1.6.6 Present Conditions of Cargo Movements through Bangkok Port

(1) Containers

Most of the containers are discharged/loaded at the berths of the east quay. Small amount of containers are also handled at the berths of the west quay.

As to import FCL containers, the containers are stacked on the marshaling yard at the east quay after being discharged from container vessels. Presently, free rent for import container storage is three days, and therefore, most import containers are brought out within the free days from the premise of Bangkok Port to consignees' premises or ICDs in bonded conditions.

Import LCL containers are hauled to the CFSs or sheds behind the berths at the west quay after being discharged from vessels, and then unstuffed, stored, cleared and delivered to consignees. Average dwelling time of import LCL cargoes is about seven days.

Some portion of import LCL containers are hauled to the designated open yards surrounding CFSs or sheds, and then, stored, cleared, unstuffed and directly delivered to consignees without being stored in loose cargoes inside sheds (LCL direct delivery). Average dwelling time of import LCL-direct-delivery cargoes is about five days.

Import empty containers discharged from vessels are once stacked in storage yards for empty containers at the west quay, and then hauled directly to stuffing places inside/outside the port or the off-dock empty container depots.

On the other hand, export FCL containers are once stacked in the marshaling yard at the east quay before being loaded onto container vessels. According to the existing tariff, free rent for export container storage is three days and therefore, most of the export containers are stored within the free rent period. Some portion of export FCL containers are loaded onto container vessels without being stacked in the marshaling yard at the east quay, namely by so-called direct loading.

As to export LCL containers, it is roughly estimated that presently around 70% of the total number of the containers are once stored at the stuffing yards for two to three days on an average after being stuffed. Then, the LCL containers are hauled to and loaded onto container vessels by direct loading mentioned above.

(2) Conventional Cargoes

Most of the conventional cargoes handled at the west quay are import cargoes. After being discharged from conventional vessels, those conventional cargoes are once stored in the transit sheds, the open yards, or delivered directly to consignees by barges.

1.6.7 Information System

(1) The Present Condition of Information Business in Thailand

Thailand Computer Association reported that sales related to the information industry in 1990 reached 416.5 million dollars with an annual growth rate of 36.4 percent. Growth has been especially remarkable in the manufacturing industry and trading areas.

(2) Computerization of Port Related Bodies at the Present Time

1) The Port Authority of Thailand's (PAT's) IBM ES/9000 computer system came on line at Bangkok Port in December, 1992, and is responsible for the processing of salaries, accounts and budgets, import issue bills, export issue bills, miscellaneous issue bills and goods issue bills.

2) Customs presently has a computer system with a database for trade statistics and accounting. The system is on-line not only with its own divisions but also with the Ministry of Finance.

3) The State Railway of Thailand (SRT) utilizes a computer system responsible for the processing of salaries, accounts, statistics and seat ticketing reservations.

4) The Express Transportation Organization (ETO) utilizes a computer system for such internal works as salaries, accounts, revenue and statistics.

5) Shipping companies/agents utilize computer to control their management and operations. In addition, most of them have advanced computer systems which cover almost all the container operations in the port area including the necessary documentation, and also have world-wide information networks using computer and telecommunications.

As mentioned above, some shipping companies/shipping agents have highly advanced computer systems to support their management and operations. However computerization in port related business is not so advanced in general.

(3) Detail of Service Scope of PAT as a Container Terminal Operator at Present

PAT has been appointed as the operator of the container terminal, and thus takes charge of major roles in the container cargo handling at Klong Toei Wharves. All the shoreside cargo operations in PAT area are, in principle, to be executed by laborers and equipment belong to PAT. However due to insufficiency of resources, shipping agents have to provide laborers and equipment by themselves with PAT's permission. In addition, PAT has not yet proved successful as the operator of the container terminal and therefore, shipping agents themselves take charge of terminal operations and entrust physical cargo handling to PAT and stevedoring companies.

(4) Data Utilization for Computer

Along with container movements, numerous documents and information are made and submitted by each parties concerned.
The data described in these documents are keyed-in to computers at the container control center and stored in the main frame computer. The data are transferred to remote terminals within the on-line network. Where they are used for checking containers passing through gates. Data are not used however for yard control in PAT.

(5) Aspects of Future Development

To have competence and to be independent as the container terminal operator, PAT should declare the detail of its job and obligations. There are many divisions and sections related to container terminal operations within PAT. Exchange of information is complicated. Each division and section should study the necessary information and when such information is required for their job. It is advisable that PAT designates one section as a connective section with related bodies, assigns staff for study and educates them to become experts of container handling operations. Computer systems and advanced knowledge of shipping companies will be very helpful to PAT in the future.

1.6.8 Navigation System

(1) Regulations

Regulations concerning vessel sailing are found in 'Navigation in Thai Territorial Water Act(No.14), 1992' which has been issued by the Thai government. The points are as follows; vessels' speed in specified water shall not exceed that prescribed by the Harbor Master, there are restrictions, on front crossing of vessels sailing downstream, restriction on anchoring under certain conditions, and penal regulations for violations of the rule for preventing collision, grounding on 'International Regulations for Preventing Collisions at Sea'.

In addition, in order to maintain efficiency and safety in Bangkok Port, the Harbor Department prescribes regulations (B.E.2530, 1987) for practice and control of vessels in the Port of Bangkok. The points are as follows; pilotage is compulsory in the port limits, there are regulations for vessels concerning max. length and departing time, and draft restrictions.

(2) Navigational Aids

Navigational Aids such as leading lighted beacons, lateral lighted marks and distance beacons of the channels are properly arranged and are well maintained.

Also, 12 tug boats of 1,000 - 2,400ps owned by PAT are available to assist in berthing.

(3) Sea Accidents

The team has analyzed the reported sea accidents in Bangkok Port in the last ten years, by type/location and cause.
The most prevalent type is collisions between two vessels followed by collisions between vessels and lighters in tow. And, the distinctive feature of those accidents is that they can be found in places where the waterway is particularly narrow, sharply curved, traffic is jammed or around the turning basins.

1.6.9 Cargo-Handling System

(1) Container-Handling

Presently, at the berths of the east quay of Klong Toei Wharf, containers are discharged from or loaded onto container vessels by using rail-mounted container gantry cranes. At the berths of the west quay, containers are discharged from or loaded onto vessels by using ship cranes/derricks. There is a marshaling yard behind the berths of the east quay, and containers are mainly stacked there by rubber-tired gantry cranes of small size (4 row + 1 lane, 3 high stacking and 4 high over), and some portion of them by toplifters. Containers are hauled by tractor-chassis units between the marshaling yard and the berths.

On the other hand, to handle containers at the empty container storage yards of the west quay, toplifters or forklifts are used. Tractor-chassis units are used to bring in/out containers to/from the yards.

LCL cargoes are stuffed into or unstuffed from container boxes by laborers or forklifts of small lifting capacity.

(2) Handling Conventional Cargoes

As mentioned previously, most of conventional cargoes handled at the west quay are import cargoes. A large portion of the import cargoes are discharged directly onto barges by using ship cranes/derricks. A lesser portion of the import cargoes are discharged on land side. After being discharged on land side, some of them are shifted into sheds or open storage yards behind the berths by forklifts or combination of forklifts and trucks. Import steel products are loaded onto trucks directly from vessels and then hauled to Import Steel Open Storage Yard located outside the port and near Checking Post 1. Import cargoes for Laos are stored In-transit Warehouse adjacent to Import Steel Open Storage Yard.

1.6.10 Management and Operation

(1) PAT

The Port Authority of Thailand (PAT) is a Public Utilities State Enterprises under the Ministry of Transport and Communication and is the only agency which manages and operates the existing international ports: Bangkok Port and Laem Chabang Port.

The Government controls PAT and has authority of approval of important matters such as the construction of new port, the maximum and minimum limits of the tariff, the capital budget and loans etc.. In addition, the Government has the power and duty to order an inquiry into the facts concerning the management and to issue ministerial regulations, advice and instructions etc..

The organization chart of PAT and that of Bangkok Port are shown in Fig. 1-6-1 and Fig. 1-6-2, respectively.

PAT has more than 7000 personnel, of which more than 3300 personnel belong to Bangkok Port Office.

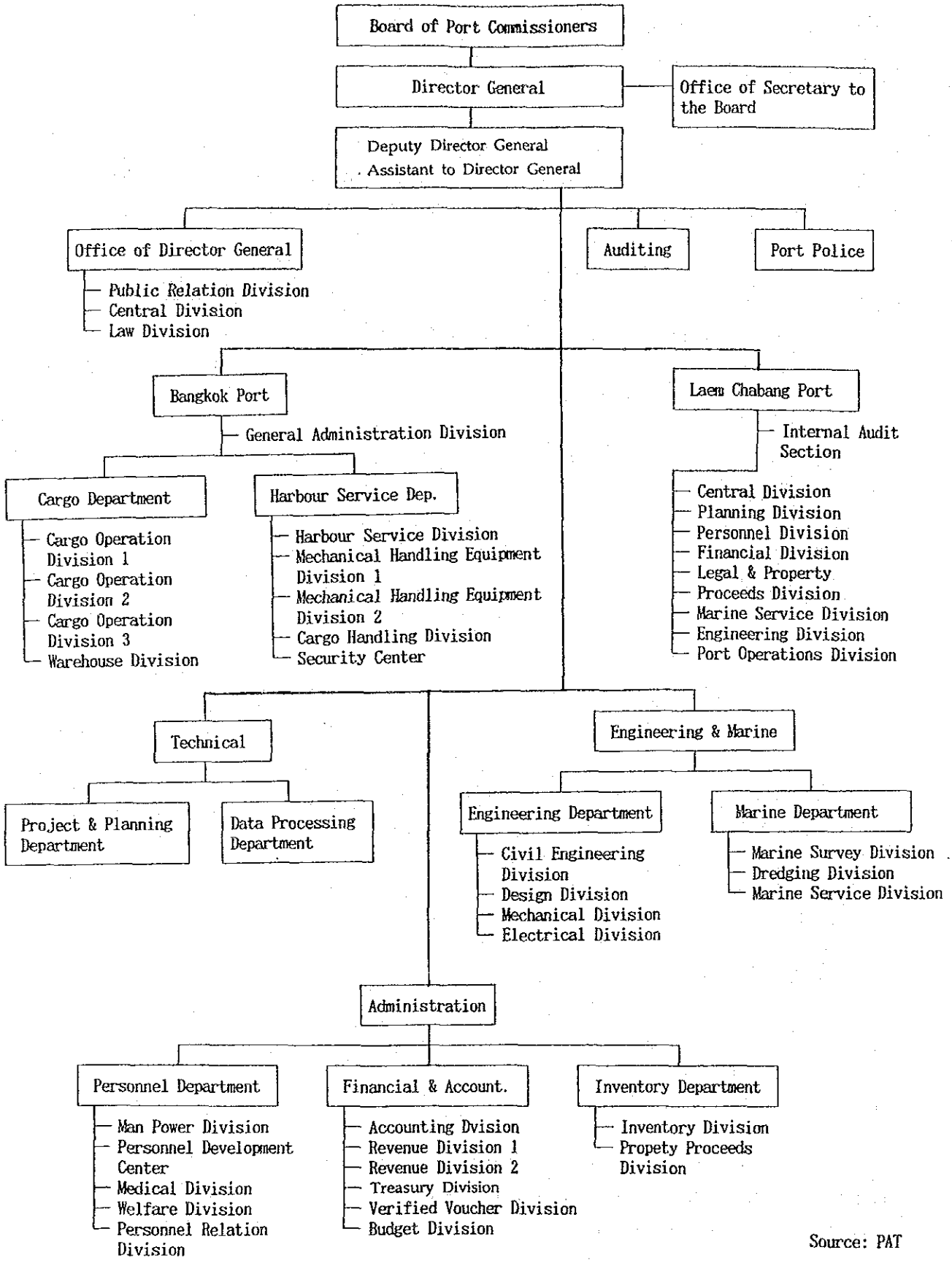
(2) Port Management and Operation

PAT provides various kinds of services such as cargo handling, berth assignment, hydrographic survey, dredging, communication service, tug service, water and electricity supply, telephone service etc.. Cargo handling service is available for 24 hours. Shoreside cargo handling is carried out by PAT with its own equipment and employees in principle, while cargo handling on board is done by private stevedoring companies.

Berth assignment and allocation of the transit sheds are decided by a meeting held every morning based on the principle of "First come, First serve". Vessels with general cargoes are berthed at the west quay, the dolphins and the buoys, while container vessels basically moor at the east quay. In order to mitigate the congestion of the port, PAT has applied a priority berthing right scheme which gives groups of shipping lines priority at container berths.

(3) Customs

For the customs clearance procedure, the advance entry system is applied in Thailand, namely, necessary documents can be submitted at any time prior to arrivals of vessels. Customs inspections of imported conventional cargoes are done in the PAT bonded area



Source: PAT

Fig. 1-6-1 Organization Chart of PAT

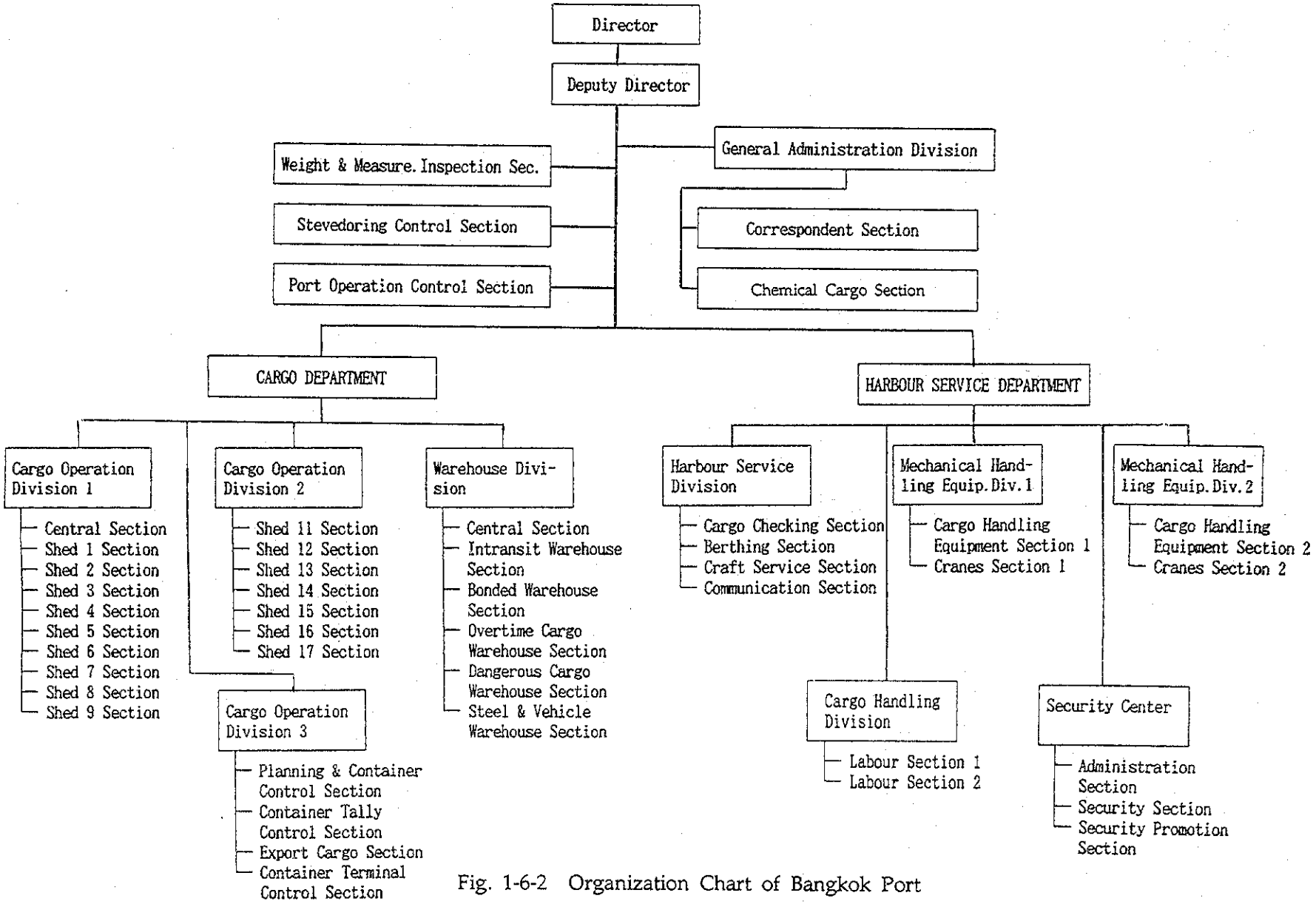


Fig. 1-6-2 Organization Chart of Bangkok Port

(sheds), importers premises or the lighter where cargoes are discharged overside. In case of exporting conventional cargoes, the inspections are done at the export customs inspection wharf, the lighters or shippers' premises. The inspections of imported and exporting containers are carried out at the PAT bonded area, CFSs, inland container depots, consignees'/consignors' premises etc.. Customs has standards for setting up the inland container depots for imports and off-dock CFSs/CYs for exports, which regulate qualification of the projecting body, required area and required equipment etc..

Bonded transportation is admitted when it is carried out by reliable forwarding companies with customs seals. It is not necessary for customs officers to accompany the containers but they are checked at the time of both departure and arrival.

(4) Port Charges

Port charges were revised in June, 1993. The tariff can be classified into five categories such as charges against ship owners/ship's agents and consignees/consignors, container charges and equipment hire/admission fee etc..

(5) Financial Conditions

PAT has been aiming at realizing self-supporting accounting and adopted a corporate accounting system. In recent years, PAT's net earning have been so large amount (that of fiscal year 1992 reached 2.4 billion Bahts) that PAT contributes 60% of the net earnings of the previous fiscal year to the Government.

1.6.11 Dredging

Access to Bangkok Port is through a 18 Km long bar channel. The design depth of the bar channel is 8.5 m below MSL and design width is 100 m in the straight reaches and 250 m in the bends. The river channel is 56 Km in length and 200 m to 400 m in width with a depth of more than 8.5 m below MSL.

PAT has 4 hopper suction dredgers for the maintenance dredging of bar channel and 1 bucket dredger and 2 clam shell dredgers for the maintenance of river channel. The main characteristics of the dredgers are as shown below.

Main Characteristics of Dredgers

Name of Dredger	Sandon 4	Sandon 5	Sandon 6	Sandon 7	Rua Khut 2
Year Built	1995	1956	1960	1990	1967
Hopper Capacity (m3)	2,000	750	2,000	2,500	-
Bucket Capacity (m3)	-	-	-	-	0.25
Length Overrail (m)	87.4	67.9	87.0	77.0	35.0
Mean Draft (m)	5.1	4.7	6.4	6.2	1.5
Dredging Depth (m)	14.0	14.0	14.0	14.0	10.0

According to the dredging report, the maintenance dredging volumes of the bar channel and river channel in last 4 years were as shown in table below. The volumes of the bar channel were estimated by the number of round trips made by the hopper suction dredgers, assuming that 75% of the capacity of hopper is the dredged volume of in-situ density. The volumes of the river channel which were dredged by the bucket and clam shell dredgers were estimated assuming that 100% of the capacity of hopper is the dredged volume of in-situ density.

Maintenance Dredging Volume of Bangkok Port

Year	Bar Channel	River Channel
1989	2,534,200m3	261,360m3
1990	5,071,650m3	255,940m3
1991	3,481,425m3	276,300m3
1992	4,306,575m3	304,419m3

Now, PAT has a plan to widen the existing bar channel from 100 m to 135 m, and has ordered 1 hopper suction dredger of 2,500 m^3 capacity named Sandon 8, which will be available by the end of July 1993. Upon completion of Sandon 8, the existing Sandon 4 and 5 are planned to be scrapped.

1.7 Conditions for Design and Cost Estimation

1.7.1 Design Standards

If there are prevailing design standards of Thailand or of other foreign counties in Thailand for the facilities concerned, these design standards shall be adopted for this study. Only when there are no prevailing standards for the facility, like a marine facility, the Japanese design standards such as "Technical Standards for Port and Harbour facilities in Japan" will be applied.

1.7.2 Design Criteria

1) Marine Facilities

- Maximum Objective Vessel
  - L.O.A. : 172 m
  - Draft : 8.2 m
- Tide at Klong Toei
  - H.H.W. : + 3.83 m
  - M.S.L. : + 1.72 m
  - L.L.W. : 0.00 m
- Live Loads
  - Quay Wall : 3.0 t / m2
  - Open Storage : 3.0 t / m2
  - Container Yard : 3.0 t / m2
  - CFS : 3.0 t / m2
  - Shed / Warehouse : 3.0 t / m2
- Wind Velocity : 20 m / sec.
- Dead Loads
  - Reinforced concrete : 2.45 t / m3
  - Plain Concrete : 2.30 t / m3
  - Steel : 7.85 t / m3
- Seismic Force : None

2) Port Buildings

- Live Loads
  - Office Building : 0.25 t / m2
  - Service Building : 0.25 t / m2
  - Stairways : 0.30 t / m2
- Wind Velocity : 20 m / sec.
- Seismic Force : None

3) Road and Pavement

- Live Loads

Road : 40' Container Trailer

Open Storage : 40 ton Top Loader and 3.0 t / m2

1.7.3 Cost Estimates

In recent years, the economy of Thailand, especially of Bangkok has been growing rapidly and the material costs and labour costs have been escalating at a high rate. Therefore, the estimation of construction costs for this project shall be conducted considering these trends carefully.

The construction costs of major works as of 1993 are estimated as shown below.

Construction Costs of Major Works

Work Item	Unit	Cost (Baht)	Remarks
1. Land Excavation	m3	23	Without transportation cost
2. Back Filling	m3	27	Without filling material cost
3. Concrete Piling Work	m	1,050	RC pile:450mm x 450mm
4. Steel Sheet Piling Work	m	111	Without material cost
5. Concreting	m3	1,542	Concrete: 210Kg/cm2
6. Concrete Form Work	m2	216	
7. Re-Bar Work	ton	15,200	SD 30
8. Asphalt Pavement(Light duty)	m2	369	6 cm thick
9. Asphalt Pavement(Heavy duty)	m2	880	5 cm+15 cm thick
10. Concrete Pavement	m2	980	25 cm thick
11. Concrete Pavement (Container)	m2	1,120	35 cm thick
12. Concrete Block Pavement	m2	750	12 cm thick block
13. Masonry	m2	150	
14. Structural Steel Work	ton	17,000	
15. Plastering Work	m2	110	
16. Painting Work	m2	65	
17. Roofing Work	m2	150	
18. Office Building	m2	12,000	
19. Transit Shed	m2	8,500	
20. Warehouse	m2	8,500	

1.8 Demand Forecast

1.8.1 Socioeconomic Frame for the Target Year

To prepare the Master Plan up to the year of 2005 and the Short-term Development Plan up to the year of 1997 of Bangkok Port, "Demand Forecast" is carried out to determine the cargo volume handled at the port in the target year.

(1) Population

The population of Thailand will reach 62 million in 1997 and 68 million in 2005.

(2) Economy

The forecast values of GDP in 1997 and 2005 are shown as follows.

Unit: Billions of 1988 Baht

	1997	2005
GDP	3,383	5,192
Agricultural sector	340	444
Manufacturing sector	1,046	1,630
Construction sector	226	365

1.8.2 Methodology for Demand Forecast

Two methods are used to forecast the cargo volume handled at Bangkok Port (Klong Toei), Laem Chabang Port and private container terminals within the limits of Bangkok Port. One is a macro forecast which estimates the cargo volume as a group including entire commodities, regardless of the volume of each commodity. The other is a micro forecast which estimates the cargo volume of each commodity individually. And the results of the cargo volume forecast by both methods are checked mutually.

When forecasting the cargo volume handled at Bangkok Port (Klong Toei), it might be desirable to handle the entire throughput (for both Klong Toei Wharf and Klong Toei Dolphins) as one port. But in this study, demand forecast was conducted separately for Klong Toei Wharf and for Klong Toei Dolphins because breakdown of the cargo volume by commodity at Klong Toei Dolphins is not available.

In the forecast of the volume of container cargo through the ports of Bangkok (Klong Toei Wharf) and Laem Chabang in the target year of the Master Plan, the total volume through the two ports was projected in the first step. Then it was broken down to the

respective volumes in the next step because of the overlap in their hinterlands in container transportation.

In the forecast of the volume container cargo through the ports of Bangkok (Klong Toei Wharf) and Laem Chabang, the historical data of Klong Toei Wharf was solely used because up to the year 1992, which is the last year of the statistics adopted in the forecast in this study, achievement of the volume of cargo through Laem Chabang was still negligible.

1.8.3 Results of the Forecast

The results of the forecast are shown as follows.

		Unit	1997	2005
The volume of cargo at the Bangkok Port (Klong Toei Wharf)	Export	Thousand Tons	10,895	17,543
	Import	Thousand Tons	11,694	16,740
The volume of container cargo at the ports of Bangkok (Klong Toei Wharf) and Laem Chabang	Export	Thousand Tons	10,895	17,544
	Import	Thousand Tons	7,884	12,831
Number of containers to be handled at the ports of Bangkok (Klong Toei Wharf), Laem Chabang and private container terminals		Thousand TEUs	2,120	3,470
The volume of conventional cargo through Bangkok Port (Klong Toei Wharf)	Export	Thousand Tons	0	0
	Import	Thousand Tons	3,810	3,909
The volume of import conventional cargo at Klong Toei Dolphins		Thousand Tons	2,880	3,450

1.9 Functional Allotment of Port Activities Between the Ports of Bangkok and Laem Chabang

1.9.1 Container-Handling

According to the analysis of the import manifests (May and September of 1992), 74% and 15% of the total volume of import containers were destined to Bangkok Metropolis and the Central region, respectively, totaling 89%. On the other hand, according to the analysis of the entry permission for export cargoes (May of 1993), 82% and 8% of the total volume of export containers originated from Bangkok Metropolis and the Central region, respectively, totaling 90%. The percentages of other regions including the East region (less than 1%) are very small.

Concerning the origin/destination ports of the container vessels that called at the east quay in 1991/1992, Singapore takes the largest share of 63% of the total in terms of the number of containers loaded/discharged at Bangkok Port. Singapore is followed by Japanese ports (19%) and Hongkong (17%).

With respect to the origin countries of import container cargoes discharged at Bangkok Port, Japan ranks first (19.7% of the total imports) followed by Singapore (17.6%), the USA (15.4%), the Netherlands (6.9%), Germany (6.4%), Hongkong (5.8%), Taiwan (4.1%), Australia (2.5%), Canada (2.2%), England (2.2%), Korea (2.0%).

On the other hand, as to the origins of export container cargoes loaded from Bangkok Port, Japan again ranks first (20% of the total exports) followed by the USA (16%), Hongkong (12%), Singapore (6%), Australia (5%), England (5%), France (4%), Taiwan (4%), the Netherlands (3%), Korea (2%), Germany (2%).

Since a great portion of containers originate from or are destined for in and around Bangkok Metropolis as mentioned above, and the container-handling capacity of Bangkok Port is restricted due to the limitation of available space and necessity of reducing road traffic generated from its port activities, a considerable portion of containers must be diverted to Laem Chabang Port, a deep sea port that has recently opened.

Although presently most containers are transported through Bangkok Port and the portion through Laem Chabang Port is still small, the number of containers through Laem Chabang Port is expected to steadily increase in the future on routes where the cost of land transport from Bangkok area to Laem Chabang Port can be compensated or covered by the savings on maritime transport costs derived through the introduction of bigger container vessels. Some east bound routes including routes for East Asia are

considered to be such routes where Laem Chabang Port has an advantage or potential advantage over Bangkok Port.

Consequently, proper functional allotment between the ports of Bangkok and Laem Chabang is expected to be achieved. That will be beneficial to both ports and also for port users; the moderate amount of containers that will be handled at Bangkok Port will enable services for port users to be upgraded, and Laem Chabang Port will be promoted at the same time.

1.9.2 Handling Conventional Cargo

Presently, heavy or bulky cargoes such as steel products, vehicles and fertilizer are mainly discharged from conventional vessels at the west quay of Bangkok Port. On the other hand, at Laem Chabang Port, the major conventional cargoes are also heavy or bulky cargoes such as cement, steel products, vehicles and grains. Those cargoes are suitable for water-borne transport and after discharging at the ports, they are delivered to consignees located around the respective ports mainly by trucks or lighters/barges so as to achieve economical transport and avoid the restricted road transport as much as possible.

In the stage of the Master Plan, they are expected to be still the major conventional cargoes despite the progress of the containerization, since those cargoes are generally not suitable to be containerized. Thus, with respect to the handling of the conventional cargoes, the ports of Bangkok and Laem Chabang are expected to serve the respective local users as they do at present.

1.10 Master Plan for Bangkok Port

1.10.1 Master Plan for Container-Handling

(1) The Basic Concept of Modernization of Bangkok Port

The purpose of the Master Plan (target year 2005) is to serve as a target and guideline for phase plans including the Short-Term Plan (target year 1997). The Master Plan shall be an integrated plan covering the layout plans for modernization plans for existing facilities and effective management and operation systems. In making the Master Plan for Bangkok Port, the following various aspects concerning the port modernization are recognized:

- Serious Port Congestion in Container-Handling
  Since the start of containerization in Thailand in 1977, along with the development of the Thai economy, especially in the export-oriented industries, the number of containers through Bangkok Port has continuously increased. In the last five years, from 1988 to 1992, the number shows a sharp increase, indicating an average growth rate of 14% per annum. In 1992, the number of containers handled at Klong Toei Wharf of Bangkok Port reached around 1.3 million TEUs. In 1991/1992, the average berth occupancy rate of seven berths of the east quay where over 90% of containers are handled reached a high value of 75%.

- Present System of Terminal Operations
  Although machines specialized for container-handling were introduced and containers of more than one million TEUs per annum are already passing through the port, the container terminal at Klong Toei Wharf of Bangkok Port remains as an open type terminal as of old where operations are performed by an individual shipping line/agent independently with the permission of PAT by each operation. The modernized system is no yet adopted in which container-handling operations are wholly controlled by a terminal operator that takes full responsibility for handling and storing containers after receipt or before delivery at its terminal gates by conducting yard planning and inventory control of containers based on data/information interchanged with customers or the authorities concerned (hereinafter referred to as "the closed terminal system").

- Shortage of Marshaling Yard Space
  In addition to the above fact, the marshaling yard in the east quay can only rarely afford to prepare necessary stacking space for outbound containers before

ship arrivals due to shortage of yard area. Consequently, the marshaling yard in the east quay is left in a chaotic condition.

- Long Berthing Hours due to Direct Loading and Long Hauls
  Shortage of marshaling yard space often forces shipping lines/agents to do costly direct loading of containers onto ships from the open yard at the west quay or off-dock CYs outside the port.

  In addition to the direct loading, long hauls of outbound boxes once stacked within the marshaling yard from stacking places to dockside are often found due to lack of proper yard planning. Thus, the actual gross container-handling productivity per dockside gantry crane is low, with the result that costly container ships are forced to berth for a long period, 33 hours per vessel on average.

- Decreasing On-dock CFS Cargoes (LCL)
  With respect to unstuffing operations in 1992/93 (March of 1992-Feb. of 1993), 42% of inbound container cargoes were unstuffed in the port area, showing a sharp drop from 69% in 1988/89. On the other hand, as for stuffing operations in the same period, 63% of outbound cargoes were stuffed in the port area, showing a decrease from 80% in 1988/89.
  Such cargoes are categorized as LCL by the definition of PAT's tariff.

Based on the above situation of Bangkok Port, the following concept of modernization of Bangkok Port is proposed to resolve the present problems mentioned above and achieve economical, efficient, safe and reliable terminal operations for the port users:

- 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 by Installing new Import CFSs in Area II and Export CFSs in Zone 1.

(2) Land Preparation for Future Port Activities

The land under the jurisdiction of the PAT extends beyond the existing customs fences. A great part of the land beyond the customs fences is used for various activities such as residential areas that have no direct linkage with 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, Zone I, the area facing the Phra Kanong Canal and

the area behind the planned storage yard for dangerous cargo into the areas for port activities collaborating with the Housing Authority.

(3) Layout of the Main Facilities for Container-Handling

The main facilities for container-handling are arranged so as to embody the basic concept of the modernization shown in 1.10.1(1).

1) Marshaling Yard

The marshaling yard is arranged at the east quay as it is at present. To increase container-stacking capacity of the marshaling yard, it is proposed to prepare an additional marshaling yard by demolishing sheds No.11 and No.12 and by preparing large RTGs (six rows and one lane, four high stacking and five high over) to be used there. Actual stacking capacity considering an operational factor will increase to around 10,000 TEUs from the present capacity of around 6,200 TEUs.

To introduce a closed container terminal system and closing time, gates with the required number of lanes must be prepared at the entrance of the marshaling yard. A gate (referred to as Gate No.2) is under construction at the entrance of the existing marshaling yard. It is necessary to prepare an additional gate (referred to as Gate No.3) corresponding to the above-mentioned additional marshaling yard (Terminal No.3).

To examine the possibility of divided control of the marshaling yard, a computer simulation was conducted. In a case when the number of containers handled per annum is one million TEUs and the marshaling yard is divided into three yards with three gates and controlled independently by three units, the resulting number of containers dwelling at the marshaling yard is 9,570 TEUs during peak conditions. The number is almost the same as the stacking capacity of the marshaling yard, and therefore, containers of one million TEUs can be handled per annum and the yard can be divided into three yards if larger RTGs are partly used at Terminal No.3. In other words, the container-handling capacity of the marshaling yard is estimated to be one million TEUs per annum under the divided control system which enables simple and easy operations. In this case, the third gate (referred to as Gate No.1) which will be prepared near the existing control tower is considered to accommodate containers to/from the east yard (Terminal No.1). Thus, the three gates will be totally prepared. Gate No.2 will serve containers to/from the middle yard, Terminal No.2.

In the divided control system, several alternatives are considered in terms of the type of RTGs and the layout of reefer yards. As to RTGs at the west yard of the

marshaling yard (Terminal No.3) to be newly procured, introduction of small RTGs (four rows and one lane, three high stacking and four high over) which are presently used at the existing marshaling yard is considered as an alternative case besides the introduction of large RTGs.

On the other hand, as to a layout of reefer yards at the marshaling yard of the east quay, two alternatives are considered: a single reefer yard and separately-placed yards. By combining the above alternatives of RTGs and reefer yards, several alternatives were considered and compared with each other from various points of view, and finally, the case where a single reefer yard is allocated west of Terminal No.3 and the following RTGs are used at the respective Terminals was selected to be the optimum plan (see Fig.1-10-1):

Terminal	Dry containers	Reefer containers
Terminals No.1 and No.2	19 small RTGs	-
Terminal No.3	9 large RTGs	3 small RTGs

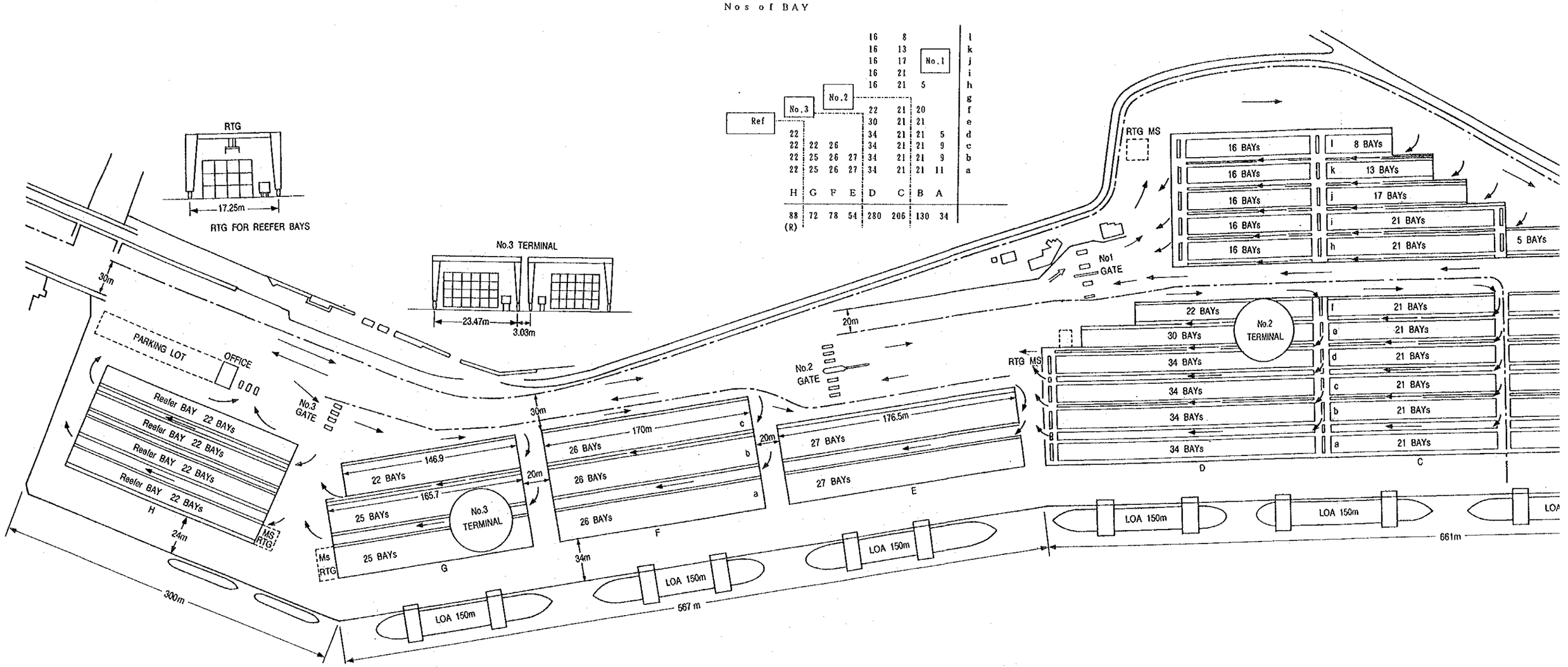


Fig. 1-10-1 Modernization Plan of the East Quay

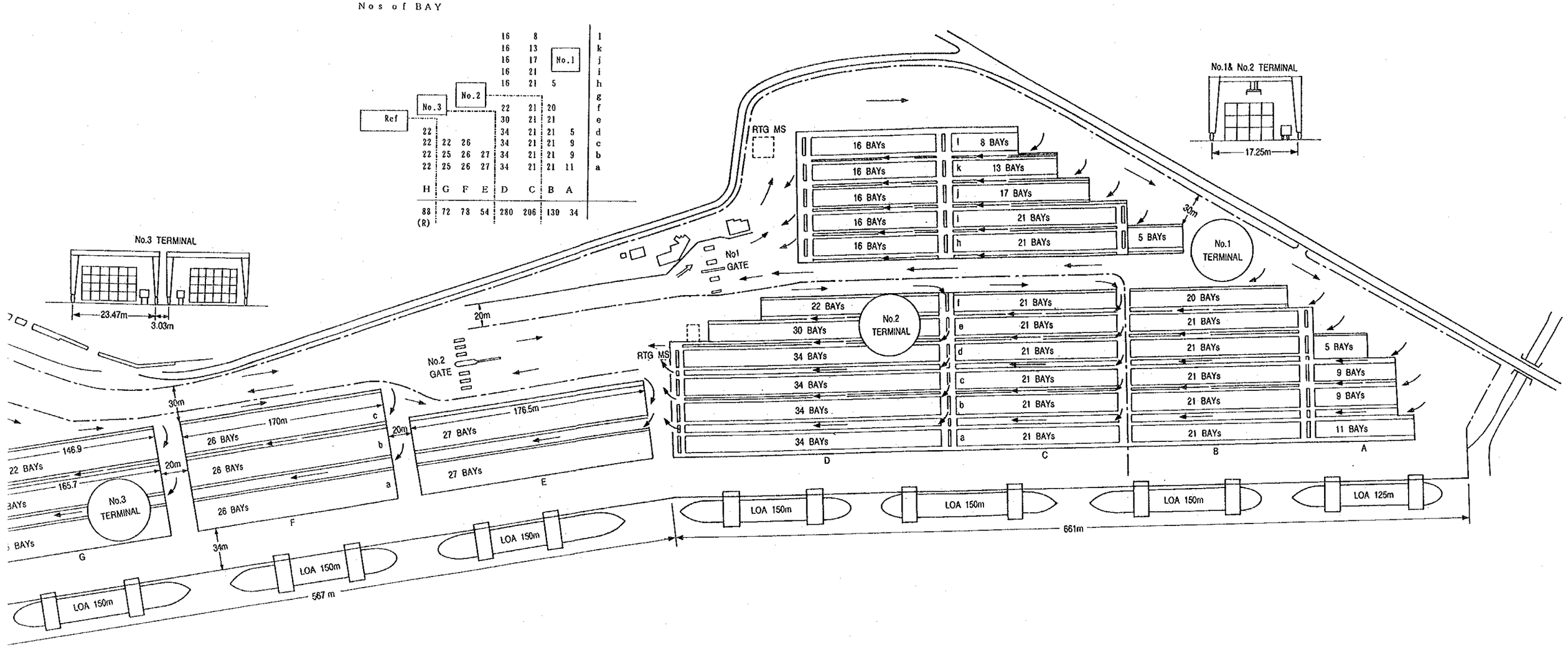


Fig. 1-10-1 Modernization Plan of the East Quay

2) Container Freight Stations (CFSs)

Import CFSs are arranged at the west quay. The existing Sheds No.13 and No14 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. On the other hand, the new Export CFSs are planned to be prepared in Zone 1 at the west quay (see Fig. 1-10-2).

3) 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 Import CFSs.

4) Parking Lot for Container Chassis and Tractors

A parking lot with the capacity of 210 container chassis and 100 tractors will be prepared behind sheds Nos 15-17. The total required number of container chassis are estimated as 210 and 110 in the stage of the Master Plan. Thus, most of the chassis and tractors can be parked at the above parking lot.

5) 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.

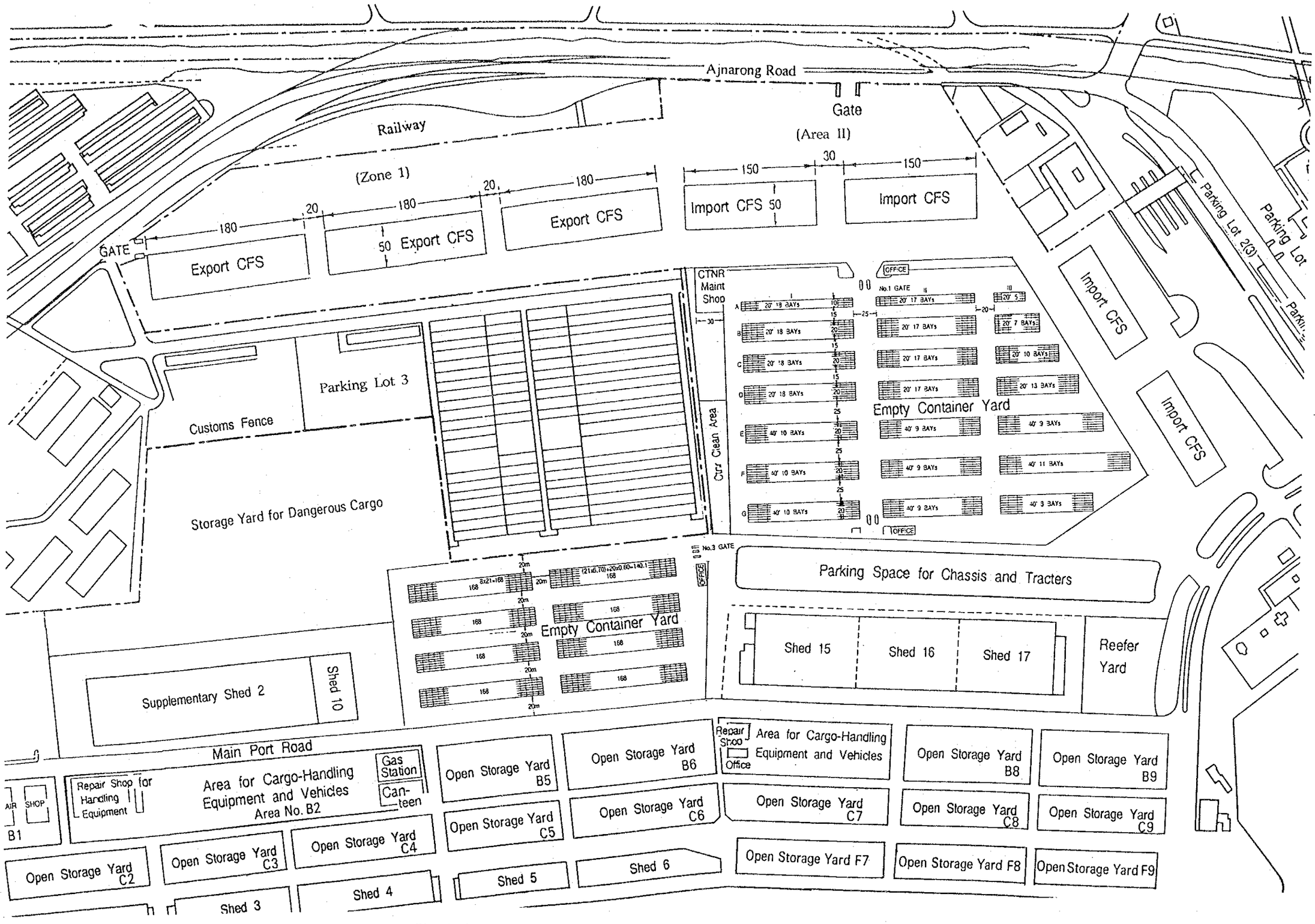


Fig. 1-10-2 Modernization Plan of the West Quay for Container-Handling

(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. The resulting figures of the simulation are used to estimate container-handling capacity per annum. According to the results of the simulation, the container-handling capacity of the marshaling yard at the east quay can be said to be approximately one million TEUs per annum as mentioned in Section 1.10.1(3).

The resulting berth occupancy rate of the seven berths of the east quay is 25.6%.

(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 13,610 tons during peak condition. To store the volume, existing sheds No13 and No14 are planned to be used as they are at present. The storage capacity of the two existing sheds is estimated to be 4,880 tons. Hence, additional Import CFSs with a storage capacity of 8,730 tons need to be prepared.

On the other hand, as to Export CFSs, the volume of container cargoes dwelling at Export CFSs is estimated to be 15,880 tons during peak condition. To store the volume, new Export CFSs need to 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 therefore, a storage yard with that capacity is planned to be prepared at the west quay.

3) Required Number of Lanes of the Terminal Gates

According to the result of the simulation in terms of daily traffic volume through the terminal gates, corresponding required number of lanes at the marshaling yard of the east quay is seven at each gate.

4) Reefer Plugs

The required number of reefer plugs is estimated as 340.

5) Repair Shop and Cleaning Area

A repair shop for damaged containers with the site area of 1,500 sq.m is planned to be prepared within the storage yard for empty containers at the west quay. Cleaning area is also allocated at the same yard

6) Terminal Office

It is necessary to prepare a new terminal office with the total floor space of 600 sq.m at Gate No.3.

(6) Container-Handling System

There are four representative container-handling systems, namely transfer crane system (RTG system), straddle carrier system, chassis control system and toplifter (toploader, forklift) system. As to container-handling system adopted at the marshaling yard of the east quay whose space is narrow and is difficult to be expanded, the transfer crane system is selected as the most appropriate system in the stage of the Master Plan as it is at present.

On the other hand, as to container-handling system adopted at the storage yards for empty containers of the west quay, toplifters can move empty containers speedily from chassis on to stacking yards or vice versa compared with other machines such as the transfer cranes, and therefore the toplifter system is selected as the optimum system.

The required numbers of container-handling machines in the stage of the Master Plan are summarized as follows:

	Required Nos.
- Dockside gantry cranes	14
- RTGs (Rubber tired gantry cranes)	
- Small RTGs	22
- Large RTGs	9
- Toplifters (10 tons)	27
- Forklifts (3 tons)	138
- Tractors	111
- Chassis	208

1.10.2 Master Plan for Handling Conventional Cargo

(1) The Basic Concept of Modernization for the West Quay

In making the Master Plan for the west quay, the following various aspects concerning the port modernization are recognized.

- Present Conditions of the Berths Usage at the West Quay
  In 1991/1992, the berth occupancy rate of ten berths at the west quay of Klong Toei Wharf of Bangkok Port which received mainly conventional vessels (87% of the total number at the west quay) reached a high value of 78%. In recent years the volume of conventional cargoes handled at the west quay has shown a downward trend, and the volume of conventional cargo handled in the stage of the Master Plan is projected to remain almost at the same level as at present. On the other hand, container vessels, some of which are presently received at the west quay, are planned to be received only at the east quay in the stage of the Master Plan as a result of the modernization of container-handling at Klong Toei Wharf of Bangkok Port and the subsequent reduction in the total container number from the present level. This means all ten berths will be exclusively used for conventional vessels. Thus, the usage conditions of the west quay are expected to remain almost the same as at present and the preparation of additional berths for conventional cargo in the Master Plan is not required.

- Mixed Usage of Sheds and Open Yards behind the Berths
  The sheds and open storage yards behind the conventional berths of the west quay are presently used for not only conventional cargo but container cargo, resulting in shortage of space for storing conventional cargo, especially in open storage yards for steel products. Consequently, import steel products are forced to be stored at the yard outside the custom fences, resulting in inefficient discharging of the cargo from conventional vessels.

- Traffic Congestion on the Roads behind the Berths
  Moreover, mixing use of the sheds and open storage yards behind the conventional berths for both conventional and container cargoes induces serious traffic congestion on the roads behind the berths due to intricate movements of various kinds of vehicles such as ordinary trucks and tractor-chassis units. Also, passenger cars and trucks/tractor-chassis units parking along the existing roads narrow the effective widths of the roads and exacerbate the traffic congestion.

- Warehouse and Open Yard outside the Port
  Presently, there are In-transit Warehouse and Import Steel Open Storage outside the port and near Checking Post 1. The warehouse is mainly used for storing cargoes for Laos. The open yard is used for storing steel products.

- Obsolete Dockside Cranes for handling Conventional Cargo

- Location of the Existing Warehouses and Open yard for Dangerous Cargo
  The existing warehouses and open yard for dangerous cargo are located along the boundary between the port and outside areas, namely customs fences without a sufficient buffer zone.

- Present Railway Operations inside the Port
  Presently, railway operations are conducted at the east quay

According to the above, 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 (see Fig. 1-10-3)

- Usage of Berths at the West Quay Exclusively for Conventional Vessels
- Rearrangement of Usage of the Existing Sheds, Warehouses and Open Storage Yards for Conventional Cargo
- Rearrangement and Expansion of the Existing Port Roads
- Dismantlement of the Existing Dockside Cranes at the West Quay
- Relocation of the Existing Warehouses for Dangerous Cargo
- Transferring Railway Yard to the West Quay
- Preparation of Parking Lots for Passenger Cars and Trucks/Tractor-Chassis Units
- Transferring the Offices inside the Port Having no Direct Linkage with Cargo-Handling Operations to outside the Port

(2) Usage Plan for the Existing Storage Facilities

1) Movements of Conventional Cargoes within the Port

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 Master Plan, a computer simulation was conducted.

Resulting figures of the required areas for sheds and open storage yards during peak conditions obtained from the simulation are 18,000 sq.m and 2,500 sq.m, respectively.

The resulting berth occupancy rate of 10 berths of the west quay is 80.6%. As shown above, the percentage of berth occupancy in the stage of the Master Plan will remain almost at the same level as at present. Traffic volume of trucks each way during the peak condition is estimated as 710 vehicles per day.

2) Usage Plan for Sheds

Transit sheds No.1-No.6 with a total storage area of 32,460 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 and In-transit Warehouse outside the port is planned to be replaced by that in sheds No.15-No.17 (see Fig. 1-10-3).

3) Usage Plan for Open Storage Yards

Open storage yards with a total area of 118,600 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 transit sheds No.7-No.9 and supplementary sheds No.4-No.9 will be demolished and converted into open yards to achieve efficient operations for handling the above bulky cargoes. Furthermore, storage in Import Steel Open Storage Yard outside the port is also planned to be replaced by the open storage yards near the berths mentioned above.

(3) Storage Plan for Dangerous Cargoes

Though cotton is a type of dangerous cargo, it is presently stored in and around supplementary shed No.1 apart from the existing dangerous cargo warehouses. In the Master 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.

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

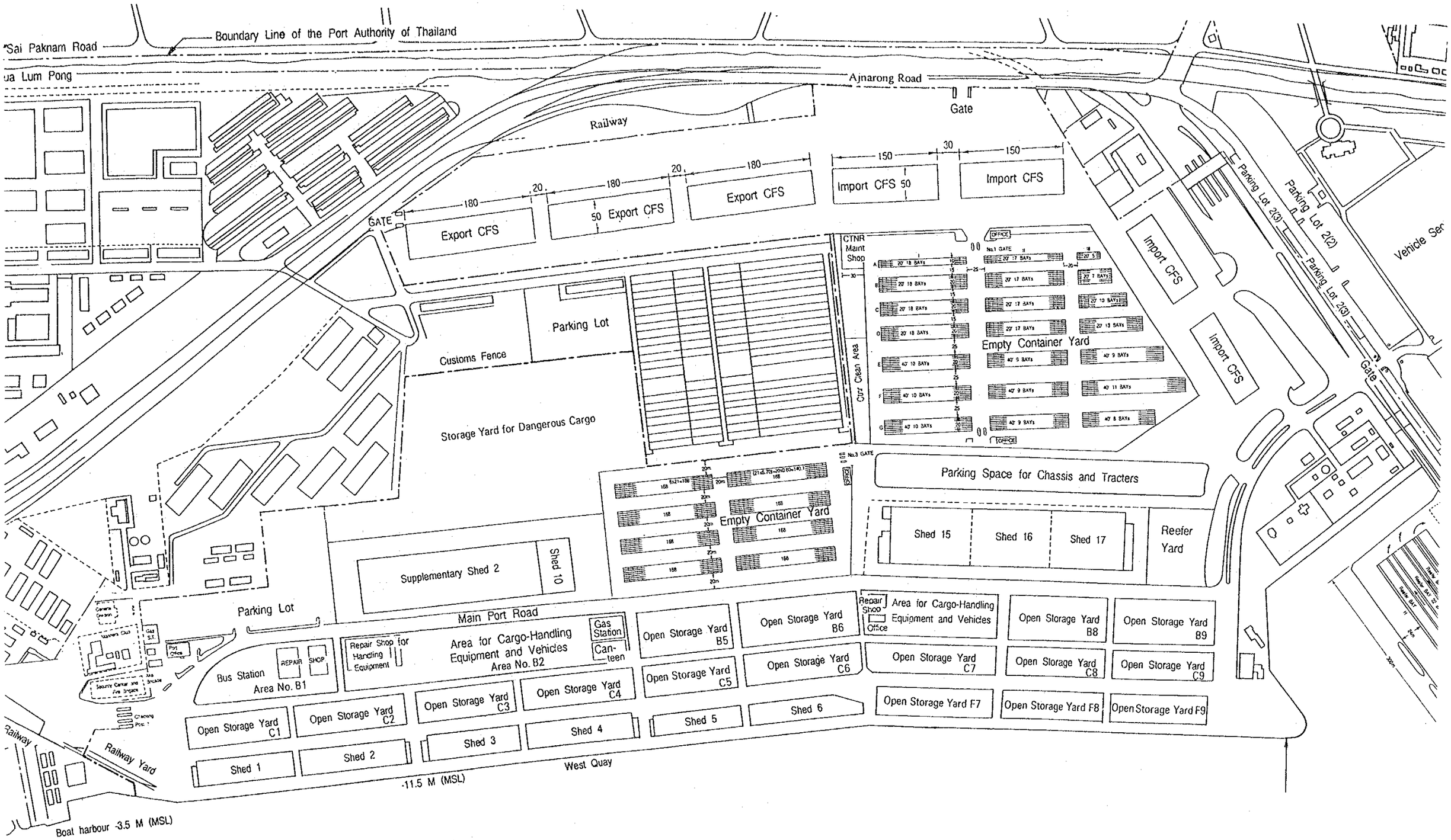


Fig. 1-10-3 Modernization Plan of the West Quay for Handling Conventional Cargo

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, passages for tractor-chassis units/trucks, offices, etc. need to be prepared in the dangerous cargo yard.

(4) Area for Cargo-Handling Machines

In the Master 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.

(5) Parking Lots

Three parking lots for passenger cars and trucks/tractor-chassis units will be prepared near Checking Posts 1 and 2, and behind the dangerous cargo yard. The total capacity are as follows:

- 2,590 passenger cars
- 420 trucks
- 80 tractor-chassis units

(6) Area for Offices near Checking Post 1

Along with relocation of Checking Post 1 and the port road through the post, the offices comprising Fire Station and Common Use Building with the total floor space of 2,550 sq.m and site area of 892 sq. m will be also relocated.

(7) Railway Yard

Present railway operations at the east quay are planned to be transferred west of the west quay. A new railway yard with an area of 5,500 sq.m will be prepared.

(8) System for Handling Conventional Cargo

By the preparation of the open storage yards behind the conventional berths, steel products can be discharged directly on the apron of the berths and then lifted and moved to the open yards by forklift equipped with an attachment for a specific packing type such as bundle, sheet and coil.

As to the conventional cargoes excluding steel products, there are various kinds of package types such as bag, pallet, carton, roll, drum, barrel and wooden case. Such disunity of the package types of conventional cargoes causes low cargo-handling productivity. To improve the cargo-handling productivity, it is necessary to promote unitization of the package type such as containerization and palletization.

The required numbers of machines for handling conventional cargoes in the stage of the Master Plan are summarized as follows:

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

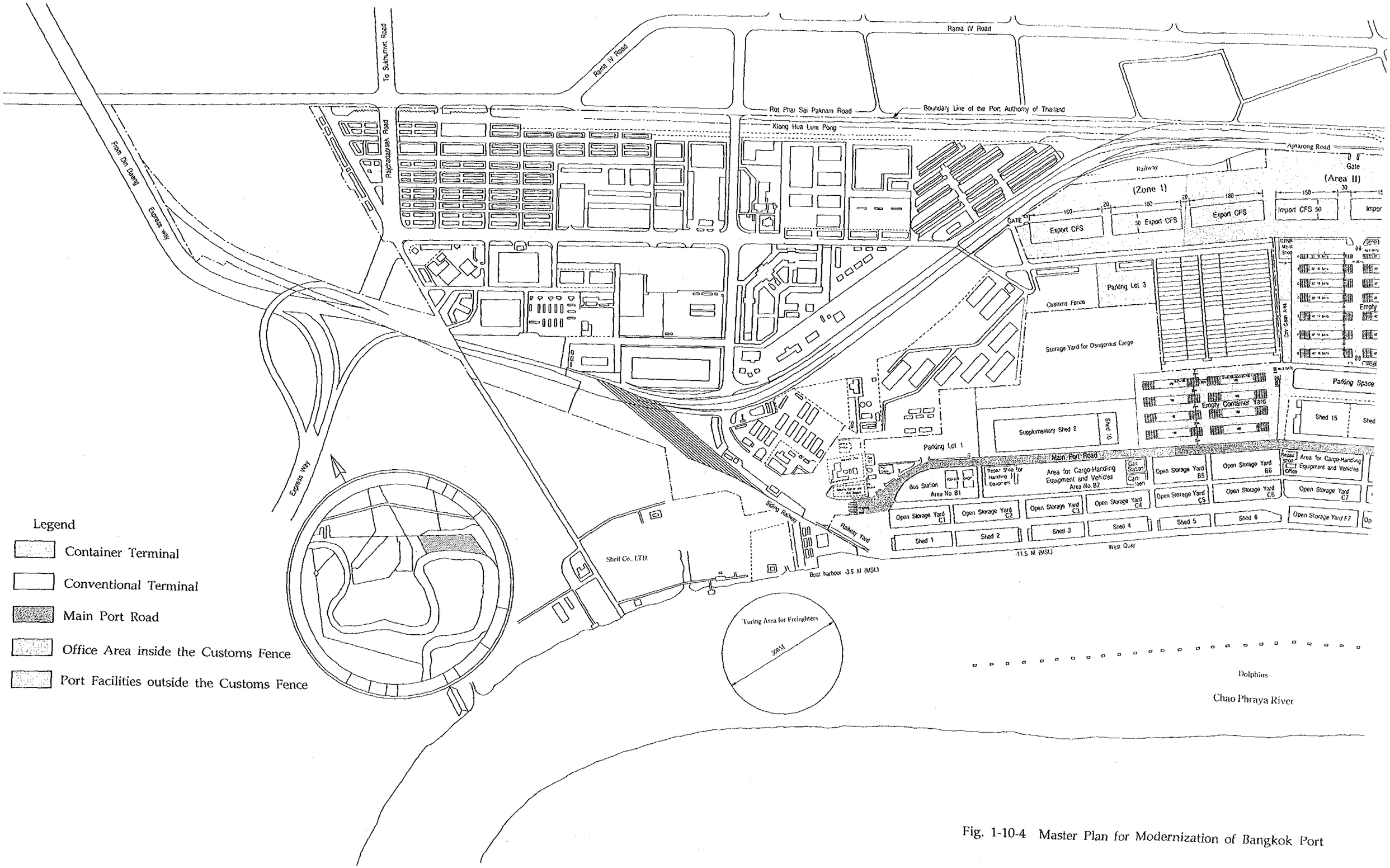


Fig. 1-10-4 Master Plan for Modernization of Bangkok Port

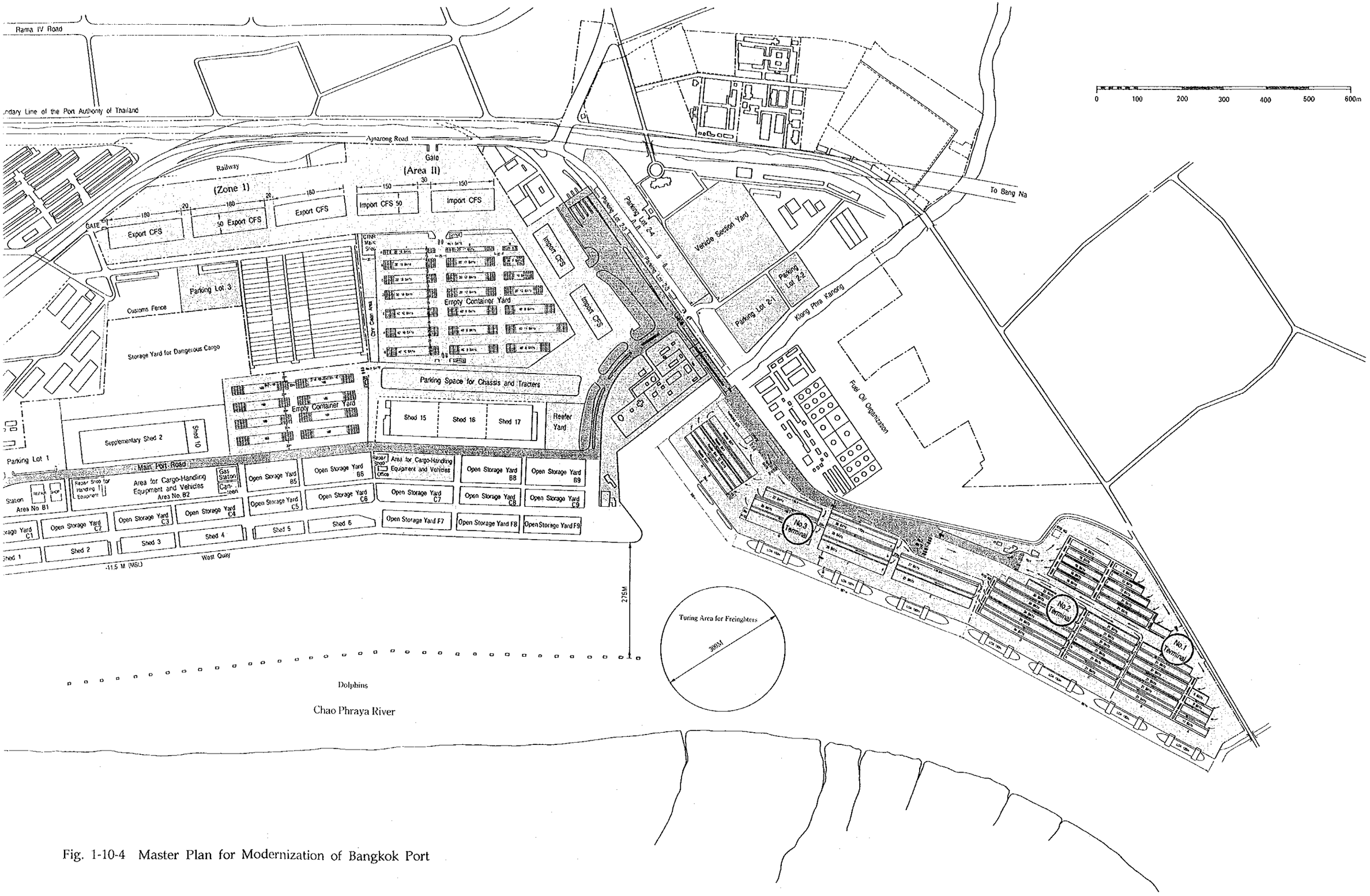


Fig. 1-10-4 Master Plan for Modernization of Bangkok Port

1.10.3 Master Plan relevant to the Waterway

The layout of the waterway from off harbor to the inner port is as follows; a far leg of 25 miles, a restricted water way either in terms of depth or width, a meandering one with inherent sharp bends, a highly congested one with various type/size of vessels, a falling tide generates current more then three knots and navigational obstacles such as fish stakes project in close proximity to the fairway, that ship handlers are continuously confronted with inconvenient or even hazardous conditions.

However, any improvement works pertaining to the river channel, which has been created by nature, will hardly be feasible.
A plan to widen the bar channel between the entrance buoys and the estuary from 100m to 135m has been approved among the relevant authorities to respond to the strong demand among users.

Although the team supports the above widening plan of 135m as a urgent countermeasure (Short-Team Plan), we recommend widening the stretches to 150m as part of the Master Plan (Long-Term Plan) for improving the bar channel. The reasoning, according to the latest paper on the issue, is that if a channel's width is more than six times that of the largest passing vessel's, the inconvenience from the narrowness disappears.

In addition, if the bar channels is widened to 150m, reciprocal meetings of largest vessels which are permitted by the existing harbor regulations are impossible. To ensure safety, the width of a waterway must be 2.2 times the length of the larger vessel during reciprocal meetings.

Consequently, it is desired to set up a practical phase plan for widening the bar channel, minding the above mentioned width with the studies on environmental assessment, number/size of calling vessels, navigable width of the river channel and financing.

1.10.4 Phase Plans for Modernization of Bangkok Port

It is necessary to implement the entire project proposed in the Master Plan according to phase plans. The first phase project is that proposed in the Short-Term Plan with the target year 1997 (cf.Vol.2 Short-Term Plan). The remaining project will be realized in the second phase plan with the target year 2005 the same as the Master Plan.

1.11 Information System

1.11.1 Computer Systems Among the Container Terminals

The level of computerization in the container handling operation at PAT is not so advanced when compared with other container terminals in the world.

The information processing function of the computer becomes indispensable to ensure accurate and efficient handling of intermodal containerized cargo. On the other hand, computerization of conventional cargo handling operations is not so advanced even in the developed countries because of the trading and cargo pattern. The Study Team has limited the scope to the basic design of the computer system which focuses on the cargo container service system.

The marine container terminal is the connecting point for land and sea transportation of containers. The typical facility is a common-user container terminal consisting of container stacking storage with vessel berthing facilities. It has in and out gate ways with multiple truck lanes where the gate booths are equipped with computer data entry units, which are the key to high levels of service and turn-around times.

The concept of theYard Plan Computer System (YPCS) which is installed in the container terminal is as follows:

1) The data entry units at the gate way interface with the YPCS, a main computer system, which is an essential part of the total computerized equipment control data base.
2) The YPCS provides a high degree of efficiency for daily operations, improves storage and equipment utilization, maintains inventory records and provides timely management information.

1.11.2 Strategy of Software Development

Improved computer and communications systems contribute to more effective approach to problem solving, new jobs and services, and enhanced PAT competitiveness across broad areas of terminal operations. System development does not mean only programing. There are three important factors; analyzing/designing, programming, and testing. There are many choices in developing software, namely self developing, purchasing package software, or hiring a private software company. PAT should clarify its role, have knowledge and experience on the job, and haveexperts who can supervise the implementation of each job. Nowadays, commercial transactions are not only

between firms in of the same or different fields of business within a single country but also across National borders. Thus Electronic Data Interchange (EDI) has become a common information infrastructure for people around the world. Combined transports, such as land-bridge which carries containers by transcontinental railway and sea-air transport are a high ratio of the total. In this circumstance, the needs for management of business and communications which includes customs clearance at borders must be quick and simple. Interchanging these large quantities of data accurately and quickly realizes less documents and certain business transactions. This is why EDI has become so general.

1.11.3 Maintenance of Computerization

Software technology has been developing rapidly day by day and PAT should assign its staff to study new technology colleges or software companies. Realizing the full potential of computing and networking systems will require advanced software and people educated and trained to use these tools. PAT has to maintain steady progress for educating and training its staff to adopt computerized port management and operations.

1.12 Port Traffic Planning

1.12.1 General

In this section, based on traffic volume projected in the Master Plan, sections of port roads in Bangkok Port are set up, and then affects of port traffic on roads around Bangkok Port are considered. Furthermore, based on limited container handling capacity in Bangkok Port, container-related traffic volume may be diverted from/to Laem Chabang Port to/from in Bangkok Metropolis and it's vicinity.

1.12.2 Forecast of Traffic Volume

Assuming that the following measures are implemented, total traffic volume will decrease from its present level.

a. To decrease transport of documents by motorcycles through introduction of computerization

b. To control passenger cars at entrance gates with traffic passes and to ban private cars

c. To limit workers in Bangkok Port to those only involved in port activities by moving administration facilities outside of port area

d. To operate round trip bus service in Bangkok Port and to conduct "Park and Ride System"

1.12.3 Port Traffic Facility Plan

Based on the traffic volume and condition, the required number of lanes is shown as follows (both directions):

	No. of Present Lanes	No. of Planned Lanes
Main Road at the West Quay	3 Lanes	4 Lanes
Bridge connecting East & West Quays	4 Lanes	5 Lanes

Increase of a lane at the bridge is available by converting a present sidewalk to a truck lane without widening the bridge itself.

1.12.4 Main Roads from Bangkok Port

Assuming that vehicles from/to Bangkok Port and through the expressway will account for 50% of the total port traffic and will split into the three directions, Bang Na, Doa Kanong and Ding Daeng with the shares of 40%, 30% and 30%, respectively in the stage

of the Master Plan as they do at present, the port traffic represents only 2% of the traffic capacity in the above three directions, Bang Na, Doa Kanong and Ding Daeng. On the other hand, assuming that 18% of the total port traffic volume will pass Rama IV Road as at present, the volume through the road accounts for only 3% of the capacity of the road. The total traffic volume from/to Bangkok Port in the stage of the Master Plan is forecast to decrease about 50% from the present traffic volume due to the reduction in the number of containers through the port, the percentages of 20 ft. containers and LCL containers, though the traffic volume of the conventional cargo is forecast to increase at this stage.

1.12.5 Traffic Development Plan between Bangkok and Laem Chabang Port

(1) Road

Outer Ring Road which is expected to be constructed by 2005, and then existing National Highway Routes No.34, No.3 or Bangkok-Chon Buri New Highway (81.7km) along the eastern road network (see Fig.1-12-1) connecting with the Outer Ring Road will be able to be used. That highway runs from Bangkok through three prefectures, Samut Prakhan, Chachoingsao and Chon Buri which include large-scale industrial estates and the new airport site, and links with the Chon Buri-Pattaya New Highway.

(2) Railway

Railway transports container cargo between Bang Sue Terminal and Laem Chabang Port on a contract between SRT and APL, however, transport capacity of railway is limited due to its single track. SRT does not plan to construct double tracks in East Region in 7th railway development plan, but there is a plan to construct double tracks with a length of 2,744 km in its long-term plan. It is also desirable that the plan includes double tracks between Bangkok Metropolis and Laem Chabang Port to complement the development of Lard Krabang ICD project.

(3) Transport Share of Road and Railway

2,190,000 TEUs of containers will be transported to/from Laem Chabang Port in the stage of the Master Plan, and this cargo volume is expected to be shared by road and railway considering the capacity of the existing single track railway as follows:

Road transport: 2,123,000TEUs,
Railway transport: 67,000TEUs

Total volume of 2,123,000TEUs for road transport is estimated to be 6,150 vehicles/day per side.

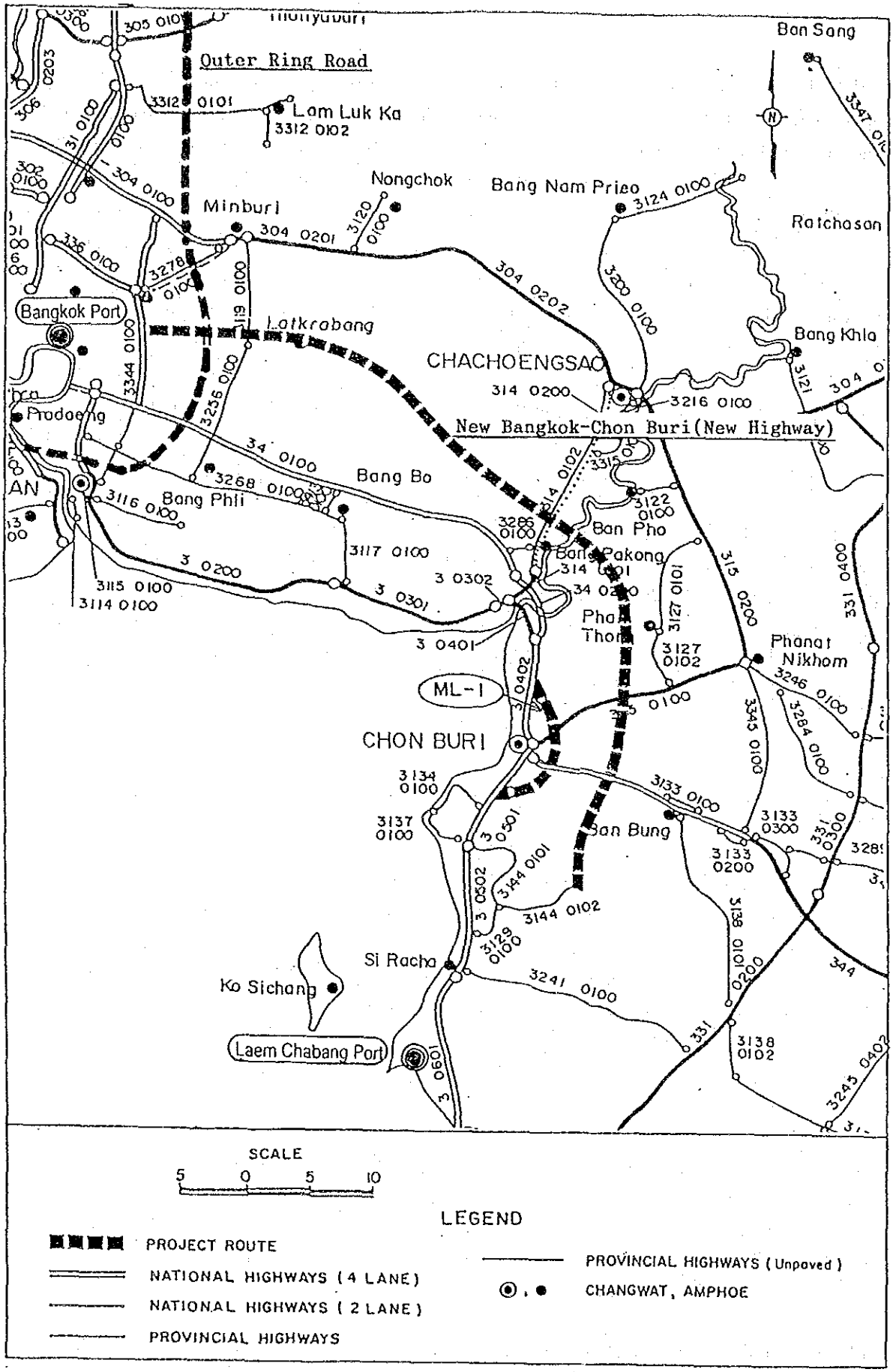


Fig. 1-12-1 Road Network between Bangkok Port and Laem Chabang Port

1.13 Design and Cost Estimates

1.13.1 Design of Facilities

In the Master 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) Transit sheds No.7, 8 & 9
    10) Bonded warehouse
    11) Bangkok Port Head Office
    12) PAT O.B. Building
    13) Quay Side Cranes No.1 to No.12
2. East Quay
    1) Repair Shop for Handling Equipment
    2) Gas Station
    3) Cargo Warehouse
    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
    2) 3 Export CFS Sheds
    3) Maintenance Shop
    4) Container Cleaning Area
    5) Gates & Fence of CFS & Empty Container Storage Yards
    6) Container Handling Equipment & Vehicle Area

7) Port Office Building
8) Gas Station
9) Canteen
10) Fire Station
11) Main Port Road
12) Open Storages
13) Checking Post No.1
14) Railway Yard
15) Parking Lots No.1, 2 & 3
16) Repair Shop and Office for Container Handling Equipment
17) Vehicle Section Yard
18) Access Road and Additional Gate for Parking Lot No.2
19) 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 6
2. East Quay
1) Bridge

The outline of new facilities is summarized in Table 1-13-1.

Table 1-13-1 Outline of New Facilities (1)

Name of Facilities	Area	Capacity	Structural Type
1) Import CFS Sheds	2X7500m2	3.0t/m2	Steel frame, Concrete block wall, RC slab, Pile foundation
2) Export CFS Sheds	3x9000m2	3.0t/m2	Steel frame, Concrete block wall, RC slab, Pile foundation
3) CFS Yards			
-Import CFS Yard	65,600m2	3.0t/m2	Soil improvement, Concrete block pavement
-Export CFS tard	87,730m2	3.0t/m2	Soil improvement, Concrete block pavement
4) Maintenance Shop			
-Shop	1,500m2	3.0t/m2	Steel frame, Concrete block wall, RC slab, Pile foundation
-Maintenance Open Area	3,750m2	3.0t/m2	Concrete pavement
5) Container Cleaning Area	3,430m2	3.0t/m2	Concrete pavement
6) Gates for CFS and Empty Container Yard			
-Import CFS			1 Steel Gate, 20m in width
-Export CFS			1 Steel Gate, 20m in width
-Empty Container Yard			
No.1			2 Incoming, 2 Outgoing lanes
No.2			1 Incoming, 1 Outgoing lanes
No.3			1 Incoming, 1 Outgoing lanes
7) Container Marshaling Yards			
-Existing Building Area	26,260m2	3.0t/m2	RC slab, Pile foundation
-Other Area	70,400m2	3.0t/m2	Concrete pavement
8) RTG Repair Area			
-RTG Small	3x300m2	3.0t/m2	Concrete pavement
-RTG Large	1x375m2	3.0t/m2	Concrete pavement
9) Container Terminal Office	600m2	0.25t/m2	3 Story RC structure, Pile foundation

Table 1-13-1 Outline of New Facilities (2)

Name of Facilities	Area	Capacity	Structural Type
10) Container Terminal Gates			
-No.1			4 Incoming, 3 Outgoing lanes, 2 Truck scales
-No.2			4 Incoming, 3 Outgoing lanes, 3 Truck scales
-No.3			4 Incoming, 3 Outgoing lanes, 2 Truck scales
11) Bridge(modification)	252m		PC Girder Bridge 3 Incoming, 2 Outgoing lanes
12) Main Port Road	1,500m		21m wide, Concrete pavement
13) Checking Post No.1			2 Incoming, 3 Outgoing lanes
14) Fences			
-Customs Fence	2,715m		Concrete block, 2.8m high
-Container Terminal Fence	2,195m		Steel Netting, 1.5m high
-Empty Container Yard	2,523m		Steel Netting, 1.5m high
15) Port Office Building	2,300m2	0.25t/m2	3 Story RC structure, Pile foundation
16) Repair Shop and Office			
-Repair shop	750m2	3.0t/m2	Steel frame, Concrete block wall, RC slab, Pile foundation
-Office	900m2	0.25t/m2	2-story RC structure, Pile foundation
17) Parking Lots			
-No.1	24,000m2	1.0t/m2	Asphalt pavement
-No.2	29,000m2	1.0t/m2	Asphalt pavement
-No.3	13,300m2	1.0t/m2	Asphalt pavement
18) Vehicle Section Yard	46,600m2	1.0t/m2	Office building: 1,000m2 2 Repair shop:2x1,500m2 Gas station: 1,200m2
19) Access Road and Gate for Parking Lot No.2	580m		Asphalt pavement: 20m wide An additional gate on customs fence for incoming traffic only
20) Railway Yard	5,500m2	3.0t/m2	New 1 lane siding railway branch from the existing line. Concrete pavement yard
21) Bar Channel Dredging	1.6 mil.m3		Channel Width 150m, Depth MSL-8.5m

1.13.2 Cost Estimates

The costs for the construction of the proposed CFS and parking area to be done before construction work commences is not included in this project cost. The budget for the facilities of dangerous cargos and the proposed dredging work to widen the bar channel from 100m to 135m has been completed by PAT. Therefore, only the dredging work cost from 135m to 150m is included in this project cost. The contingency for price escalation is not included because it is difficult to predict this with accuracy, especially in the long range-term. The summary of the project costs are presented in Table 1-13-2.

Table 1-13-2 Summary of Project Cost

Construction Cost			COST	Budget by PAT
East Quay	unit	Quantity	Million Baht	Million Baht
Container Yard	m2	83470	88.47	
Container Yard on Existing Sheds	m2	26620	58.03	
RTG Repair Area & Passing Way	LS	1	19.59	
Terminal Office	m2	600	8.63	
Terminal Gates 1,2 & 3	LS	1	12.81	
Road Improvement & Fence	LS	1	3.52	
Gas Station	LS	1	5.50	
Demolishing work	LS	1	7.02	1.80
Utilities	LS	1	29.50	3.24
Sub-Total			233.07	5.04
West Quay				
Import CFSs & Yard	LS	1	328.95	328.95
Export CFSs & Yard	LS	1	503.25	
Empty Container Yard & Gate 1,2 & 3	LS	1	5.24	
Checking Post 1	Unit	1	7.45	
Main Port Road	m2	29340	23.08	
Parking Lot 1 & 3	m2	18700	16.88	
Maintenance Shop & Cleaning Yard	LS	1	24.64	
Demolishing Work	LS	1	12.15	
Buildings & Facilities	LS	1	59.61	1.46
Vehicle Section Yard	LS	1	66.33	
Parking Lot 2 & Additional Gate, Road	LS	1	74.69	15.84
Utilities	LS	1	16.81	
Dredging	m3	1600000	160.00	
Modification Transit Shed No1~No9	LS	1	3.99	
Modification Transit Shed No.13 &14	LS	1	22.50	
Modification Bridge	LS	1	1.49	
Sub-Total			1327.06	346.25
Construction Cost Sub-Total			1560.13	351.29
Engineering Fee	%	10	156.01	35.13
Physical Contingency	%	10	156.01	35.13
Construction Cost Total			1872.16	421.55
			COST	Budget by PAT
Procurement Cost	unit	Quantity	Million Baht	Million Baht
Rail Mounted Gantry Crane	Unit	2	280.00	280.00
Rubber Tyred Gantry Crane (4+1)	Unit	12	507.00	507.00
Rubber Tyred Gantry Crane (6+1)	Unit	9	549.90	
Computer (terminal)	Set	32	7.68	
Package Soft-ware	LS	1	16.50	
Procurement Cost Sub-Total			1361.08	787.00
Engineering Fee	%	3	40.83	23.61
Physical Contigency	%	0	0.00	0.00
Procurement Cost Total			1401.91	810.61
Total Cost (Construction & Procurement)			3274.07	1232.16
VAT	%	7	229.18	86.25
Project Cost			3503.25	1318.41

1.14 Navigation Safety

In adopting measures to promote navigation safety in Bangkok Port, or to minimize the occurrence of sea accidents, it is useful to make a detailed examination of past records, in particular to trace the origins of past accidents.

Although the direct causes of sea accidents are intertwined with indirect factors in the background, the study team proposes three countermeasures to promote navigation safety in Bangkok Port as follows:

(1) Improving waterway

Necessity of widening the bar channel, in particular, as has already been described in report 10.3.

(2) Promotion of vocational training for seafarer

Generally, inexperienced seafarers cause most of sea accidents, thus vocational training especially for handlers of small craft/tug/lighter should be emphasized. As for control over foreign vessels/seafarer, proper execution of 'Port State Control' and/or 'Compulsory Pilotage' would be effective.

(3) Revision of traffic regulations

In line with the actual development of the port activities, revision of the current traffic regulations including spacial rules within the channels, priorities of large seagoing vessels' sailing and etc. would be indispensable.

1.15 Management and Operation

1.15.1 General Principles of Port Management and Operation

In principle, three points of (1)efficiency, (2)provision of services at reasonable charges and (3)reliability and safety are commonly required for port management and operation around the world. With these factors, port activities can be promoted and a port management body can make the most use of port facilities. Even if these factors are given different priorities, it is impossible to attract users to ports without all of them.

1.15.2 Present Problems of Port Management and Operation

(1) Need to Improve the Incentive System for Employees to Work Efficiently

In general, a mature and large organization like PAT has a tendency for the decision-making process to become complicated and slower since the number of persons who take part in the process increases. Orders which are given by high ranking officials become unclear as they go down to lower ranks, so that many of them are likely to be eventually postponed or disappear according to circumstances.

An organization which adopts a seniority system with respect to wages and personnel, also has a tendency that internal competitions are excluded and that the morale of the members deteriorates.

So it cannot be said that PAT has no worries of having the above problems.

Actually in PAT, a system for employees to work hard and to improve their own skills according to the advancement of technology does not seem to function well as can be seen in many public organizations. There remains much room for improvement in terms of the modernization of the container terminal operation and it seems to be not necessarily well understood as a necessary direction of PAT by all personnel except high ranking officials and persons in the container related divisions.

From the above points of view, an overall management system such as reformation, activation of organization, payroll and promotion etc. involving all personnel of PAT is required to be reviewed and improved.

(2) Need to Improve Reliability and Safety

Security checks at the gate are insufficient, so that many people who are not closely related with port operations can go in and out of the port area at will. Such lax security risks accidents at the time of cargo handling and as well as crimes such as theft and smuggling of cargoes. One reason for the above difficulty is that many office buildings for PAT personnel whose duties are not directly related with physical port operation are located within the operating area, so that many automobiles owned by PAT personnel go in and out of the gates. Also, neighboring inhabitants are able to freely enter container terminal as a closed operation system is not adapted.

1.15.3 Future Port Management and Operation System at Bangkok Port

(1) Management and Operation System in Container Terminals

There are basically two methods of terminal operations around the world. One is where a port management body takes charge of not only public duties such as port planning, construction of port facilities, maintenance and management but also cargo handling business which is of a commercial nature. The other is that the role of the port management body is limited to the public duties and commercial business like cargo handling is done by private enterprises under the general control of the port management body. The important thing to be considered is to choose the best method which enables a port management body to operate a port efficiently and effectively without sacrificing public interest, based on a detailed examination of the present situation of the study port rather than seeking a common management and operation system.

Generally, it is desirable that a container terminal be operated by an operator who has sufficient skilled personnel and equipment to provide good service to port users. The following three candidates are considered as the future terminal operator of Bangkok Port.

Case 1) PAT
Case 2) Private companies
Case 3) A new organization founded by PAT
A new organization would be established by separating PAT's divisions related with operations and would carry out all kinds of tasks of the terminal operations.

Privatisation of the terminal operation (Case 2) sounds desirable because the cargo

handling would be carried out in a commercial manner; business would be run efficiently using a flexible management system. However, it is not realistic taking account of the situation of Bangkok Port, namely, many shipping lines use the port where terminal space for container handling is limited and difficult to expand and the social problems (relocation of workers) derived from the abolishment of divisions of cargo handling operation of PAT. When Case 1 and Case 3 are compared, Case 3 is basically recommendable in order to avoid inefficiency expected from the fixed management such as budget system, seniority system and formalism.

An example of the newly established organization is shown in Fig. 1-15-2.

(2) Management and Operation except Container Terminal

For efficient port operation, it is also recommended that the cargo handling at the west quay where only conventional cargoes are handled in the Master Plan be entrusted the newly established organization mentioned in the above.

1.15.4 Organization for Port Management and Operation

(1) Reorganization of PAT

In general, because of the numerous and complicated processes of decision making, an organization faces difficulties in taking quick countermeasures against changes of business circumstances as it expands and becomes larger in size. In order to avoid the tendency in which nothing gets done without the agreement of all concerned (which requires complicated internal adjustment), and to activate the organization itself, it is recommended to reorganize PAT.

It is recommended that PAT be basically divided into two functions, namely, headquarters' function and two individual port management functions (Bangkok Port and Laem Chabang Port). Headquarters would be in charge of making decisions on important matters such as long term development plans, important affairs of finance and personnel, reformation of organization and implementation of important projects etc.. In addition, headquarters would check all business of PAT from the global point of view and contribute to activation and efficiency of the entire PAT organization through the improvement of management and the amendment of regulations etc.. It is desirable that headqnarters consist of a small number of competent personnel.

Bangkok Port Office would take charge of almost all duties of port administration except the important affairs mentioned in the above. Even within Bangkok Port, it is

recommended that for a smooth and efficient management, authorities for everyday routine business be entrusted to lower ranking officials as much as possible.

An example of the PAT organization is shown in Fig. 1-15-1.

(2) PAT is required to reinforce port promoting function and to improve its statistic system.

(3) It is recommended that PAT introduce and improve measures for activation of the organization such as QC circles, proposal activities system and personnel management system.

1.15.5 Customs

(1) To achieve a proper functional allotment between Bangkok Port and Laem Chabang Port through promotion of Laem Chabang Port, it is recommended to encourage the construction of inland container depots by easing the customs standards for establishment.

(2) In line with establishment of inland container depots, it is also recommended to gradually simplify the procedure of the bonded transportation.

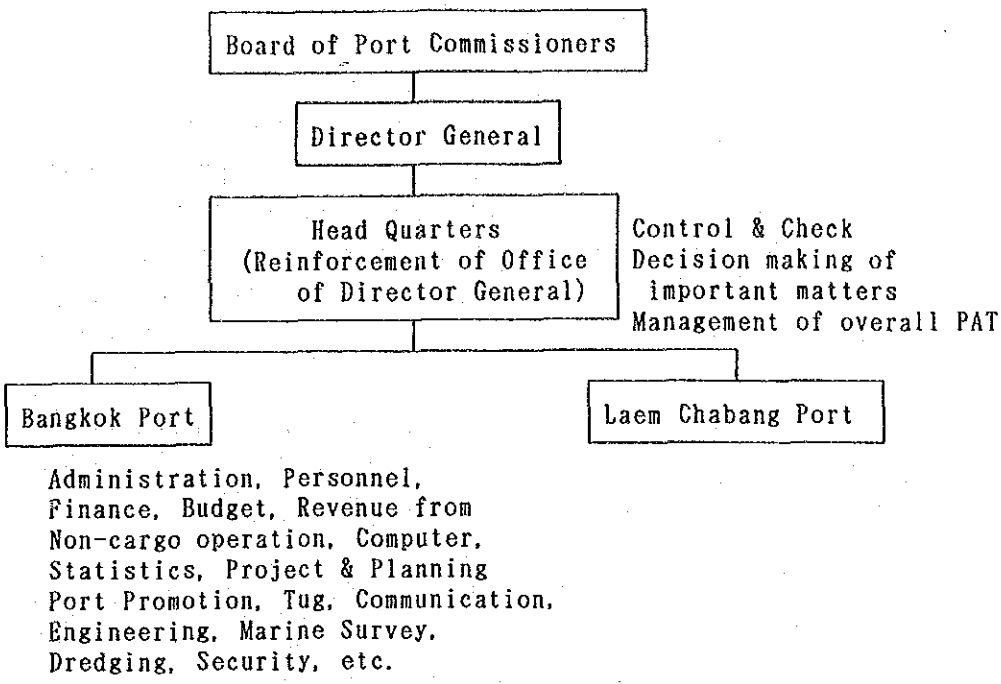


Fig. 1-15-1 Outline of the PAT Organization

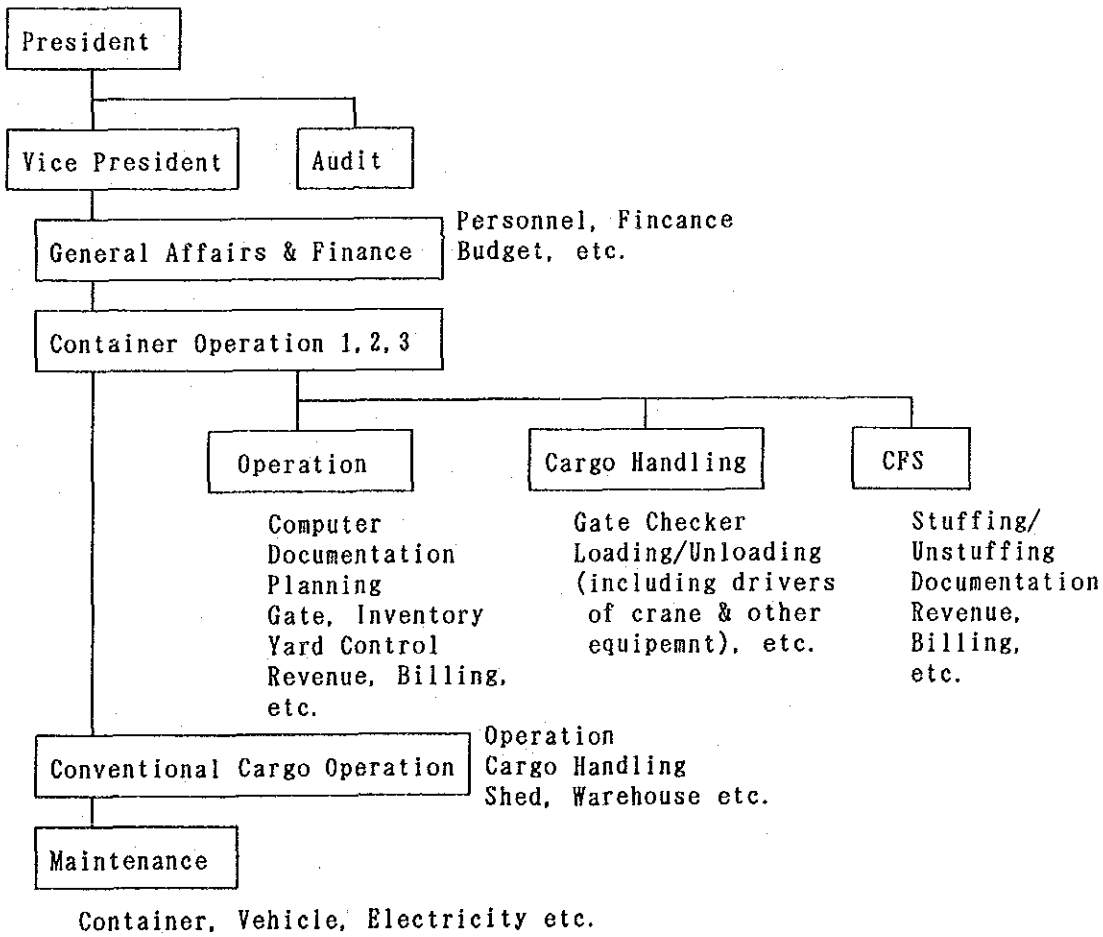


Fig. 1-15-2 Outline of the Organization of the Newly Established Organization

1.16 Initial Environmental Examination (IEE)

Bangkok Port is already an operating port with an annual throughput of 16 million tons. Estimated annual throughput in 2005, when the modernization project is completed, is less than the present level. The maximum size of calling vessels will not be changed and the total traffic volume to be generated from the port activities will decrease from the present level. Consequently, the project has positive environmental effects reducing numbers of calling ships and induced road traffic.

Main items to be dealt with in the stage of EIA are; (a) Widening of present bar channel, and (b) Sewage system of the terminal offices and the port office. With proper consideration, these items are considered not to cause problems.

Thai Government is expected to sign MARPOL 73/78 convention in the near future. A comprehensive system to satisfy requirements of MARPOL 73/78 should be studied by the Government of Thailand. Because the area of Klong Toei Wharf is very limited and dangerous goods storage area is in close proximity, reception facilities for engine room wastes from ocean-going and domestic vessels should be prepared along the Chao Praya River excluding Klong Toei Wharf.

PART II SHORT-TERM PLAN

2.1 Short-Term Plan for Bangkok Port

2.1.1 Short-Term Plan for Container-Handling

(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. The following concept of modernization 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 proposed to install a new Import CFS in Area II as proposed in the Master Plan. In the open yard south of the Import CFSs to be installed in Area II, it is proposed that a yard for stuffing export CFS cargoes (LCL) and an empty container storage yard be separately allocated.

(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, PAT intends to convert Area II, the area facing the Phra Kanong Canal and the area behind the planned storage area for dangerous cargo into areas for port activities in collaboration with the Housing Authority.

(3) Layout of the Main Facilities for Container-Handling

The main facilities for container-handling are arranged so as to embody the basic concept of the modernization shown in Section 2.1.1(1).

1) Marshaling Yard

The same marshaling yard as proposed in the Master Plan is arranged at the east quay (see Fig 2-1-1). 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 mentioned previously, 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.

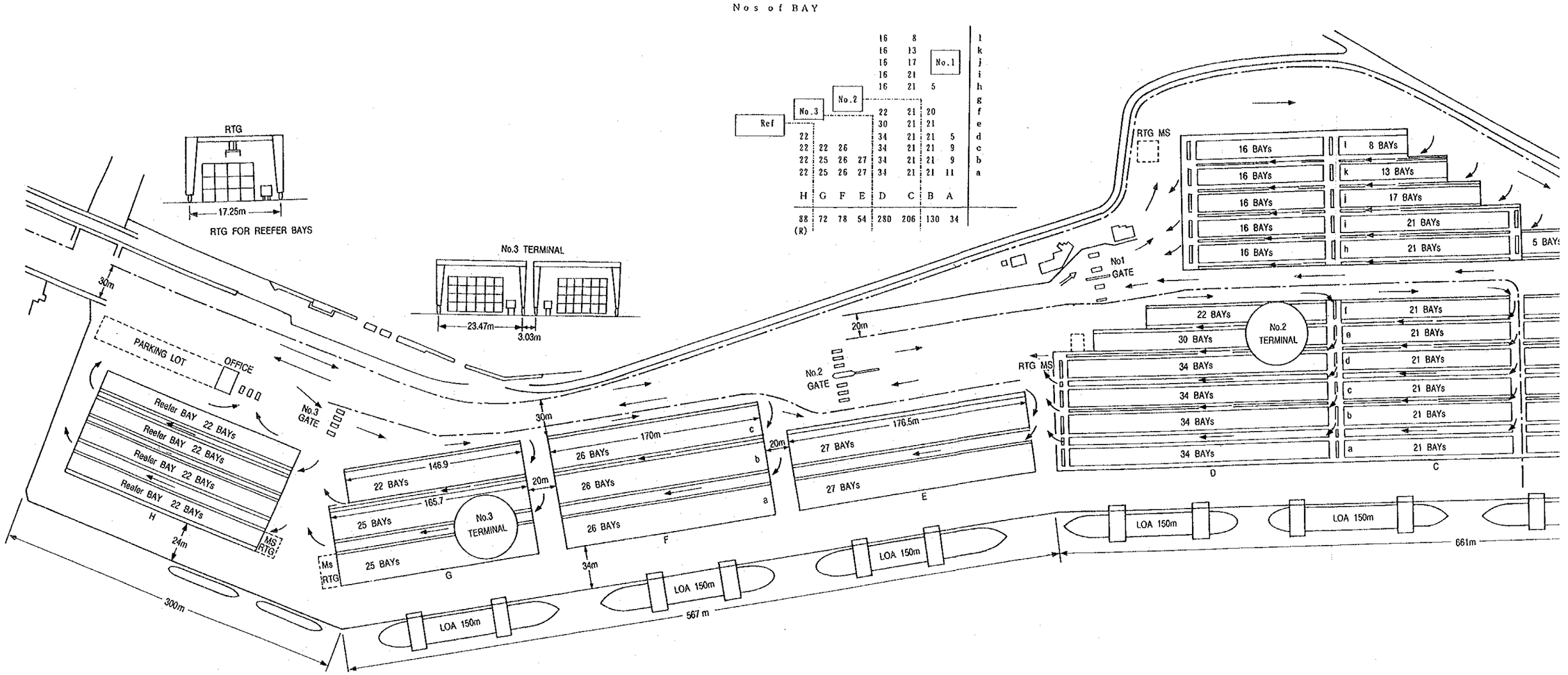


Fig. 2-1-1 Short-Term Modernization Plan of the East Quay

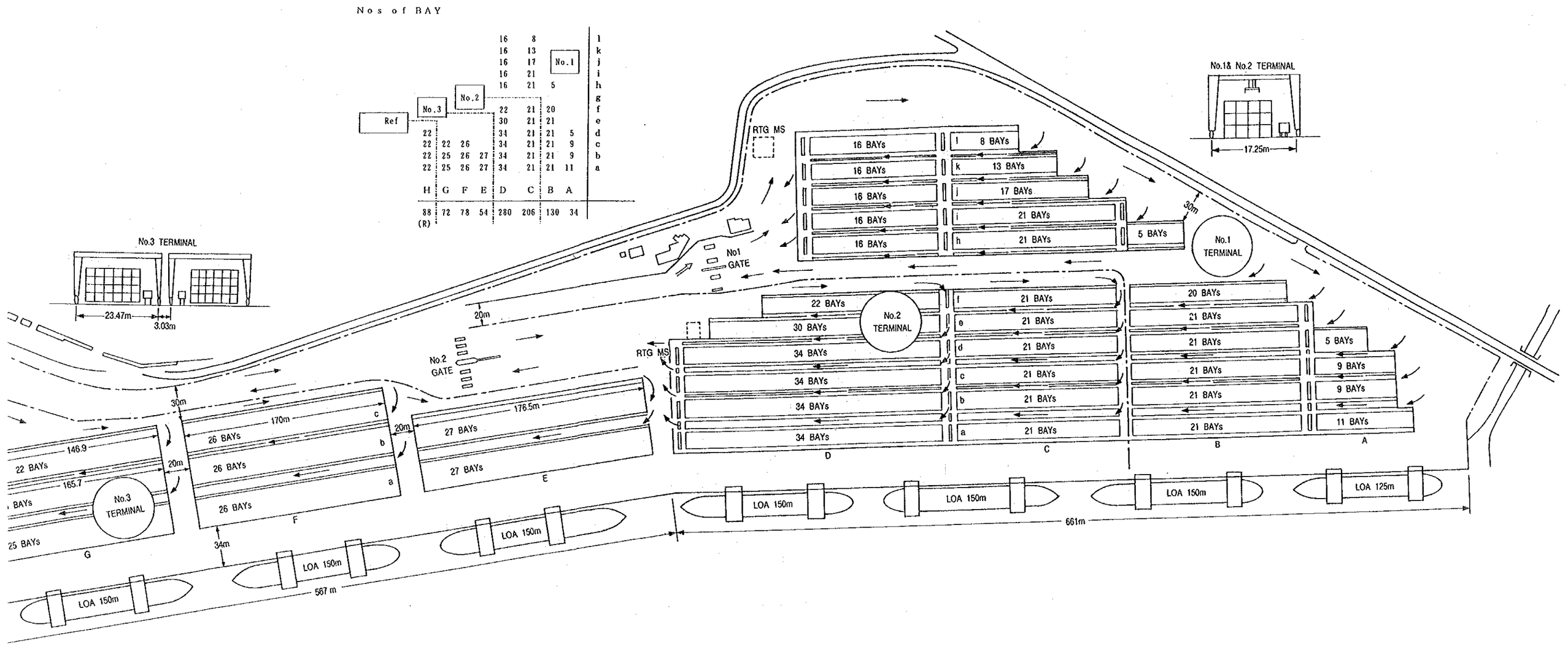


Fig. 2-1-1 Short-Term Modernization Plan of the East Quay

2) 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. On the other hand, the open yard for stuffing 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. 2-1-2).

3) 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 planned in the stage of the Short-Term Plan.

4) 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 shed No.17. The total required number of container chassis and tractors is estimated as 210 and 130, respectively, in the stage of the Short-Term Plan. 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.

5) 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.

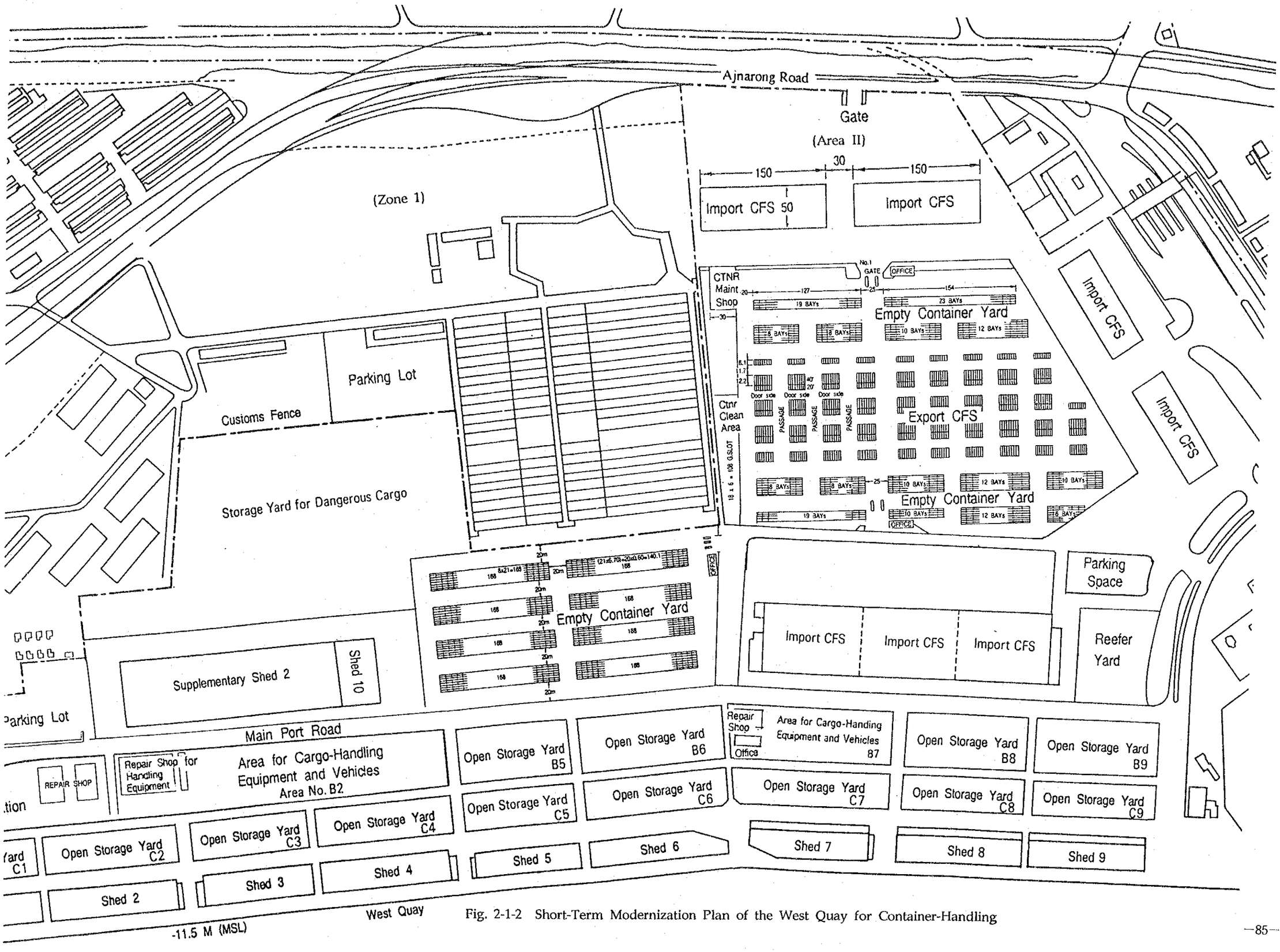


Fig. 2-1-2 Short-Term Modernization Plan of the West Quay for Container-Handling

(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. According to the results of the simulation, 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 berth occupancy rate of the seven berths of the east quay is 29.8%.

(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.

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. 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, corresponding required number of lanes at the marshaling yard of the east quay is seven at each gates.

4) Reefer Plugs

The required number of reefer plugs is estimated as 350.

5) Repair Shop and Cleaning Area

A repair shop for damaged containers with the site area of 1,500 sq.m is planned to be prepared within the storage yard for empty containers at the west quay. Cleaning area is also allocated at the same yard

6) Terminal Office

It is necessary to prepare a new terminal office with the total floor space of 600 sq.m at Gate No.3.

(6) 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 machines such as the transfer cranes, and therefore the toplifter system is selected as the optimum system.

The required numbers of container-handling machines in the stage of the Short-Term Plan are 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)	233
- Tractors	134
- Chassis	213

2.1.2 Short-Term Plan for Handling Conventional Cargo

(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 (see Fig.2-1-3):

- Usage of Berths at the West Quay Exclusively for Conventional Vessels
- Rearrangement of Usage of the Existing Sheds, Warehouses and Open Storage Yards for Conventional Cargo
- Rearrangement and Expansion of the Existing Port Roads
- Dismantlement of the Existing Dockside Cranes at the West Quay
- Relocation of the Existing Warehouses for Dangerous Cargo
- Transferring Railway Yard to the West Quay
- Preparation of Parking Lots for Passenger Cars and Trucks/Tractor-Chassis Units
- Transferring the Offices inside the Port Having no Direct Linkage with Cargo-Handling Operations to outside the Port

(2) Usage Plan for the Existing Storage Facilities

1) Movements of Conventional Cargoes within the Port

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. Resulting figures of the required areas for sheds and open yards during peak conditions obtained from the simulation are 23,100 sq.m and 55,200 sq.m, respectively. The resulting berth occupancy rate of 10 berths of the west quay is 87.7%. As shown above, the berth occupancy rate in the stage of the Short-Term Plan will increase from the present level. The berth occupancy rate, 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. Traffic volume of trucks each way during the peak condition is estimated as 680 vehicles per day.

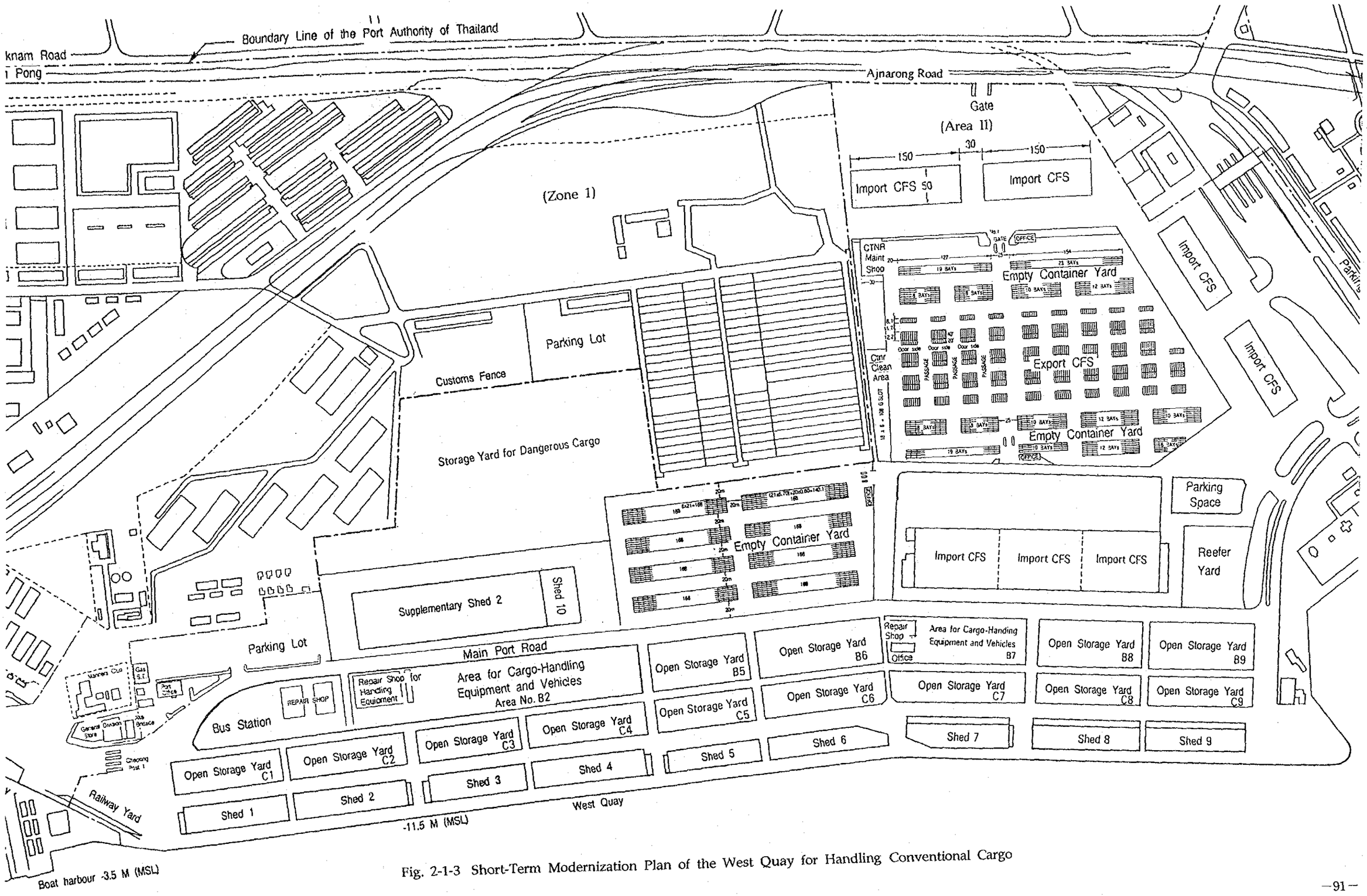


Fig. 2-1-3 Short-Term Modernization Plan of the West Quay for Handling Conventional Cargo

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.

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. Furthermore, storage in Import Steel Open Storage Yard outside the port is also planned to be replaced by the open storage yards near the berths mentioned above.

(3) Storage Plan for Dangerous Cargoes

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.

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.

(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.

(5) Parking Lots

Three parking lots for passenger cars and trucks/tractor-chassis units will be prepared near Checking Posts 1 and 2, and behind the dangerous cargo yard in the framework of the Master Plan. The total capacity is as follows:

- 1,070 passenger cars
- 300 trucks
- 80 tractor-chassis units

(6) Area for Offices near Checking Post 1

Along with the relocation of Checking Post 1 and the port road through the post, the offices comprising Fire Station and Common Use Building with the total floor space of 2,550 sq.m will be also relocated.

(7) Railway Yard

Present railway operations at the east quay are planned to be transferred west of the west quay in the stage of the Short-Term Plan. A new railway yard with an area of 5,500 sq.m will be prepared.

(8) System for Handling Conventional Cargo

To handle steel products efficiently, 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. On the other hand, to handle various kinds of cargoes excluding steel products, it is necessary to promote unitization of the package type such as containerization and palletization.

The required numbers of machines for handling conventional cargoes in the stage of the Short-Term Plan are shown as follows:

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

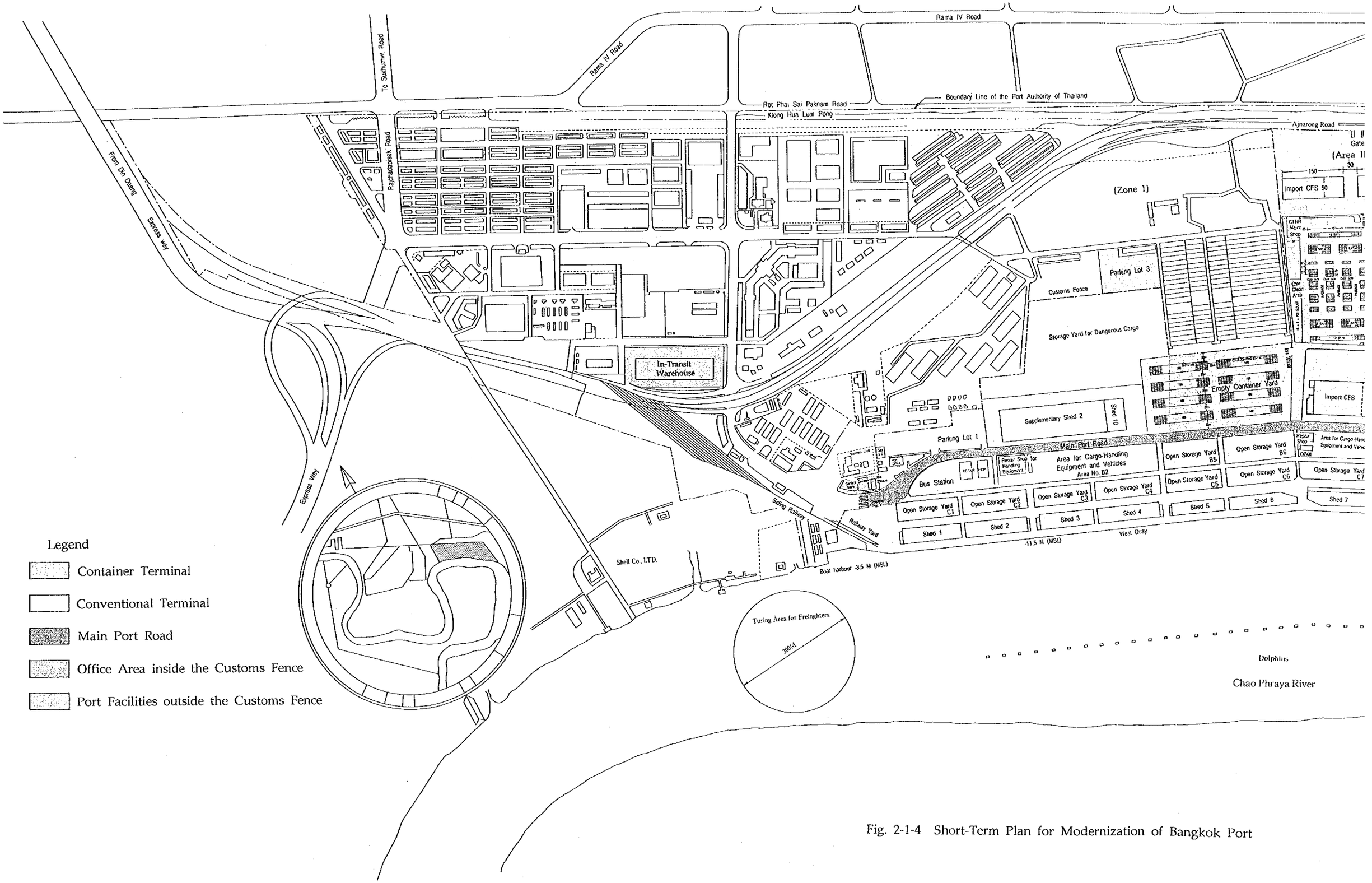
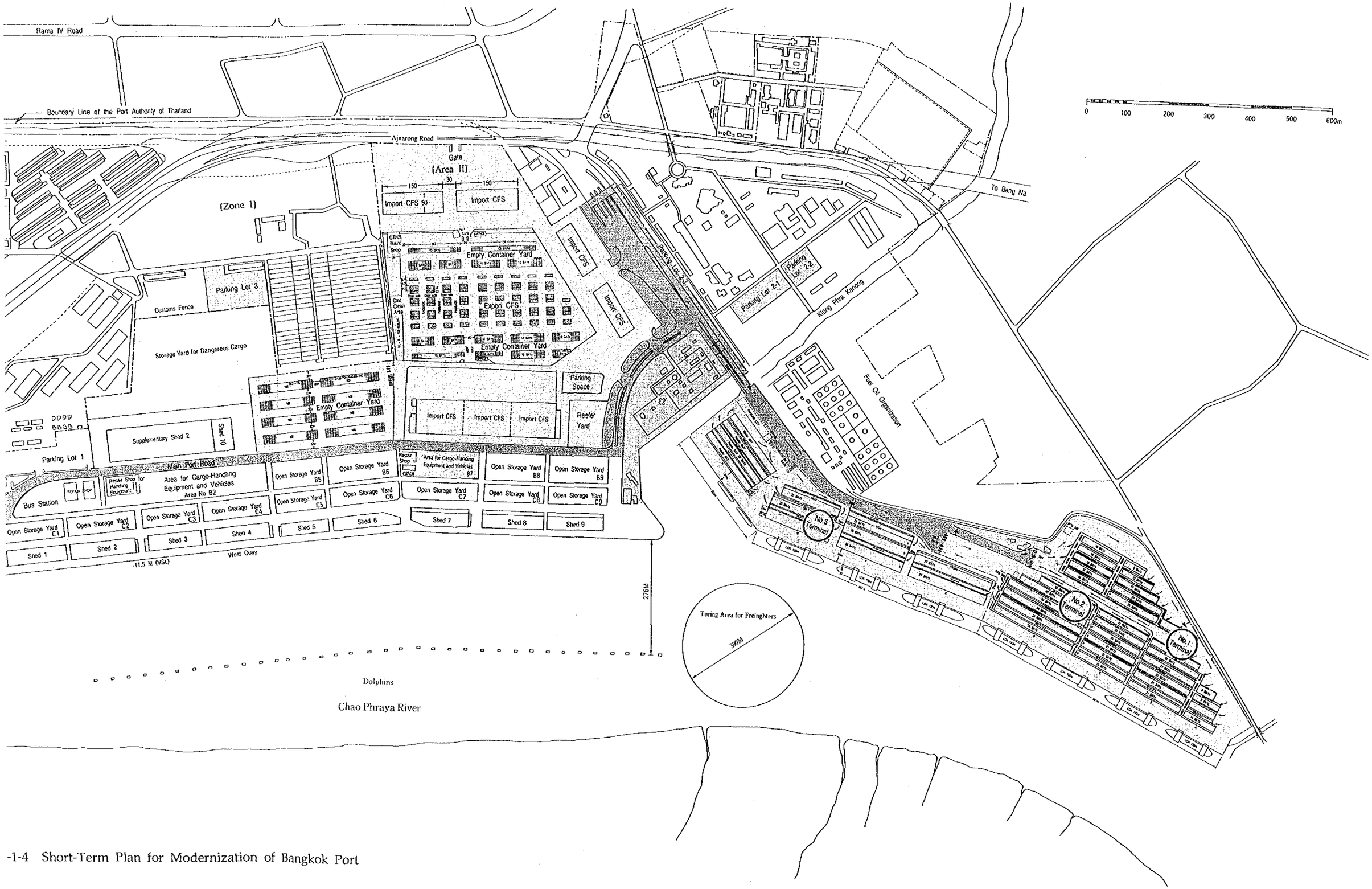


Fig. 2-1-4 Short-Term Plan for Modernization of Bangkok Port



-1-4 Short-Term Plan for Modernization of Bangkok Port

2.1.3 Short-Term Traffic Planning

(1) Forecast of Traffic Volume

In the Short-Term Plan, traffic volume generated from port operations in Bangkok Port is indicated in Fig 2-1-5.

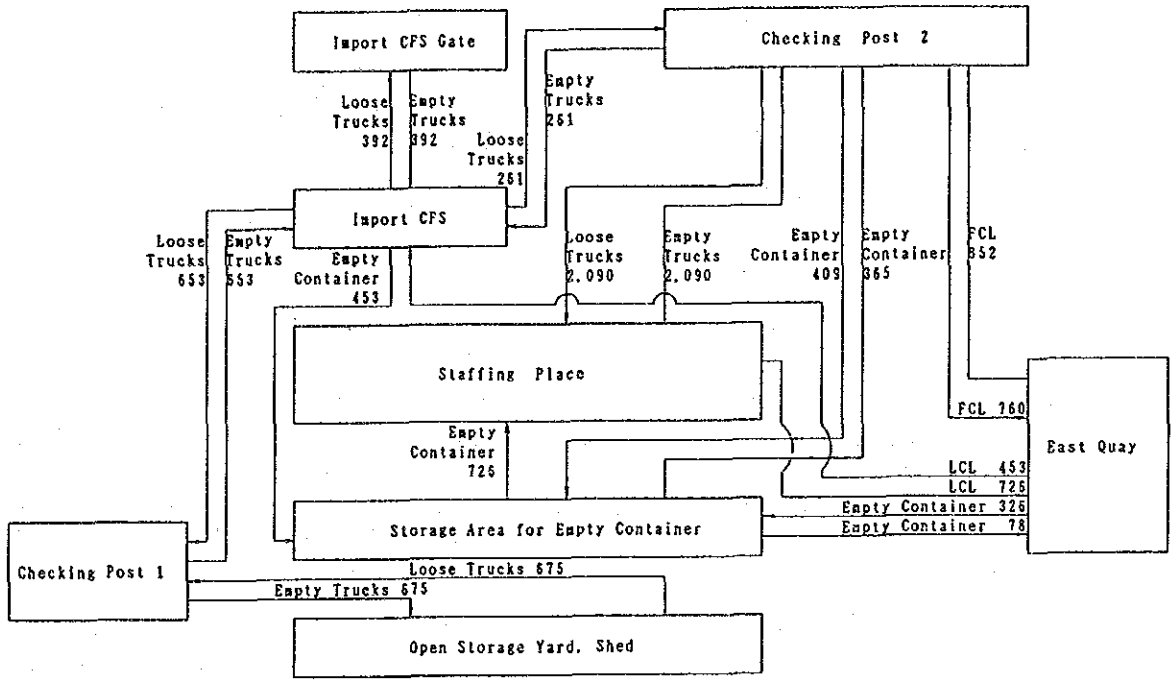


Fig.2-1-5 Movement of Container and Conventional Cargo Traffic (Peak Volume/Day) Year 1997

(2) Port Traffic Facility Plan

Traffic volume and condition are not expected to change greatly between the Short-Term and Master Plans, thus the number of lanes is the same for both stages. Number of required lanes at Checking Post 1 is 2 inbound lanes and 5 outbound lanes for passenger cars trucks; therefore a total of 7 lanes are necessary. Two lanes at the truck side gate of the Import CFSs are required for smooth traffic from/to access road of the expressway.

2.2 Information System

2.2.1 Introduction

PAT is required to develop a cargo container software system at the urgent request of related bodies. For the purpose of becoming more competitive and attractive when compered with other container terminals, PAT should computerize the container terminal operations and upgrade it's services to the customer. Computerization is a very important factor for the modern container terminal but it is not the only aspect. The most important factor is the personnel who have the knowledge and experience as container terminal operators. PAT however has no such staff at present. Practical use of private companies is necessary for problem solving and future development of computer software.

2.2.2 Improvement of the Document System

In the present circumstances in which container terminals must handle ever increasing amounts of information, numerous documents are made and submitted by each party concerned. Such paper work is costly, time-consuming and fraught with errors. Data Communication, EDI (Electronic Data Interchange) or other systems e.g. diskette will increase efficiency and thereby prevent errors from occuring. It is advisable that PAT designates a committee responsible for reaching a consensus between parties involved on unifying various operational procedures, documentation forms, and data record layout.

2.2.3 Software Developing Plan for the Short Term

The following system will be developed

1) Tally In/Out Control System
2) Sub Gate In/Out Control System
3) Indication of Yard Condition and Slot Control System
4) RTG Optimum Arrangement System
5) Ship Loading and Discharging System
6) Stevedore Control System
7) Data Transmission System

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

1) On-line Gate Control and EIR Printing
2) Container Tracking and Yard Inventory Control
3) Optimum Positioning of RTG

4) Determination or Checking of Yard Stacking Address for Receiving and Delivering Containers
5) Ship Loading and Discharging Support
6) Inquiries, Reports and Billings
7) Electronic Data Interchange with Trading Partners

2.2.4 Strategy of Software Development

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.

The level of knowledge and experience of PAT's staff as container terminal operator is not sufficient to operate all tasks by themselves at present. However, PAT is required to develop a cargo container software system at the urgent request of related bodies. It is advisable that PAT purchases a package software to meet the demand of the age. This proven package software based system is the most beneficial solution to PAT for upgrading the existing system and minimizing lead time on investment. PAT will have to train its staff in cooperation with skilled terminal operators and gradually extend the limit of their duties in accordance with up-graded skills. Employees who have a thorough knowledge of the job are indispensable for future software development.

2.3 Management and Operation

2.3.1 Management and Operation System in the Short-Term Plan

(1) Relation with Management and Operation System in the Master Plan

In the Master Plan, it is recommended 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. Considering the importance of Bangkok Port to the Thai economy, the shift of the terminal operator from PAT to the newly established organization should not be made before PAT will perfectly acquire know-how of terminal operation, arrange its organization and prepare competent personnel to operate the terminal.

With this in view, it doesn't seem practical for PAT or 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. This stage is considered as a transitional stage toward the Master Plan.

(2) Terminal Operator

As for a terminal operator in 1997, it is recommended that the operation is carried out by a cooperation of PAT and shipping lines/agents, namely, one of the divided terminals is operated by PAT and the other terminals are operated by them as at present. And sooner or later, PAT is required to operate the other terminals by itself in line with its acquisition of operational know-how and arrangement of organization and personnel. Improvement of personnel development through employment of expatriates on operation and dispatch of trainees to the advanced terminals abroad etc. is also recommended.

It is not considered appropriate that the new organization which is formed by personnel and investment of PAT (proposed in the Master Plan) be established until PAT can completely operate terminals with extensive knowledge of operations and until the necessary management system has been formed.

2.3.2 Management and Operation except Container Terminal in the Short-Term Plan

The west quay and sheds behind it handles only conventional cargoes in the Short-Term Plan. It is recommended that PAT take charge of the management and operation of the

west quay and sheds behind it as at present.

2.3.3 Reformation of Organization of PAT

(1) Reformation of Organization of PAT

As mentioned in the Master Plan, functions of headquarters which are in charge of important matters such as big projects, long-term development plans and finance (including tariff) etc. are to be improved or reinforced in the stage of the Short-Term Plan. In addition, headquarters would contribute to activation and efficiency of the entire PAT organization through the improvement of management and the amendment of regulations etc.. And it is desirable that headquarters consist of a small number of competent personnel.

Bangkok Port would take charge of almost all duties of port administration except the important affairs mentioned above. Even within Bangkok Port, it is recommended that for a smooth and efficient management, authorities for everyday routine business be entrusted to lower ranking officials as much as possible.

And it is also recommended that departments of container handling and conventional cargo handling be separated. As for container terminal operation, it is necessary to organize three divisions (units) according to the proposed three terminals which will be independently controlled, while it is advisable that small repair/maintenance of handling equipment be carried out by a single division.

Examples of proposed organization of PAT and its cargo operation department are presented in Fig. 2-3-1 and Fig. 2-3-2 respectively.

(2) Personnel

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, in departments concerning port administration/management and engineering excluding operation departments, PAT has too large a number of personnel considering cargo volumes handled at the port. It is recommended that PAT reduce its personnel by business rationalization through introduction of machinery and entrusting its works to outside etc..

However, since a rapid reduction of personnel is usually accompanied by social problems (relocation of workers), it is advisable that this reduction be phased gradually such as

through attractive voluntary retirement packages or scaled down recruitment.

(3) Others

In addition to the above mentioned reforms, recommendations mentioned in the Master Plan such as reinforcement of port promotion function, improvement of statistic 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.

2.3.4 One Stop Service

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. So 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.

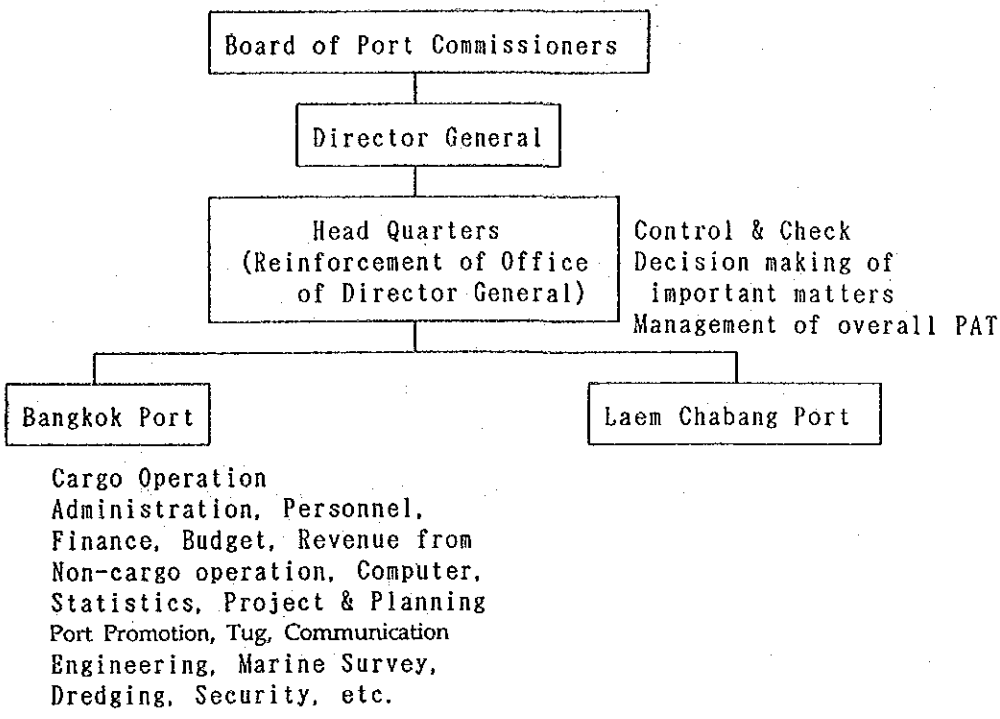


Fig. 2-3-1 Outline of the PAT Organization

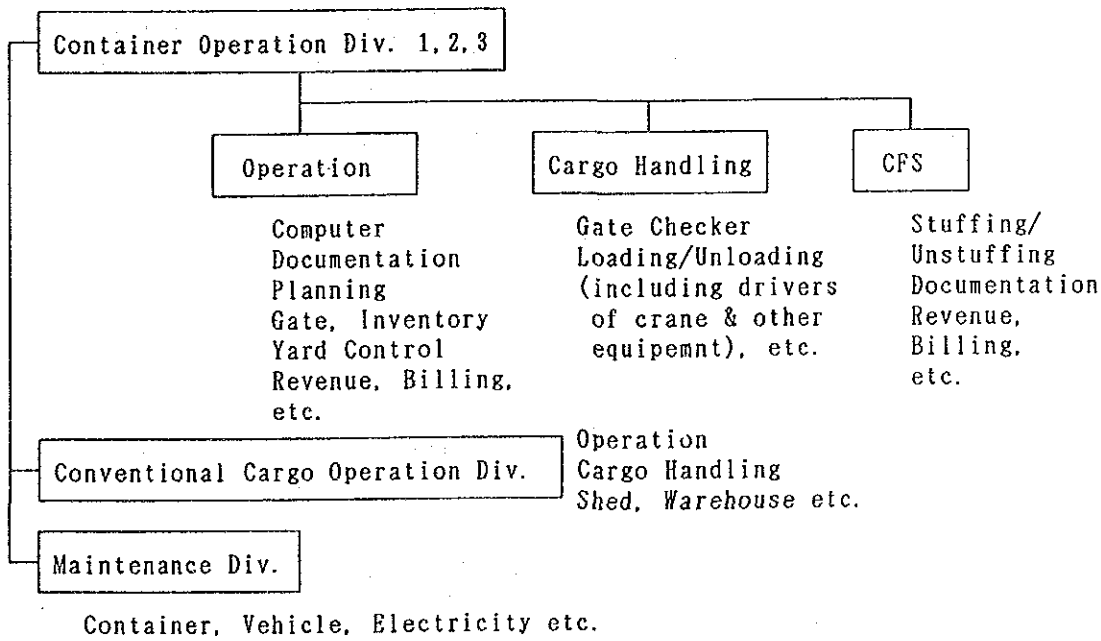


Fig. 2-3-2 Outline of the Organization of Cargo Operation Department of Bangkok Port

2.4 Environmental Impact Assessment (EIA)

The Short-Term Plan proposed in the study only consists of changes in land utilization and no construction works of basic port and harbor facilities such as wharves or breakwaters are not 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, and the maximum size of calling vessels will not be changed. Total traffic volume in and around the port will decrease from the present level.

So, the Short-Term Plan has basically a positive environmental effect, reducing a number of calling ships and induced road traffic.

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

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.