JICA JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
BRAZILIAN COOPERATION AGENCY (ABC), MINISTRY OF EXTERNAL RELATION
SEPLAN-PLANNING AND COORDINATION SECRETARIAT OF STATE OF CEARA (CEARÁPORTOS)
SDE-STATE SECRETARIAT OF ECONOMIC DEVELOPMENT (CIPP/GTP)
SEINFRA-INFRASTRUCTURE SECRETARIAT OF STATE OF CEARA

No.

PECEM INDUSTRIAL AND PORT COMPLEX DEVELOPMENT PLAN IN THE FEDERATIVE REPUBLIC OF BRAZIL

FINAL REPORT

VOLUME II

MARCH 2006

INTERNATIONAL DEVELOPMENT SYSTEM Inc. (IDS)
NIPPON KOEI Co., Ltd. (NK)

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FOR

THE STUDY

ON

PECEM INDUSTRIAL AND PORT COMPLEX DEVELOPMENT PLAN

IN

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PREFACE

In response to a request from the Government of the Federative Republic of Brazil, the Government of Japan decided to conduct a study on Pecem Industrial and Port Complex Development Plan and entrusted to the study to the Japan International Cooperation Agency (JICA).

JICA selected and dispatched a study team headed by Mr. Kobune of International Development System Inc. and consists of International Development System Inc. and Nippon Koei Co., LTD. between February, 2005 and March, 2006.

The team held discussions with the officials concerned of the Government of the Federative Republic of Brazil and conducted field surveys at the study area. Upon returning to Japan, the team conducted further studies and prepared this final report.

I hope that this report will contribute to the promotion of this project and to the enhancement of friendly relationship between our two countries.

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of the Federative Republic of Brazil for their close cooperation extended to the study.

March 2006

KAZUHISA MATSUOKA,
Deputy Vice President
Japan International Cooperation Agency

LETTER OF TRANSMITTAL

March 2006

Mr. Kazuhisa MATSUOKA
Deputy Vice President
Japan International Cooperation Agency

Dear Mr. MATSUOKA,

It is my great pleasure to submit herewith the Final Report of "Pecem Industrial and Port Complex Development Plan in the Federative Republic of Brazil".

The Study Team comprised of International Development System Inc. and Nippon Koei Co., Ltd. conducted studies in the Federative Republic of Brazil over the period between February 2005 and March 2006 according to the contract with the Japan International Cooperation Agency (JICA).

The Study Team compiled this report, which proposes the long-term development plan to the target year 2022, the short-term development plan to the target year 2012 and the strategic port management and operation plan for Pecem Port, through close consultations with officials of the Federal Government, Ceara State Government and other authorities concerned.

On behalf of the Study Team, I would like to express my sincere appreciation to the Federal Government, Ceara State Government and other authorities concerned for their cooperation, assistance, and heartfelt hospitality extended to the Study Team.

We are also very grateful to the Japan International Cooperation Agency, the Ministry of Foreign Affairs, the Ministry of Land, Infrastructure and Transport, and Embassy of Japan in the Federative Republic of Brazil for valuable suggestions and assistance during the course of the Study.

Yours faithfully,

Koji KOBUNE,
Team Leader
Pecem Industrial and Port Complex Development Plan
in the Federative Republic of Brazil

Location Map of the Study Port

Pecem Port and its Surroundings

Abbreviation

AAE	Strategic Environment Evaluation
ABC	Brazil Cooperation Agency
ABRATEC	Brazil Association of Public use Container Terminal
AL	Alagoas
AM	Amazonas
ANTAQ	National Agency of Waterway Transport
ANTT	National Terresrial Transport Agency
AP	Amapá
ASEAN	Association of Southeast Asian Nations
ASSFAP	Pecem´s Families Association
Av.	Average
B/C	Benefit/Cost
b/d	barrels/day
B/water	Breakwater
BA	Bahia
BACTSSA	buenos aires container terminal services S.A.
BEC	State Bank of Ceara
BNB	Bank of Northeast of Brazil
BNDES	National Bank of Development
BOI	Board of Investment
BR-xxx	Designation of Brazilian federal highway
C.Y.	Container Yard
C/S	Central/South
c1	Type of Petroleum Chemical Product
c2+	Type of Petroleum Chemical Product
C3	Type of Petroleum Chemical Product
C4	Crude Gasoline
C5+	Type of Petroleum Chemical Product
CAGECE	Water and Sewer System Company of Ceara
Cap	Capita
CCT	Colon Container Terminal
CE	Ceará
CE xxx	Ceara State highway
CEDIN	State Industrial Development Board
CEGAS	Ceara Gas Company
CFN	Companhia Ferroviária do Nordeste
CFS	Container Freight Station
CFSL	Conversion Factor for Skilled Labor
CFUL	Conversion Factor for Unskilled Labor
CGTF	Thermoelectric generated energy Plant of Fortaleza
CHESF	Hydroelectric Company of São Francisco River
CIF	Cargo, Insurance and Freight
CIPP	Pecem Industrial Port Complex
CIS	Commonwealth of Independent States
CMA CGM	Compagnie Maritime d'Affrètement & Compagnie Générale Maritime
CNT	National Transport Confederation
COELCE	Ceara Electric Company
COEMA	State Environment Council

COGERH	Hydrologic Resources General Company
CONAMA	National Environment Council
CRAS	Reference Center for Social Assistance
CSX-WT	CSX World terminals
CTO	Ceara Terminal Operator
CVM	Valores Formuladaturs' Commission
CVRD	Companhia Vale do Rio Doce
CVT	Technological Training Center
DECON	Consumer Rights Department
deg	Degree
DERT	State Highway Department
DHN	Bureau of Hydrolgeology and Navigation
DNER	National Transport Infrastructure Department
DNIT	National Transport Infrastructure Department
DRI	Direct Reduced Iron
DWT	Dead Weight Tonnage
E	East
EAS	Simplified Environmental Study
EDI	Electronic Data Interchange
EIA	Environmental Impact Study
EIRR	Economic Intern Return Rate
EMBRAPA	Brazilian Livestock and Agriculture Company
ENE	East-North-East
EPZ	Environment Protection Zone
ES	Espirito Santo
ESE	East-South-East
EVA	Environmental Viability Study
F/D	Floating Dock
FAO	Food and Agriculture Organization
FDI	Industrial Development Fund
FIEC	Federation of the Industries of Ceara State
Fig.	Figure
FINOR	Fund of Investment of Northeast Region
FIRR	Financial Intern Return Rate
FMR	Fortaleza Metropolitan Region
FOB	Free On Board
FUNCEME	Ceara State Foundation of Meteorology and Hydrologic Resources
GASFOR	Gas Pipeline
GDP	Gross Domestic Production
Gis	Geographic Information System
GL	Ground Level
GM	Metacenter to the Center of Gravity
GRT	Gross Registered Tonnage
GTP	Participative Group of Work
GW	Gigawatt
GWT	Gross Weight Tonnage
H	Height
H/Hi	Wave height at point of interest over incident Wave height ratio
há	Hectare
HHWL	Highest High Water Level

HP	Horsepower
Hs	Wave Height
HWL	High Water Level
Hz	Hertz
IALA	International Association of Lighthouse Authorities
IBAMA	Brazilian Institute of Environment and Renewable Natural Resources
IBGE	Brazilian Institute of Geography and Statistics
ICMS	Brazilian Excise Tax
ICTSI	International Container Terminal Services Inc.
IDACE	Institute of Rural Development of Ceara
IDB	Inter-American Development Bank
IDM	Municipality Development Index
IDS	International Development System
IEE	Initial Environment Evaluation
IMO	International Maritime Organization
INEMET	National Institute of Meteorology
INPH	National Institute of hydrologic Research
IPECE	Institute of Economic Research of Ceara State
IR	Infrared
ISPS	International Ship and Port Facility Security
J2	Jota Dois
JICA	Japan International Cooperation Agency
Kd	Stability Coefficient
Kg	Kilogram
KN	KiloNewton
kV	kilovolt
KWh	Kilowatt/hour
Kxx	Radius of Gyration
Lat	Latitude
LI	License of Installation
LLDPE	Linear Low Density Polyethylene
LLWL	Lowest Low Water Level
LNG	Liquefied Natural Gas
LO	License of Operation
LOA	Length Over All
Long	Longitude
LP	Previous License
LPG	Liquefied Petroleum Gas
LS	Lump sum
LT	Lifting Tonnage
LWL	Low Water Level
m	Meter
m/s	meter/second
m^3	Cubic meter
MA	Maranhão
Max	Maximum
MDF	Medium Density Fiber
MG	Minas Gerais
MHWN	Mean Higher High Water Neap
MHWS	Mean Higher High Water Spring

MISC	Miscellaneous
MIT	Puerto manzanillo International Terminal
MLWN	Mean Lower Low Water Neap
MLWS	Mean Lower Low Water Springs
mm/ye	millimeter/year
MMA	Ministry of Environment
MMBTU	Million British Thermal Units
MOL	Mitsui O.S.K. Lines, Ltd
MS	Mato Grosso do Sul
MSL	Mean Sea Level
MT	Mato Grosso
MTC	Manzanillo International Container terminal
MTI	Ministry of Trade and Industry
MW	Megawatt
N	Newton
N/A	Not available
NAVIS	Navy Automated Video Information System
NE	North-East
NGO	Non-Governmental Organization
NK	Nippon Koei
NNE	North-North-East
NNW	North-North-West
NPV	Net Present Value
Nqgc	Number of Quay side Gantry Crane
Nr	Number
Nrtg	Number of Rubber Tyred Gantry Crane
Ns	Stability Number
NUTEC	Industrial Technology Center
NVOCC	Non-Vessel Operating Common Carrier
NW	North-West
O&M	Operations & Maintenance
OOCL	Orient Overseas Container Line
P&O	Peninsular & Oriental (shipping company)
PA	Pará
PAIF	National Plan for Family Assistance
PB	Parnaíba
PCA	Environmental Control Plan
PDR	Rational deforestation Plan
PE	Pernambuco
PET	Polyethylene Terephthalate
PI	Piauí
PIANC	Permanent International Association of Navigation Congresses
PMF	Forest Management Plan
PP	Polypropylene
PPA	Pluriannual Plan
Pqgs	Productivity of Quay side Gantry crane
PR	Paraná
PRAD	Plan of Recovery of Degraded Areas
PROARES	Social Reforms Support for Children and Adolescent Development Program
PROVIN	Industrial Development Incentive Program

Prtg	Productivity of Rubber-Tyred Gantry crane
PS&D	Production, Supply & Distribution
PU	Polyurethane
PVC	Polyvinyl Chloride
QSGC	Quay Side Gantry Crane
R$	Brazilian Real
RAA	Environmental Consulting Report
RAS	Simplified Environmental Report
RCA	Environmental Control and Monitoring Report
Re	Brazilian Real
Rec	Recession
REFAP	Refinery Alberto Pasqualini
RIMA	Environmental Impact Report
RJ	Rio de Janeiro
RLAM	Refinery Landulpho Alves/Mataripe
RMF	Metropolitan Region of Fortaleza
RMG	Rail-Mounted Gantry crane
RN	Rio Grande do Norte
RO	Roráima
RO/RO	Roll on/Roll off
RPBC	Refinery President Bernades/Cubatão
RS	Rio Grande do Sul
RTG	Rubber-Tyred Gantry crane
S	South
S.B.R.	Styrene Butadiene Rubber
Samp	Sample
SBF	Secretariat of Forest and Biological Diversity
SC	Santa Catarina
SCA	Secretariat of Amazon Coordination
SCF	Standard Conversion Factor
SDE	Secretariat of Economic Development
SE	Sergipe
SE	South-East
SEBRAE	Brazilian Support Service for micro and small companies
SECULT	Secretariat of Culture
SEINFRA	Secretariat of Infrastructure
SEMACE	Secretariat of environment of Ceara
SENAC	National Service of trade training
SEPLAN	Secretariat of Planning and coordination
SESC	Trade Social Service
SINE	National employment System
SOMA	State Secretariat General of Environment
SP	São Paulo
sq.m	Square Meter
SQA	Quality in the Human Settlement
SRH	Secretariat of Water Resources
SSA	Stevedore Service of America
SSE	South-South-East
SSW	South-South-West
SUDENE	Superintendency of Development of Northeast Region

SW	South-West
TECON	Container Company S.A. (Terminal de Contêineres S.A.)
TEP	Temporary jetty
TEU	Twenty-foot equivalent unit
TOR	Terms of reference
Tp	Wave Period
TP&E	Tarcísio Pinheiros & Economistas
TPA	Third Party Administrator
Troll	Natural Period of Rolling of the Waves
TWH	Terawatt/hour
Tz	Mean Wave Period
U	Wind speed
U.S.A.	United States of America
UFC	Federal University of Ceara
ULCV	Ultra Large Container Vessel
US	United States (of America)
US$	US Dollar
USBC	United States Border Control
USC	Ceara Steel Factory
USDA	United States Department of Agriculture
UVA	University of Vale do Acaraú
V	Volt
VAT	Value Added Tax
Vb	Lump Sum
Vel	Velocity
VSL	Vessel
VTMS	Vessel Traffic Management Services
WNW	West-North-West
WSW	West-South-West
YB	Year Book
ZPMC	Shanghai Zhenhua Port Machinery Co., Ltd.

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CHAPTER 6 LONG-TERM DEVELOPMENT PLAN OF PECEM PORT

6.1 Port Capacity Analysis

6.1.1 Methodology

(1) General

Based on the basic concept mentioned in Section 4.3 of Chapter 4 and the results of the demand forecast shown in Chapter 5, the Long-Term Development Plan has been made through the port capacity analysis using a computer simulation model. The computer simulation reveals the complicated movements of cargoes and their transport means comprising vessels, railway cars and trucks within the Port as outlined in Figure 6.1.1. The results of the simulation have been used to estimate the following scales of the port facilities that will be needed to meet the future demand to the Port.

- The required number of berths
- Required storage areas
- The number of lanes of the port access road and the port road
- The number of siding lines diverted from the principal railway lines
- The required access channel lanes (one-way or two-way)

To estimate the optimum number of berths and access channel lanes, in the first step of the simulation, initial numbers of berths and channel lanes (two-way or one-way) are given and it is examined through the simulation whether the seaside port capacity is sufficient or reaches saturation. If reaching saturation, the incremental numbers of berths and/or channel lanes are added to increase the seaside capacity and then the simulation is repeated until the port reaches adequate capacity without excessive port congestion.

On the contrary, if it is judged that the given berths are excessively unused and/or channel lanes (in case of two-way), the initial numbers of berths and/or channel lanes are reduced (in case of channel, from two-way to one way) and then the simulation is repeated until the port reaches adequate capacity without excessively unused conditions.

(2) Seaside Capacity

The seaside capacity is determined by the combination of the capacities of access channel and berths. An auspice of saturation in the seaside capacity is found in a sharp increase in the number of ships waiting offshore. The shortage of capacity in specified berths with high berth occupancy rate causes offshore ship waiting in vessels using these berths. On the other hand, the shortage of access channel capacity also causes offshore waiting but this is incurred by all calling ships. The resulting figures of the simulation reveal causes of seaside saturation.

As to the seaside capacity, there are two categories. One is the capacity adequate to keep a service level for a calling vessel at a port that is expressed as the percentage of an offshore waiting time to a turnaround time from arrival to departure of a vessel at a port (hereinafter referred to as “the adequate seaside capacity”). The figure of 10% is

generally used as the service level, and in this study the figure has been used as a criterion to determine the seaside capacity.

The other is the capacity that enables a port to maximize the number of vessels receivable at berths during a certain period (one year), in which offshore ship waiting is on the verge of unstable conditions indicating an auspice of a sharp increase in waiting times (hereinafter referred to as "the absolute seaside capacity").

The following conditions of the simulation related to the seaside capacity have been used:

Access channel

It is assumed that the existing off-shore anchorage and the access channel to the existing port will be kept intact and a new one-way access channel to the expanded port area will be created (see Figure 6.3.1).

Berths

The berth conditions as shown in Table 6.1.1 has been used. .

Shore cranes

Loading/unloading capacities of the existing shore cranes on Pier No.1 in the existing port area have been used. In addition, the following new shore cranes are planned to be installed:

- Container gantry cranes in the expanded port area
- Grain loaders/unloaders in the existing port area

Vessel arrival pattern

In case of liners of container ships, regular schedules referring to the present schedule by shipping routes have been used. On the other hand, in case of trampers, a random arrival pattern has been applied.

(3) Landside Capacity

On the other hand, as to the landside capacity, the capacities of storage and railway access have been assumed to be limitless in the simulation. In the case of the storage capacity, the resulting figure of the maximum storage volume at a peaking condition in the simulation period (one year) has been used to estimate required storage capacities in each cargo item. In case of container-stacking where the required stacking capacity exceeds the existing capacity, the expansion of container stacking yard has been planned at the reserved area adjacent to the existing yard. .

In the case of the railway access capacity, the resulting figure of the maximum traffic volume at a peaking condition in the simulation period has been used to plan new siding railways to be connected to the principal railway line of CFN.

As to cargo train arrival pattern in case of outbound cargo, it has been assumed that a train would start to bring specified cargo into the port storage before a certain period from an arrival date of a vessel to stow the shipped cargo.

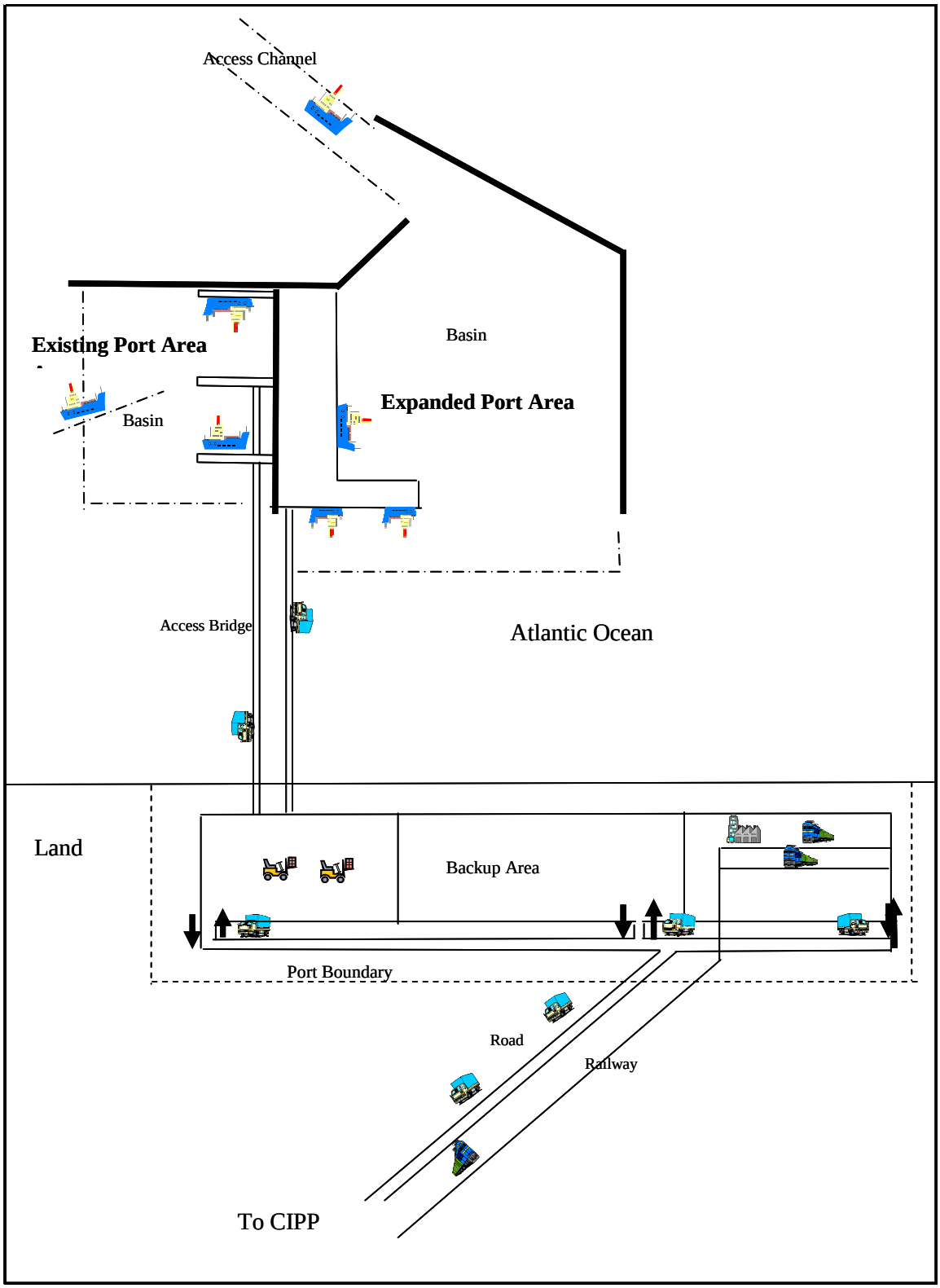

Figure 6.1.1 Movements of Cargoes within the Port

Table 6.1.1 Ship Sizes and Berth Allocation

Cargo Item		Ship Type	Ship Size	Representative Principal Dimensions				Annual Cargo Throughput in 2022 ('000 tons/TEUs)	Berth Allocation									
				(DWT/ TEUs)	LOA (m)	Draft (m)	Beam (m)		Pier 1		Pier 2		Pier 3			Container Berths		Grain/ Fertilizer Berth
									No. 1	No. 2	No. 3	No. 4	No. 1	No. 2	No. 3	No. 1	No. 2	
Solid Bulk Cargo																		
	Iron Ore Pellets	Ore Carrier	Panamax(L)	72,000	225.00	13.52	32.20	5,000	O									
	Cokes	Bulk Carrier	Panamax(S)	51,000	182.00	12.00	32.20	200					O	O				
	Soybeans	Grain Carrier	Capesize	114,000	266.00	14.52	40.56	4,500										O
			Panamax(L)	72,000	225.00	13.52	32.20											
	Fertilizers	Bulk Carrier	Handysize	45,000	186.00	10.95	30.40	1,000										O
							Solid bulk total	10,700										
Liquid Bulk Cargo																		
	Crude Oil	Petroleum Tanker	Aframax	107,000	245.10	15.00	43.00	8,800			O	O						
	Naphtha	Petroleum Tanker	Aframax	106,000	240.99	14.90	42.00	450			O	O						
	Refined Petroleum	Petroleum Tanker	Aframax	106,000	240.99	14.90	42.00				O	O						
	C+(Crude Gasoline)	Petroleum Tanker	Large1	47,000	182.50	12.65	32.20	200			O	O						
	LNG	LNG Tanker		75,000	278.80	12.30	42.60	3,440										
							Liquid bulk total	12,890										
Break-bulk Cargo																		
	Thick Slabs	Bulk Carrier	Panamax(S)	51,000	182.00	12.00	32.20	3,000		O			O	O				
	Steel Rolls	Bulk Carrier	Handy Size	45,000	186.00	10.95	30.40	180		O			O	O				
	Steel Billets	Bulk Carrier	Small 3	26,000	168.05	10.00	25.33	90		O			O	O				
	Bagged Cement	Multi-purpose Ship	Multi-purpose	32,000	188.00	11.65	27.70	300					O	O				
	Fresh Fruits	Reefer Ship	Reefer	6,100	133.92	7.60	15.80	327							O			
							Break- bulk total	3,897										
							Conventional total ('000 tons)	27,487										
Container																		
		Main Line Ship	Post-Panamax	9,200	346.98	14.50	46.00									O	O	
			Panamax (4th)	4,800	294.00	13.50	32.20									O	O	
			Panamax (3rd)	3,700	243.00	12.50	32.20									O	O	
							Main line total	568										
		Coaster		1,400	170.00	9.50	24.80	78										
		Feeder Ship		1,400	170.00	9.50	24.80	139								O	O	
							Container total ('000 TEUs)	784										

Source: JICA Study Team