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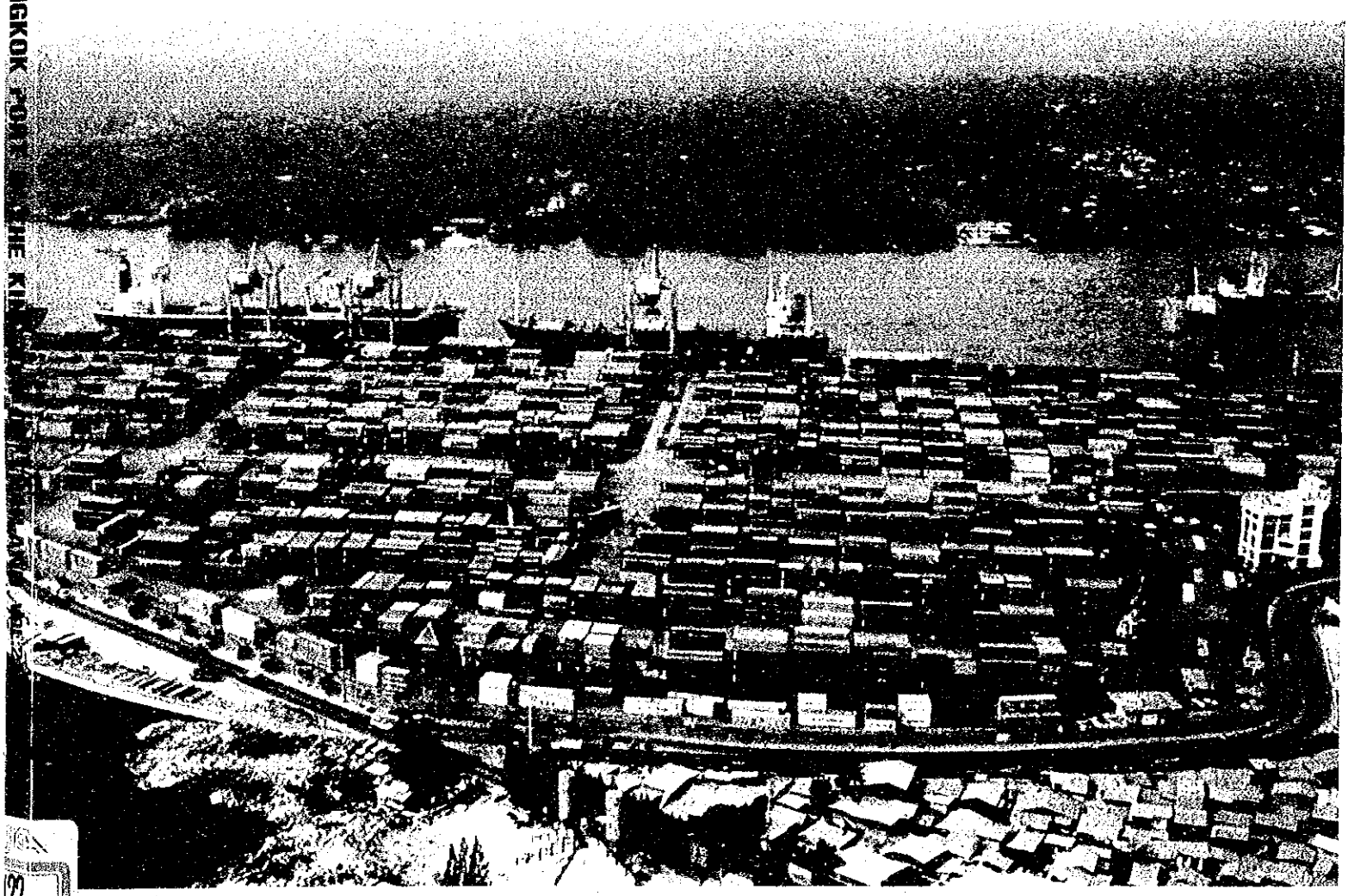
PORT AUTHORITY OF THAILAND

THE KINGDOM OF THAILAND

FINAL REPORT

THE STUDY ON MODERNIZATION OF BANGKOK PORT IN THE KINGDOM OF THAILAND

VOL.2 SHORT-TERM PLAN



JULY 1994

THE OVERSEAS COASTAL AREA DEVELOPMENT INSTITUTE OF JAPAN (OCDI)

PACIFIC CONSULTANTS INTERNATIONAL (PCI)

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
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THE STUDY ON MODERNIZATION OF BANGKOK PORT IN THE KINGDOM OF THAILAND

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JULY 1994

Exchange Rate

US$ 1.00 = Baht 25.18 = ¥ 107.50
(As of June 18th, 1993)

ABBREVIATIONS

A	
A/N	Arrival Notice
AASHTO	American Association of State Highway and Transportation Office
AC	Alternate Current
ACI	American Concrete Institute
AISC	American Institute of Steel Construction
APL	American President Line
ASTM	American Society for Testing Materials
B	
B/N	Boat Note
B/L	Bill of Lading
BHP	British Horse Power
BKK	Bangkok
BKP	Bangkok Port
BMA	Bangkok Municipal Administration
BMT	Bangkok Modern Terminal
C	
CAT	Communication Authority of Thailand
CFC	Conversion Factor for Consumption
CFS	Container Freight Station
CIF	Cost Insurance Freight
CLP	Container Load Plan
CY	Container Yard
D	
D/O	Delivery Order
D/R	Dock Receipt
DBT	Declaration of Bonded Transportation
DC	Direct Current
DOH	Department of Highway
DTS	Data Transmission System
DWT	Dead Weight Tonnage
E	
E/D	Export Declaration

E

EDI	Electronic Data Interchange
EDO	Equipment Dispatch Order
EIA	Environmental Impact Assessment
EIR	Equipment Interchange Receipt
EIRR	Economic Internal Rate of Return
EIT	Engineering Institute of Thailand
ESCAP	Economic Social Conference Asia and Pacific
ETA	Estimated Time of Arrival
ETA	Expressways and Rapid Transit Authority of Thailand
ETO	Express Transportation Organization of Thailand

F

FCL	Full Container Load
FEU	Forty-foot Equivalent Unit
FIRR	Financial Internal Rate of Return
ft.	foot/feet

G

GDP	Gross Domestic Products
GRT	Gross Registered Tonnage

H

HWL	High Water Level

I

IALA	International Association of Lighthouse Authorities
IBRD	International Bank for Reconstruction and Development
IC	Integrated Circuit
ICD	Inland Container Depot
IEAT	Industrial Estate Authority of Thailand
IEE	Initial Environmental Examination
IES	Illumination Engineering Society
IMO	International Maritime Organization

J

JICA	Japan International Cooperation Agency
JIS	Japanese Industrial Standard

L

LOA	Length Over All
LBP	Length between Perpendiculars
LCL	Less than Container Load
LCP	Laem Chabang Port
LLW	Lowest Low Water
LSI	Large-scale Integration
LT	Long Ton

M

M/F	Manifest
MARPOL	The International Convention of the Prevention of Pollution form Ships of 1973 with Protocal of 1978
MEA	Metropolitan Electricity Authority
MOTC	Ministry of Transport and Communications
MSL	Mean Sea Level
MT	Metric Ton
MWWA	Metropolitan Water Works Authority

N

NEC	National Electric Code
NESDB	National Economic and Social Development Board
NFPA	National Fire Protection Associates
NIDA	National Institute of Development Administration
NPKC	National Peace-keeping Council
NRT	Net Registered Tonnage

O

O/D	Origin and Destination
ODA	Official Development Assistance
OEP	Office of Environmental Policy and Planning

P

PAT	Port Authority of Thailand
PDC	Personnel Development Center
PDS	Position Detection System
PR	Ply Rating
PTT	Petroleum Authority of Thailand

R

RC	Reinforced Concrete
RPM	Revolution Per Minutes
RTG	Rubber-tired Gantry Crane

S

S/A	Shipping Application
SCF	Standard Conversion Factor
SHIPNETS	Shipping Cargo Information Network System
SRT	State Railway of Thailand
SSP	Ship Stowage Planning

T

TEU	Twenty-foot Equivalent Unit
TIS	Thailand Industrial Standard
TMN	Thai Maritime Navigation
TORC	Thai Oil Refinery Company
TOS	Transtainer Operation Supervising System
TOT	Telephone Authority of Thailand
TPT	Thai Prosperity Terminal

U

Unithai	United Thai Shipping Co.

V

VAT	Value Added Tax
VVVF	Variable Voltage and Variable Frequency

W

WCTS	Worldwide Cargo Trace System

Y

YOCS	Yard Operation Computer System
YPCS	Yard Plan Computer System
YSP	Yard Stowage Planning

CONTENTS OF VOLUME 2

PART II SHORT-TERM PLAN

List of Figures

List of Tables

PART II

SHORT-TERM PLAN

Chapter 1 Short-Term Plan for Bangkok Port

1.1 Short-Term Plan for Container-Handling

1.1.1 The Basic Concept of the Short-Term Plan

The Short-Term Plan is prepared as a first-phase plan with a target year of 1997 for modernization of container-handling at Bangkok Port. The Short-Term Plan is made within the framework of the Master Plan described in Chapter 10 of Part I. The following concept of modernization plan for container-handling in the stage of the Short-Term Plan is proposed:

- Introduction of a Closed Container Terminal System
- Introduction of Closing Time
- Increase of Container Stacking Capacity of the Marshaling Yard in the East Quay
- Rationalization of the Container Yard in the West Quay

  It is advisable to rationalize container-handling operations in the west quay which are conducted somewhat disorderly at present. First, the movements of ordinary trucks from outside to CFSs should be separated from the movements of tractor-chassis units/containers so as to reduce the present traffic congestion inside the port. It is proposed to install new Import CFSs in Area II as proposed in the Master Plan.

  In the open yard behind the Import CFS to be installed in Area II, it is proposed that an yard for stuffing export CFS cargoes (LCL) and an empty container storage yard be separately allocated.

1.1.2 Land Preparation for Future Port Activities

To resolve the present congestion at Bangkok Port and upgrade the level of the services for port users, the PAT intends to convert Area II, and the area facing the Phra Kanong Canal and the area behind the dangerous cargo storage yard into areas for port activities in collaboration with the Housing Authority.

1.1.3 Layout of the Main Facilities for Container-Handling

(1) General

The main facilities for container-handling are arranged so as to embody the basic concept of the modernization shown in Section 1.1.1.

(2) Marshaling Yard

The same marshaling yard as proposed in the Master Plan is arranged at the east quay (see Fig 1.1.1). Hence, actual stacking capacity considering an operational factor will increase to around 10,000 TEUs from the present capacity of around 6,200 TEUs.

It is proposed to prepare three gates at the marshaling yard. As to a divided control system, according to the results of the simulation, the marshaling yard can be divided into three yards controlled independently by operational units. In that case, the container-handling capacity of the marshaling yard is estimated to be one million TEUs per annum.

As to a reefer yard, a single reefer yard will be allocated west of Terminal No.3. Three small RTGs (4 row + 1 lane, 3 high stacking and 4 high over) will be used at the reefer yard. At the remaining yard of Terminal No.3, nine large RTGs (6 row + 1 lane, 4 high stacking and 5 high over) will be used. At Terminals No1 and No2, 19 small RTGs will be used (see Chapter 10, Section 10.1.3 (2)).

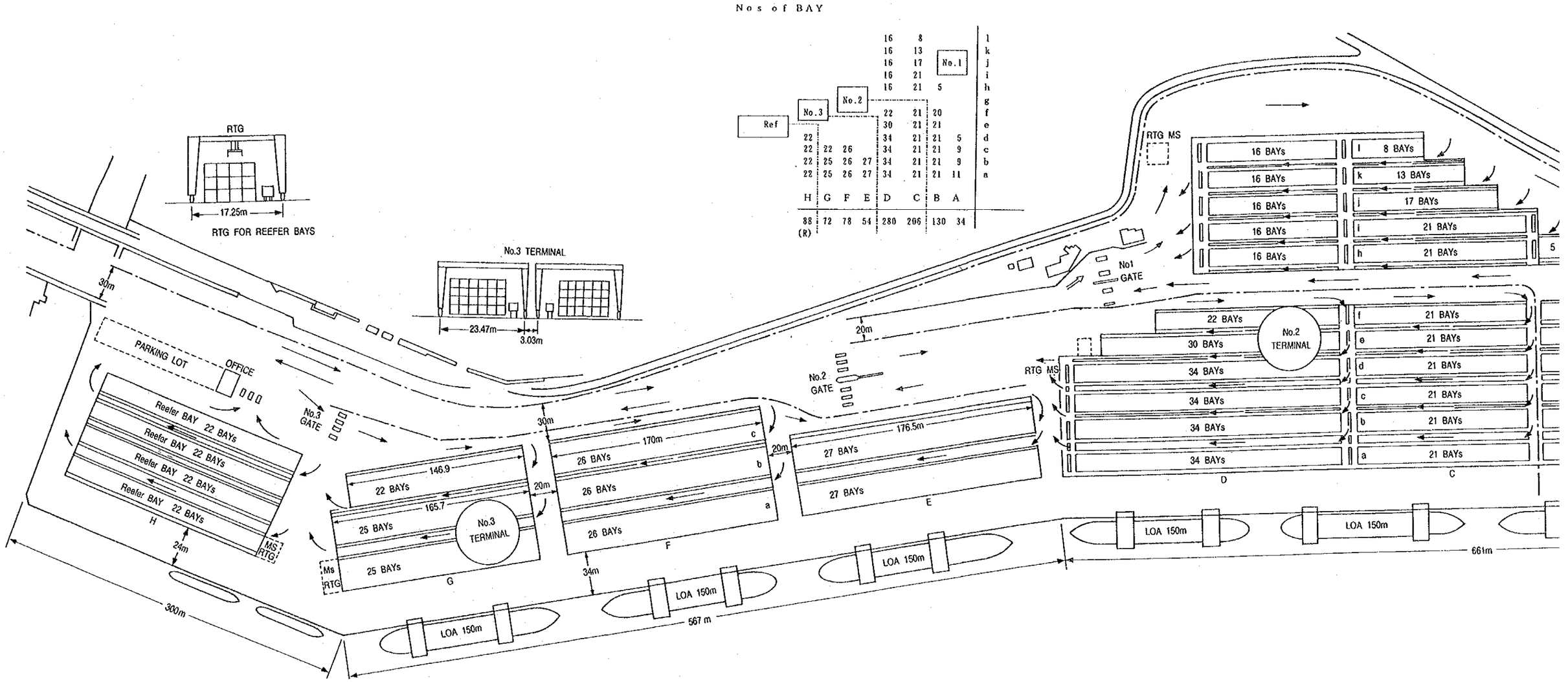


Fig. 1-1-1 Modernization Plan of the East Quay (Short-Term Plan)

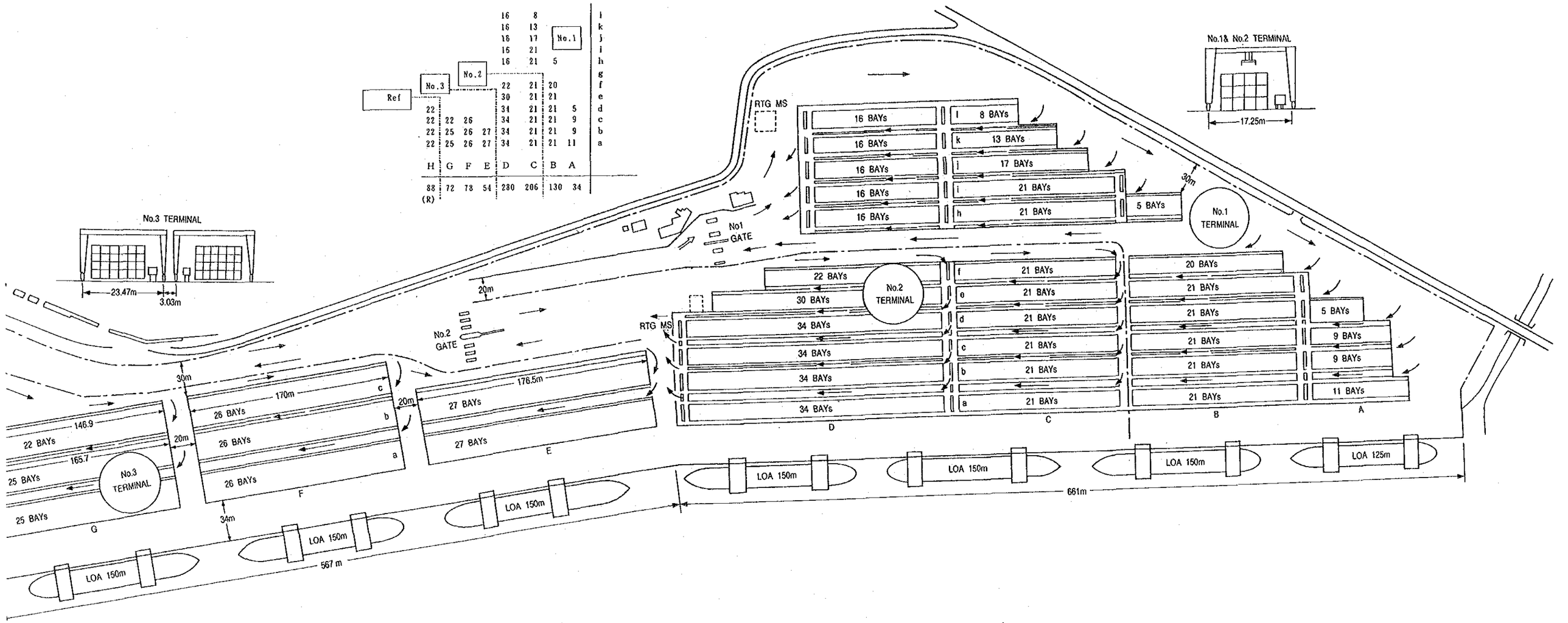


Fig. 1-1-1 Modernization Plan of the East Quay (Short-Term Plan)

(3) Container Freight Stations (CFSs)

Import CFSs are arranged at the west quay. The existing sheds No.13-No.17 are planned to be used for Import CFSs as they are at present. In addition to them, new Import CFSs are planned to be prepared in Area II.

In this study, import LCL containers are planned to be once stacked at the marshaling yard after being discharged from container ships, hauled to container side of the Import CFSs, unstuffed and stored in the CFSs as conducted at leading container terminals in the world to achieve quick dispatches of container ships.

In the mean time, in the transitional period up to the stage of the Short-Term Plan, however, some of LCL container cargoes might remain to be LCL-direct-delivery cargoes which are directly loaded onto ordinary trucks from container boxes after completion of necessary procedures. In case of such LCL-direct-delivery cargoes, it seems to be proper to haul those cargoes to the open yards surrounding the Import CFSs at the west quay immediately after they are discharged from container ships as at present. Possible LCL-direct-delivery containers can be received at the open yards surrounding the Import CFSs even in the stage of the Short-Term Plan if necessary, though LCL-direct-delivery operation itself is considered to be undesirable due to fear of damages on those cargoes especially in the rainy seasons.

On the other hand, the open yard for stuffing yard export CFS cargoes (export LCL) will be prepared between the new Import CFSs and transit sheds No.15-No.17, being separated from the storage yards for empty containers (see Fig 1-1-2).

(4) Storage Yard for Empty Containers

A storage yard for empty containers is planned to be prepared at the open yard behind and west of the existing sheds No.15-No.17 and adjacent to the new Import CFSs in the stage of the Short-Term Plan.

As to the gate preparation, three gates, (the first gate is near the CFSs, the second gate is on the opposite side of the first gate and the third gate is west of sheds Nos 15-17) will be prepared (see Fig. 1-1-2 and 10-1-3).

(5) Parking Lot for Container Chassis and Tractors

A parking lot with the capacity of 40 container chassis and 20 tractors will be prepared northeast of the shed No.17. The total required number of container chassis and tractors

are estimated as 210 and 130, respectively, in the stage of the Short-Term Plan (see Section 1.1.6(3)). In the stage of the Short-Term Plan, approximately 20% of the total will be parked at the above parking lot. The remaining chassis and tractors are assumed to be in operation within the port.

(6) LCL Reefer Yard

In addition to the concentrated reefer yard at the east quay, present reefer yard with 100 plugs east of shed No.17 at the west quay will be kept intact for handling LCL reefer containers.

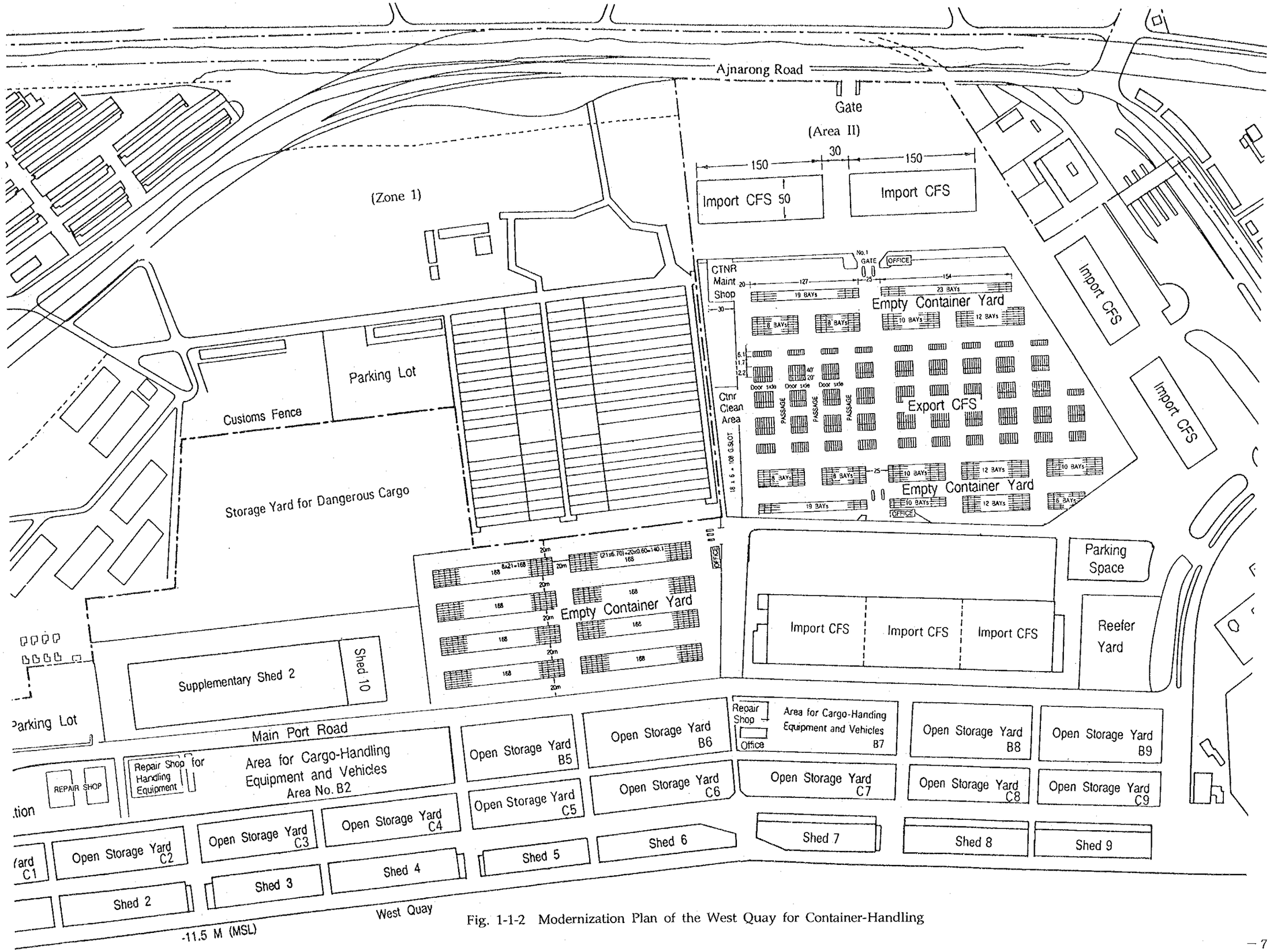
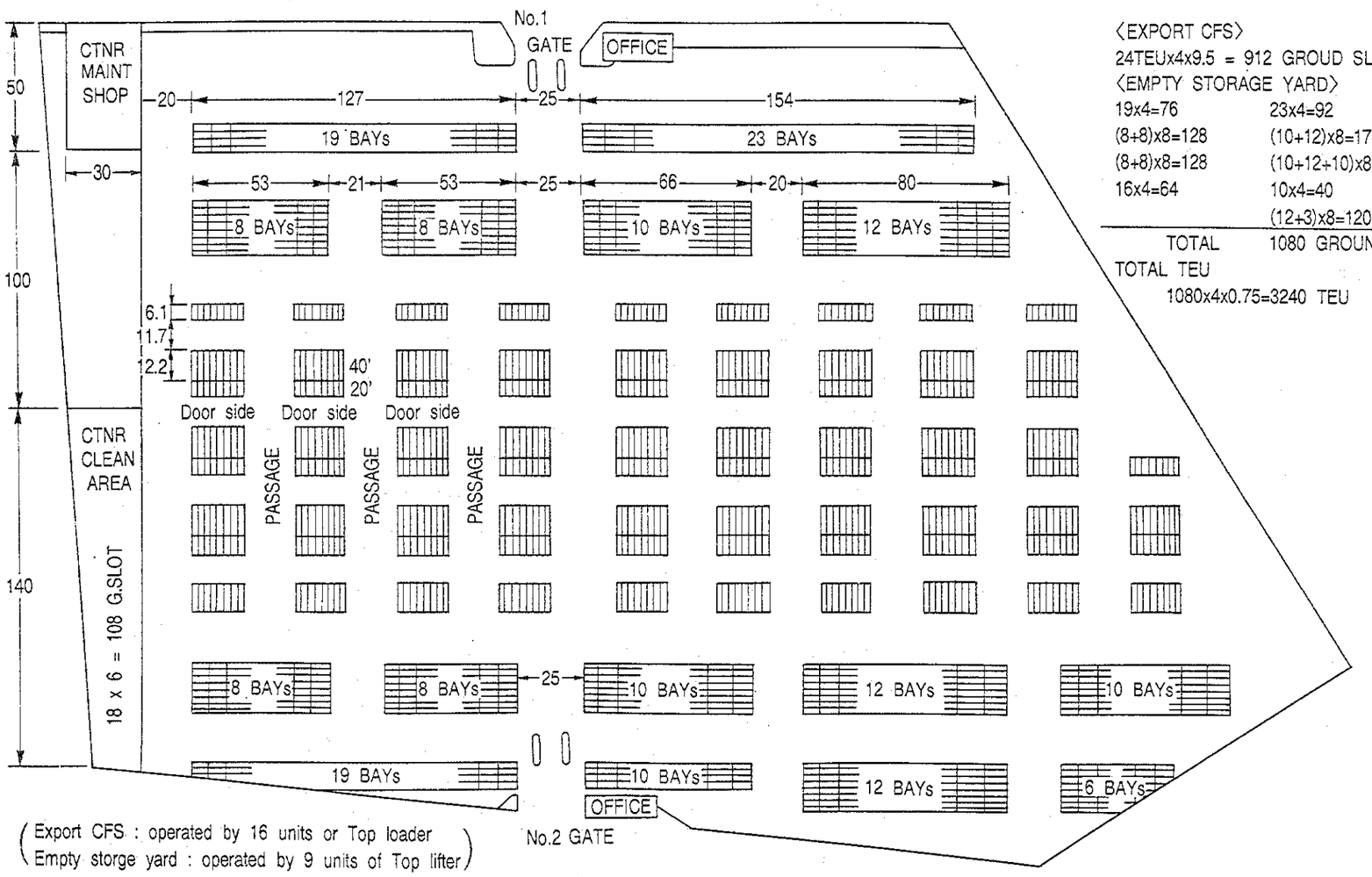


Fig. 1-1-2 Modernization Plan of the West Quay for Container-Handling

West Quay Export CFS & Empty Storage Yard I (1997)

1/2000



〈EXPORT CFS〉
24TEUx4x9.5 = 912 GROUD SLOTS
〈EMPTY STORAGE YARD〉

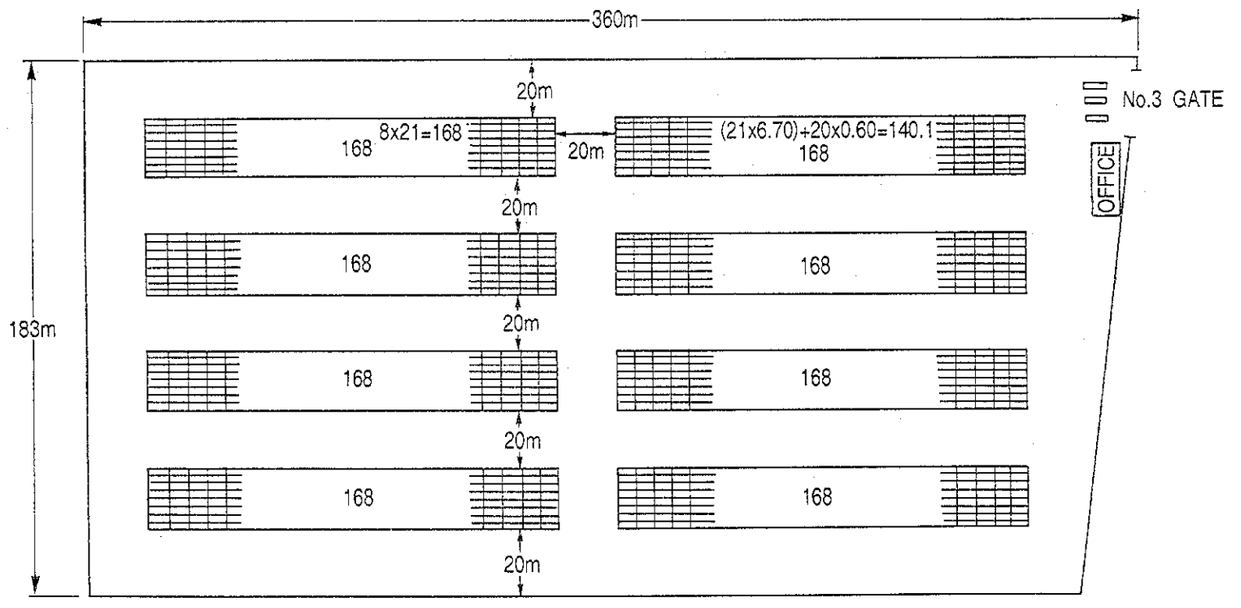
19x4=76	23x4=92
(8+8)x8=128	(10+12)x8=176
(8+8)x8=128	(10+12+10)x8=256
16x4=64	10x4=40
	(12+3)x8=120
TOTAL	1080 GROUND SLOTS

TOTAL TEU
1080x4x0.75=3240 TEU

(Export CFS : operated by 16 units or Top loader
Empty storge yard : operated by 9 units of Top lifter)

West Quey Empty Storage Yard II

1/2000



(168 x 8 = 1344 G.SLOTs
1344 x 4 x 0.75 = 4032 TEUs)

OPERATED BY 10 UNITS
OF TOP LIFTER (FOR EMPTY)

Fig. 1-1-3 Modernization Plan of the West Quay for Container-Handling
(Stuffing Yard for Export LCL and Empty Container Storage Yards)

1.1.4 Container Movements within the Port in the New Operational System

To reveal container movements in the new operational system proposed in this study, a computer simulation was conducted as the case of the Master Plan. The resulting figures of the simulation are used to estimate required scale of the main facilities for container-handling such as the number of lanes of the terminal gates, floor space of CFSs and the number of slots at the storage yard for empty containers corresponding to the container-handling capacity mentioned above. The conditions for the simulation are as follows:

- Arrival times of container ships: the actual arrival records in 1991/1992 were used (see Chapter 6, Section 6.4 of Part I).
- The number of containers discharged/loaded per ship: the actual container-handling records were used (see Chapter 6, Section 6.4 of Part I).
- Gross container-handling productivity at the dockside: 21 boxes/hr (referring to the actual records of the new terminal at Laem Chabang Port)
- The percentage of 20 ft. boxes: 56%
- The percentage of export CFS cargoes (LCL): 49% of laden containers
- The percentage of import CFS cargoes (LCL): 35% of laden containers
- The percentage of empty export containers: 5%
- The percentage of empty import containers: 20%
- Annual working days: 365 days
- Daily working hours: 24 hours
- Closing time: 24 hours before a ship arrival
- Arrival distribution of Export FCL and LCL, and Import FCL containers:

  - Export FCL and LCL:
    35%: 24-48 hours (2 days) before a ship arrival
    35%: 48-72 hours (3 days) before a ship arrival
    15%: 72-96 hours (4 days) before a ship arrival
    15%: 96-120 hours (5 days) before a ship arrival

  - Import FCL:
    30%: 24-48 hours (2 days) after final loading
    30%: 48-72 hours (3 days) after final loading
    14%: 72-96 hours (4 days) after final loading
    13%: 96-120 hours (5 days) after final loading
    13%: 120-144 hours (6 days) after final loading
    (referred to the leading container terminals in the world)

- Dwelling time of Import LCL containers at the marshaling yard: 24 hrs

In the simulation, the number of containers passing through Bangkok Port per annum must be a given condition. Hence, several alternative cases with different numbers of containers were considered, and the corresponding simulations were conducted. According to the results of the simulation, in the case when the number of containers handled per annum is one million TEUs (the number of calling vessels per annum is 1,141) and the marshaling yard is divided into three yards and controlled independently by three units, the resulting number of containers dwelling at the marshaling yard is around 10,000 TEUs during peak conditions. Thus, the required storage capacity of the marshaling yard is around 10,000 TEUs. Compared to the above required storage capacity with the stacking capacity of 9,900 TEUs of the marshaling yard, the container-handling capacity of the marshaling yard at the east quay can be said to be approximately one million TEUs per annum.

The resulting average berth occupancy rate of the seven berths of the east quay is 27.2%.

1.1.5 Required Scale of the Main Facilities for Container-Handling

(1) Container Freight Stations (CFSs)

According to the result of the simulation, the volume of container cargoes dwelling at Import CFSs is estimated to be 25,380 tons during peak condition. To store the volume, the existing sheds No13-No17 are planned to be used as they are at present. The storage capacity of the five existing sheds are estimated to be 16,820 tons. Hence, additional Import CFSs with a storage capacity of 8,560 tons need to be prepared. The required dimensions of the new CFS are shown as follows:

- Required floor area: 14,270 sq.m
- Total length: 300 m
- Width: 50 m
- Total number of bays on each side: 45

Taking account of a suitable size of one CFS building, two CFSs each with a length of 150 m are arranged at Area II.

On the other hand, the volume of Export CFS (LCL) cargoes stuffed at the open yard is estimated to be 13,060 tons (1,045 TEUs) per day during peak condition. The required dimensions of the yard are shown as follows:

- Required slot number: 523

To meet the demand, 910 slots will be prepared.

(2) Storage Yard for Empty Containers

According to the result of the simulation, the total required volume of empty containers to be stacked in the storage yard is estimated to be approximately 12,000 TEUs during peak condition, and in the stage of the Short-Term Plan, storage yard with a capacity of 7,000 TEUs (around 60% of the total required number) is planned to be prepared at the west quay. The remaining portion is expected to be stored in off-dock yards.

(3) Required Number of Lanes of the Terminal Gates

According to the result of the simulation, daily traffic volume through the terminal gates and corresponding required number of lanes at the marshal-ing yard of the east quay in the condition of an hourly peaking factor of 1.5 (refer to the traffic survey conducted by the study team) are shown as follows:

Unit: Vehicles/day

Gate	Receipt			Delivery			Number of Lanes
	Laden	Empty	Chassis	Laden	Empty	Chassis	
Gate No.1	560	30	690	550	140	590	7
Gate No.2	500	30	660	530	130	530	7
Gate No.3	650	30	890	720	180	690	7

The required number of lanes at the storage yard for empty containers and the stuffing yard for Export LCL cargo at the west quay is shown as follows:

Gate	Receipt			Delivery				No.of Lanes
	Empty	Chassis	Truck	Empty	Chassis	Truck	Lanen	
Gate No.1	450	-	2,090	-	450	2,090	-	4
(to/from CFSs)	(450)							
(to/from outside)			(2,090)			(2,090)		
Gate No.2	320	190	-	190	320	-	730	2
(to/from east quay)	(140)			(30)			(730)	
(to/from outside)	180)			(160)				
Gate No.3	420	260	-	260	420	-	-	2
(to/from east puay)	(190)			(50)				
(to/from outside)	230)			(210)				

(4) Reefer Plugs

The required number of reefer plugs is shown as follows:

- The percentage of reefer containers to the total laden containers:
  Import: 1.5%
  Export: 7.0%
- The percentage of 20 ft. containers among reefer containers: 30%
- Operational factor: 0.75
- Required number of reefer plugs: 350

(5) Repair Shop and Cleaning Area

A repair shop for damaged containers is planned at the storage yard for empty containers at the west quay. The dimensions are as follows:

- Site area for a building: 50 m x 30 m = 1,500 sq.m

Cleaning area is also allocated at the same yard.

(6) Terminal Office

It is necessary to prepare a new terminal office at Gate No.3. The dimensions are as follows:

- Stories: 3
- Site area for a building: 20 m x 10 m = 200 sq.m
- Floor space: 600 sq. m

1.1.6 Container-Handling System

(1) Selection of Container-Handling System

The transfer crane system is selected as the most appropriate system to be adopted at the marshaling yard of the east quay in the stage of the Short-Term Plan as proposed in the Master Plan.

On the other hand, as to container-handling system adopted at the storage yards for empty containers and the yard for stuffing export CFS (LCL) cargoes of the west quay, toplifters can move empty containers speedily from stacking yards to the stuffing yard or from chassis on to stacking yards or vice versa compared with other systems such

as the transfer crane system (RTG system). Moreover, even in the toplifter system, empty containers can be stacked in blocks like the transfer crane system because the percentage of digged empty containers is generally low by being stacked by size, type and shipping line, resulting in space-saving. And not only do toplifters perform swift operation, the unit price of a toplifter is much cheaper than a transfer crane or a straddle carrier. Other advantages of the toplifter system include the low cost of paving or repairing yards and flexibility in the layout of ground slots. Thus, the toplifter system is selected as the optimum system at the yards of the west quay.

(2) Divided Control System at the Marshaling Yard (See Fig.1-1-1)

As proposed in the Master Plan, the divided control system is proposed in the stage of the Short-Term Plan.

In the meantime, as to a reefer yard, a single reefer yard will be allocated west of Terminal No.3 as mentioned in Section 1.1.3 (2).

(3) Required Numbers of Container-Handling Machines to be Used at Bangkok Port

Required number of container-handling machines to be used at Bangkok Port in the stage of the Short-Term Plan is estimated according to the following conditions:

1) Number of containers to be handled at Bangkok Port: one million TEUs
2) Storage capacity for empty containers at the yard: 7,000 TEUs

The resulting numbers are summarized as follows:

- Yards for empty containers and for stuffing export CFS (LCL) car-goes

1) Top lifters (30-45 tons): 12 units
   - Number of LCL containers in peaking conditions:
     1,044 TEUs/day;725 Boxes/day (peaking factor: 1.77 from a simula-tion)
   - Daily working hours: 16.5 hours
   - Gross cargo-handling productivity in normal conditions: 20 boxes/hour
   - Operational factor: 0.5
   - Percentage of dug containers when being lifted: 10%
   - Average handling times when containers being digged: 9 times
   - Typical operation:a. lifting empty containers-laying them on the stuffing places
     b. lifting stuffed LCL containers onto chassis for the marshaling yard

   725 boxes/16.5hr/(20 boxes/hr/unit)/0.5 x (0.9 + (0.1) x 9 + 1) = 12 units

2) Top lifters of 4-high-stacking (10 tons): 18 units

- Number of empty containers to be received from outside the yard in peaking conditions:
  1,720 TEUs/day; 1,194 Boxes/day (peaking factor: 1.77 from a simulation)
- Number of empty containers to be delivered to outside the yard in peaking conditions:
  676 TEUs/day; 469 Boxes/day (peaking factor: 1.77 from a simula-tion)
- Daily working hours: 16.5 hours
- Gross cargo-handling productivity in normal conditions: 20 boxes/hour
- Operational factor: 0.5
- Percentage of dug containers: 10%
- Average handling times when containers being digged: 9 times
- Typical operation: a. Receiving empty containers from the marshal-ing yard, Import CFSs or outside the port
  b. Delivery of empty containers to the marshal-ing yard, Export CFSs or outside the port

(1,194 + 469)boxes/16.5hr/(20 boxes/hr/unit)/0.5 x (0.9 + (0.1) x 9) = 18 units

3) Yard tractors for delivery of Export LCL containers to the marshal-ing yard at the east quay: 29 units

- Number of LCL containers in peaking conditions:
  1,044 TEUs/day;725 Boxes/day (peaking factor: 1.77 from a simulation)
- Daily working hours: 16.5 hours
- Average velocity of a tractor within the port: 15 km/hr
- Average haul distance between the CFSs and the marshaling yard: 1.5 km in one way
- Cycle time of lift on and lift off: 6 minutes
- Gate in and out: 2 minutes
- Total cycle time of the operation: 20 minutes
- Number of container boxes hauled by tractors: 3 boxes/hr/unit
- Operational factor: 0.5

725 boxes/16.5hr/(3 boxes/hr/unit)/0.5 = 29 units

4) Chassis for delivery of Export LCL containers to the marshaling yard at the east quay: 29 units (the same as the number of tractors)

5) Forklifts (3 tons) used at stuffing yard for Export LCL: 132 units

- Number of Export LCL containers per annum: 215,730 TEUs
- Number of LCL containers in peak conditions:
  1,044 TEUs/day;733 Boxes/day (peaking factor: 1.77 from a simulation)
- Daily working hours: 16.5 hours
- Unit weight: 12.5 tons/TEU
- Cargo volume in peak conditions: 13,054 tons per day
- Average weight per lift by a forklift at Export CFSs: 0.7 ton
- Productivity of a forklift: 20 lifts per hour
- Cargo-handling productivity of a forklift: 14 tons per hour
- Operational factor: 0.6
- Percentage of forklift's use: 70%

13,054 tons x 0.7/16.5hr/(14 tons/hr/unit)/0.6 x 2 = 132 units

- Import CFSs

1) Yard tractors for receiving Import LCL containers from the marshaling yard at the east quay: 34 units

- Number of LCL containers in peaking conditions:
  930 TEUs/day;646 Boxes/day (peaking factor: 2.48 from a simulation)
- Daily working hours: 16.5 hours
- Total cycle time of the operation: 26 minutes
- Number of container boxes hauled by tractors: 2.3 boxes/hr/unit
- Operational factor: 0.5

646 boxes/16.5hr/(2.3 boxes/hr/unit)/0.5 = 34 units

2) Chassis for receiving Import LCL containers from the marshaling yard at the east quay: 104 units

- Number of LCL containers in peaking conditions:
  930 TEUs/day;646 Boxes/day (peaking factor: 2.48 from a simulation)
- Daily working hours: 16.5 hours
- Number of container boxes hauled by tractors: 0.54 boxes/hr/unit
- Average operational factor: 0.7

646 boxes/16.5hr/(0.54 boxes/hr/unit)/0.7 = 104 units

3) Forklifts (3 tons) used at Import CFSs: 101 units

- Number of Import LCL containers per annum: 136,820 TEUs
- Number of LCL containers in peak conditions:
  930 TEUs/day;646 Boxes/day (peaking factor: 2.48 from a simulation)
- Daily working hours: 16.5 hours
- Unit weight: 10.8 tons/TEU
- Cargo volume in peak conditions: 10,044 tons per day
- Aver ge weight per lift by a forklift at Export CFSs: 0.7 ton
- Productivity of a forklift: 20 lifts per hour
- Cargo-handling productivity of a forklift: 14 tons per hour
- Operational factor: 0.6
- Percentage of forklift's use: 70%

10,044 tons x 0.7/16.5hr/(14 tons/hr/unit)/0.6 x 2 = 101 units

- Marshaling yard at the east quay

1) Small RTGs: 22 units

- Number of containers received or delivered through the gates in peak conditions:
  5,826 TEUs/day; 4,046 Boxes/day (peaking factor: 2.13 from a simulation)
- Dry containers excluding imported empty containers: 3,482 boxes
  - Terminals No1 and No2: 2,164 boxes (Percentage of Import FCL containers: 30%)
  - Terminals No3: 1,318 boxes
- Reefer containers: 159 boxes (Percentage of Import FCL containers: 15%)
- Daily working hours: 24 hours
- Gross cargo-handling productivity in normal conditions: 20 boxes/hour
- Operational factor: 0.7
- Percentage of dug containers when being lifted: 50%
- Average handling times when containers being digged:
  - Dry containers at Terminals No1 and No2: 2 times
  - Reefer containers at Terminals No3: 1.5 times
- Dry containers at land side of Terminals No.1 and No.2

2,164 boxes/24hr/(20 boxes/hr/unit)/0.7 x(1-0.30+(0.5+0.5 x 2)x 0.30) = 7 units

- Reefer containers at land side of Terminal No.3

  159 boxes/24hr/(20 boxes/hr/unit)/0.7 x(1-0.15+(0.5+(0.5) x 1.5)x 0.15) = 1 unit

- Dry containers at dock side of Terminal No.1 and No.2

  1.5 RTGs / dock-side crane x 8 dock-side cranes = 12 RTG units

- Reefer containers at dock-side of Terminal No.3: 1 RTG unit
- Considering the layout of reefer lanes at Terminal No.3, one RTG unit is added.

2) Large RTGs: 9 units

- Number of containers received or delivered through the gates in peak conditions:

  5,826 TEUs/day; 4,046 Boxes/day (peaking factor: 2.13 from a simulation)

- Dry containers excluding imported empty containers: 3,482 boxes
  - Terminals No1 and No2: 2,164 boxes (Percentage of Import FCL containers: 30%)
  - Terminals No3: 1,318 boxes
- Daily working hours: 24 hours
- Gross cargo-handling productivity in normal conditions: 25 boxes/hour
- Operational factor: 0.7
- Percentage of dug containers when being lifted: 50%
- Average handling times when containers being digged:
  - Dry containers at Terminals No1 and No2: 2 times
  - Reefer containers at Terminals No3: 1.5 times

- Dry containers at land side of Terminals No.1 and No.2
  1,318 boxes/24hr/(25 boxes/hr/unit)/0.7 x(1-0.30+(0.5+0.5x2)x 0.30) = 3 units
- Dry containers at dock side of Terminal No.3
  1 RTG / dock-side crane x 6 dock-side cranes = 6 units

3) Yard tractors working at dock side: 70 units
- Average velocity of a tractor within the port: 15 km/hr
- Average haul distance per cycle within the marshaling yard: 1.62km
- Cycle time of lift on and lift off: 4 minutes

- Total cycle time of the operation: 10 minutes
- Cycle time of a dock-side crane: 3 minutes
- Operational factor: 0.7
- Number of dock-side cranes: 14

14 dock-side cranes x 10 min/3min/0.7 = 70 units

4) Chassis used at dock side: 80 units

- 70 units the same number as tractors
- 10 units for damaged or over-size containers

Thus, the required numbers of container-handling machines in the stage of the Short-Term Plan is summarized as follows:

	Required Nos.
- Dockside gantry cranes	14
- RTGs (Rubber tired gantry cranes)	
- Small RTGs	22
- Large RTGs	9
- Toplifters (30-45 tons)	12
- Toplifters (10 tons)	18
- Forklifts (3 tons)	
- Stuffing yard for Export LCL	132
- Import CFSs	101
- Total	233
- Tractors	
- Stuffing yard for Export LCL	29
- Import CFSs	34
- Dockside	70
- Total	134
- Chassis	
- Stuffing yard for Export LCL	29
- Import CFSs	104
- Dockside	80
- Total	213

1.2 Short-Term Plan for Handling Conventional Cargo

1.2.1 The Basic Concept of Modernization for the West Quay

The following concept of modernization for handling conventional cargo at the west quay is proposed in line with the modernization for container-handling at the east and west quays:

- Usage of Berths at the West Quay Exclusively for Conventional Vessels
  The berths at the west quay will be used exclusively for conven-tional vessels.

- Rearrangement of Usage of the Existing Sheds, Warehouses and Open Storage Yards for Conventional Cargo

  The existing sheds No.1-No.9 and open storage yards behind them will be used exclusively for storing conventional cargo as a result of the modernization of container-handling and subsequent withdraw-al of container cargoes from those sheds and open yards. Thus, cargoes which are presently stored at Import Steel Open Storage Yard outside the Checking Post 1 will be able to be stored inside the port. It is also proposed to convert the existing bonded warehouse and supplementary sheds behind sheds No1-No9 into open stor-age yards. The preparation of import steel open storage yards inside the port is expected to improve efficiency of handling bulk cargo such as steel products. Such rearrangement of the usage of the existing sheds and yards will result in a reduction of traffic congestion in and around the port by streamlining cargo movements.

- Rearrangement and Expansion of the Existing Port Roads
  Corresponding to the above modernization of the port, rearrangement and expansion of the existing port roads is proposed. To expand the port roads, some of the existing offices must be transferred. Site of the existing supplementary shed No.1 will be used for the of-fices to be transferred.

- Dismantlement of the Existing Dockside Cranes
  It is proposed to dismantle the existing rail-mounted dockside cranes that are left without being used and hinder dockside opera-tions.

- Relocation of the Existing Warehouses for Dangerous Cargo
  The existing warehouses for dangerous cargo will be transferred to a place with a sufficient buffer zone by expanding the present area for the storage beyond the

existing customs fences. Open storage yards for dangerous cargo will be expanded and enclosed by buffer zone. Cotton, a type of dangerous cargo, which is presently stored in and around supplementary shed No.1 will be stored in the above area.

- Transferring Railway Operations to the West Quay
  Considering conventional cargoes are mainly transported by roads and that even in the future such conditions are expected to remain unchanged, it is proposed to transfer railway operations from the east quay to the west quay.

- Preparation of Parking Lots for Passenger Cars and Trucks/Chassis
  It is proposed to prepare a parking lot for trucks/chassis at the land near the Checking Post 2 that faces the Phra Kanong Canal so as to reduce traffic congestion inside the port. A parking lot for passenger cars will be prepared near Check-ing post 1. Moreover, a parking lot for trucks/chassis will be prepared behind the yard for dangerous cargo. The parking lot is allocated outside of the customs fences.

- Transferring the Offices Having no Direct Linkage with Cargo-Handling Operations
  It is proposed to transfer the offices that have no direct linkage with cargo-handling operations so as to reduce the traffic congestion inside the port.

1.2.2 Usage Plan for the Existing Storage Facilities

(1) Movements of Conventional Cargoes

To reveal movements of conventional cargoes within the west quay and propose a usage plan for the existing storage facilities in the stage of the Short-Term Plan, a computer simulation was conducted. In the simulation, the actual statistical distribution forms for ship arrivals and berthing periods at the west quay were used. Conventional vessels calling at the west quay are divided into two categories: vessels laden with var-ious kinds of cargoes and vessels laden with steel products referring to the actual berthing records. The following premises are adopted considering the records of actual operations:

- Conventional vessel laden with various kinds of cargoes
  - Total volume of cargoes discharged: 1,545,000 tons
  - Average cargo-handling volume: 3,800 tons per vessel
  - Number of calling vessel: 407 vessels per year
  - Weighed gross cargo-handling productivity: 37 tons/hr/vessel
    (see Chapter 10, Section 10.2.2 (1) of Part I)

- Conventional vessel laden with steel products
  - Total volume of cargoes discharged: 2,265,000 tons
  - Average cargo-handling volume: 5,550 tons per vessel
  - Number of calling vessel: 408 per year
  - Weighed gross cargo-handling productivity: 80 tons/hr/vessel (see Chapter 10, Section 10.2.2 (1) of Part I)

Resulting figures of the required areas for cargo storage during peak conditions were obtained from the simulation as follows:

- Required storage areas :
  for sheds: 23,100 sq.m (peak condition)
  for open yards: 55,200 sq.m (peak condition)

In the meantime, the following results were also obtained from the simula-tion:

- Percentage of berth occupancy: 87.7%
- Traffic volume of trucks each way:
  680 vehicles per day (peak condition)

As shown above, the percentage of berth occupancy in the stage of the Short-Term Plan will increase from the present level. The percentage of berth occupancy, however, is expected to decrease toward the stage of the Master Plan owing to an increase of the portion of steel products whose cargo-handling productivity is higher than other conventional cargo as mentioned above. In the meantime, to meet the above traffic demand within the port, improvement of the existing port roads is proposed in Section 1.3.

(2) Usage Plan for Sheds

Transit sheds No.1-No.9 with a total storage area of 46,750 sq.m are planned to store conventional cargoes excluding dangerous cargoes to meet the above demand and considering their locations just behind the berths. Transit shed No.10 and supplementary shed No.2 will be used for auction and storage of overtime cargoes, respectively, as they are at present. Storage in Bonded Warehouse is planned to be replaced by that in supplementary shed No.2. In-transit Warehouse outside the port will be kept intact in the stage of the Short-Term Plan. The usage plans for the existing sheds and warehouses are summarized as follows (see Fig. 1-2-1):

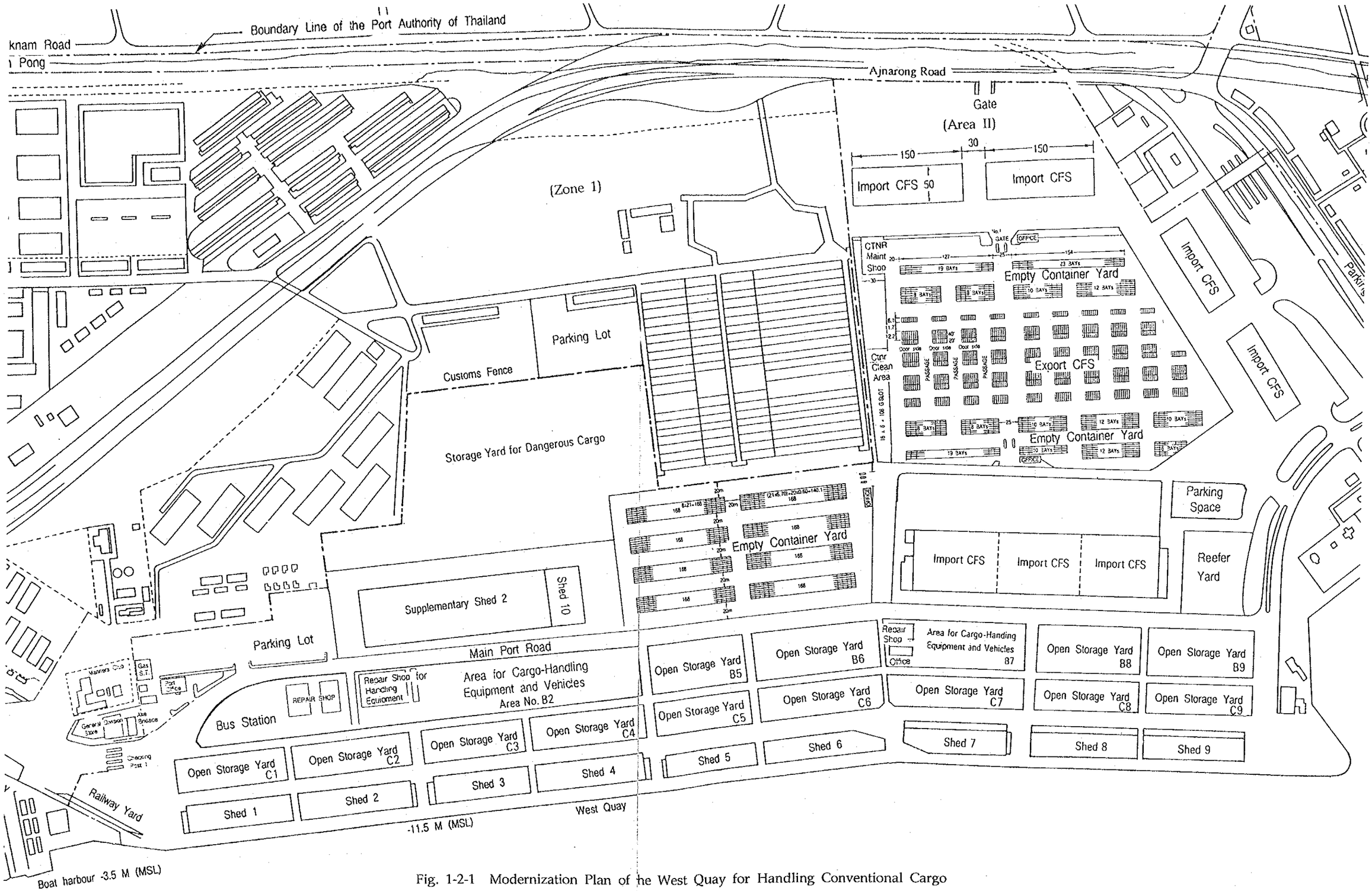


Fig. 1-2-1 Modernization Plan of the West Quay for Handling Conventional Cargo

Existing shed	Floor space (sq. m)	Usage plan in the Short-Term Plan
Transit shed No.1	5,843	Transit shed
Transit shed No.2	5,843	Transit shed
Transit shed No.3	5,843	Transit shed
Transit shed No.4	5,843	Transit shed
Transit shed No.5	4,545	Transit shed
Transit shed No.6	4,545	Transit shed
Transit shed No.7	4,690	Transit shed
Transit shed No.8	4,800	Transit shed
Transit shed No.9	4,800	Transit shed
Total	32,460	
Transit shed No.10	3,550	Auction
Supplementary shed No.1	12,480	Conversion to office, parking lot, and road space
Supplementary shed No.2	20,280	Storage for overtime cargoes and bonded cargoes
Supplementary shed No.4	2,000	Conversion to an open yard
Supplementary shed No.5	2,000	Conversion to an open yard
Supplementary shed No.6	2,000	Conversion to an open yard
Supplementary shed No.7	2,000	Conversion to an open yard
Supplementary shed No.9	2,000	Conversion to an open yard
In-transit Warehouse	9,600	Storage for cargoes to Laos

(3) Usage Plan for Open Storage Yards

Open storage yards with a total area of 100,000 sq.m are planned to store bulky cargoes such as steel products and vehicles so as to meet the above demand and considering their locations near the berths. The existing supplementary sheds No.4-No.9 will be demolished and converted into open yards to achieve efficient operations for handling the above bulky cargoes. Such replacement will streamline the present intricate cargo flow in and around the port. The existing open storage yards will be rearranged by the new port roads. Their areas are shown as follows (see Fig. 1-2-1):

Open Storage Yard	Floor space (sq. m)
Open storage yard No.C1	6,660
Open storage yard No.C2	7,110
Open storage yard No.C3	6,300
Open storage yard No.C4	7,200
Open storage yard No.C5	5,985
Open storage yard No.C6	7,528
Open storage yard No.C7	8,248
Open storage yard No.C8	6,570
Open storage yard No.C9	6,525
Open storage yard No.B5	8,512
Open storage yard No.B6	10,752
Open storage yard No.B8	9,344
Open storage yard No.B9	9,280
Total	100,014

1.2.3 Storage Plan for Dangerous Cargoes

(1) Storage Plan for Cotton

In the Short-Term Plan, cotton is planned to be stored at the new dangerous cargo yard together with other dangerous cargoes so as to ensure safe storage by concentrating dangerous cargoes in one place with a sufficient buffer zone (see Chapter 10, Section 10.2.3). Storage plan for cotton in 1997 is summarized as follows:

- Volume of cotton to be handled per annum:
    - Total: 185,010 tons (100%); 11,540 TEUs
    - Conventional: 11,900 tons (6.4%)
    - FCL containers: 86,555 (46.8%); 5,770 TEUs
    - LCL direct delivery: 86,555 (46.8%); 5,770 TEUs
- Storage capacity in a shed: 1.5 tons/sq.m
- Effective floor space for storage: 50%
- Operational factor: 0.75
- Peaking factor:
    - Storage: 2.0
    - Unstuffing: 2.43
- Average dwelling time:
    - Conventional: 7 days

- Containers: 3 days
- Unstuffing productivity: 11 TEUs/day
- Required floor space of a shed:
  11,900 tons/365 daysx7 daysx2.0/(1.5 tons/sq.m)/0.5/0.75 = 811 sq.m
- Required yard area for container-stacking:
  (5,570+5,570)TEUs/365daysx3 daysx2.0/(0.0212TEU/sq.mx2high)/0.75=5,970sq.m
- Required number of bays for unstuffing cotton:
  5,570 TEUs/365daysx2.43/(11 TEUs/day/bay) = 3 bays

(2) Storage Plan for Dangerous Cargoes Excluding Cotton

Storage plan for dangerous cargoes excluding cotton in 1997 is summarized as follows:

- Volume of dangerous cargoes handled per annum:
  - Total: 244,080 tons (100.0%); 19,040 TEUs
  - Conventional: 15,630 tons (6.4%)
  - Real LCL: 19,240 tons (7.9%); 1,600 TEUs
  - FCL containers: 44,490 tons (18.2%); 3,710 TEUs
  - LCL direct delivery: 44,490 (18.2%); 3,710 TEUs
  - FCL direct delivery: 120,230 tons (49.3%); 10,020 TEUs
- Storage capacity in a shed: 1.5 tons/sq.m
- Effective floor space for storage: 30%
- Operational factor: 0.75
- Peaking factor: 2.0
- Average dwelling time:
  - Conventional: 7 days
  - Containers: 3 days
- Unstuffing productivity: 11 TEUs/day
- Required floor space of a shed:
  34,870 tons/365 daysx7 daysx2.0/(1.5 tons/sq.m)/0.3/0.75 = 3,960 sq.m
- Required yard area for container-stacking:
  (3,710+3,710)TEUs/365daysx3daysx2.0/(0.0212TEU/sq.mx2high)/0.75 = 3,840 sq.m
- Required number of bays for unstuffing dangerous cargo:
  3,710 TEUs/365daysx2.43/(11 TEUs/day/bay) = 2 bays

(3) Total Required Area for Storing Dangerous Cargoes

The total required area for dangerous cargoes including cotton is shown as follows:

- Total floor space of sheds: 5,000 sq.m
- Total storage area: 10,000 sq.m

Within the same storage yard, cotton and other dangerous cargo will be stored separately in the respective sheds and/or storing areas. In addition to the above storage areas, areas for buffer zone, passage for tractor-chassis units/trucks, offices, unstuffing yards need to be prepared in the dangerous cargo yard.

1.2.4 Area for Cargo-Handling Machines

In the Short-Term Plan, most of the existing facilities for cargo-handling machines in the west quay will be kept intact. On the other hand, the area for the existing facilities for cargo-handling machines near transit sheds No.11 and No.12 in the east quay will be converted into the marshaling yard for containers, Terminal No.3. Instead, an additional area for cargo-handling machines will be allocated south of transit shed No.15. In the stage of the Short-Term Plan, the following areas the same as the existing areas as a total, will be used for cargo-handling machines (see Fig. 1-2-1):

Area for Cargo-handling Machines	Area (sq. m)
Area No.B1	12,500
Area No.B2	29,800
Area No.B7	12,200
Total	54,500

The existing gas station for cargo-handling machines in area No.B2 and the canteen in area No.B5 will be kept intact.

1.2.5 Parking Lots

The following parking lots are planned in the framework of the Master Plan and taking account of the availability of the required land up to the stage of the Short-Term Plan (see Section 10.2.5 of Chapter 10 of Part I):

- Unit area for a parking lot including passages:
  - Passenger car: 18.0 sq.m/vehicle
  - Tuck/tractor-chassis units: 91.0 sq.m/vehicle
- Parking capacity:
  - Parking Lot No.2-1 (near Checking Post 2): 8,400 sq.m: 90 trucks
  - Parking Lot No.2-2: 4,960 sq.m: 60 trucks

- Parking Lot No.2-3: 3,070 sq.m: 80 tractor-chassis units (270m/3.25m)
- Parking Lot No.1 (near Checking Post 1): 19,200 sq.m: 1,070 passenger cars
- Parking Lot No.3 (behind the dangerous cargo yard): 13,300 sq.m: 150 Trucks
- Total capacity: 1,070 passenger cars
  300 trucks
  80 tractor-chassis units

An additional gate will be prepared near parking Lot No. 2-3 near Checking Post 2 (see Fig. 1-2-2). Signals must be installed at the intersection crossing with the common road and siding railway outside the port running along the customs fence. The new gate will be mainly used for trucks to receive import conventional and LCL cargoes at the sheds of the west quay excluding the Import CFSs to be located along Ajnarong Road. Furthermore, a gas station for passenger cars and a canteen will be prepared adjacent to Parking Lot No.1 near Checking Post 1.

1.2.6 Area for Offices near Checking Post 1

Along with relocation of Checking Post 1 and the port road through the post, the following offices must be also relocated:

	Floor space (sq.m)	Planned number of stories	Required site area (sq.m)
Fire Station	250	2	125
Common use building	2,300	3	767
Import Examination	(900)		
Export Inspection	(250)		
Harbor Section	(400)		
Vehicle Section	(500)		
Craft Service	(250)		
Total	2,550		892

1.2.7 Railway Yard

As mentioned in Section 1.2.1, the railway operations presently conducted at the east quay is planned to be transferred to west of the west quay in the stage of the Short-Term Plan. It is necessary to install one siding railway line of an effective length of 110 meters of which both ends must be connected to the existing siding railway line running along the customs fence and in the direction of the apron at the west quay.

Between the existing and new railway lines, a 20 meter wide yard for discharging/loading break-bulk or container cargoes from/into railway wagons will be prepared. Another a 20 meter wide yard for discharging/loading containers or break-bulk cargoes from/into railway wagons will also be prepared behind the new railway line. Container cargoes brought into the port in break-bulk condition by railway covered wagons can be stuffed directly from the railway wagons into container boxes on chassis which are laid in touch with the railway wagons. Adding space necessary for installing railway tracks, the resulting dimensions of the railway yard including part of the above existing siding railway line are as follows (refer Section 10.2.7 of Chapter 10 of Part I):

- Length: 110m
- Width: 50m
- Area: 5,500 sq.m

1.2.8 System for Handling Conventional Cargo

(1) Handling of Steel Products

To improve present inefficient operations on land side, it is proposed to prepare sufficient open storage yards behind berths of the west quay and to use forklifts with appropriate attachments in the stage of the Short-Term Plan. Swift cargo-handling operations can be achieved by using forklifts inside ships' holds. It is also effective for the swift operations to introduce conventional vessels equipped with ship cranes. By adopting these measures, a lifting lot size could be increased from the present level of around 2-3 tons to around 5 tons, resulting in swift operations.

(2) Handling of Various Kinds of Cargoes Stored in Sheds except for Steel Products

To improve the cargo-handling productivity, it is necessary to promote unitization of the package type such as containerization and palletization.

Swift cargo-handling operations can be achieved by using forklifts inside ships' holds as the case of steel products. It is also effective for the swift operations to introduce conventional vessels equipped with ship cranes. By adopting these measures, a lifting lot size could be increased from the present level of around 1 tons, resulting in swift operations. It is also effective to use appropriate slings for lifting cargoes for efficient handling.

As to discharging on a barge side, it seems also difficult to improve cargo-handling productivity from the present level as long as small barges will be used as present.

(3) Required Number of Machines Handling Conventional Cargoes

The required numbers of machines for handling conventional cargoes in the stage of the Short-Term Plan are shown as follows (see Chapter 10, Section 10.2.7 (3) of Part I):

	Required Nos.
- Forklifts (5-10 tons)	28
- Forklifts (5 tons)	14
- Forklifts (3 tons)	18
- Tractor-trailers/trucks	33

1.2.9 Usage Plan of PAT's Dolphins and Buoys

The following usage plan for handling conventional cargoes at PAT's dolphins/buoys in the stage of the Short-Term Plan is proposed as follows:

- Usage of the Dolphins/Buoys both for Imports and Exports

  As mentioned in Chapter 8, Section 8.7 of Part I, the volume of import cargoes in 1997 is estimated as 2.9 million tons. Compared with the cargo-handling capacity of 5.2 million tons of the facilities mentioned above, exports of 2.3 million tons can be received there in the target year.

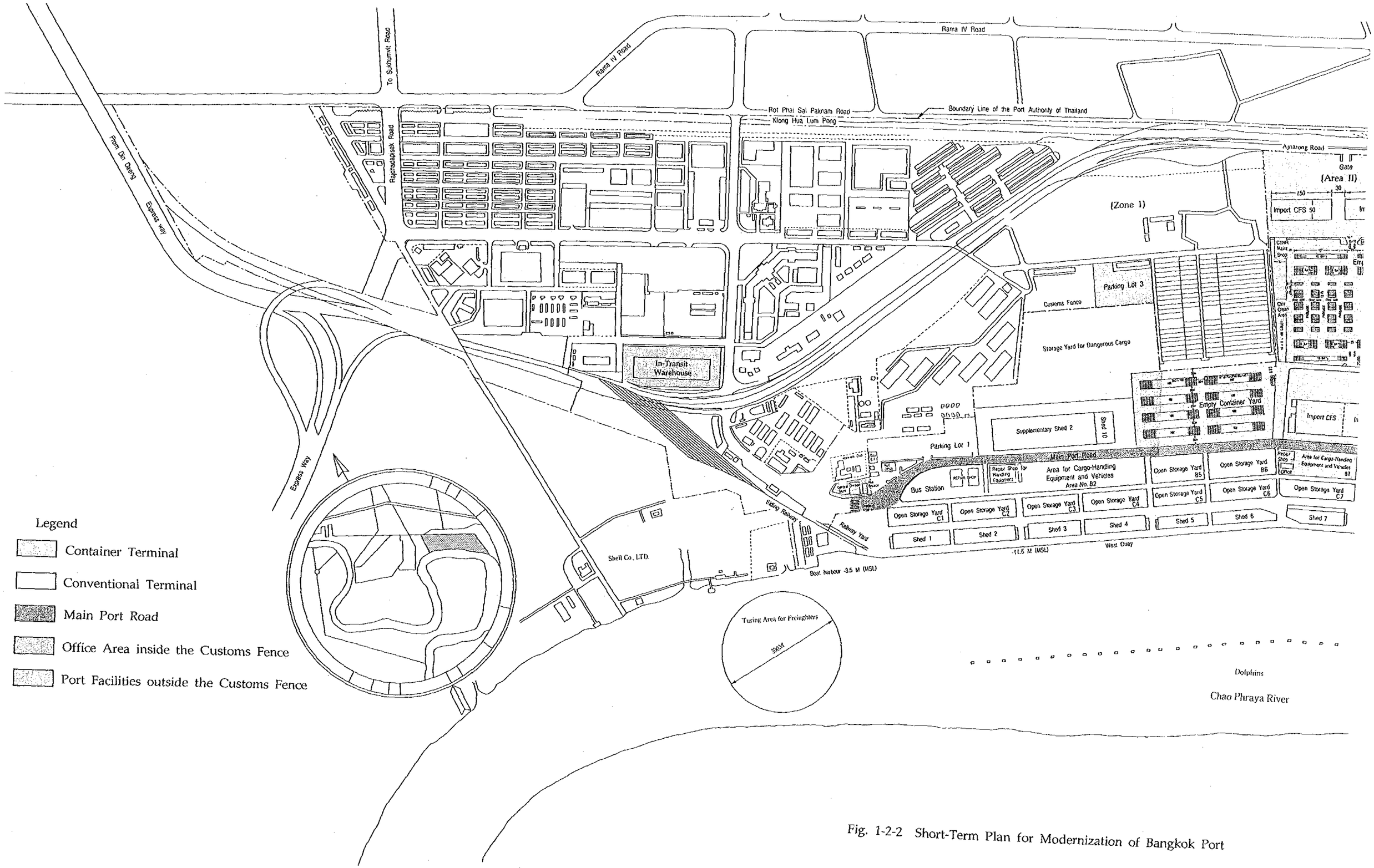
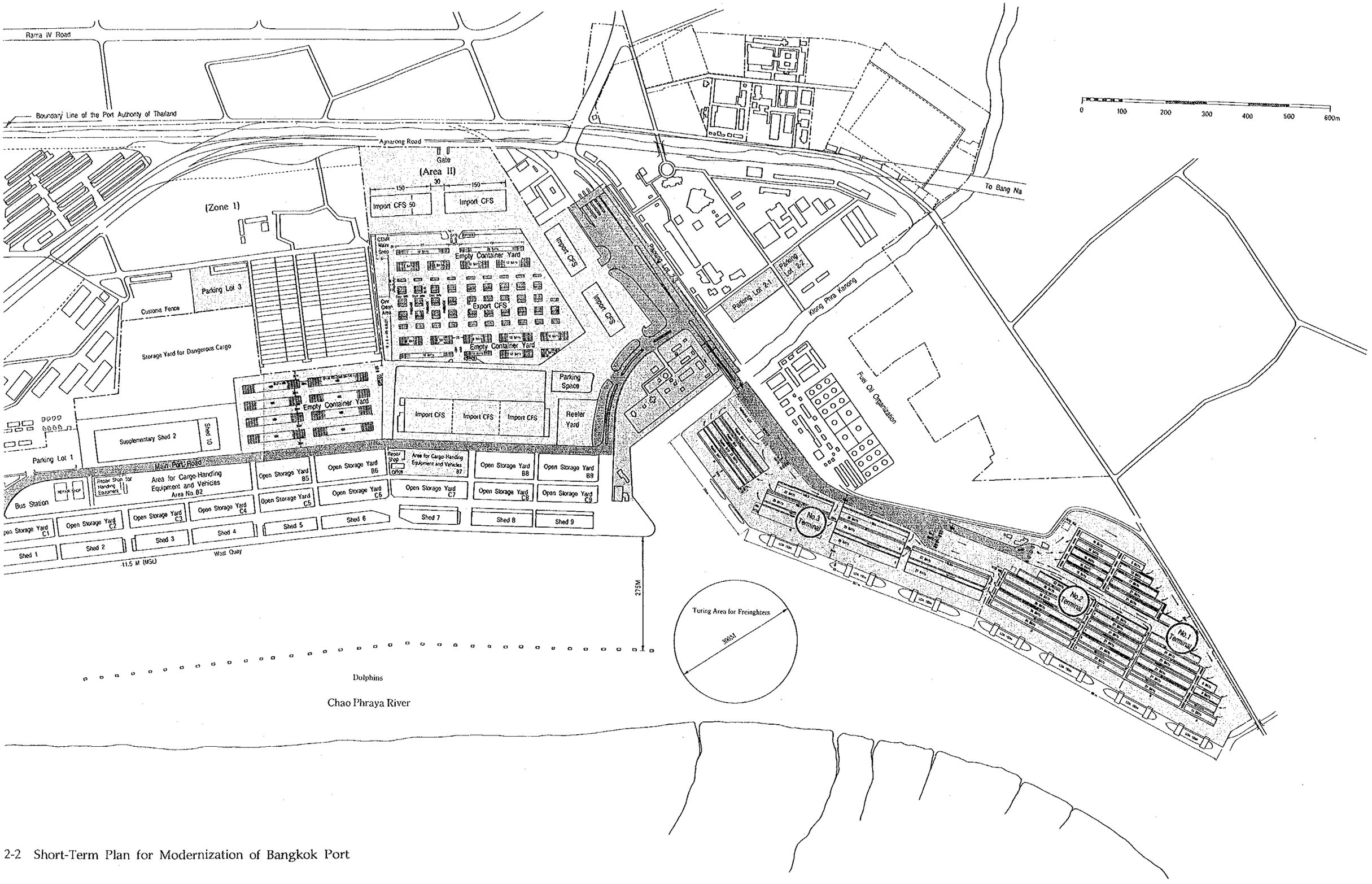


Fig. 1-2-2 Short-Term Plan for Modernization of Bangkok Port



2-2 Short-Term Plan for Modernization of Bangkok Port

1.3 Short-Term Traffic Planning

1.3.1 Forecast of Traffic Volume

According to the assumption of measures in Chapter 12.2 of Part I, traffic volume generated from port operations in Bangkok Port is summarized as follows;

a. Container and conventional cargo traffic (see Fig 1-3-1)

a.1 Traffic volume of container cargo (unidirectional)

*Peak volume/day ---------- 4,610
*Peaking factor/hour ---------- 3
*Peak volume/hour ---------- 580

Remarks: The above peak volume includes empty trucks and ex-cludes passenger cars and motorcycles. Volume/day and peaking factor/day are taken from the results of simulation mentioned in Chapter 1.1. Peaking factor/hour is taken from the traffic investigation by the study team. Average volume/day includes general trucks passing through truck side gates at the CFSs.

a.2 Traffic volume of conventional cargo (unidirectional)

*Peak volume/day ---------- 680
*Peaking factor/day ---------- 1.48
*Average volume/day---------- 460
*Peaking factor/hour ---------- 2.5
*Peak volume/hour ---------- 70

Remarks: The above peak volume includes empty trucks and ex-cludes passenger cars and motorcycles. Volume/day and peaking factor/day are taken from the results of simulation mentioned in Chapter 1.2. Peaking factor/hour is taken from the traffic investigation by the study team.

b. Business traffic (motorcycles and passenger cars)

b.1 Traffic volume of motorcycles (unidirectional)
*Peak volume/hour ---------- 140 Vehicles/hour

Remarks: The above peak volume/hour is expected to decrease to 10% of the present peak volume/hour investigated by JICA Study Team due to the reduction in document transfer for container cargo which is presently conveyed by

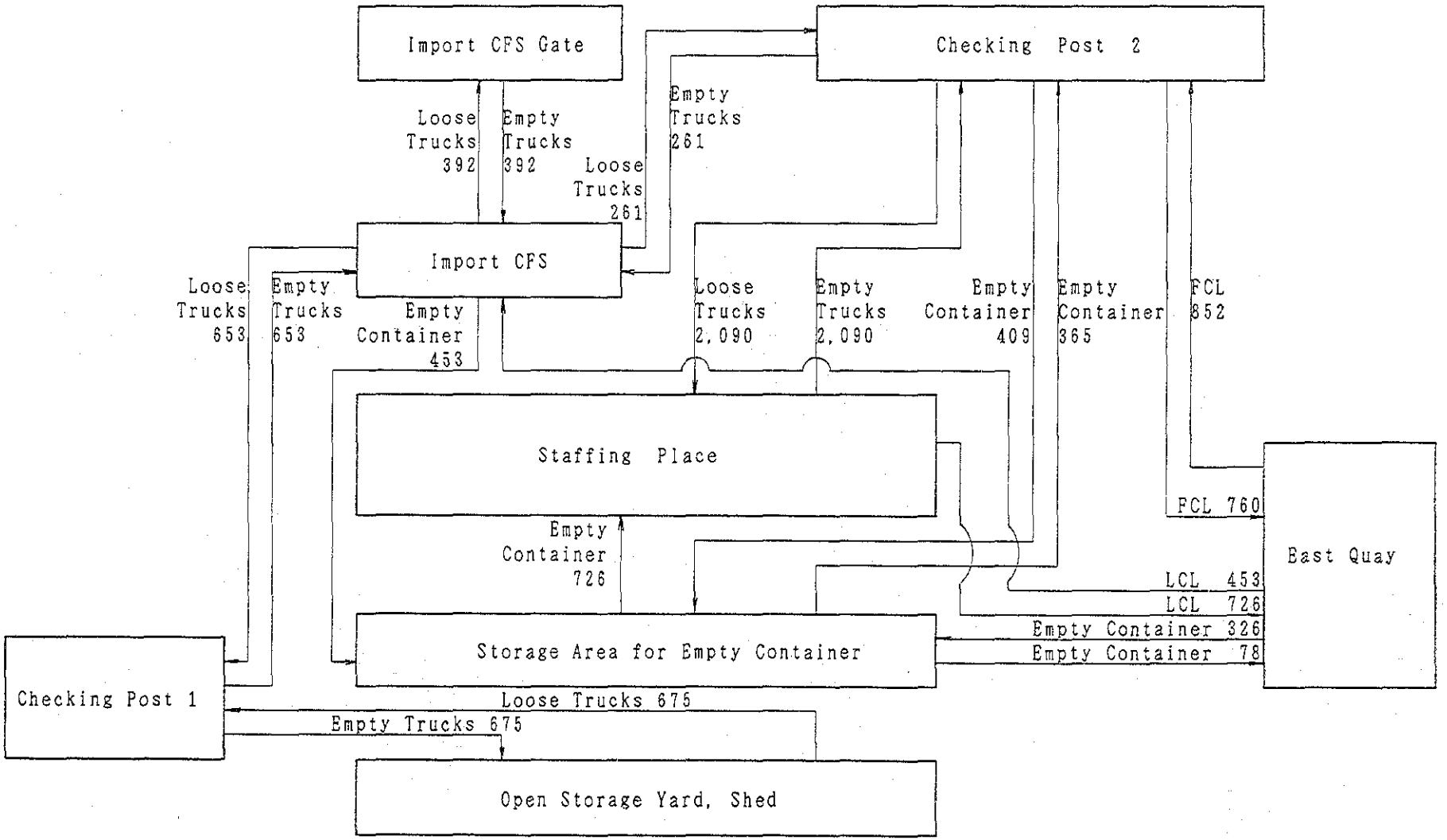


Fig. 1-3-1 Movement of Container and Conventional Cargo Traffic (Peak Volume/Day) Year 1997

motorcycles and will be replaced by communication using computers in the stage of the short-term plan.

b.2 Traffic volume of passenger cars (unidirectional)

*Peak volume/hour(Checking Post 1) ----- 650 Vehicles/hour
*Peak volume/hour(Checking Post 2) ----- 490 Vehicles/hour

Total 1,140 Vehicles/hour

Remarks: The above peak volume(Checking Post 1) is 90% of the present peak volume investigated by JICA Study Team, according to decrease in percentage of total cargo volume in 1997.

c. Traffic through main gates (Checking Posts), the bridge connecting the west and east quays and truck side gates at CFSs

From above-mentioned traffic volume, following peak volumes/hour by vehicle type are found at each location (unidirectional).

c.1 Main gate 1 (Checking Post 1)

*Tractor-trailer units and trucks ---------- 150 Vehicles/hour
*Passenger cars ---------- 650 Vehicles/hour
*Motorcycles ---------- 140 Vehicles/hour

Total 940 Vehicles/hour

c.2 Main Gate 2 (Checking Post 2)
*Tractor-trailer units and trucks ---------- 450 Vehicles/hour
*Passenger cars ---------- 490 Vehicles/hour

Total 940 Vehicles/hour

c.3 Bridge connecting the west and east quays
*Tractor-trailer units ---------- 120 Vehicles/hour
*Passenger cars ---------- 250 Vehicles/hour

Total 370 Vehicles/hour

c.4 Truck side gate at Import CFSs

*General trucks ---------- 50 Vehicles/hour

1.3.2 Port Traffic Facility Plan

(1) Number of port road lanes

Sections for number of lanes are considered on W-Section, E-Section and B-Section. W-Section is on the main road from the main gate 1 (Checking Post 1), E-Section is near the main gate 2 (Checking Post 2) and B-Section is on the bridge (see Fig.12-3-1 of Part I).

In terms of volume of each section, peak traffic volume per side is 850 vehicles/hour on W-section, 940 vehicles/hour on E-Section and 370 vehi-cles/hour on B-section. These figures are expected to change greatly between the short-term and master plan, thus the number of lanes is the same for both cases.

(2) Number of lanes at Checking Post 1

Control of Checking Post 1 is conducted by PAT, ETO, Custom and Agriculture Ministry (only for agricultural products) for import cargo trucks present-ly. According to the results of JICA team investigation, inspections take an average of 1 minute per truck at Checking Post 1, therefore, given that 150 vehicles/hour (import cargo trucks) are currently inspected 3 lanes are necessary. Meanwhile, for empty trucks and passenger cars, 2 lanes in both directions are necessary. According to the results, 2 inbound lanes are necessary for empty trucks and passenger cars, and 5 outbound lanes are required (2 lanes for passenger cars and 3 lanes for import cargo trucks); therefore a total of 7 lanes is necessary at Checking Post 1.

(3) Number of lanes at the truck side gate of the Import CFSs

Traffic volume of cargo trucks at the import CFSs is 1,306 vehicles/day (unidirectional), however depending on the position of truck side, these vehicles distributes among the three gates (See Fig 1-3-1). Traffic volume at the truck side gates at the CFSs is forecast at 50 vehicles/hour in the short-term plan, therefore 2 lanes are required (including 1 extra lane for smooth traffic from/to access road of the expressway).

Chapter 2 Information System

2.1 Introduction

PAT is required to develop a cargo container software system at the urgent request of related bodies. For the purpose of wining a victory of competition with other container terminal, PAT should computerized the container terminal operation and upgrade the services to the customer.

Computerization is a very important factor for the modern container terminal but is not sufficient in every respect. The most important factor is the personnel who have the knowledge and experience as container terminal operator, however PAT has no staff at present. Practical use of the private companies is necessary for problem solving and future development of computer software.

In this chapter, the study team has limited the scope of the software development to smooth and accurate operation of the marshalling yard.

2.2 Documentation

In the present circumstances in which container terminals must handle ever increasing amounts of information, numerous documents are made and submit-ted by each party concerned. Such paper work is costly, time-consuming and fraught with errors. Once errors are keyed into a computerized data-processing system, such input data can not be easily corrected, because it is very difficult to find these errors once they have gone into the final processing flow. Thus it is very important to install a reliable verification system before and after input operation.

Data Communication, EDI (Electronic Data Interchange) or other systems e.g. diskette, will increase efficiency and accuracy and thereby prevent errors from occuring.

Once the data is captured in data storage devices which have the ability to send or receive information to or from computer, there is no possibility for error and the data can be used repeatedly immediately or in future. While creating cargo container file, the data is classified according to the requirements as to the first priority data, secondary one and others.

Below is a sample of the classification

First priority data

- Operator
- Ship's Name
- Voyage Number
- Container Number
- Weight
- Port of Destination
- Container Size
- Container Type
- Kind of Cargo
- Container Status

Secondary data

- Dangerous Goods Classification
- Reefer Cargo Setting Temperature
- Reefer Ventilation Status
- Over Dimension
- Ship's Location
- Gate in Date/Time
- Loading Date/Time
- Discharging Date/Time
- Gate out Date/Time
- Yard Location

Others

- Shipper Name
- Consignee Name
- Forwarder Name
- Botanical/Zoological Quarantine
- Container Material
- Custom Clearance
- Vehicle Number
- Trailer Number
- Shed Number
- Shed Location
- B/L Number
- Booking Number
- Vanning Place
- Devanning Place
- Seal number
- Container Repairing
- Stuffing Date
- Unstuffing Date
- Document Number
- Document Date

It is advisable that PAT designate a committee responsible for reaching a consensus between parties involved on unifying various operational procedures, documentation forms, and data record lay out.

The way of improvement and rationalization for the documentation is as follows:

(1) Simplicity

To decrease the number of data elements

(2) Combination

To combine two or more documents into one document

(3) Replacement

To replace the present document with a new document

(4) Abolition

To abolish unnecessary/redundant documents and functions

(5) Unification

To adjust present document form to standard form

2.3 Container Terminal Computer System

2.3.1 Software Developing in Short Term Plan

1. Tally In/Out Control System

   Tally In/Out Control System is designed to confirm container number which is handled by gantry crane for both loading and discharging. All gantry cranes are equipped with terminals which are directly linked with the central computer system by wireless radio data communication equipment. Introduction of computer system would ensure reduction of repeated works and quick preparation of reports and statistics, having container numbers which are discharged from ships and loaded onto ships.

2. Sub Gate In/Out Control System

   Sub Gate In/Out Control System is designed to ensure smooth, accurate and efficient gate operation for road receiving and road devivery containers. Introduction of computer system would make it possible to confirm container number and to print out slips, i.e., EIR (Equipment Interchange Receipt), location slip, etc., for passing containers through sub gate, in addition reports and invoices could be made.

3. Indication of Yard Condition and Slot Control System

Indication of Yard Condition and Slot Control System is designed to display the present stacking condition of the containers in the unit of yard, area, lane and bay. The lane display indicates how many tiers containers are stacked in at each location, and bay display indicates each container number with some necessary data for making stacking plan. Introduction of computer system would help the yard operator to make container stacking plan, marshalling plan for export container, and bulldozing plan for import container.

4. RTG Optimum Arrangement System

RTG (Rubber Tired Gantry Crane) Optimum Arrangement System is designed to indicate RTG allocation on the area and lane display in Indication of Yard Condition System. Introduction of computer system would help the yard operator in deciding optimum arrangement of RTG.

5. Ship Loading and Discharging System

Ship Loading and Discharging System is designed to make ship loading, discharging and restow plan. Introduction of computer system would help the yard operator to make ship loading and discharging plan, Gantry crane and RTG sequence plan, and lists, i.e. loading container list, dangerous container list, reefer container list, etc.

6. Stevedore Control System

Stevedore Control System is designed to make sequence list for onboard stevedoring work.

7. Automated Container Terminal System

In a growing number of container terminals information, progress and productivity are increasingly dependent on the close interaction of operators, sharing and accessing computational resources across networks. Systems that will contribute to more effective operation of container terminals in PAT are introduced as follows:

(1) Yard operation Computer System

Containers handling equipments will be linked by radio data terminals which provided field personnel with direct access to the Yard Operation Computer System (YOCS). In other words, the YOCS will allow field personnel to obtain work instruction messages for the on-board radio data unit. The work instruction messages are compiled for available container handling equipment automatically and effectively routed by the YOCS's equipment optimization logic. Real yard operations are monitored by terminal managers on a larger high-resolution color graphic screen in the office.

(2) Data Transmission System

The on-board radio data unit communicates with the YOCS all the time via the RF data communication system or the spread-spread-spectrum system. This technology is incorporated into the Data Transmission System (DTS). The on-board unit is mounted either in the operator's cab or in the yard clerk's truck and displays the location of containers in the computer while providing receiving/delivery, shifting and loading/discharging work instructions to the field personnel.

2.3.2 Data Transfer

EDI (Electronic Data Interchange) has become a common information infrastructure for people around the world. With the advance of world economies, international business deals have accelerated, and it is getting difficult to handle such business in the traditional ways, based on the documents, even when the work flow is managed by computer. In addition, cargo transportation by air is not a special case anymore and shipping, trucking and railway transportation have been advanced remarkably in terms of speed and volume. EDI realizes interchanging large quantities of data using computer and electronic communication.

The reasons for using EDI are said to be as follows:

1) Acquisition of information and quick response
2) Cost performance
3) Customer's request
4) Less document work and the pursuit of speed
5) Accuracy
6) Improvement in communication

Electronic Data Interchange (edi) is a set of rule-based and automated transmissions of structured data among information management domains. PAT will have to investigate the trend of EDI in Thailand before setting up the system.

An integrated information system, which can greatly contribute to container cargo handling and connect related bodies is one of the great and common concerns.

2.3.3 Effectiveness of Computerization

The following functions are expected to be achieved after installing a computer system in the container terminal.

- On-line gate control and EIR printing
- Container tracking and yard inventory control
- Optimum positioning of RTG
- Determination or checking of yard stacking address for receiving and delivering containers
- Ship loading and discharging support
- Inquiries, reports and billings
- Electronic Data Interchange with trading partners

2.4 Strategy of Software Development

In the software development field, it is not too much to say that the most important investment to be made is in education. Technological innovations, which refer not only to the technology itself but also to a comprehenpsive proroject, are penetrating rapidly into the business world. In creating a program, system specifications should be prepared starting from explaining how each item that appears on a report or a display is derived and from what it is derived. Input specifications explain where input comes from and how it is to be used in the system. Any algorithms, formulas, or calculations should be clearly defined. The overall logic of the system should be specified either in a flow diagram or a decision table. A data flow chart should be prepared to show how data flows through the system.

The level of knowledge and experience of PAT staffs as container terminal operator is not sufficient to operate all tasks by themselves at present. In other words, PAT has no senior system engineers who realize the full potential of computing in container terminal operation. However, PAT is required to develop a cargo container software system at the urgent request of related bodies.

It is advisable that PAT purchases the package software to meet the demand of the age. The proven package software based system is the most benefi-cial solution to PAT for upgrading the existing system and minimizing lead time on investment.

PAT will have to train its stuffs in cooperation with skilled terminal operator and gradually extend the limit of their duties in accordance with upgraded skill of staffs. PAT has to recognize the importance of human resources. Employees who have a thorough knowledge of the job are indispensable for future software development.

Chapter 3 Port Management and Operation

3.1 Management and Operation System in the Short-Term Plan

3.1.1 Relation with Management and Operation System in the Master Plan

As mentioned in the Master Plan, it is proposed that container terminal including CFSs be operated by a single terminal operator for its efficient operation with sufficiently skilled personnel and sufficient equipment. In the Master Plan, it is recommended from the long term point of view that the newly established organization founded by PAT operate the terminal in an efficient manner. However, under the status quo PAT takes charge of only the physical shoreside cargo handling and does not carry out overall control of the container terminal including yard planning and inventory control of containers which are essential for a modernized container terminal. Hence it is necessary for PAT to obtain know-how of overall control of the container terminal as soon as possible and to prepare the establishment of the above new organization. Since Bangkok Port is the largest container port in Thailand and it is impossible to stop its operation even for a moment due to some disturbance which might be caused by shifting of complete operations to PAT before PAT will perfectly acquire know-how, arrange its organization and prepare competent personnel to operate the terminal. Thus, such shift should be made in a cautious manner.

With this in view, it doesn't seem practical for PAT or the new organization founded by PAT to start the complete terminal operation immediately after facilities proposed by the Short-Term Plan will have been prepared, namely in 1997. A transitional stage for smooth shifting of the complete operations should be considered toward the Master Plan.

3.1.2 Terminal Operator

In the transitional stage for smooth shifting of complete operations to PAT mentioned above, the following two alternative cases of a proper terminal operator are considered.

(1) Case 1 (Operation by PAT)

In this case, all operational business for each divided terminal is carried out solely by

PAT. PAT would be required to hire some experts to acquire know-how for operations at its own expense. Employees of PAT would acquire know-how through on-the-job training. Shipping lines/agents who used to take charge of planning and control business would no longer directly take part in the operation.

(2) Case 2 (Operation by Cooperation of PAT and Shipping Lines/Agents)

This case assumes that one of the divided terminals is operated solely by PAT using method mentioned in the above case (1) and that other terminals are operated by cooperation of PAT and shipping lines/agents as at present. They would utilize the information system equipped by PAT for operations. However, this is just a provisional situation because PAT is essentially responsible for operations. So sooner or later, PAT is required to operate the other terminals by itself, and the operation for them is taken over by the newly established organization founded by PAT at the time of the Master Plan.

When the two cases are compared, case (1) includes a quite drastic change in which PAT carries out all kinds of terminal operation works at the time when facilities for the Short-Term Plan are completed.

Considering the importance of Bangkok Port to the Thai economy, container handling operations at the port cannot be stopped even for a moment. Therefore, Case (2) is considered to be practical and preferable.

PAT has an idea to divide the east quay into several terminals and to operate one of the terminals (which is now used as a public use) by itself and to entrust shipping lines with operation of other terminals. This idea is not contradictory to Case (2) fundamentally.

In all events, it is necessary for PAT to cooperate with port users in introducing these operation methods. So PAT is required to keep in close contact with them and to make efforts for smooth operation by respecting the opinions and requests of port users.

3.1.3 Period of Establishment of the New Organization

It is not considered appropriate that the new organization mentioned in the Master Plan is established in the stage of the Short-Term Plan with the target year 1997.

Since the new organization is formed by personnel and investment of PAT (100% at first), it is not appropriate to establish the organization until PAT can competently operate terminals. This will follow the acquisition of extensive knowledge of operations and the formation of the necessary management systems.

The following Table 3-1-1 shows the functional allocation of the terminal operation among PAT and others in the Short-Term Plan and the Master Plan.

Table 3-1-1 Functional Allotment of the Terminal Operation in Short Term Plan and the Master Plan

	Short-Term Plan(1997)	Master Plan(2005)
Operation Planning Container Inventory Work Checking Container Condition Documentation etc.	Private Company Partly PAT	New Organization by PAT
Cargo Handling on Board	Private Company	Private Company
Shoreside Cargo Handling	PAT	New Organ. by PAT

3.1.4 Personnel Development

No matter how great the modernization may be, it cannot succeed if personnel of PAT does not understand importance and necessity of the new system sufficiently. So as mentioned in Chapter 15 in Part I, it goes without saying that the present personnel training carried out by Personnel Development Center of PAT would be also improved in the Short-Term Plan to cope with the modernized operations i.e.; fundamental concept of modernization, planning know-how on yard control and stowage, new actual work flows of operations, new documentation system, new information system and so on.

The followings can be recommended as examples of effective methods for personnel development.

(1) To employ some expatriates who have experience of actual container terminal operations especially in yard planning and can transfer knowhow of the operations to PAT's staff through daily working for operations together with the PAT's staff.
(2) To select several suitable candidates and send them overseas to take training courses on the terminal operation. This method is most effective for staff who require a comparatively high level of technical knowledge in their fields.

3.1.5 Creation of New Tariff Items

By the modernization of the container terminal operation, new kinds of businesses such as cleaning and repairing of containers are added as duties to PAT's service. Naturally, new tariff items for those services are to be set up. Tariff levels should be determined by taking costs for services and tariff levels of Laem Chabang Port etc. into consideration.

3.2 Management and Operation except Container Terminals in the Short-Term Plan

As mentioned in the Master Plan, the west quay and shed behind it handles only conventional cargoes in the Short-Term Plan, too. The volume of the conventional cargoes handled will be 3.81 million tons in 1997 which is not a large increase compared with the present volume.

Although modernization such as rearrangement of usage of sheds, warehouses and open storage yards is required for more efficient port service in the west quay as mentioned in Chapter 1, it can be said that there is no need to change the port management and operation body, namely, PAT goes on managing and operating the west quay.

3.3 Reformation of Organization of PAT

3.3.1 Improvement of Headquarters' Function

As mentioned in the Master Plan, functions of headquarters which are in charge of important matters such as big projects, long-term development plans, finance (including tariff), important personnel affairs, and reformation of organization and implementation management of important projects etc. are to be improved or reinforced in the stage of the Short-Term Plan.

And talking about the functional allotment of headquarters and Bangkok Port/Laem Chabang Port, the same things can be proposed as mentioned in the Master Plan. That is, the two ports are to be given the necessary power and authority to discharge their duties excluding the above said important matters.

Figure 3-3-1 shows an example of proposed organization of PAT.

3.3.2 Reformation of Organization of Bangkok Port

In both the Master Plan and the Short-Term Plan, areas for handling of container cargoes and conventional cargoes are completely separated and handling methods of both cargoes are quite different. So for efficient operations, it is recommended that departments of container handling and conventional cargo handling be separated. As for container terminal operation, since the east quay is planned to be divided into three terminals which will be independently controlled, it is necessary to organize three operational divisions (units) corresponding to the respective terminals within the new organization, while it is advisable that small repair/maintenance of container handling equipment be carried out by a division common for the three operational divisions within the new organization.

In terms of restructuring cargo operation department of PAT, an example of the proposed organization is presented in Figure 3-3-2.

Moreover, as mentioned in the master plan, within Bangkok Port, it is also recommended that power and authority concerning routine businesses be entrusted to lower ranking officials as much as possible for smooth and efficient management.

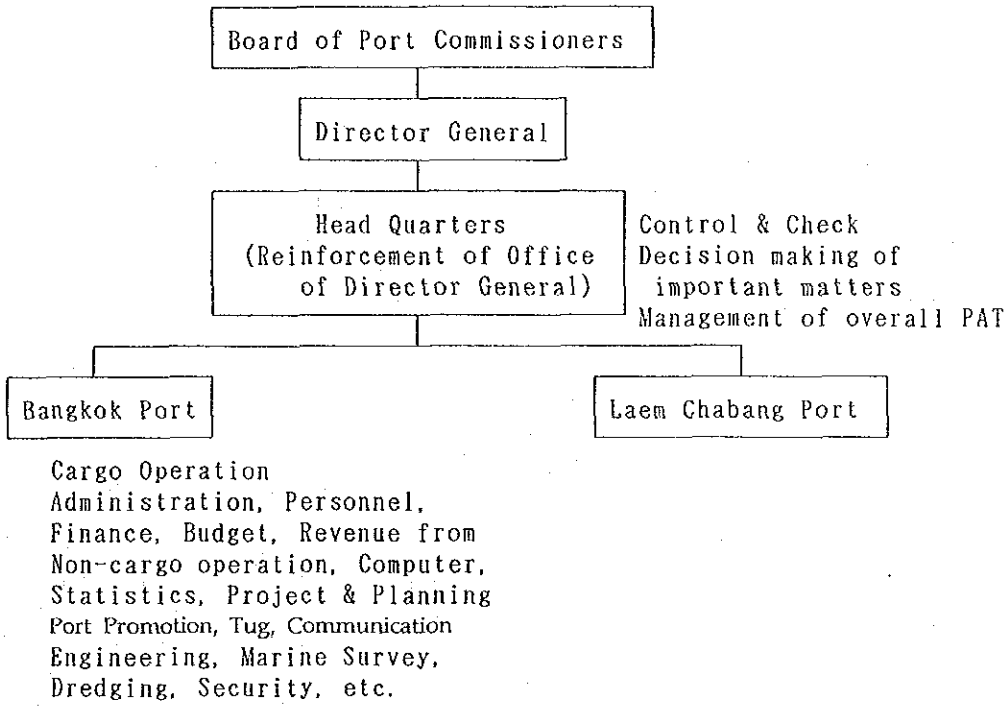


Figure 3-3-1 Outline of the PAT Organization

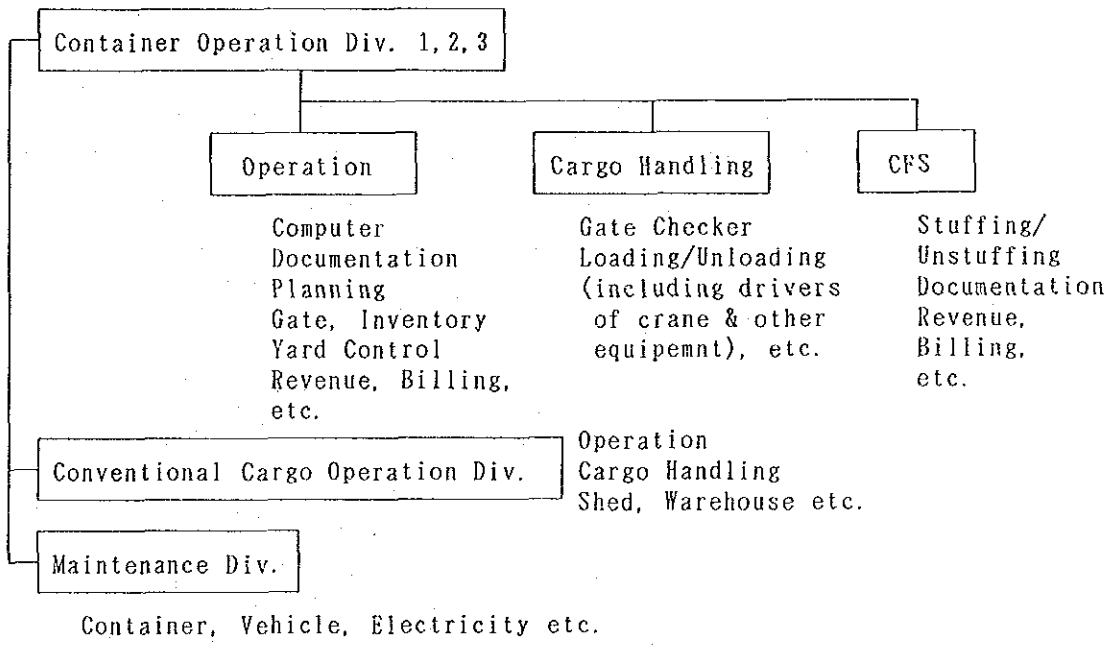


Figure 3-3-2 Outline of the Organization of Cargo Operation Department of Bangkok Port

3.3.3 Other Recommendations on Activities of PAT

In addition to the above mentioned reforms, recommendations mentioned in the Master Plan such as reinforcement of port promotion function, improvement of statistical system, introduction of quality control circles and proposal activities and improvement of personnel management and training system for activation of the organization of PAT are also effective in the Short-Term Plan.

3.3.4 Personnel

One of the purposes of container transportation is to curtail transportation period and manpower by utilizing cargo handling equipment for all steps of transportation works such as loading/unloading, handling and delivering/receiving etc. in place of manpower as in the past handling. Terminal businesses also include container stowage planning, yard planning, container repair & cleaning, maintenance of equipment and so on. Since a modernized container terminal can be operated efficiently with a limited number of personnel, it is possible to reduce the number of personnel who are currently engaged in cargo handling operations.

On the other hand, PAT has more than 3000 personnel in departments concerning port administration/management and engineering excluding operation departments like Bangkok Port Office. Roughly speaking, it can be said that the number is too large considering cargo volumes handled at the port. (For example, at a certain port in Japan whose cargo volume is more than 170,000,000 tons, the port is administrated/managed by less than 500 personnel excluding cargo handling operations.) This is partly because PAT under-takes several businesses such as many kinds of engineering works, marine survey, dredging and security etc. But in future, reduction of personnel can be promoted by business rationalization through introduction of machinery and entrusting of special, that is not routine, works to outside enterprises etc..

However, since a reduction of personnel is usually accompanied by social problems, drastic reductions should be avoided. It is advisable that this reduction be phased gradually such as through attractive voluntary retirement packages or scaled down recruitment.

3.4 Clarification of Responsibility for Container Damage

At present, repair and compensation for damaged containers and cargoes are carried out by shipping lines/agents and individual labours directly engaged in handling. As in developed container terminals in the world, PAT will be responsible for all damages caused by terminal operations when PAT operates terminals as a terminal operator. So PAT has to check damages of containers at gates and repair of containers and handling equipment and damages caused in terminals are repaired by PAT in the proposed maintenance shop or entrusted to external repair shops at its cost. Proper utilization of insurance is considered to be effective to cover these expenses.

3.5 One Stop Service

As proposed in Chapter 2 (Information System), documentation flows would be expected to improve drastically especially in the field of container operations at the stage of Short-Term Plan.

However, at present many kinds of documents with many copies must be submitted to each division and section in PAT by customers for cargo handling operations. Such complicated exchange of information among them is quite inconvenient for customers.

Therefore, as a transition stage toward the Short-Term Plan, it is recommended that PAT control flows of all documents for correct and quick delivery by receiving documents at one section of PAT and delivering them by itself (called "one stop service", now being studied in PAT).

At the same time, it also has an effect on reducing port traffic volume because all documents would be controlled by PAT instead of individual shipping agents.

Chapter 4 Environmental Impact Assessment (EIA)

The Short-Term Plan of Bangkok Port proposed in this study consists of the following.

1. Demolition Works in East Quay
2. Demolition Works in West Quay
3. Construction of Dry Container Yard in East Quay
4. Construction of Reefer Container Yard
5. Container Terminal Office Building No.2
6. Parking Lot near Container Terminal Office No.2
7. RTG Repair Yards
8. Gas station in East Quay
9. Road Pavement in East Quay
10. Modification of Existing Reefer Facilities
11. Fence and Gates in East Quay
12. Modification of Bridge and Access Road
13. Modification of Transit Shed No.13 & No.14
14. Construction of Maintenance Shop
15. Construction of Cleaning Yard
16. Preparation of Empty Container Storage No.1 (Export CFS)
17. Preparation of Empty Container Storage No.2
18. Construction of Office & Repair Shop for Container Handling Equipment
19. Modification of Transit Sheds No.1 to No.9
20. Construction of Open Storage
21. Construction of Main Road and main Gates
22. Construction of Port Office Building near Checking Post 1
23. Extension Work for fire Station (Fire Brigade)
24. Construction of Police Station
25. Gas Station in West Quay
26. Construction of Canteen Building
27. Construction of Parking Lot near Checking Post 1
28. Construction of Parking Lot near Checking Post 2

Basically, these items are only changes in land utilization and no construction works of basic port and harbor facilities such as wharves or breakwaters are included.

Moreover, estimated annual throughput in 1997, when the Short-Term Plan is completed,

is about 14 million tons, less than the present cargo throughput. The maximum size of calling vessels will not be changed.

Furthermore, total traffic volume in and around the port will decrease from the present level as is stated in Part I, Chap. 12. 1.
So basically the Short-Term Plan has a positive environmental effect, reducing a number of calling ships and induced road traffic.

Therefore EIA as an admimstration procedure will not be needed according to the authority concerned (Enviromental Impact Evaluation Division, Office of Environmental Policy and Planning).

In this study, three items are listed in Part I, Chap. 16 (IEE) as main items to be dealt with in the stage of the Master Plan. Two of these should be considered in the stage of the Short Term Plan.

1. Resettlement of squatters
   In the short-term plan, Area II will be converted into Import CFS area. As is described in Part I, Chap. 16, the area is now used as a residential area by squatters.
   For this area, an agreement has already been reached among squatters, National Housing Authority and Port Authority of Thailand to resettle the squatters from Area II to the new residences which the National Housing Authority has already prepared.

2. Sewage system
   As was described in Part I, Chap. 16, water pollution of the Chao Phraya River is a serious problem. Therefore, the installation of a sewage treatment system is recommended for the proposed terminal offices and the port office.

Regarding environmental impact at the construction stage, there will be no major item to be considered particularly. This is because all the construction works will be done only in the port area and only demolition works, pavement and construction of buildings are included in the Short-Term Plan.
Contractors of these works should take heed of regulations in Thailand regarding environmental consideration such as disposition of waste materials from demolition sites.

Chapter 5 Design and Cost Estimates

5.1 General

In the Short-Term Plan, the following existing facilities shown in "A: Demolishing Works" are going to be demolished and the new facilities shown in "B: New Construction Works" will be constructed and the existing facilities shown in "C: Modification Works" are required to be improved.

A: Demolishing Works

1. West Quay
    1) Checking Post No.1
    2) Police Station
    3) Harbor Service Sec.
    4) Craft service Sec.
    5) Import Control & Immigration Office
    6) Export Inspection Office
    7) Vehicle Section
    8) Supplementary Sheds No.1, 4, 5, 6, 7 & 9
    9) Bonded warehouse
    10) Bangkok Port Head Office
    11) PAT O.B. Building
    12) Quay Side Cranes No.1 to No.12
2. East Quay
    1) Repair Shop for Handling Equipment
    2) Gas Station
    3) Cargo Warehouse (Budget is already allocated by PAT)
    4) Transit Sheds No.11 & 12
    5) Reefer Container Storage Yard
    6) Railway

B: New Construction Works

1. West Quay
    1) 2 Import CFS Sheds (Budget is already allocated by PAT)
    2) Maintenance Shop
    3) Container Cleaning Area

4) Gates & Fence of CFS & Empty Container Storage Yards
5) Container Handling Equipment & Vehicle Area
6) Port Office Building
7) Gas Station
8) Canteen
9) Fire Station
10) Trunk Road
11) Open Storage
12) Checking Post No.1
13) Railway
14) Parking Lots
15) Repair shop and Office for Container Handling Equipment
16) Utilities

2. East Quay
1) Container Marshaling Yard
- Existing Building Area
- Surrounding Area
2) Reefer Container Storage Yard
3) 4 Transtainer Repair Areas
4) Terminal Office Building
5) Gates & Fence of Container Terminals
6) Gas Station
7) Utilities

C: Modification Works

1. West Quay
1) Transit Sheds No.13 & 14
2) Transit Sheds No.1 to 9

2. East Quay
1) Bridge

MAJOR CONSTRUCTING STRUCTURE

: PAVING AREA (Without Demolished Facilities Yard)

: CONSTRUCTING STRUCTURE

1. IMPORT CFS
2. CHECKING POST 1
3. GAS STATION
4. CANTEEN, FIRE VEHICLE GARAGE
5. PORT OFFICE BUILDING
6. REPAIR SHOP FOR HANDLING EQ
7. OFFICE FOR HANDLING EQ. DIV
8. MAINTENANCE SHOP
9. EMPTY CONTAINER YARD GATE 1
10. EMPTY CONTAINER YARD GATE 2
11. EMPTY CONTAINER YARD GATE 3
12. TERMINAL OFFICE BUILDING
13. TERMINAL GATE 3 (EXIT)
14. TERMINAL GATE 3 (ENTRANCE)
15. TERMINAL GATE 2
16. GAS STATION
17. TERMINAL GATE 1
18. MODIFICATION TRANSIT SHED No. 13, 14
19. RAILWAY
20. Customs Fence: ——
21. Yard Fence: — - —

Fig. 5-1-1 General Site Plan

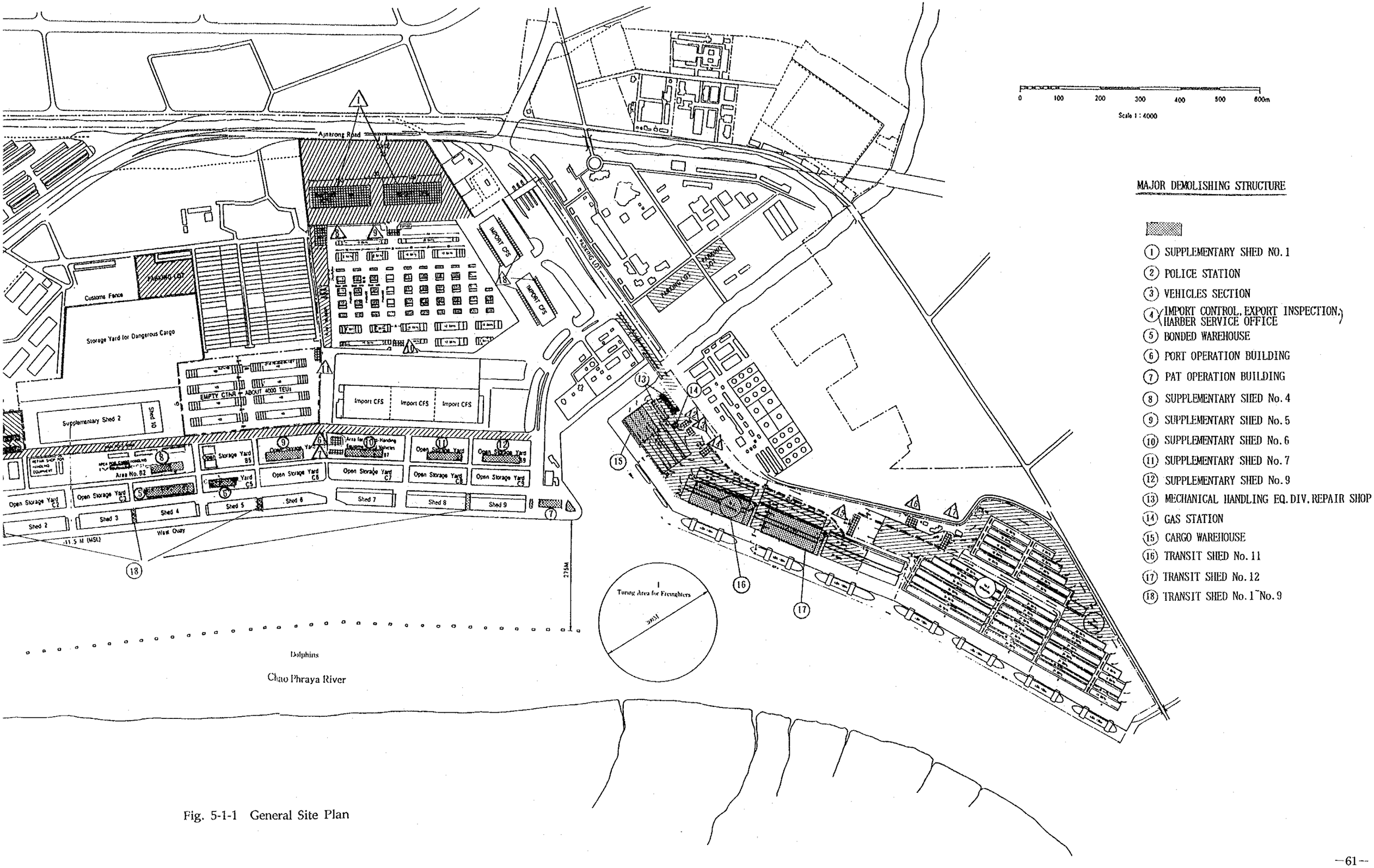


Fig. 5-1-1 General Site Plan