%

$NC = 29,952 \ (1 + \frac{20}{80}) \times (0.6 \times 0.75 + 0.4) = 31,824$ TEU

j. Export empty CNTR: $GSj = \frac{7,738 \times 5}{3 \times 0.9 \times 300} = \underline{48 \text{ TEU}}$

* $NC = (IF - EF) \times (1 + \frac{s}{100-s})$

$= (36,142 - 29,952) \times (1 + \frac{20}{80}) = 7,738$ TEU

Total ground slots: $GSt = GSa + - - - - - + GSj = \underline{1,677 \text{ TEU}}$

* Reference: The required ground slots of refrigerated CNTR at CNTR yard are calculated as follows:

$$GSr = (GSb + GSd + GSf + GSh) \times \gamma + GSk$$

GSr : Ground slots of refrigerated CNTR

γ : Refrigerated CNTR ratio to all special ones, 0.3

GSq : Ground slots of empty refrigerated CNTR for pretrip (cooling)

$$GSq = \frac{955 \times 3}{1 \times 0.9 \times 300} = \underline{11 \text{ TEU}}$$

CS : Days of CNTRs stay, 3 days

NC = EFS x e x γ + ELS x γ = 2,246 x 0.75 x 0.3 + 1,498 x 0.3 = 955 TEU

EFS: Number of export FCL special CNTR handled per year

ELS: Number of export LCL special CNTR handled per year

$\therefore$ GSr = (91 + 20 + 59 + 17) x 0.3 + 11 = 68 TEU

Appendix V-2

Necessary Floor Space of CFS at Inland Container Freight Station

a. Urgent plan

1. Full CNTR (TEU) handled at the inland container freight station

Import	36,142 x (1 + 20/80) =	45,178 TEU
Export	29,952 x (1 + 20/80) =	37,440 TEU
Total	66,094 (1 + 20/80) =	82,618 TEU

80% of total cargo is transported from the new CNTR terminal and 20% of them from the present port.

2. Import cargo unstuffed & export cargo stuffed at the inland container freight station

Import	45,178 x 9 x 0.4 =	162,641 MT
Export	37,440 x 11 x 0.4 =	164,736 MT
Total	82,618 =	327,377 MT

3. The necessary floor space of CFS

$$\frac{(162,641 + 164,736) \times 7}{1 \times 0.45 \times 300} = 16,975 \text{ m}^2$$

b. Master plan

1. Full CNTR (TEU) handled at the inland container freight station

Import	144,329 ÷ 0.85 =	169,799 TEU
Export	95,989 ÷ 0.85 =	112,928 TEU
Total	240,318 ÷ 0.85 =	282,727 TEU

2. Import cargo unstuffed & export cargo stuffed at the inland container freight station

Import	169,799 x 9 x 0.4 =	611,276 MT
Export	112,928 x 11 x 0.4 =	496,883 MT
Total	282,727 =	1,108,159 MT

3. The necessary floor space of CFS

$$\frac{(611,276 + 496,883) \times 7}{1 \times 0.45 \times 300} = 57,460 \text{ m}^2$$

Appendix V-3

Number of Equipment in Inland Container Freight Station (1,999–2,000)

The necessary number of equipment is calculated as follows:

(1) Equipment for unit train and CNTR yard operation

$$NE = \frac{NC \times p}{WD \times GH \times w \times AP}$$

Where :

- NE : Number of equipment at peak hour (units)
- NC : Number of CNTR movements per year (units)
- WD : Annual working days, 365 - 65 = 300 days
- p : Peak day factor, 1.25
- GH : Gross working hours per day
- w : Net working hour ratio
- AP : Average productivity per equipment hour

(A)-1 Rail-mounted transfer cranes for unit train

$$NE = \frac{254,698 \times 1.25}{300 \times 22 \times 0.4 \times 20} = \underline{6 \text{ units}}$$

$$* NC = (DS + LS) \times \left(1 + \frac{s}{100-s}\right) \times u \times t$$

- DS : Number of CNTR discharged from full CNTR ship per year (TEU)
- LS : Number of CNTR loaded to full CNTR ship per year (TEU)
- s : Percentage of CNTR discharged and loaded by semi-and RORO CNTR ship at the present Karachi port, 15%
- u : Ratio of transportation by unit train, 42.7%
- t : Exchange rate from TEU to units of CNTR, 0.75

$$NC = (338,007 + 338,007) \times \left(1 + \frac{15}{85}\right) \times 0.427 \times 0.75 = 254,698 \text{ units}$$

(A)-2 Top lifters for unit train

$$NE = \frac{254,698 \times 1.25}{300 \times 22 \times 0.4 \times 14} = 8.6 = \underline{9 \text{ units}}$$

(B)-1 Rail-mounted / Rubber-tired) transfer cranes at CNTR yard

a. Unit train : $NE_a = \frac{254,698 \times 1.25}{300 \times 22 \times 0.4 \times 20} = 6$ units

b. LCL by road : $NE_b = \frac{169,636 \times 1.25}{300 \times 22 \times 0.75 \times 20} = 2.1 = 3$ units

* $NC = (IF + EF) \times (1 + \frac{s}{100-s}) \times \ell \times (1 + e) \times t$

IF : Number of import CNTR carried from the new port CNTR terminal (TEU)

EF : Number of export CNTR carried to the new port CNTR terminal (TEU)

s : Percentage of CNTR discharged and loaded by semi and RORO CNTR ship at the present Karachi port, 15%

ℓ : Percentage of LCL CNTR, 40%

e : Percentage of empty CNTR stored at terminal, 100%

t : Exchange rate from TEU to units of CNTR, 0.75

$NC = (144,329 + 95,989) \times (1 + \frac{15}{85}) \times 0.4 \times (1 + 1) \times 0.75$
$= 169,636$ units

c. FCL by road : $NE_c = \frac{229,046 \times 1.25}{300 \times 8 \times 0.9 \times 15} = 8.8 = 9$ units

* $NC = 2(IF + e \times EF) \times (1 + \frac{s}{100-s}) \times f \times t$

e : Percentage of empty CNTR stored at terminal, 50%

f : Percentage of FCL CNTR, 60%

$NC = 2(144,329 + 0.75 \times 95,989) \times (1 + \frac{15}{85}) \times 0.6 \times 0.75$
$= 229,046$ units

Total number of transfer cranes : $NE_t = NE_a + NE_b + NE_c = \underline{18 \text{ units}}$

Remark : The miscellaneous operations regarding inspection, repair and adjustment of CNTR are managed at other working hours than the peak ones.

d. Tractors & chassis 40' (20' x 2) for unit train operation

4 sets of tractors & chassis per crane x 6 = $\underline{24 \text{ sets}}$

(B)-2 Straddle carriers

a. Unit train : $NE_a = \frac{254,698 \times 1.25}{300 \times 22 \times 0.4 \times 16} = 7.5 = 8$ units

b. LCL by road : $NE_b = \frac{169,636 \times 1.25}{300 \times 22 \times 0.75 \times 12} = 3.6 = 4$ units

c. FCL by road : $NE_c = \frac{229,046 \times 1.25}{300 \times 8 \times 0.9 \times 12} = 11.0 = 11$ units

d. Spare : NE_d = 2 units

Total number of straddle carriers: $NE_t = NE_a + NE_b + NE_c + NE_d$ = 25 units

e. Tractors & chassis 40' (20' x 2) for unit train operation

4 sets of tractors & chassis per crane x 6 = 24 sets

(B)-3 Combined system of rubber-tired transfer cranes and straddle carriers

a. Transfer cranes: $NE_a = 18 \div 2 = 9$ units

b. Straddle carriers: $NE_b = 25 \div 2 = 12.5 = 13$ units

Total : 9 units of transfer cranes & 13 units of straddle carriers

c. Tractors & chassis 40' (20' x 2) for unit train operation

4 sets of tractor & chassis per crane x 6 = 24 sets

(B)-4 All chassis and shifters

a. Chassis : 4,635 units of 20 footer and 2,318 units of 40 footer chassis

b. Tractors

Unit train operation :	4 units per crane x 6 = 24 units
Gate operation :	4 units per shifter x 9 = 36 units
Total :	60 units

c. Shifters: $NE_c = \frac{229,046 \times 1.25}{300 \times 8 \times 0.9 \times 15} = 8.8 =$ 9 units

* NC = Number of FCL CNTR movements per year (units)

(B)-5 Top lifters and chassis feed

a. Unit train : $NE_a = \frac{254,698 \times 1.25}{300 \times 22 \times 0.4 \times 14} = 8.6 = 9$ units

b. LCL by rail : $NE_b = \frac{169,636 \times 1.25}{300 \times 22 \times 0.75 \times 14} = 3.0 = 3$ units

c. FCL by road : $NE_c = \frac{229,046 \times 1.25}{300 \times 8 \times 0.9 \times 10} = 13.3 = 14$ units

d. Spare : $NE_d = 3$ units

Total number of top lifters: $NE_t = NE_a + NE_b + NE_c + NE_d =$ 29 units

e. Tractors & chassis 40' (20' x 2) for unit train operation

4 sets of tractors and chassis x 6 = 24 sets

(2) Gate operation

(A) Lane (NL : Number of lane)

$NL = \frac{229,046 \times 1.25}{300 \times 8 \times 0.9 \times 15} = 8.8 =$ 9 lanes

(B) Booths

One booth between two lanes ----- 5 booths

(C) Weighing scales (NS: Number of weighing scales)

Export FCL only : $NS = \frac{50,818 \times 1.25}{300 \times 8 \times 0.9 \times 15} =$ 2 units

* $NC = 95,989 \times (1 + \frac{15}{85}) \times 0.6 \times 0.75 = 50,818$ units

(3) Equipment and pallets for CFS operation

(A) 3 ton fork lift trucks

$NE = \frac{NC \times p \times AW}{WD \times GH \times w}$

Where :

NE : Number of equipment at peak hour (units)

NC : Number of LCL CNTR per year (units)

P : Peak day factor

AW : Average working hours per CNTR

Import 20 footer = 1.0 hour

Import 40 footer = 1.5 hours

Export 20 footer = 0.5 hour

Export 40 footer = 0.75 hour

WD : Annual working days, 365 - 65 = 300 days

GH : Gross working hours per day

w : Net working hours ratio

a. Unstuffing import 20'; $NE_a = \frac{33,960 \times 1.25 \times 1.0}{300 \times 22 \times 0.75} = 8.6 = 9$ units

* $NC = IF \times (1 + \frac{s}{100-s}) \times \ell \times d$

IF : Number of import CNTR carried from the new port terminal (TEU)

s : Percentage of CNTR discharged and loaded by semi-and RORO CNTR ship at the present Karachi port, 15%

ℓ : Percentage of LCL CNTR, 40%

d : Exchange rate from TEU to units of 20' or 40'

$NC = 144,329 \ (1 + \frac{15}{85}) \times 0.4 \times 0.5 = 33,960$ units

b. Unstuffing import 40'; $NE_b = \frac{16,980 \times 1.25 \times 1.5}{300 \times 22 \times 0.75} = 6.4 = 7$ units

* $NC = 144,329 \ (1 + \frac{15}{85}) \times 0.4 \times 0.25 = 16,980$ units

c. Stuffing export 20'; $NE_c = \frac{22,586 \times 1.25 \times 0.5}{300 \times 22 \times 0.75} = 2.9 = 3$ units

* $NC = EF \times (1 + \frac{s}{100-s}) \times \ell \times d$

EF : Number of export CNTR carried to the new port terminal (TEU)

$NC = 95,989 \ (1 + \frac{15}{85}) \times 0.4 \times 0.5 = 22,586$ units

d. Stuffing export 40'; $NE_d = \frac{11,293 \times 1.25 \times 0.75}{300 \times 22 \times 0.75} = 2.1 = 3$ units

* $NC = 95,989 \ (1 + \frac{15}{85}) \times 0.4 \times 0.25 = 11,293$ units

Total number of forklifts for unstuffing & stuffing LCL cargo from/to containers; $NE_t = NE_a + NE_b + NE_c + NE_d = 22$ units.

e. The same number of equipment for the above mentioned ones (NE_t) are required to remove/feed cargo between CNTR and stack place, and receive/deliver cargo from/to consignor; $NE_e = NE_t = 22$ units.

Grand total : $NE_t + NE_e = 44$ units

(B) 6 ton fork lift trucks for handling heavy cargo

One unit every 10 units of 3 ton fork lift trucks : NE = 5 units

(C) Tractors

4 units per transfer crane for handling LCL CNTR x 3 : NE = 12 units

(D) Chassis

NE_2 = 44 units of 20' chassis
NE_4 = 22 units of 40' chassis
NE_t = 66 units

* Required number of chassis are three times as many as number of containers stuffed and unstuffed at the peak hour.

(E) Pallets with 1.8 m x 1.2 m two-way reversible winged type

$$NP = \frac{FS \times \gamma \times t}{(WP + w) \times (LP + \ell)}$$

Where :

NP : Number of pallets (sheets)
FS : Floor space of CFS (m^2)
γ : Floor utilization ratio of cargo stacking space, 45%
t : Number of stacking tiers of pallet, 1
WP : Width of pallet, 1.8 m
w : Widthwise clearance between pallets, 0.2 m
LP : Length of pallets, 1.2 m
ℓ : Lengthwise clearance, 0.1 m

$$NP = \frac{57,460 \times 0.45 \times 1}{(1.8 + 0.2) \times (1.2 + 0.1)} = 9,945 \text{ sheets}$$

(5) **Equipment for the repair shop**

(A) 3 ton fork lift trucks for lifting damage CNTR on the repair stands: NE = 2 units

(B) 15 ton fork lift trucks with telescopic side spreader : NE = 2 units

(6) **Multipurpose equipment**

(A) Mobile cranes with 35 ton capacity for emergency measures at CNTR yard and CFS operation : NE = 2 units

(B) 3 ton fork lift trucks for carrying cargo gears and others : NE = 4 units

(C) 15 ton fork lift trucks with telescopic side spreader for handling heavy cargo and empty CNTR : NE = 2 units

(7) **Terminal office**

(A) Computer for inventory control of CNTR in terminal : NE = One set

(B) Wireless telephones(VHF)

	Main equipments	Office, CFS & maintenance	Total
a. Transfer crane	60	4	64
b. Straddle carrier	67	4	71
c. Combined system	64	4	68
d. All chassis	87	4	91
e. Top lifter	71 units	4 units	75 units

Appendix V-4

Number of Equipment in Inland Cotainer Freight Station (1987–1988)

The necessary number of equipment is calculated as follows:

(1) Equipment for unit train and CNTR yard operation

$$NE = \frac{NC \times p}{WD \times GH \times w \times AP}$$

where:

- NE : Number of equipment at peak hour (units)
- NC : Number of CNTR movements per year (units)
- WD : Annual working days, 365 - 65 = 300 days
- P : Peak day factor, 1.25
- GH : Gross working hours per day
- w : Net working hours ratio
- AP : Average productivity per equipment hour.

(A) Rail-mounted transfer cranes for unit train

$$NE = \frac{67,767 \times 1.25}{300 \times 22 \times 0.4 \times 20} = 1.6 = \underline{2 \text{ units}}$$

$$* NC = (DS + LS) \times \left(1 + \frac{s}{100-s}\right) \times u \times t$$

- DS : Number of CNTR discharged from ship per year (TEU)
- LS : Number of CNTR loaded to ship per year (TEU)
- s : Percentage of CNTR discharged and loaded by semi-and RORO CNTR ships at the present Karachi port, 20%
- u : Ratio of transportation by unit train, 42.7%
- t : Exchange rate from TEU to units of CNTR, 0.75

$$NC = (84,642 + 84,642) \times \left(1 + \frac{20}{80}\right) \times 0.427 \times 0.75 = 67,767 \text{ units}$$

(B) Rubber-tired transfer cranes for CNTR yard operation

a. Unit train : $NE_a = \frac{67,767 \times 1.25}{300 \times 22 \times 0.4 \times 20} = 1.6 = 2$ units

b. LCL by road : $NE_b = \frac{49,571 \times 1.25}{300 \times 22 \times 0.75 \times 20} = 0.6 = 1$ unit

$$* NC = (IF + EF) \times (1 + \frac{s}{100-s}) \times \ell \times (1 + e) \times t$$

IF : Number of import CNTR carried from the new port terminal (TEU)

EF : Number of export CNTR carried to the new port terminal (TEU)

s : Percentage of CNTR discharged and loaded by semi-and RORO CNTR ships at the present Karachi port, 20%

ℓ : Percentage of LCL CNTR, 40%

e : Percentage of empty CNTR stored at terminal, 100%

t : Exchange rate from TEU to units of CNTR, 0.75

$$NC = (36,142 + 29,952) \times (1 + \frac{20}{80}) \times 0.4 \times (1 + 1) \times 0.75 = 49,571 \text{ units}$$

c. FCL by road : $$NE_c = \frac{65,932 \times 1.25}{300 \times 8 \times 0.9 \times 15} = 2.5 = 3 \text{ units}$$

$$* NC = 2(IF + e \times EF) \times (1 + \frac{s}{100-s}) \times f \times t$$

e : Percentage of empty CNTR stored at terminal, 75%

f : Percentage of FCL CNTR, 60%

$$NC = 2(36,142 + 0.75 \times 29,952) \times (1 + \frac{20}{80}) \times 0.6 \times 0.75 = 65,932 \text{ units}$$

Total number of transfer cranes: $NE_t = NE_a + NE_b + NE_c = 6$ units

Remark : The miscellaneous operations regarding inspection, repair and adjustment of CNTR are managed at other working hours than the peak ones.

d. Tractors & chassis 40' (20' x 2) for unit train operation

4 sets of tractor & chassis per crane x 2 = 8 sets

(2) Gate operation

(A) Lanes: (NL: Number of lanes)

$$NL = \frac{65,932 \times 1.25}{300 \times 8 \times 0.9 \times 15} = 2.6 = 3 \text{ lanes}$$

(B) Booth

One booth between two lanes ------ 2 booths

(C) Weighing scales used by export FCL CNTR only

$$NS = \frac{16,848 \times 1.25}{300 \times 8 \times 0.9 \times 15} = 0.7 = \underline{1 \text{ unit}}$$

$$* \; NC = EF \left(1 + \frac{s}{100-s}\right) \times f \times t$$

NS : Number of weighing scales

EF : Number of export FCL CNTR carried to the new port terminal (TEU)

s : Percentage of CNTR discharged and loaded by semi-and RORO CNTR ships at the present Karachi port, 20%

f : Percentage of FCL CNTR, 60%

t : Exchange rate from TEU to units of CNTR, 0.75

$$NC = 29,952 \times \left(1 + \frac{20}{80}\right) \times 0.6 \times 0.75 = 16,848 \text{ units}$$

(3) Equipment and pallets for CFS operation

(A) 3 ton fork lift trucks

$$NE = \frac{NC \times p \times AW}{WD \times GH \times w}$$

where :

NE : Number of equipment at peak hour (units)

NC : Number of LCL CNTR per year (units)

p : Peak day factor

AW : Average working hours per CNTR

Import 20 footer = 1.0 hour

Import 40 footer = 1.5 hours

Export 20 footer = 0.5 hour

Export 40 footer = 0.75 hour

WD : Annual working days, 365 - 65 = 300 days

GH : Gross working hours per day

w : Net working hours ratio

a. Unstuffing import 20' : $NE_a = \frac{9,036 \times 1.25 \times 1.0}{300 \times 22 \times 0.75} = 2.3 = 3$ units

* $NC = IF \times (1 + \frac{s}{100-s}) \times \ell \times d$

IF : Number of import CNTR carried from the new port terminal (TEU)

s : Percentage of CNTR discharged and loaded by semi-and RORO CNTR ships at the present Karachi port, 20%

ℓ : Percentage of LCL CNTR, 40%

d : Exchange rate from TEU to units of 20' or 40' CNTR

$NC = 36,142 \times (1 + \frac{20}{80}) \times 0.4 \times 0.5 = 9,036$ units

b. Unstuffing import 40' : $NE_b = \frac{4,518 \times 1.25 \times 1.5}{300 \times 22 \times 0.75} = 1.7 = 2$ units

* $NC = 36,142 \times (1 + \frac{20}{80}) \times 0.4 \times 0.25 = 4,518$ units

c. Stuffing export 20' : $NE_c = \frac{7,488 \times 1.25 \times 0.5}{300 \times 22 \times 0.75} = 0.9 = 1$ unit

* $NC = EF \times (1 + \frac{s}{100-s}) \times \ell \times d$

EF : Number of export CNTR carried to the new port terminal (TEU)

$NC = 29,952 \times (1 + \frac{20}{80}) \times 0.4 \times 0.5 = 7,488$ units

d. Stuffing export 40' : $NE_d = \frac{3,744 \times 1.25 \times 0.75}{300 \times 22 \times 0.75} = 0.7 = 1$ unit

$NC = 29,952 \times (1 + \frac{20}{80}) \times 0.4 \times 0.25 = 3,744$ units

Total number of fork lift trucks for unstuffing & stuffing cargo from/to containers; $NE_t = NE_a + NE_b + NE_c + NE_d = 7$ units

e. The same number of equipment for the above mentioned ones (NE_t) are required to remove/feed cargo between CNTR and stack place, and receive/deliver cargo from/to consignor; $NE_e = NE_t = 7$ units

Grand total : $NE_t + NE_e = \underline{14 \text{ units}}$

(B) 6 ton fork lift trucks for handling heavy cargo

One unit every 10 units of 3 ton fork lift trucks; NE = 2 units

(C) Tractors

4 units per transfer crane for handling LCL CNTR x 1; NE = 4 units

(D) Chassis:

NE_2 = 14 units of 20' chassis

NE_4 = 7 units of 40' chaasis

NE_t = 21 units

* Required number of chassis are three times as many as number of containers stuffed and unstuffed at the peak hour.

(E) Pallets with 1.8 m x 1.2 m two-way reversible winged type

$$NP = \frac{FS \times r \times t}{(WP + w) \times (LP + 1)}$$

Where : NP = Number of pallets (sheets)

FS = Floor space of CFS (m^2)

r = Floor utilization ratio of cargo stacking space, 45%

t = Number of stacking tiers of pallets, 1

WP = Width of pallet 1.8 m.

w = Width wise clearance between pallets, 0.2 m.

LP = Length of pallets, 1.2 m.

1 = Length wise clearance, 0.1 m.

$$NP = \frac{16,975 \times 0.45 \times 1}{(1.8+0.2) \times (1.2+0.1)} = 2,938 \text{ sheets}$$

(4) Equipment for the repair shop

(A) 3 ton fork lift truck for lifting damage CNTR on the repair stands: NE = 1 unit

(B) 15 ton fork lift truck with telescopic side spreader: NE = 1 unit

(5) Multipurpose equipment

(A) Mobile crane with 35 ton capacity for emergency measures at CNTR yard and CFS operation: NE = 1 unit

(B) 3 ton fork lift trucks for carrying cargo gears and others:

NE = 2 units

(C) 15 ton fork lift truck with telescopic side spreader for handling heavy cargo and empty CNTR: NE = 1 unit

(6) Terminal office

Wireless telephone (VHF)

a.	Rail-mounted transfer cranes for unit train operation	2 units
b.	Yard tractors for unit train operation	8
c.	Rubber-tired transfer cranes	6
d.	Yard tractors for CFS operation	4
e.	Terminal office	1
f.	Maintenance shop	1
g.	CFS	1
h.	Spare	1
	Total	24 units