

6.4 Required Cargo Handling Equipment

6.4.1 Summary

(1) Introduction

This section deals with the required cargo handling equipment for the Master Plan development. Since the port is the sole gate port of Romania, it contains all of the port facilities from ship building docks for 200,000 DWT vessels and barge terminals for the long haul to up stream of canal. It handled 80 million tons of cargo at the peak period.

Since the changes of political system from the planned economy to the so-called market mechanism at the end of 1980s, cargo volume went down to less than half of the peak. Contents of the cargo have been changed also to meet with real demands.

Method of port operation has been transformed from the public owned and operated port to the public owned but private-sector operated port. This new situation keeps the fixed assets such as civil works in the public sector, however ownership of the cargo handling equipment moves to the private sector. Now the private operators can introduce new equipment at his expenses as required. The study team extend their appreciation to CPA and local consultants namely IPTANA for the data collection of present cargo handling equipment.

(2) Issues on the Planning of Cargo Handling Equipment

In order to plan the cargo handling equipment at the Master Plan stage, present conditions relating to the equipment planning have been analyzed including following aspects:

- a. Understanding of the existing cargo handling equipment
- b. Project type
- c. Participation of the private sector
- d. Relation to the concession contract

Descriptions on these aspects are as below:

a. Understanding of the Existing Cargo Handling Equipment

The study team collected and analyzed the data of existing cargo handling equipment of more than 180 units, from three ton capacity to 50 ton capacity.

b. Project Type

Study of type of the project of cargo handling equipment: either independent project or integrated project.

c. Participation of the Private Sectors (or Source of Finance)

Study of the source of finance: either private sector or public sector.

d. Relation to the Concession Contract

Study of the duty of private operators in relation to cargo handling equipment

(3) Issues on Existing Cargo Handling Equipment

a. At the North Port

The North Port, especially northern area of the North Port, has the following particulars:

- Shallow water depth, capable of vessels berthing up to medium size
- Narrow site area, low storage capacity, traffic congestion - roads and railway lines
- Old-fashioned, low efficiency, aged equipment
- Adjacent to residential areas, city center, historical site, resort areas which require good environmental conditions.

Particularly, the following terminals have much worse conditions:

- i. Grain terminals
- ii. Containerized cargo terminals
- iii. General cargo terminals

The north most area of the North Port is not suitable for modernized usage because this area is the oldest part of the Port and the water depth in front of the berths from No. 13 to No. 21 is shallow. According to the Master Plan, berths of this area are to be closed in the near future. This will influence to the Grain Terminal (berths from No. 17 to No. 19) and Edible Oil Terminal (berths No. 20 and 21).

The Grain Terminal (AGROEXPORT) will construct new grain handling facilities at berths from No. 31 to No. 33 at the middle area of the North Port to improve the productivity.

The Edible Oil Terminal (FRIAL) has oil handling facilities of sufficient capacity and will be able to cope with the future cargo demand. However, relocation of the facilities may be required when considering the closing of this area in the future. Although the relocation and site selection should be decided by the terminal operator, it is necessary to study the required scale of the facilities.

b. At the South Port

Contrary to the above North Port, the South Port has the following particulars:

- Relatively deep water depth, capable of larger size vessels berthing
- Wide open space, suitable for future development of infrastructure, cargo handling terminals, storage area, etc.
- Relatively modern equipment

(4) Improvement Scenario

Improvement scenarios of the cargo handling equipment were studied in parallel to the terminal requirement study. The existing cargo handling equipment conditions are important input data for studying the cargo handling capacity of the terminals. In order to facilitate this study, the following aspects were taken into account:

- 1) Study on comprehensive port layout
- 2) Overall redevelopment of the Port, including the North Port and the South Port

In order to harmonizing with the Master Plan including planning concepts of other facilities, the following three-step approach was considered.

a. First Step

Cargo traffic demand and present port capacity was compared by commodity and type of cargo. The basic criteria to recommend a new terminal are shortage of present port capacity against traffic demand. In order to materialize this study following analyses were performed:

- 1) Cargo traffic by commodity
- 2) Estimation of present cargo handling capacity of equipment
- 3) Itemization of commodities having handling shortage
- 4) Possibility of relocation of the existing terminals from the old North Port to the new South Port
- 5) Terminal expansion at the South Port

b. Second Step

At the second step, following aspects was studied in detail:

- 1) Zoning of the total Port area, by commodity handled,
- 2) Zoning of the total Port area, by calling vessel size,
- 3) Zoning of the total Port area, by environmental considerations

And finally, construction of new terminals at the South Port were selected for implementation. The south port will have various advantages as shown below:

- 1) Deep water depth allowing calling of larger size vessels
- 2) Wide site area, modern infrastructure, less traffic congestion, well arranged roads, railway tracks, sufficient cargo storage areas
- 3) Latest technology, high efficiency, environment friendly, new modern equipment

c. Third Step

It is so important to redevelop the North Port areas. In order to implement this, following actions should be taken into account:

- 1) Redevelopment of the North Port, especially old northern area:
- 2) Demolishing and removal of aged, old fashioned, low efficiency equipment
- 3) Renovation of old historical buildings, facilities to memorial objects at the North Port
- 4) Introduction of new business, e.g. business center, shopping center, amusement center at the North Port

(5) Cargo Handling Equipment for the Master Plan

The required cargo handling equipment for the Master Plan is studied as described in the following sections.

6.4.2 Issues on Existing Cargo Handling Terminals and Improvement Scenarios

For the analysis of improvement scenarios, the following reference data was prepared for review:

Commodities are classified into 14 groups by type of cargo. Each cargo is assigned to one of four types of cargo categories: namely, general cargo, containerized, dry bulk and liquid bulk. Study year are 1999, 2010 for the short-term plan and 2020 for the Master Plan. Both cargo traffics case-1 and case-2 are taken into account.

Table 6.4.2-1 Cargo Volume Arrangement by Commodity and Type of Cargo (1999, 2010 and 2020) (Case 1, Case 2)

Balance between future traffic and existing cargo handling capacity was evaluated for both traffic forecasts Case-1 and Case-2. Estimated berth capacities of 19 operators are shown by the eight cargo type classification.

Table 6.4.2-2-1 Balance between Future Traffic and Existing Cargo Handling Capacity (Case 1)

Table 6.4.2-2-2 Balance between Future Traffic and Existing Cargo Handling Capacity (Case 2)

Forecast cargo volume is generally lower than the present total cargo handling capacity of the terminals, except for handling capacities of **containerized cargoes** and **dry bulk grain cargoes**.

Considering the tendency for cargo demand to increase, the following improvement scenario can be proposed:

(1) New Container Terminal at Pier S2 of the South Port

- a. 1st Phase Construction
- b. 2nd and 3rd Phase Construction

(2) New Grain Terminal at Pier S3 of the South Port

(2)-1 In case of Case 1 Cargo Demand

- a. 1st Phase Construction (2.0 million tons/year)
- b. 2nd Phase Construction (2.0 million tons/year)

(2)-2 In case of Case 2 Cargo Demand

No additional terminal will be required.

Table 6.4.2-3 Issues on Existing Cargo Handling Terminals and Improvement Scenario

Table 6.4.2-3 indicates issues of existing terminals by commodity classification and improvement scenarios also provided.

Table 6.4.2-1-1 Cargo Volume Arrangement by Commodity and Type of Cargo (1999)

Category	No.	Type	Commodities	1999											
				Case 1					Case 2						
				Total	General	Container	Bulk	Liquid	Total	General	Container	Bulk	Liquid		
Export-Load	1	B	Cereals	1.01			1.01			1.01					
	4	C	Foods, Beverage, Tobacco	0.14		0.14			0.14		0.14				
	6	G	Timber, Charcoal	0.64	0.64				0.64	0.64					
	7	B/G	Fertilizers(B-50%+G-50%)	0.68	0.34		0.34		0.68	0.34			0.34		
	9	B/G	Iron Ore, Scrap	0.62	0.62		0.00		0.62	0.62			0.00		
	10	B	Non-Ferrous Ore	0.02			0.02		0.02				0.02		
	13	B	Solid Fuel(Coal, Coke, etc.)	0.10			0.10		0.10				0.10		
	14	L	Crude Oil	0.00				0.00	0.00					0.00	
	15	L	Oil & Gas Products	1.38				1.38	1.38					1.38	
	17	L/G	Chemical Products(L-50%+G-50%)	0.70	0.35			0.35	0.70	0.35				0.35	
	18	B/G	Cement, Construction Mat'ls(B-70%+G-30%)	1.81	0.54		1.27		1.81	0.54			1.27		
	20	G	Ferrous/NonFerrous Materials	1.33	1.33				1.33	1.33					
	23	C	Various Manufactured Products	0.36		0.36			0.36		0.36				
	24	C	Other Cargoes	0.62		0.62			0.62		0.62				
		Total	9.41	3.82	1.12	2.74	1.73	9.41	3.82	1.12	2.74	1.73			
Import-Unload	1	B/G	Cereals(B-90%+G-10%)	0.04	0.00		0.04		0.04	0.00			0.04		
	4	C	Foods, Beverage, Tobacco	0.47		0.47			0.47		0.47				
	6	G	Timber, Charcoal	0.00	0.00				0.00	0.00					
	7	B/L	Fertilizers(B-40%+L-60%)	0.37			0.15	0.22	0.37			0.15	0.22		
	9	B/G	Iron Ore, Scrap	4.17	0.00		4.17		4.17	0.00		4.17			
	10	B	Non-Ferrous Ore	1.07			1.07		1.07			1.07			
	13	B	Solid Fuel(Coal, Coke, etc.)	1.73			1.73		1.73			1.73			
	14	L	Crude Oil	3.14				3.14	3.14				3.14		
	15	L	Oil & Gas Products	0.83				0.83	0.83				0.83		
	17	L/G	Chemical Products(L-50%+G-50%)	0.03	0.02			0.02	0.03	0.02			0.02		
	18	B	Chalk, Cement, Construction Materials	0.01			0.01		0.01			0.01			
	20	G	Ferrous/NonFerrous Materials	0.05	0.05				0.05	0.05					
	23	C	Various Manufactured Products	0.35		0.35			0.35		0.35				
	24	C	Other Cargoes	0.09		0.09			0.09		0.09				
		Total	12.35	0.07	0.91	7.16	4.21	12.35	0.07	0.91	7.16	4.21			
Transit-Load	1	B	Cereals	0.68			0.68		0.68				0.68		
	4	C	Foods, Beverage, Tobacco	0.03		0.03			0.03		0.03				
	6	G	Timber, Charcoal	0.00	0.00				0.00	0.00					
	7	B	Fertilizers(Natural, Chemical)	0.01			0.01		0.01			0.01			
	9	B/G	Iron Ore, Scrap	0.08	0.08		0.00		0.08	0.08			0.00		
	10	B	Non-Ferrous Ore	0.01			0.01		0.01			0.01			
	13	B	Solid Fuel(Coal, Coke, etc.)	0.00			0.00		0.00			0.00			
	14	L	Crude Oil	0.00				0.00	0.00				0.00		
	15	L	Oil & Gas Products	0.00				0.00	0.00				0.00		
	17	L/G	Chemical Products(L-50%+G-50%)	0.00	0.00			0.00	0.00	0.00			0.00		
	18	B	Chalk, Cement, Construction Materials	0.00			0.00		0.00			0.00			
	20	G	Ferrous/NonFerrous Materials	0.06	0.06				0.06	0.06					
	23	C	Various Manufactured Products	0.00		0.00			0.00		0.00				
	24	C	Other Cargoes	0.04		0.04			0.04		0.04				
		Total	0.91	0.14	0.07	0.70	0.00	0.91	0.14	0.07	0.70	0.00			
Transit-Unload	1	B/G	Cereals(B-90%+G-10%)	0.04	0.00		0.04		0.04	0.00			0.04		
	4	C	Foods, Beverage, Tobacco	0.00		0.00			0.00		0.00				
	6	G	Timber, Charcoal	0.00	0.00				0.00	0.00					
	7	B	Fertilizers(Natural, Chemical)	0.01			0.01		0.01			0.01			
	9	B/G	Iron Ore, Scrap	0.00	0.00		0.00		0.00	0.00			0.00		
	10	B	Non-Ferrous Ore	0.10			0.10		0.10			0.10			
	13	B	Solid Fuel(Coal, Coke, etc.)	0.00			0.00		0.00			0.00			
	14	L	Crude Oil	0.07				0.07	0.07				0.07		
	15	L	Oil & Gas Products	0.00				0.00	0.00				0.00		
	17	L/G	Chemical Products(L-50%+G-50%)	0.01	0.01			0.01	0.01	0.01			0.01		
	18	B	Chalk, Cement, Construction Materials	0.00			0.00		0.00			0.00			
	20	G	Ferrous/NonFerrous Materials	0.00	0.00				0.00	0.00					
	23	C	Various Manufactured Products	0.00		0.00			0.00		0.00				
	24	C	Other Cargoes	0.01		0.01			0.01		0.01				
		Total	0.24	0.01	0.01	0.15	0.08	0.24	0.01	0.01	0.15	0.08			
Total	1	B	Cereals	1.77	0.01	0.00	1.76	0.00	1.77	0.01	0.00	1.76	0.00	0.00	
	4	C	Foods, Beverage, Tobacco	0.64	0.00	0.64	0.00	0.00	0.64	0.00	0.64	0.00	0.00	0.00	
	6	G	Timber, Charcoal	0.64	0.64	0.00	0.00	0.00	0.64	0.64	0.00	0.00	0.00	0.00	
	7	B	Fertilizers(Natural, Chemical)	1.07	0.34	0.00	0.51	0.22	1.07	0.34	0.00	0.51	0.22		
	9	B/G	Iron Ore, Scrap	4.87	0.70	0.00	4.17	0.00	4.87	0.70	0.00	4.17	0.00		
	10	B	Non-Ferrous Ore	1.20	0.00	0.00	1.20	0.00	1.20	0.00	0.00	1.20	0.00		
	13	B	Solid Fuel(Coal, Coke, etc.)	1.83	0.00	0.00	1.83	0.00	1.83	0.00	0.00	1.83	0.00		
	14	L	Crude Oil	3.21	0.00	0.00	0.00	3.21	3.21	0.00	0.00	0.00	3.21		
	15	L	Oil & Gas Products	2.21	0.00	0.00	0.00	2.21	2.21	0.00	0.00	0.00	2.21		
	17	L/G	Chemical Products	0.74	0.37	0.00	0.00	0.37	0.74	0.37	0.00	0.00	0.37		
	18	B	Chalk, Cement, Construction Materials	1.82	0.54	0.00	1.28	0.00	1.82	0.54	0.00	1.28	0.00		
	20	G	Ferrous/NonFerrous Materials	1.44	1.44	0.00	0.00	0.00	1.44	1.44	0.00	0.00	0.00		
	23	C	Various Manufactured Products	0.71	0.00	0.71	0.00	0.00	0.71	0.00	0.71	0.00	0.00		
	24	C	Other Cargoes	0.76	0.00	0.76	0.00	0.00	0.76	0.00	0.76	0.00	0.00		
		Total	22.91	4.04	2.11	10.75	6.01	22.91	4.04	2.11	10.75	6.01			

Table 6.4.2-1-2 Cargo Volume Arrangement by Commodity and Type of Cargo (2010)

Category	No.	Type	Commodities	2010											
				Case 1				Case 2							
				Total	General	Container	Bulk	Liquid	Total	General	Container	Bulk	Liquid		
Export-Load	1	B	Cereals	1.80			1.80			1.50					
	4	C	Food, Beverage, Tobacco	0.24		0.24			0.19		0.19		1.50		
	6	G	Timber, Charcoal	1.13	1.13				1.13	1.13					
	7	B/G	Fertilizers(B-50%+G-50%)	0.36	0.18		0.18		0.48	0.24			0.24		
	9	B/G	Iron Ore, Scrap	0.85	0.85		0.00		0.85	0.85			0.00		
	10	B	Non-Ferrous Ore	0.00			0.00		0.00				0.00		
	13	B	Solid Fuel(Coal, Coke, etc.)	0.00			0.00		0.00				0.00		
	14	L	Crude Oil	0.00				0.00	0.00					0.00	
	15	L	Oil & Gas Products	2.39				2.39	2.82					2.82	
	17	L/G	Chemical Products(L-50%+G-50%)	0.67	0.34			0.34	0.70	0.35				0.35	
	18	B/G	Cement, Construction Matls(B-70%+G-30%)	1.07	0.32		0.75		1.36	0.41			0.95		
	20	G	Ferrous/NonFerrous Materials	1.90	1.90				1.90	1.90					
	23	C	Various Manufactured Products	0.63		0.63			0.49		0.49				
	24	C	Other Cargoes	1.08		1.08			0.84		0.84				
			Total	12.12	4.72	1.95	2.73	2.73	12.26	4.88	1.52	2.69	3.17		
	Import-Unload	1	B/G	Cereals(B-90%+G-10%)	0.20	0.02		0.18		0.38	0.04			0.34	
		4	C	Food, Beverage, Tobacco	0.82		0.82			0.64		0.64			
		6	G	Timber, Charcoal	0.00	0.00				0.00	0.00				
		7	B/L	Fertilizers(B-40%+L-60%)	0.69			0.28	0.41	0.52				0.21	0.31
		9	B/G	Iron Ore, Scrap	6.90	0.00		6.90		6.90	0.00			6.90	
		10	B	Non-Ferrous Ore	1.68			1.68		1.39				1.39	
		13	B	Solid Fuel(Coal, Coke, etc.)	2.11			2.11		2.10				2.10	
		14	L	Crude Oil	11.92				11.92	9.33					9.33
		15	L	Oil & Gas Products	1.44				1.44	1.13					1.13
17		L/G	Chemical Products(L-50%+G-50%)	0.00	0.00			0.00	0.00	0.00				0.00	
18		B	Chalk, Cement, Construction Materials	0.00			0.00		0.00				0.00		
20		G	Ferrous/NonFerrous Materials	0.00	0.00				0.00	0.00					
23		C	Various Manufactured Products	0.62		0.62			0.48		0.48				
24		C	Other Cargoes	0.16		0.16			0.13		0.13				
		Total	26.54	0.02	1.60	11.15	13.77	23.00	0.04	1.25	10.94	10.77			
Transit-Load	1	B	Cereals	2.65			2.65		0.50				0.50		
	4	C	Food, Beverage, Tobacco	0.03		0.03			0.03		0.03				
	6	G	Timber, Charcoal	0.00	0.00				0.00	0.00					
	7	B	Fertilizers(Natural, Chemical)	0.00			0.00		0.00				0.00		
	9	B/G	Iron Ore, Scrap	0.11	0.11		0.00		0.11	0.11			0.00		
	10	B	Non-Ferrous Ore	0.00			0.00		0.00				0.00		
	13	B	Solid Fuel(Coal, Coke, etc.)	0.00			0.00		0.00				0.00		
	14	L	Crude Oil	0.00				0.00	0.00					0.00	
	15	L	Oil & Gas Products	0.00				0.00	0.00					0.00	
	17	L/G	Chemical Products(L-50%+G-50%)	0.00	0.00			0.00	0.00	0.00				0.00	
	18	B	Chalk, Cement, Construction Materials	0.00			0.00		0.00				0.00		
	20	G	Ferrous/NonFerrous Materials	0.10	0.10				0.10	0.10					
	23	C	Various Manufactured Products	0.07		0.07			0.07		0.07				
	24	C	Other Cargoes	0.13		0.13			0.13		0.13				
		Total	3.09	0.21	0.23	2.65	0.00	0.94	0.21	0.23	0.50	0.00			
Transit-Unload	1	B/G	Cereals(B-90%+G-10%)	0.05	0.01		0.05		0.13	0.01			0.12		
	4	C	Food, Beverage, Tobacco	0.09		0.09			0.09		0.09				
	6	G	Timber, Charcoal	0.00	0.00				0.00	0.00					
	7	B	Fertilizers(Natural, Chemical)	0.00			0.00		0.00				0.00		
	9	B/G	Iron Ore, Scrap	0.83	0.00		0.83		0.83	0.00			0.83		
	10	B	Non-Ferrous Ore	0.27			0.27		0.22				0.22		
	13	B	Solid Fuel(Coal, Coke, etc.)	0.00			0.00		0.00				0.00		
	14	L	Crude Oil	0.39				0.39	0.39					0.39	
	15	L	Oil & Gas Products	0.00				0.00	0.00					0.00	
	17	L/G	Chemical Products(L-50%+G-50%)	0.00	0.00			0.00	0.00	0.00				0.00	
	18	B	Chalk, Cement, Construction Materials	0.00			0.00		0.00				0.00		
	20	G	Ferrous/NonFerrous Materials	0.00	0.00				0.00	0.00					
	23	C	Various Manufactured Products	0.08		0.08			0.08		0.08				
	24	C	Other Cargoes	0.02		0.02			0.02		0.02				
		Total	1.73	0.01	0.19	1.15	0.39	1.76	0.01	0.19	1.17	0.39			
Total	1	B	Cereals	4.70	0.03	0.00	4.68	0.00	2.51	0.05	0.00	2.46	0.00		
	4	C	Food, Beverage, Tobacco	1.18	0.00	1.18	0.00	0.00	0.95	0.00	0.95	0.00	0.00		
	6	G	Timber, Charcoal	1.13	1.13	0.00	0.00	0.00	1.13	1.13	0.00	0.00	0.00		
	7	B	Fertilizers(Natural, Chemical)	1.05	0.18	0.00	0.46	0.41	1.00	0.24	0.00	0.45	0.31		
	9	B/G	Iron Ore, Scrap	8.69	0.96	0.00	7.73	0.00	8.69	0.96	0.00	7.73	0.00		
	10	B	Non-Ferrous Ore	1.95	0.00	0.00	1.95	0.00	1.61	0.00	0.00	1.61	0.00		
	13	B	Solid Fuel(Coal, Coke, etc.)	2.11	0.00	0.00	2.11	0.00	2.10	0.00	0.00	2.10	0.00		
	14	L	Crude Oil	12.31	0.00	0.00	0.00	12.31	9.72	0.00	0.00	0.00	9.72		
	15	L	Oil & Gas Products	3.83	0.00	0.00	0.00	3.83	3.95	0.00	0.00	0.00	3.95		
	17	L/G	Chemical Products	0.67	0.34	0.00	0.00	0.34	0.70	0.35	0.00	0.00	0.35		
	18	B	Chalk, Cement, Construction Materials	1.07	0.32	0.00	0.75	0.00	1.36	0.41	0.00	0.95	0.00		
	20	G	Ferrous/NonFerrous Materials	2.00	2.00	0.00	0.00	0.00	2.00	2.00	0.00	0.00	0.00		
	23	C	Various Manufactured Products	1.40	0.00	1.40	0.00	0.00	1.12	0.00	1.12	0.00	0.00		
	24	C	Other Cargoes	1.39	0.00	1.39	0.00	0.00	1.12	0.00	1.12	0.00	0.00		
		Total	43.48	4.95	3.97	17.67	16.89	37.96	5.14	3.19	15.30	14.33			

Table 6.4.2-1-3 Cargo Volume Arrangement by Commodity and Type of Cargo (2020)

Category	No.	Type	Commodities	2020										
				Case 1					Case 2					
				Total	General	Container	Bulk	Liquid	Total	General	Container	Bulk	Liquid	
Export-Load	1	B	Cereals	2.64			2.64			1.50			1.50	
	4	C	Foods, Beverage, Tobacco	0.42		0.42			0.29		0.29			
	6	G	Timber, Charcoal	0.68	0.68				0.68	0.68				
	7	B/G	Fertilizers(B:50%+G:50%)	0.19	0.10		0.10		0.30	0.15			0.15	
	9	B/G	Iron Ore, Scrap	0.30	0.30		0.00		0.30	0.30			0.00	
	10	B	Non-Ferrous Ore	0.00			0.00		0.00				0.00	
	13	B	Solid Fuel(Coal, Coke, etc.)	0.00			0.00		0.00				0.00	
	14	L	Crude Oil	0.00				0.00	0.00					0.00
	15	L	Oil & Gas Products	1.57				1.57	2.02					2.02
	17	L/G	Chemical Products(L:50%+G:50%)	0.36	0.18			0.18	0.51	0.26				0.26
	18	B/G	Cement, Construction Mat'ls(B:70%+G:30%)	0.64	0.19		0.45		0.94	0.28			0.66	
	20	G	Ferrous/NonFerrous Materials	1.90	1.90				1.90	1.90				
	23	C	Various Manufactured Products	1.07		1.07			0.73		0.73			
	24	C	Other Cargoes	1.85		1.85			1.26		1.26			
		Total	11.62	3.35	3.34	3.18	1.75	10.43	3.57	2.28	2.31	2.28	2.28	
Import-Unload	1	B/G	Cereals(B:90%+G:10%)	0.20	0.02		0.18		0.38	0.04			0.34	
	4	C	Foods, Beverage, Tobacco	1.41		1.41			0.96		0.96			
	6	G	Timber, Charcoal	0.00	0.00				0.00	0.00				
	7	B/L	Fertilizers(B:40%+L:60%)	1.24			0.50	0.74	0.81				0.32	0.49
	9	B/G	Iron Ore, Scrap	8.30	0.00		8.30		6.90	0.00			6.90	
	10	B	Non-Ferrous Ore	1.01			1.01		0.84				0.84	
	13	B	Solid Fuel(Coal, Coke, etc.)	2.55			2.55		2.10				2.10	
	14	L	Crude Oil	16.40				16.40	10.64					10.64
	15	L	Oil & Gas Products	2.47				2.47	1.68					1.68
	17	L/G	Chemical Products(L:50%+G:50%)	0.00	0.00			0.00	0.00	0.00				0.00
	18	B	Chalk, Cement, Construction Materials	0.00			0.00		0.00				0.00	
	20	G	Ferrous/NonFerrous Materials	0.00	0.00				0.00	0.00				
	23	C	Various Manufactured Products	1.05		1.05			0.72		0.72			
	24	C	Other Cargoes	0.28		0.28			0.19		0.19			
		Total	34.91	0.02	2.74	12.54	19.61	25.22	0.04	1.87	10.51	12.81	12.81	
Transit-Load	1	B	Cereals	3.84			3.84		0.50				0.50	
	4	C	Foods, Beverage, Tobacco	0.08		0.08			0.08		0.08			
	6	G	Timber, Charcoal	0.00	0.00				0.00	0.00				
	7	B	Fertilizers(Natural, Chemical)	0.00			0.00		0.00				0.00	
	9	B/G	Iron Ore, Scrap	0.04	0.04		0.00		0.04	0.04			0.00	
	10	B	Non-Ferrous Ore	0.00			0.00		0.00				0.00	
	13	B	Solid Fuel(Coal, Coke, etc.)	0.00			0.00		0.00				0.00	
	14	L	Crude Oil	0.00				0.00	0.00					0.00
	15	L	Oil & Gas Products	0.00				0.00	0.00					0.00
	17	L/G	Chemical Products(L:50%+G:50%)	0.00	0.00			0.00	0.00	0.00				0.00
	18	B	Chalk, Cement, Construction Materials	0.00			0.00		0.00				0.00	
	20	G	Ferrous/NonFerrous Materials	0.10	0.10				0.10	0.10				
	23	C	Various Manufactured Products	0.21		0.21			0.21		0.21			
	24	C	Other Cargoes	0.36		0.36			0.36		0.36			
		Total	4.63	0.14	0.65	3.84	0.00	1.29	0.14	0.65	0.50	0.00	0.00	
Transit-Unload	1	B/G	Cereals(B:90%+G:10%)	0.05	0.01		0.05		0.13	0.01			0.12	
	4	C	Foods, Beverage, Tobacco	0.26		0.26			0.26		0.26			
	6	G	Timber, Charcoal	0.00	0.00				0.00	0.00				
	7	B	Fertilizers(Natural, Chemical)	0.00			0.00		0.00				0.00	
	9	B/G	Iron Ore, Scrap	1.00	0.00		1.00		0.95	0.00			0.95	
	10	B	Non-Ferrous Ore	0.16			0.16		0.13				0.13	
	13	B	Solid Fuel(Coal, Coke, etc.)	0.00			0.00		0.00				0.00	
	14	L	Crude Oil	0.46				0.46	0.46					0.46
	15	L	Oil & Gas Products	0.00				0.00	0.00					0.00
	17	L/G	Chemical Products(L:50%+G:50%)	0.00	0.00			0.00	0.00	0.00				0.00
	18	B	Chalk, Cement, Construction Materials	0.00			0.00		0.00				0.00	
	20	G	Ferrous/NonFerrous Materials	0.00	0.00				0.00	0.00				
	23	C	Various Manufactured Products	0.21		0.21			0.21		0.21			
	24	C	Other Cargoes	0.05		0.05			0.05		0.05			
		Total	2.19	0.01	0.52	1.21	0.46	2.19	0.01	0.52	1.20	0.46	0.46	
Total	1	B	Cereals	6.73	0.03	0.00	6.71	0.00	2.51	0.05	0.00	2.46	0.00	
	4	C	Foods, Beverage, Tobacco	2.17	0.00	2.17	0.00	0.00	1.59	0.00	1.59	0.00	0.00	
	6	G	Timber, Charcoal	0.68	0.68	0.00	0.00	0.00	0.68	0.68	0.00	0.00	0.00	
	7	B	Fertilizers(Natural, Chemical)	1.43	0.10	0.00	0.59	0.74	1.11	0.15	0.00	0.47	0.49	
	9	B/G	Iron Ore, Scrap	9.64	0.34	0.00	9.30	0.00	8.19	0.34	0.00	7.85	0.00	
	10	B	Non-Ferrous Ore	1.17	0.00	0.00	1.17	0.00	0.97	0.00	0.00	0.97	0.00	
	13	B	Solid Fuel(Coal, Coke, etc.)	2.55	0.00	0.00	2.55	0.00	2.10	0.00	0.00	2.10	0.00	
	14	L	Crude Oil	16.86	0.00	0.00	0.00	16.86	11.10	0.00	0.00	0.00	11.10	
	15	L	Oil & Gas Products	4.04	0.00	0.00	0.00	4.04	3.70	0.00	0.00	0.00	3.70	
	17	L/G	Chemical Products	0.36	0.18	0.00	0.00	0.18	0.51	0.26	0.00	0.00	0.26	
	18	B	Chalk, Cement, Construction Materials	0.64	0.19	0.00	0.45	0.00	0.94	0.28	0.00	0.66	0.00	
	20	G	Ferrous/NonFerrous Materials	2.00	2.00	0.00	0.00	0.00	2.00	2.00	0.00	0.00	0.00	
	23	C	Various Manufactured Products	2.54	0.00	2.54	0.00	0.00	1.87	0.00	1.87	0.00	0.00	
	24	C	Other Cargoes	2.54	0.00	2.54	0.00	0.00	1.86	0.00	1.86	0.00	0.00	
		Total	53.35	3.51	7.25	20.76	21.82	39.13	3.76	5.32	14.51	15.54		

Table 6.4.1-2-1 Balance between Future Traffic and Existing Cargo Handling Capacity (Case 1)

No	Operator	Berth No.	Handling Commodities	Handling Operation	Cargo Handling Capacity (x 1,000 tons)						Total		
					Break Bulk General Cargo	Containerized cargo	Grain	Coal/Ore	Phosphate/ Fertilizer	Cement		Crude Oil / Oil Products	Liquid Bulk Edible Oil
01	ROTRAC	Berth RR4	General Cargoes (timber, etc.)	Loading, Unloading								0	
02	DEZROBUREA	Berth 0 - 5 Berth 6,7 Berth 11,12 Berth 13-16 Berth 20 Berth 17,18 & 24 Berth 31-33	General Cargoes (steel scrap, timber, etc.) General Cargoes (fruits, etc.) General Cargoes (timber, etc.) General Cargoes (Kaolin, soda, timber, etc.) General Cargoes (timber, etc.) Bulk Cargoes (grains) Grain (New Project)	Loading, Unloading Loading, Unloading Loading, Unloading Loading, Unloading Loading, Unloading Loading, Unloading Loading	634 101 171 257 101							634 101 171 257 101	
03	AGROEXPORT	Berth 17,18 & 24 Berth 31-33	Grain (New Project)	Loading		1,000						1,000	
04	FRIAL	Berth 19 Berth 21 Berth 53 Berth 23 Berth 47-50 Berth 8	Edible Oil General Cargoes (rice, etc.) General Cargoes & Refrigerated Food General Cargoes (timber, rice, etc.) General Cargoes (timber, steel scrap, cement, etc.) General Cargoes (timber)	Loading, Unloading Loading, Unloading Loading, Unloading Loading, Unloading Loading, Unloading Loading, Unloading	93 152 203 771						550	550 93 152 203 771	
05	DECIROUM	Berth 35-37 & 41-43 Berth 51,52	General Cargoes (bulk soda, steel scrap, timber, etc.) Containerized Cargoes	Loading, Unloading Loading, Unloading								0	
06	PHOENIX	Berth 22 Berth 35-37 & 41-43 Berth 51,52	General Cargoes (rice, etc.) General Cargoes (bulk soda, steel scrap, timber, etc.) Containerized Cargoes	Loading, Unloading Loading, Unloading Loading, Unloading	1,227							1,227	
07	SOCEP	Berth RR4 Berth 38-40 Berth 44 Berth 45,46 Berth 64-66 Berth 85	General Cargoes (timber etc.) General Cargoes (timber, Steel scrap, cement, etc.) General & Containerized Cargoes General Cargoes (steel products, timber,) Bulk Cargoes (coals, ores)	Loading, Unloading Loading, Unloading Loading, Unloading Loading, Unloading Loading, Unloading	264 610 152 582							810 264 610 152 582	
08	UMEX	Berth 54-59 Berth 60 Berth 61 Berth 62 Berth 63 Berth 67 Berth 68	General Cargoes (timber, etc.) Grain (New Project) Bulk Cargoes Bulk Cargoes (phosphate ores) Bulk Cargoes (fertilizers) General Cargoes	Loading, Unloading Loading Loading Unloading Loading Loading, Unloading	1,750	450						1,750 450	
09	MINMETAL	Berth 69-79 Berth 80-84 Berth 107-112 & 115-118 Berth 113 & 114 Berth 119A-119B	Bulk Cargoes (phosphate ores) Bulk Cargoes (fertilizers) General Cargoes Bulk Cargoes (Cement) Liquid Bulk (crude oil, methanol, chemical liquids, etc.) Bulk Cargoes (Coals, ores)	Loading, Unloading Loading, Unloading Loading, Unloading Loading, Unloading Loading, Unloading					743 743			743 743	
10	CHIMPEX	Berth 120 Berth 120 Berth 124-125 Berth 55	General Cargoes (meat, etc.) General Cargoes General Cargoes (cement, ores, etc.) Grain (New Project)	Loading, Unloading Loading, Unloading Loading, Unloading Loading			12,000			2,501		12,000 2,501	
11	SICUM	Berth 69-79 Berth 80-84 Berth 107-112 & 115-118 Berth 113 & 114 Berth 119A-119B	Liquid Bulk (crude oil, methanol, chemical liquids, etc.) Bulk Cargoes (Coals, ores)	Loading, Unloading Loading, Unloading Loading, Unloading Loading, Unloading							36,000	36,000	
12	COMVEX	Berth 120 Berth 120 Berth 124-125	General Cargoes (timber, ferrous/non-ferrous metal, etc.) General Cargoes (grains)	Loading, Unloading Loading, Unloading Loading, Unloading	652							652	
13	OMVEX	Berth 120 Berth 120 Berth 124-125	General Cargoes (meat, etc.) General Cargoes Bulk Cargoes (cement, ores, etc.)	Loading, Unloading Loading, Unloading Loading, Unloading		2,000						2,000	
14	ROMTRANS	Berth 120 Berth 120 Berth 124-125	General Cargoes General Cargoes Bulk Cargoes (cement, ores, etc.)	Loading, Unloading Loading, Unloading Loading, Unloading								0	
15	SLOTTRANS	Berth 120 Berth 120 Berth 124-125	General Cargoes General Cargoes Bulk Cargoes (cement, ores, etc.)	Loading, Unloading Loading, Unloading Loading, Unloading								0	
16	FREE TRADE ADMINISTRATION	Berth 120 Berth 120 Berth 124-125	General Cargoes General Cargoes Bulk Cargoes (cement, ores, etc.)	Loading, Unloading Loading, Unloading Loading, Unloading								0	
17	SNTFM	Berth 120 Berth 120 Berth 124-125	General Cargoes General Cargoes Bulk Cargoes (cement, ores, etc.)	Loading, Unloading Loading, Unloading Loading, Unloading								0	
18	CPA RO-RO TERMINAL	Berth 120 Berth 120 Berth 124-125	General Cargoes General Cargoes Bulk Cargoes (cement, ores, etc.)	Loading, Unloading Loading, Unloading Loading, Unloading								0	
19	MAST (Floating Operator)	Berth 120 Berth 120 Berth 124-125	General Cargoes General Cargoes Bulk Cargoes (cement, ores, etc.)	Loading, Unloading Loading, Unloading Loading, Unloading								0	
20	ARTS	Berth 55	Grain (New Project)	Loading		250						250	
A	Total Cargo Handling Capacity				7,720	810	3,700	24,000	1,486	2,501	36,000	550	76,767
B	Cargo Demand Forecast (Case 1) - (2020)				3,540	7,050	8,470	13,020	590	450	21,820	250	55,160
C	Balance(A-B)				-4,180	-6,240	-4,770	10,980	896	2,051	14,180	300	21,577
	New Container Terminal (S2) - Phase 1					1,180							
	New Container Terminal (S2) - Phase 2, 3					4,200							
	New Grain Terminal(S3) - Phase 1					2,000							
	New Grain Terminal(S3) - Phase 2					2,000							
	Edible Oil Terminal Relocation												250

Table 6.4.1-2-2 Balance between Future Traffic and Existing Cargo Handling Capacity (Case 2)

No.	Operator	Berth No	Handling Commodities	Handling Operation	Break Bulk General Cargo	Containerized cargo Containers	Cargo Handling Capacity (x 1,000 tons)					Total	
							Coal/Ore	Phosphate/ Fertilizer	Cement	Crude Oil / Oil Products	Edible Oil		
01	ROTRAC	Berth RRI-RR3	General Cargoes (timber, etc.)	Loading, Unloading								0	
02	DEZROBIREA	Berth 0 - 5	General Cargoes (steel scrap, timber, etc.)	Loading, Unloading	634							634	
		Berth 6,7	General Cargoes (fruits, etc.)	Loading, Unloading	101							101	
03	AGROEXPORT	Berth 11,12	General Cargoes (timber, etc.)	Loading, Unloading	171							171	
		Berth 13-16	General Cargoes (kaolin, soda, timber, etc.)	Loading, Unloading	257							257	
04	FRIAL	Berth 20	General Cargoes (timber, etc.)	Loading, Unloading	101							101	
		Berth 17,18 & 24	Bulk Cargoes (grains)	Loading		1,000						1,000	
05	DECIRUM	Berth 31-33	Grain (New Project)	Loading								550	
		Berth 19	Edible Oil	Loading, Unloading								93	
06	PHOENIX	Berth 21	General Cargoes (rice, etc.)	Loading, Unloading	93							93	
		Berth 53	General Cargoes & Refrigerated Food	Loading, Unloading	152							152	
07	SOCEP	Berth 23	General Cargoes (timber, rice, etc.)	Loading, Unloading	203							203	
		Berth 47-50	General Cargoes (timber, steel scrap, cement, etc.)	Loading, Unloading	771							771	
08	UMEX	Berth 8	General Cargoes (timber)	Loading, Unloading								0	
		Berth 22	General Cargoes (timber, rice, etc.)	Loading, Unloading								0	
09	MINMETAL	Berth 35-37 & 41-43	General Cargoes (bulk soda, steel scrap, timber, etc.)	Loading, Unloading	1,227							1,227	
		Berth 51,52	Containerized Cargoes	Loading, Unloading		810						810	
10	CHIMPEX	Berth RR4	General Cargoes (timber etc.)	Loading, Unloading	264							264	
		Berth 38-40	General Cargoes (timber, steel scrap, cement, etc.)	Loading, Unloading	610							610	
11	SICIM	Berth 44	General & Containerized Cargoes	Loading, Unloading	152							152	
		Berth 45,46	General Cargoes (steel products, timber,)	Loading, Unloading	582							582	
12	OIL TERMINAL	Berth 64-66	Bulk Cargoes (coals, ores)	Unloading				12,000				12,000	
		Berth 85	Bulk Cargoes (coals, ores)	Unloading								0	
13	COMVEX	Berth 54-60	General Cargoes (timber, etc.)	Loading, Unloading	1,750							1,750	
		Berth 60	Grain (New Project)	Loading		450						450	
14	ROMTRANS	Berth 61	Bulk Cargoes	Loading								0	
		Berth 62	Bulk Cargoes (phosphate ores)	Unloading								0	
15	SILOTRANS	Berth 63	Bulk Cargoes (fertilizers)	Loading					743			743	
		Berth 67	General Cargoes	Loading					743			743	
16	FREE TRADE ADMINISTRATION	Berth 68	Bulk Cargoes (Cement)	Loading, Unloading						2,501		2,501	
		Berth 69-79	Liquid Bulk (crude oil, metanol, chemical liquids, etc.)	Loading, Unloading							36,000	36,000	
17	SNTFM	Berth 80-84	Bulk Cargoes (Coals, ores)	Loading, Unloading								0	
		Berth 107-112 & 113-118	General Cargoes (timber, ferrous/non-ferrous metal, etc.)	Loading, Unloading	652							652	
18	CPA RO-RO TERMINAL	Berth 113 & 114	Bulk Cargoes (grains)	Loading, Unloading								0	
		Berth 119A-119B	General Cargoes (meat, etc.)	Loading, Unloading		2,000						2,000	
19	MAST (Floating Operator)	Berth 120	General Cargoes	Loading, Unloading								0	
		Berth 120	General Cargoes	Loading, Unloading								0	
20	ARTS	Berth 124-125	Bulk Cargoes (cement, ores etc.)	Loading, Unloading								0	
		Berth 55	Grains (New Project)	Loading		250						250	
A	Total Cargo Handling Capacity				7,720	810	3,700	24,000	1,486	2,501	36,000	550	76,767
B	Cargo Demand Forecast (Case 2) - (2020)				3,760	5,120	3,500	10,920	470	660	15,540	250	36,210
C	Balance (A-B)				3,960	-4,310	200	13,080	1,016	1,841	20,460	300	40,557
	New Container Terminal (S2) - Phase 1												
	New Container Terminal (S2) - Phase 2,3												
	New Grain Terminal(S3) - Phase 1												
	New Grain Terminal(S3) - Phase 2												
	Edible Oil Terminal Relocation												350

Table 6.4.2-3 Issues on Existing Terminals and Improvement Scenario

No.	Cargo Handling	Berth	Port	Facilities	Issues on Existing Terminals	Improvement Scenario
11	General Cargoes	General Cargo Berth	North	Quay	Shallow(6.6-10.0m), up to medium size vessel	
				Site Area	Narrow, low efficiency	
				Equipment	Old-fashioned, average, low efficiency	To demolish in due order from the oldest one
				Capacity	Enough capacity against present cargo volume	
		Environment	None			
		South	Quay	Relatively shallow(10.7-12.1m), slightly difficult for large vessel		
			Site Area	Extensive		
			Equipment	Relatively new	To prolong life span by adequate preventive maintenance	
Capacity	Sufficient for present cargo volume					
12	Containerized Cargo	Exclusive Use Berth	North	Quay	Shallow(8.9m), up to medium size vessel	
				Site Area	Narrow, low efficiency(due to divert use from general cargo)	
				Equipment	Old-fashioned, average, low efficiency	In case of continuing operation, sufficient maintenance required
				Capacity	Less capacity against present cargo volume	In case of continuing operation, additional equipment required
		Environment	Not in particular			
		General Use Berth	North	Quay	Relatively shallow(11.9m), slightly difficult for large vessel	
				Site Area	Narrow, low efficiency(due to divert use from general cargo)	
				Equipment	No specialized container handling equipment.	In case of continuing operation, specific equipment required
Capacity	Less capacity against present cargo volume			In case of continuing operation, specific equipment required		
Environment	Not in particular					
13	Dry Bulk Cargo	Grain Berth	North	Quay	Shallow(6.7m), up to medium size vessel	
				Site Area	Narrow, low efficiency	
				Equipment	Old-fashioned, average, low efficiency	In case of continuing operation, equipment replacement required
				Capacity	Sufficient for present cargo volume	
		Environment	Insufficient for spill prevention, dust scatter prevention	In case of continuing operation, environment protection required		
		South	North	Quay	Relatively shallow(9.9-12.1m), slightly difficult for large vessel	
				Site Area	Extensive	
				Equipment	New	
				Capacity	Sufficient for present cargo volume	
		Environment	Well protecting			
		Iron Ore Berth	North	Quay	Deep water(9.0m, 13.2-18.2m), super size vessel berthing	
				Site Area	Extensive	
				Equipment	Relatively new	To prolong life span by adequate preventive maintenance
				Capacity	Sufficient for present cargo volume	
		Environment	Insufficient for spill prevention, dust scatter prevention	To improve environment protection		
		Non-Fe Ore Berth	North	Quay	Relatively shallow(9.7-10.1m), slightly difficult for large vessel	
Site Area	Extensive					
Equipment	Relatively new			To prolong life span by adequate preventive maintenance		
Capacity	Sufficient for present cargo volume					
Environment	Insufficient for spill prevention, dust scatter prevention	To improve environment protection				
Coal, Coke Berth	North	Quay	Relatively shallow(9.0m), slightly difficult for large vessel			
		Site Area	Extensive			
		Equipment	Relatively new	To prolong life span by adequate preventive maintenance		
		Capacity	Sufficient for present cargo volume			
Environment	Insufficient for spill prevention, dust scatter prevention	To improve environment protection				
Cement Berth	North	Quay	Relatively shallow(9.0-10.6m), slightly difficult for large vessel			
		Site Area	Relatively narrow			
		Equipment	Relatively new	To prolong life span by adequate preventive maintenance		
		Capacity	Sufficient for present cargo volume			
Environment	Insufficient for spill prevention, dust scatter prevention	To improve environment protection				
Fertilizer Berth	North	Quay	Relatively shallow(10.1m), slightly difficult for large vessel			
		Site Area	Relatively narrow			
		Equipment	Relatively new	To prolong life span by adequate preventive maintenance		
		Capacity	Sufficient for present cargo volume			
Environment	Insufficient for spill prevention, dust scatter prevention	To improve environment protection				
14	Liquid Bulk Cargo	Crude Oil Berth	North	Quay	Deep water(17.2m), super size vessel berthing, directly in front of the entering route to the North Port (dangerous)	To relocate to safer site (opposite side reclaimed land)
				Site Area	Extensive	
				Equipment	Relatively new	In case of continuing operation, sufficient maintenance required
				Capacity	Sufficient for present cargo volume	
		Environment	Insufficient for leakage	To improve environment protection		
		Fuel Oil Berth	North	Quay	Relatively shallow(10.3-12.3m), slightly difficult for large vessel	
				Site Area	Extensive	
				Equipment	Relatively new	To prolong life span by adequate preventive maintenance
				Capacity	Sufficient for present cargo volume	
		Environment	Insufficient for leakage	To improve environment protection		
		Chemical Products Berth	North	Quay	Relatively shallow(11.6m), slightly difficult for large vessel	
				Site Area	Extensive	
Equipment	Relatively new			To prolong life span by adequate preventive maintenance		
Capacity	Sufficient for present cargo volume					
Environment	Insufficient for leakage	To improve environment protection				
Edible Oil Berth	North	Quay	Shallow(7.6m), up to medium size vessel			
		Site Area	Relatively narrow			
		Equipment	Old-fashioned, average, low efficiency	In case of continuing operation, sufficient maintenance required		
		Capacity	Sufficient for present cargo volume			
Environment	Insufficient for leakage	To improve environment protection				
15	Inland Waterway	Barge Berth(waiting fleet formation)	South	Quay	Shortage of quay length(low efficiency of fleet formation)	To construct new barge berths
				Water Surface	Less preparation of guards against winds and waves	

6.4.3 Required Cargo Handling Equipment by Each Terminal

(1) Container Terminal

For the analysis of required cargo handling equipment, following reference data was prepared for review:

Figure 6.4.3-1-1, 2, 3 & 4 Cargo Flow Chart - Container Terminal

Table 6.4.3-1-1 Project Scale - Container Terminal

Table 6.4.3-1-2 Cargo Handling Equipment - Container Terminal

Table 6.4.3-1-3 Design Data taken from S2 Container Terminal

(1) Estimated Cost of Equipment

(2) Required Number of Quay Gantry Crane at S2 Container Terminal

(3) Required Number of Rubber Tired Gantry (RTG) Type Yard Cranes

(4) Required Number of Gantry (RMG) Type Railway Station Cranes

Table 6.4.3-1-4 Required Major Facilities and Construction Schedule of Container Terminal

(1) Container Ground Slot and Gantry Crane Calculation Sheet, Case 1

(2) Container Ground Slot and Gantry Crane Calculation Sheet, Case 2

(3) Container Terminal Construction Schedule

Figure 6.4.3-1 Cargo Flow Charts indicate the estimated cargo movement flow by volume and direction. Data cover the flows for Case 1 and Case 2 together with those at the target years, 2010 and 2020. Main input data are the traffic forecast data and estimated modal split by commodity. This is basic data to design the cargo handling equipment and yard arrangement. Based on the cargo volume forecast, container cargo flow and cargo handling equipment are studied.

Table 6.4.3-1-1 Project Scale indicates cargo volume in TEUs and number and type of cargo handling equipment.

Table 6.4.3-1-2 Cargo Handling Equipment shows the contents of major cargo handling equipment of new container terminal.

Table 6.4.3-1-3 (1) Estimated Cost of Equipment indicates the procurement schedule and cost data taken from the design data of S2 Container Terminal.

Table 6.4.3-1-4 (1) indicates the required ground slots and quay gantry cranes for the Case 1.

Table 6.4.3-1-4 (2) indicates the same for the Case 2.

Table 6.4.3-1-4 (3) shows the possible construction of civil facilities and equipment procurement schedule for Case 1 and Case 2.

Based on these data, required cargo handling equipment for the container terminal is estimated. According to these data, total seven (in case of “Case 1”) or total six (in case of “Case 2”) quay gantry cranes, “Post-PANAMAX” type, will be required up to the year of 2020.

Considering competitive operation by plural terminal operators, provision of at least two (2) independent terminals is recommendable.

For implementing these works, two alternative plan were developed for selection.

Plan A: To meet with Case 1 requirement

- i. On-going “S2 West Container Terminal”: 4 quay gantry cranes (future stage maximum : 6 cranes)
- ii. Additional new “S2 East Container Terminal”: 3 quay gantry cranes (future stage maximum : 6 cranes)

Plan B: To meet with Case 2 requirement

- i. On-going “S2 West Container Terminal”: 3 quay gantry cranes (future stage maximum: 6 cranes)
- ii. Additional new “S2 East Container Terminal”: 3 quay gantry cranes (future stage maximum: 6 cranes)

For implementing these works, a layout of two terminals, S2-West and S2-East is proposed.

Figure 6.4.3-1-1 Cargo Flow Chart - Container Terminal - Case 1 - 2010

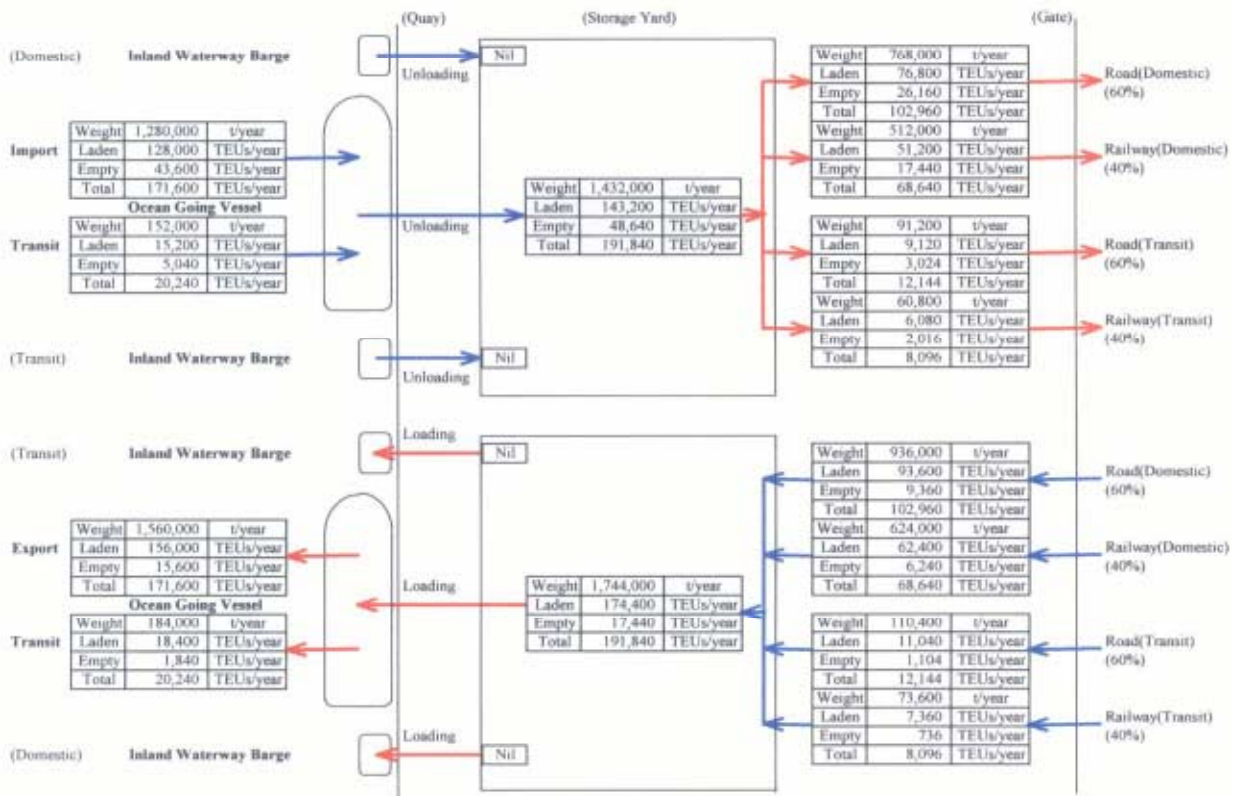


Figure 6.4.3-1-2 Cargo Flow Chart - Container Terminal - Case 1 - 2020

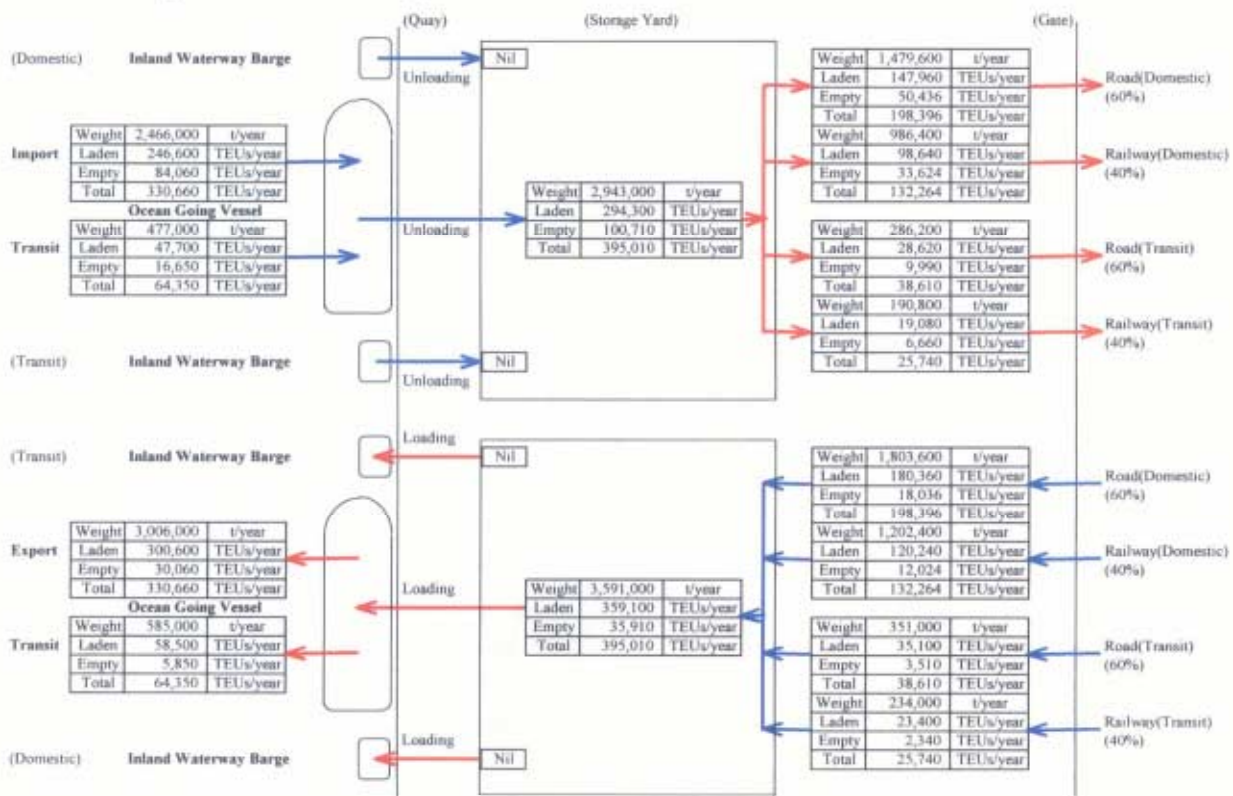


Figure 6.4.3-1-3 Cargo Flow Chart - Container Terminal - Case 2 - 2010

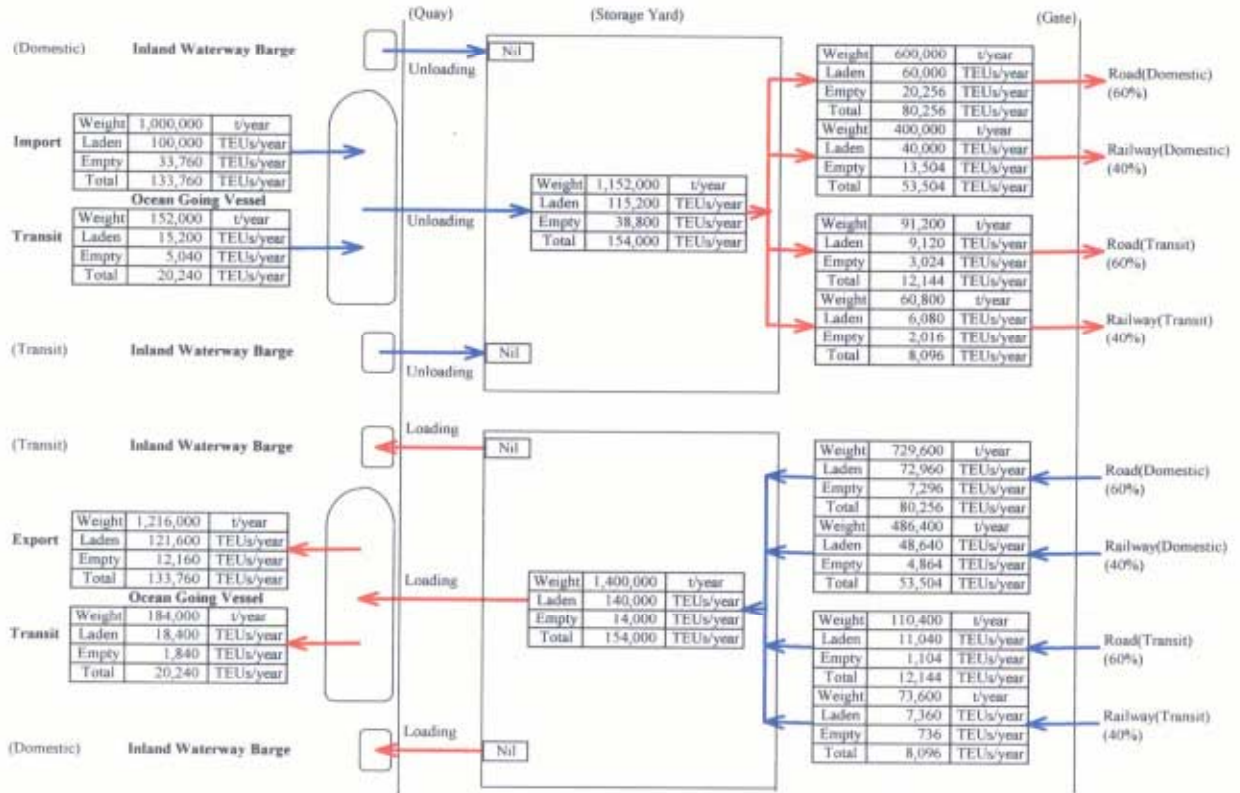


Figure 6.4.3-1-4 Cargo Flow Chart - Container Terminal - Case 2 - 2020

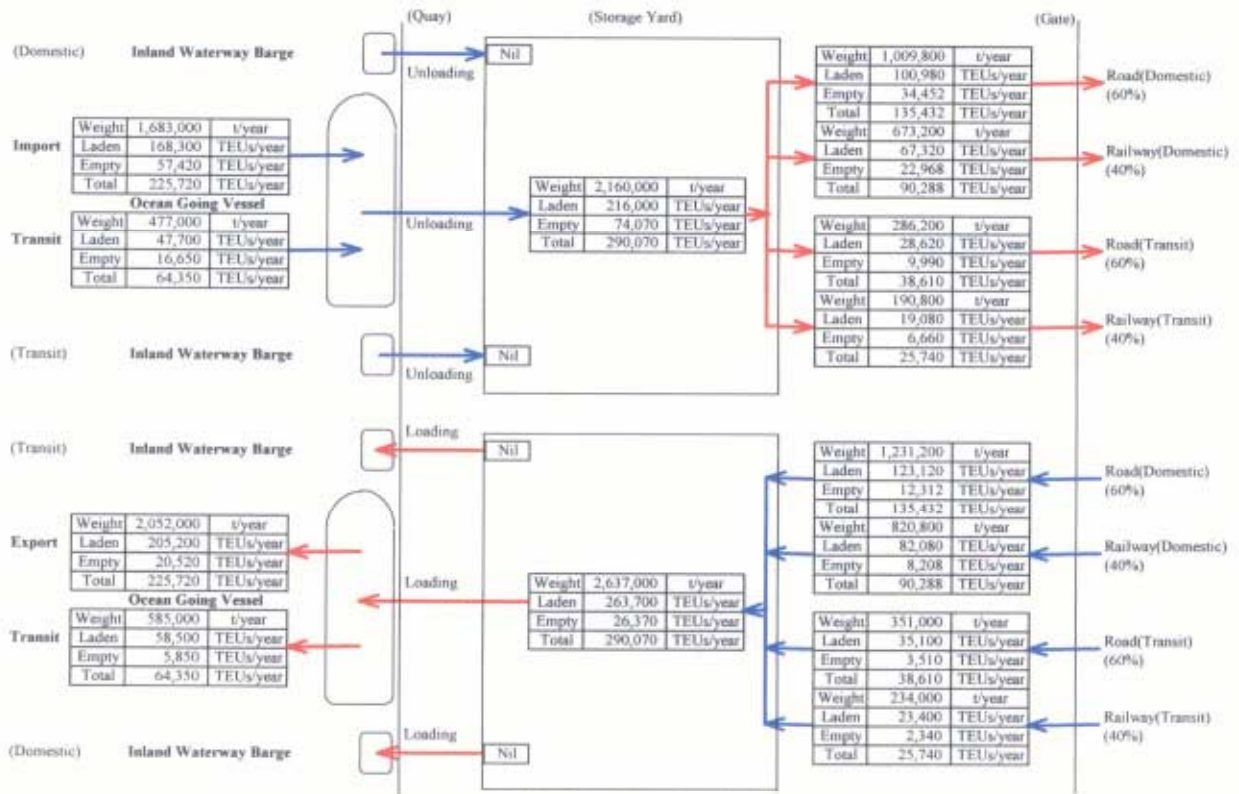


Table 6.4.3-1-1 Project Scale - Container Terminal

Cargo Volume to be Handled:

Operation	Category	Case 1				Case 2			
		2010		2020		2010		2020	
		Volume	unit	Volume	unit	Volume	unit	Volume	unit
Loading	Trade	171,600	TEUs/year	330,660	TEUs/year	133,760	TEUs/year	225,720	TEUs/year
	Transit	20,240	TEUs/year	64,350	TEUs/year	20,240	TEUs/year	64,350	TEUs/year
	Total	191,840	TEUs/year	395,010	TEUs/year	154,000	TEUs/year	290,070	TEUs/year
Unloading	Trade	171,600	TEUs/year	330,660	TEUs/year	133,760	TEUs/year	225,720	TEUs/year
	Transit	20,240	TEUs/year	64,350	TEUs/year	20,240	TEUs/year	64,350	TEUs/year
	Total	191,840	TEUs/year	395,010	TEUs/year	154,000	TEUs/year	290,070	TEUs/year
Total	TEU	383,680	TEUs/year	790,020	TEUs/year	308,000	TEUs/year	580,140	TEUs/year

Required Number of Quay Gantry Crane:

Phase	Year	Case 1				Case 2			
		Volume TEUs/year	Number of Crane			Volume TEUs/year	Number of Crane		
			S2-West	S2-East	Total		S2-West	S2-East	Total
Phase 1	2004-20010	383,680	4(*3)	0	4(*3)	308,000	3	0	3
Phase 2	2011-2015	559,100	4	2	6	409,500	3	2	5
Phase 3	2016-2020	790,020	4	3	7	580,140	3	3	6

(*3): Up to 2008

Table 6.4.3-1-2 Cargo Handling Equipment - Container Terminal

Phase	Year	No.	System	Equipment	No. x Capacity	Remarks	Case 1		Case 2	
							S2-West	S2-East	S2-West	S2-East
1	2005-2010	01	Quay Container Handling	Quay Gantry Crane	3 x (41t x 30.5m)	Post PANAMAX Type	4(*3)	0	3	0
		02	Stacking Yard Container Handling	Rubber Tired Gantry Crane	8 x (41t x 23.5m)	(6+1) Rows x (4+1) Tiers	8	0	8	0
		03	Railway Terminal Container Handling	Rail Mounted Gantry Crane	2 x (41t x 32m)	(2+1) Tiers	2	0	2	0
		04	Transportation	Trailer (Tractor Head + Chassis)	18 x (2 x 20ft/1 x 40ft)		34	0	34	0
		05	Container Freight Station (CFS) Serv	Fork Lift Truck	5 x (1t x 0.5m)	Electric Driven	5	0	5	0
		06	Maintenance Service	Fork Lift Truck	2 x (3t x 0.5m)	Diesel Driven	2	0	2	0
		07	General Service	Reach Stacker	1 x (31t x 4m x 4 high)		1	0	1	0
		08	Empty Container Handling	Side Spreader Lift Truck	2 x (4.5t x 5 high)		2	0	2	0
2	2011-2015	01	Quay Container Handling	Quay Gantry Crane	3 x (41t x 30.5m)	Post PANAMAX Type	4	2	3	2
		02	Stacking Yard Container Handling	Rubber Tired Gantry Crane	8 x (41t x 23.5m)	(6+1) Rows x (4+1) Tiers	10	6	8	6
		03	Railway Terminal Container Handling	Rail Mounted Gantry Crane	2 x (41t x 32m)	(2+1) Tiers	2	2	2	2
		04	Transportation	Trailer (Tractor Head + Chassis)	18 x (2 x 20ft/1 x 40ft)		45	12	34	12
		05	Container Freight Station (CFS) Serv	Fork Lift Truck	5 x (1t x 0.5m)	Electric Driven	5	3	5	3
		06	Maintenance Service	Fork Lift Truck	2 x (3t x 0.5m)	Diesel Driven	2	1	2	1
		07	General Service	Reach Stacker	1 x (31t x 4m x 4 high)		1	1	1	1
		08	Empty Container Handling	Side Spreader Lift Truck	2 x (4.5t x 5 high)		2	1	2	1
3	2016-2020	01	Quay Container Handling	Quay Gantry Crane	3 x (41t x 30.5m)	Post PANAMAX Type	4	3	3	3
		02	Stacking Yard Container Handling	Rubber Tired Gantry Crane	8 x (41t x 23.5m)	(6+1) Rows x (4+1) Tiers	10	8	8	8
		03	Railway Terminal Container Handling	Rail Mounted Gantry Crane	2 x (41t x 32m)	(2+1) Tiers	2	2	2	2
		04	Transportation	Trailer (Tractor Head + Chassis)	18 x (2 x 20ft/1 x 40ft)		45	18	34	18
		05	Container Freight Station (CFS) Serv	Fork Lift Truck	5 x (1t x 0.5m)	Electric Driven	5	5	5	5
		06	Maintenance Service	Fork Lift Truck	2 x (3t x 0.5m)	Diesel Driven	2	2	2	2
		07	General Service	Reach Stacker	1 x (31t x 4m x 4 high)		1	1	1	1
		08	Empty Container Handling	Side Spreader Lift Truck	2 x (4.5t x 5 high)		2	2	2	2

(*3): Up to 2008

Table 6.4.3-1-3 (2)

Required Number of Quay Gantry Crane at S2 Container Terminal - 1/2
(Design Data taken from S2 Container Terminal)

Annual container handling capacity of the Gantry Type Quay Cranes is calculated by adopting the following formula:

$$Q_b = N_q \times P_q \times H_w \times D_w \times R_b \times R_w \times R_h \times R_e$$

The results of the calculation are shown on the table below:

S2 - West Side (Continuous 2 Berths)

Marks	Descriptions	Units	Case 1-1	Case 1-2	Case 1-3	Remarks
Nq	Number of quay cranes	sets	2	3	4	
Nb	Number of berth	-	2	2	2	
Pqt	Theoret'l ave. productivity of crane	boxes/hour	32	32	32	For Post-PANAMAX size container vessel
Hw	Working hours per day	hours/day	22	22	22	
Dw	Working days per year	days/year	355	355	355	Subtracted holidays
Rb	Berth occupancy ratio	-	0.5	0.5	0.5	Nb=1:0.4, Nb=2:0.5, Nb=3:0.55
Rw	Crane working hour ratio	-	0.90	0.90	0.91	working hour/berthing hour
Rh	Cargo handling hour ratio	-	0.70	0.70	0.72	handling hour/working hour
Pqn	Nominal ave. productivity of crane	boxes/hour	20	20	21	Pqn = Pqt x Rw x Rh
Re	Crane effectiveness factor	-	1	0.9	0.9	Nc/Nb=1:1, Nc/Nb=2:0.9, Nc/Nb=3:0.8
Qb	Annual container handling capacity	boxes/year	157,450	212,557	294,746	
Note	Year		-	2008	2011	
	Cargo movement forecast	boxes/year	-	206,100	272,100	

S2 - East Side

Marks	Descriptions	Units	Case 3-1	Case 3-2	Case 3-3	Remarks
Nq	Number of quay cranes	sets	2	3	4	
Nb	Number of berth	-	1	2	2	
Pqt	Theoret'l ave. productivity of crane	boxes/hour	32	32	32	For Post-PANAMAX size container vessel
Hw	Working hours per day	hours/day	22	22	22	
Dw	Working days per year	days/year	355	355	355	Subtracted holidays
Rb	Berth occupancy ratio	-	0.4	0.5	0.5	Nb=1:0.4, Nb=2:0.5, Nb=3:0.55
Rw	Crane working hour ratio	-	0.90	0.90	0.91	working hour/berthing hour
Rh	Cargo handling hour ratio	-	0.70	0.70	0.72	handling hour/working hour
Pqn	Nominal ave. productivity of crane	boxes/hour	20	20	21	Pqn = Pqt x Rw x Rh
Re	Crane effectiveness factor	-	1.0	0.9	0.9	Nc/Nb=1:1, Nc/Nb=2:0.9, Nc/Nb=3:0.8
Qb	Annual container handling capacity	boxes/year	125,960	212,557	294,746	
Note	Year		-	-	-	
	Cargo movement forecast	boxes/year	-	-	-	

Table 6.4.3-1-3 (2)

Required Number of Quay Gantry Crane at S2 Container Terminal - 2/2
(Design Data taken from S2 Container Terminal)

No.	Descriptions	Units	S2-West	S2-East	Total	Case 1			Case 2		
-	Target Year	Year				'04-'10	'11-'15	'16-'20	'04-'10	'11-'15	'16-'20
-	Cargo Movement	TEUs/year				383,680	559,100	790,020	308,000	409,500	580,140
1	Number of quay crane	sets	3	0	3						
	Annual container handling capacity	boxes/year	212,557	0	212,557				X		
		TEUs/year			340,091	(X)					
2	Number of quay crane	sets	3	2	5						
	Annual container handling capacity	boxes/year	212,557	125,960	338,517					X	
		TEUs/year			541,627						
3	Number of quay crane	sets	3	3	6						
	Annual container handling capacity	boxes/year	212,557	212,557	425,114						
		TEUs/year			680,182						X
4	Number of quay crane	sets	4	0	4						
	Annual container handling capacity	boxes/year	294,746	0	294,746						
		TEUs/year			471,594	X					
5	Number of quay crane	sets	4	2	6						
	Annual container handling capacity	boxes/year	294,746	125,960	420,706						
		TEUs/year			673,130		X				
6	Number of quay crane	sets	4	3	7						
	Annual container handling capacity	boxes/year	294,746	212,557	507,303						
		TEUs/year			811,685			X			

Table 6.4.3-1-3 (3)
Required Number of Rubber Tired Gantry (RTG) Type Yard Cranes - 1/4
 ((6+1)Rows x (4+1)Tier Type)
 (Design Data taken from S2 Container Terminal)

1. Category of the Crane Operation:

There are two(2) major categories of container handling operation at the laden container stacking yard:

(1) Sea-side Operation: To/from apron

(2) Land-side Operation: To/from the railway station and outside of the terminal through the terminal gate.

2. Required Number of the Cranes - 1/4:

Required number of the Yard Cranes is calculated by adopting the following formula:

(1) Sea-side Operation: To/from apron (To be adequate for the Quay Crane Productivity)

$$N_{ys} = (P_q \times N_q) / P_y$$

The results of the calculation are shown on the table below:

Case-1 (2 Berths)

Marks	Descriptions	Units	Case 1-1	Case 1-2	Case 1-3	Remarks
Pya	Theoret'l ave. Y crane productivity	boxes/hour	30	30	30	
Pqa	Theoret'l ave. Q crane productivity	boxes/hour	32	32	32	Average cycle path of quay crane*
Nq	Number of Q crane	sets	2	3	4	
Nysa	Total number of Y crane(for Pqa)	sets	2.1	3.2	4.3	
	say	sets	2	3	4	At average cycle path of quay crane*
Pym	Theoret'l min. Y crane productivity	boxes/hour	22	22	22	Longest cycle path of yard crane
Pqm	Theoret'l max. Q crane productivity	boxes/hour	45	45	45	Shortest cycle path of quay crane*
Nq	Number of Q crane	sets	2	3	4	
Nysm	Total number of Y crane(for Pqm)	sets	4.1	6.1	8.2	
	say	sets	4	6	8	At shortest cycle path of quay crane*

Note* For Post-PANAMAX size container vessel

Case-2 (3 Berths)

Marks	Descriptions	Units	Case 2-1	Case 2-2	Case 2-3	Remarks
Pya	Theoret'l ave. Y crane productivity	boxes/hour	30	30	30	
Pqa	Theoret'l ave. Q crane productivity	boxes/hour	32	32	32	Average cycle path of quay crane*
Nq	Number of Q crane	sets	5	6	7	
Nysa	Total number of Y crane(for Pqa)	sets	5.3	6.4	7.5	
	say	sets	5	6	7	At average cycle path of quay crane*
Pym	Theoret'l min. Y crane productivity	boxes/hour	22	22	22	Longest cycle path of yard crane
Pqm	Theoret'l max. Q crane productivity	boxes/hour	45	45	45	Shortest cycle path of quay crane*
Nq	Number of Q crane	sets	5	6	7	
Nysm	Total number of Y crane(for Pqm)	sets	10.2	12.3	14.3	
	say	sets	10	12	14	At shortest cycle path of quay crane*

Note* For Post-PANAMAX size container vessel

Table 6.4.3-1-3 (3)
Required Number of Rubber Tired Gantry (RTG) Type Yard Cranes - 2/4
 ((6+1)Rows x (4+1)Tier Type)
 (Design Data taken from S2 Container Terminal)

2. Required Number of the Cranes - 2/4:

Required number of the Yard Cranes is calculated by adopting the following formula:

(2) Land-side Operation: To/from the railway station and outside of the terminal through the terminal gate. - 1/2

$$Nyl = (Qy \times Rp \times Th) / (Py \times Ra \times Dw \times Hw \times Rw \times Rh)$$

The results of the calculation are shown on the table below:

Case-1 (2 Berths)

Marks	Descriptions	Units	-	2008	2011	Remarks
Qid	Import dry container quantity	boxes/year	-	79,600	101,400	
Qir	Import reefer container quantity	boxes/year	-	1,500	1,900	
Qie	Import empty container quantity	boxes/year	-	11,000	14,100	
Qit	Import transit container quantity	boxes/year	-	4,400	7,400	
Qis	Import tranship container quantity	boxes/year	-	4,500	7,600	
Qiy	Total import container quantity	boxes/year	-	101,000	132,400	
Rp	Peak ratio	-	-	1.25	1.25	
Thi	Average handling times	-	-	1.8	1.8	Including container rehandling*
Py	Yard crane productivity(average)	boxes/hour	-	32	32	
Ra	Crane availability ratio	-	-	1	1	
Dw	Working days per year	days/year	-	345	345	Subtracted holidays, maintenance, etc.
Hw	Working hours per days	hours/day	-	22	22	
Rw	Crane working hour ratio	-	-	0.90	0.91	
Rh	Cargo handling hour ratio	-	-	0.70	0.72	
Nyli	Number of yard crane for import	units	-	1.5	1.9	
Qed	Export dry container quantity	boxes/year	-	65,900	84,000	
Qer	Export reefer container quantity	boxes/year	-	400	500	
Qee	Export empty container quantity	boxes/year	-	25,800	32,900	
Qet	Export transit container quantity	boxes/year	-	4,400	7,400	
Qes	Export tranship container quantity	boxes/year	-	4,500	7,600	
Qey	Total export container quantity	boxes/year	-	101,000	132,400	
Rp	Peak ratio	-	-	1.25	1.25	
The	Average handling times	-	-	1	1	Including container rehandling**
Py	Yard crane productivity(average)	boxes/hour	-	32	32	
Ra	Crane availability ratio	-	-	1	1	
Dw	Working days per year	days/year	-	345	345	Subtracted holidays, maintenance, etc.
Hw	Working hours per days	hours/day	-	22	22	
Rw	Crane working hour ratio	-	-	0.90	0.91	
Rh	Cargo handling hour ratio	-	-	0.70	0.72	
Nyle	Number of yard crane for export	units	-	0.8	1.0	
Nyl	Total number of yard crane	units	-	2.3	2.9	Including cranes for import & export
	say	units	-	3	3	

Note*: Container stacking height(average): 2.5, first come first serve service

** : Container stacking height(average): 3.0, as per vessel loading plan