RESTRICTED

Report No. PTR-46a

INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT

INTERNATIONAL DEVELOPMENT ASSOCIATION

APPRAISAL OF

THIRD BANGKOK PORT PROJECT

THAILAND

July 13, 1970

Transportation Projects Department

Currency Equivalents

Currency Unit	= Baht (฿)
US$1	= ฿ 20.80
฿ 1	= US$0.048
฿ 1 million	= US$48,076

Fiscal Year

October 1 - September 30

Units of Weights and Measures

Metric

Metric: British/US Equivalents

1 kilometer (km)	= 0.62 miles (mi)
1 meter (m)	= 3.28 feet (ft)
1 square kilometer (km^2)	= 0.368 square miles = (sq mi)
1 metric ton	= 2,204 pounds (lbs)

Acronyms

NEDECO - Netherlands Engineering Consultants
PAT - Port Authority of Thailand
USAID - United States Agency for International Development

Water Depths

In meters and related to mean sea level

THAILAND

APPRAISAL OF THIRD BANGKOK PORT PROJECT

Table of Contents

This report was prepared by Messrs. T. M. Malkani (Engineer), K. C. Rodley (Financial Analyst) and L. Y. Pouliquen (Economist).

TABLE OF CONTENTS (cont'd)

ANNEXES

TABLES

CHARTS

MAPS

THAILAND

APPRAISAL OF THIRD BANGKOK PORT PROJECT

SUMMARY AND CONCLUSIONS

i. This report appraises a project which would increase capacity and efficiency at the port of Bangkok. This medium-sized, deep-water port, at the mouth of the Chao Phraya river, is the largest in Thailand and handles 95% of the country's imports and 80% of its exports; traffic at Klong Toi, the main wharves, is expected to increase from 2.3 million tons in 1969 to 3.25 million tons in 1975. About 1,900 ships now use the port each year.

ii. In recent years traffic growth resulted in congestion which, in 1967, was so severe that surcharges were placed on freight rates by the shipping conference lines serving the port. For the six months they were in force they cost Thailand's economy about US$4 million in added foreign exchange costs. Through improved productivity some modest investments in mechanization and other measures, the immediate congestion problems were alleviated and the surcharges removed. However, increasing traffic is causing congestion to recur and, unless a major expansion of the port's berthing capacity takes place, not only is the re-imposition of surcharges likely but Thailand's development objectives will be jeopardized.

iii. The project consists of the construction of four deep-water berths, two lighterage berths, two transit sheds and consultants' and expert assistance in various fields of port management and operations. Total costs are estimated at US$21.0 million equivalent, of which the proposed loan would cover the foreign exchange component - US$12.5 million. The project is based on a feasibility study made by the Consultants (NEDECO) for the Port Authority of Thailand (PAT). PAT will be responsible for the execution of the project.

iv. Detailed economic evaluation of the proposed project (involving the use of a simulation model) shows an expected return in excess of 20% and indicates that the project is properly sized.

v. Work and procurement procedures on two previous port loans were satisfactory[1/]. The Bank's international competitive bidding procedures would apply to this project. Work is expected to take about four years and be completed in December 1973.

vi. The port is administered by PAT under the jurisdiction of the Ministries of Finance and Communications. It is reasonably well-managed and financially viable. In order to improve productivity and to permit

---

1/ 37-TH, US$4.4 million equivalent in 1950.
151-TH, US$3.4 million equivalent in 1956.

better use of existing and future port assets, PAT has agreed to engage management consultants to study the feasibility of adopting a multiple shift system for cargo handling and other related port operations. Steps will be taken in agreement with the Bank to implement the consultants' recommendations not later than January 1, 1972.

vii. In order to maintain a strong financial position and secure an adequate contribution towards future port development, PAT has agreed that tariffs will be reasonably related to costs, that the financial rate of return on net fixed assets in use will be not less than 8% p.a. and that long-term debt will not be incurred unless net cash revenue is and will remain at least 1 3/4 times the maximum debt service requirements.

viii. The project provides a suitable basis for a loan of US$12.5 million to PAT over 20 years including a four-year grace period. Substantial issues on which agreement has been reached during negotiations are listed in Chapter 7.

THAILAND

APPRAISAL OF THIRD BANGKOK PORT PROJECT

1. INTRODUCTION

1.01 The Port Authority of Thailand (PAT) has requested Bank assistance in financing a project to expand and improve port facilities at Bangkok. PAT had originally proposed a project comprising construction of six deep-water and two lighterage berths and ancillary facilities, equipment, and realignment of the bar channel. This project is part of PAT's development program estimated to cost ฿ 1,195 million over the next five years. As a result of the Bank's evaluation, including a simulation of expected port requirements, the project has been scaled down to consist of the construction of four deep-water berths, two lighterage berths, two transit sheds and ancillary works. It also includes consultants' and expert assistance for project engineering, construction supervision and various aspects of port management and operations.

1.02 The estimated cost of the project is about US$21.0 million and the proposed loan of US$12.5 million would meet the estimated foreign exchange component.

1.03 The Bank has previously made two port loans for the Port of Bangkok. The first (37-TH) in 1950, for US$4.4 million was for dredging the bar channel and purchasing rails, equipment, cranes, a tugboat and navigation aids; it was fully disbursed by 1955. The second (151-TH), in 1956, for US$3.4 million was for purchasing two hopper dredgers and a clamshell dredger, and was fully disbursed in 1958. Work and procurement under both loans was satisfactory, although dredging performance has since deteriorated.

1.04 Seven other transport loans have been made to Thailand: three railway loans and four highway loans; they are described in Annex 1.

1.05 This report is based on the findings of a Bank appraisal mission consisting of Messrs. T. M. Malkani (Engineer), L. Y. Pouliquen (Economist) and K. C. Rodley (Financial Analyst) in October 1969. Mrs. Comer (Programmer/Analyst) prepared the simulation model used in the economic evaluation.

2. BACKGROUND

A. General

2.01 Thailand (Map 1), with an area of about 510,000 km^2, is roughly the size of France. Its main coastline is on the Gulf of Thailand to the south; however, the southern isthmus also borders on the Indian Ocean. The population of 36.5 million is increasing rapidly at about 3.3% annually; although generally well distributed there is concentration in the central lowland plains of the Chao Phraya river, especially around Bangkok, the capital. With a population of 2.8 million, Bangkok is the main commercial and industrial center. Other towns are relatively small.

2.02 GDP at 1969 market prices is estimated at US$6.0 billion equivalent. During 1964-1968, both population and economic growth were rapid, the latter averaging 8% per annum. Slow agricultural development was more than compensated by the rapid expansion of industry, construction and mining which averaged 12% annually. Both exports and imports increased about 14% per annum. Per capita GNP increased by 25%, reaching about US$145 equivalent in 1969.

2.03 Immediate future prospects are less favorable. There are indications of an economic slowdown due to the possibility of sizeable reductions in U.S. military spending. During 1971-1975 the export growth rate is expected to decline to an average of about 4% annually which, despite an average import rate of only 6% annually will result in an increasing trade deficit. The economy is expected to grow at a rate of about 6% to 7% annually over the next five years.

B. The Transport Sector

2.04 The main transport arteries run from north to south, following the direction of most mountain ranges and rivers, with a lateral network of secondary roads, canals, waterways, etc., feeding into them. Most urban centers are in the lower central region while food growing areas are mainly along rivers and canals, usually north of this region. The Chao Phraya is the most important river; it also extends from north to south in the central plain. The headwaters from the catchment areas of its four main feeder rivers, Ping, Wang, Yom and Nan, lie in hilly northern Thailand.

Highways

2.05 The major road network radiates from Bangkok. The Department of Highways (under the Ministry of National Development) is responsible for administration, construction and maintenance of the national highway network and main feeder roads. Although primary and secondary paved highways now total over 6,000 km, major improvements are needed to carry the

increasing traffic resulting from the country's rapid economic development. The Government's seven-year investment program (1965-1971) contains nearly US$400 million for the construction or reconstruction of 4,500 km of roads, including a few four-lane roads and the paving of 3,100 km of existing roads. The Bank highway loans constitute an integral part of this program (Annex 1).

Air Transport

2.06 The Don Maung airport in Bangkok is the international airport serving Thailand, and 26 international air carriers provide service. It is a strategically located transit hub for international airlines serving all Asia. Some improvements are being made to the airport but in view of the increase in traffic, further expansion of facilities is being considered. Thai Airways International provides international services to neighboring countries using medium range jets, and Thai Airways provides domestic services to a network of internal airports using smaller aircraft.

Railways

2.07 The State Railway controls over 3,700 km of efficient and viable railways, also radiating from Bangkok. In 1968, about 5.5 million tons were carried by rail. A five-year investment program (1967-1971) for purchase of rolling stock, relaying of lines, etc., estimated to cost US$90 million, with a foreign exchange requirement of approximately US$41 million, is being carried out.

Inland Waterways

2.08 An extensive inland waterways system of 1,600 km is widely used by both cargo and passenger traffic. These rivers and canals serve a farm population of 9 to 10 million in the central plain and carry over half the 10 million ton rice crop. In 1968, over eight million tons of building sand moved over the system. Considerable quantities of teak for export are floated in rafts to Bangkok.

2.09 Despite wide use of the waterways, the Government has made little effort to develop them and inadequate attention and poor maintenance have frequently resulted in decreasing navigational depths. The potential of the waterways has been considered in the transport coordination study mentioned below (para. 2.11).

Ports

2.10 Thailand has some 22 ports. Bangkok is the largest and, excluding crude oil handles about 95% of the country's imports, about 2.6 million tons, and 80% of its exports, about five million tons. Crude oil is imported at Sriracha, some 100 km southeast of Bangkok. Next is Sattahip, a five-berth deep-water port with an oil jetty, built by the U.S.

in 1965-66 and located about 170 km south of Bangkok, on the east of the Gulf of Thailand. Sattahip is Thai property but presently utilized exclusively for discharging U.S. military cargo. It handles about one million tons annually, mostly in container form. The next three ports, in order of importance, are Songkla, on the west of the Gulf of Thailand, and Kantang and Phuket on the Andaman Sea. These ports are fairly specialized and their traffic, mostly exports, is independent of Bangkok's. Songkla, the second largest commercial port, handles about 250,000 tons of cargo annually and, together with Kantang, most of the rubber production. Phuket, the country's third deep-water port handles all refined tin production. The remaining sixteen ports are coastal with relatively shallow channels. NEDECO is presently making a feasibility study for the development of a new deep-water port at Laem Krabang on the east of the Gulf of Thailand about 120 km from Bangkok (paras. 3.16-3.18).

Transport Coordination

2.11 The recent rapid development of the transport sector prompted the Bank to advise the Government to undertake a transport coordination study. It was carried out by Wilbur Smith and Associates/Lyon Associates, with USAID financing and in close cooperation with the Bank. The study was to provide guidelines for: (i) establishing an appropriate coordinating organization which would inter alia, prepare investment programs for the various transport modes; and (ii) improving regulation of transport activities. The October 1969 draft final report, reviewed within the Bank and USAID, identified the following major transport coordination problems: (i) faulty pricing policy in road and rail transport; (ii) inefficiency and high costs resulting from ETO's (the Government-owned Express Transport Organization) monopoly position in the trucking industry, particularly for pick-up services from railway stations and Bangkok port; and (iii) the need to centralize transport planning services. The Bank and USAID have suggested ways of improving the report and a new draft is being prepared. However, nothing in the report affects the conclusions of this appraisal.

3. THE PORT OF BANGKOK

A. Present and Future Organization and Administration

3.01 In 1951, as a condition of Loan 37-TH, PAT was established as an autonomous organization to take over administration of the New Harbour, which consists of the Klong Toi wharves and other riparian areas of the Chao Phraya river. PAT handles all port operations; it also dredges and maintains the navigation channel of the river from Memorial Bridge to the sea, including the bar channel (Map 2). Unless special customs exemptions are obtained, all import cargoes must, by law, be discharged at Klong Toi wharves. The Harbour Department, also under the Ministry of Communications, controls pilotage, which is compulsory for vessels of 500 tons or more, from the entrance of the bar channel.

3.02 PAT is directly responsible to the Ministries of Communications and Finance. Its annual capital budget is subject to the approval of the Council of Ministers. It is managed by a Board of Commissioners consisting of a Chairman, a Director and nine members. Of the members, seven are senior Government officials and two are Army officers. The Director, also an Army officer, who until recently was a part-time port official has now been appointed full-time and has two full-time Deputy Directors. Chiefs of various service and operational departments assist in carrying out port functions.

3.03 Port management is reasonably satisfactory. In order to give port users representation on PAT's Board of Commissioners, the Government agreed during negotiations to appoint at least one person with extensive experience in commercial management to the Board.

Accounting System

3.04 PAT's general accounting system is good. However, the costing system needs updating and PAT requires assistance in establishing a modern costing section to revise rates and introduce a more effective form of budgetary cost control. During negotiations, PAT agreed to engage an accounting expert for this purpose under terms of reference satisfactory to the Bank.

B. Port Facilities

3.05 The bar channel to Bangkok port is dredged to 8.5 m and to a width of 100 m. With a mean tidal range of 1.54 m the maximum draft of vessels that can cross the bar channel is limited to 8.5 m (i.e. 10,000 to 12,000 dwt vessels). The navigational channel in the river is dredged from 8.5 to 11.5 m. The tortuous narrow navigational channel bars entry of ships longer than 172 m (565 ft) and draft restrictions are imposed for ships longer than 145 m (476 ft).

3.06 Bangkok port facilities stretch along some 47 km of the Chao Phraya river. Most of the facilities are between 26 and 47 km upstream from the Gulf of Thailand but some wharves and anchorages are situated closer to the mouth of the river (Map 2). The main deep-water facilities, and the location of the proposed project, are the Klong Toi wharves, which are controlled by PAT and extend between 26.5 km and 28.5 km from the mouth. These wharves consist of 10 berths of a total length of 1,660 m with a dredged depth of 11.0 m. Other port facilities, not under PAT jurisdiction, include 82 private and public wharves, landing places and finger piers along a considerable distance of the river and 33 midstream anchorages and moorings at different locations. Opposite Klong Toi wharves, PAT proposes constructing 36 midstream dolphins which are expected to be completed by the end of 1971. Further details of Bangkok port, facilities, floating craft, and plant are given in Annex 2.

C. Transport Connections to the Port

3.07 Bangkok is located at the center of the country's various transport networks. The main networks used by the port are roads for imports and waterways for exports; use of the rail system is limited because most imports are either consumed in the Bangkok area or redistributed from there. Direct transfer of cargo from ship to rail is infrequent. Cargo landed on the Klong Toi wharves is usually brought into covered warehouses or to open storage spaces and later removed by road. A small amount of cargo for Laos is taken to the Laos transport shed from the berths for transshipment to Laos.

3.08 The port and the Chao Phraya river have good access to the inland waterway system. Much agricultural produce is brought by country craft and shipped for export. Similarly, import cargo is discharged overside into lighters or small cargo boats. This mode of transport is relatively important.

3.09 Road access to Klong Toi and other wharves is poor. The long-term aspects of urban transport are of particular importance to port development. With the centers of trade and commerce progressively moving toward the outskirts of the city, port traffic will have to travel increasingly through the entire city mainly by truck. The main connecting road to Klong Toi is being improved and widened and construction of a second road has just started; the increased traffic handled at Klong Toi should not therefore cause congestion above tolerable limits. During negotiations Government agreement was obtained to the proper maintenance of roads outside PAT's jurisdiction necessary for the efficient operation of the port facilities and also to the completion of an additional access road to the port by not later than December 31, 1973.

3.10 However, Bangkok's urban transport problem remains of serious concern to the Government which created an interministerial committee in July 1969 to study it. At the Government's request, a Bank mission on urban transport visited Thailand in November 1969 and recommended that a comprehensive urban transport study be undertaken (possibly with UNDP financing).

D. Operations

3.11 Use of cargo-handling equipment is not satisfactory due to oversupply and inefficient use. Semi-portal cranes are recorded as working an average of only six hours per day each but, in fact, they are rarely used as ship's gear is preferred; forklift trucks work eight hours each per day, but they are often idle because drivers are unavailable (para. 3.12); mobile crane operational hours are also low at five hours per day; tractors and trucks are somewhat better, at seven and thirteen hours respectively. Apart from the cranes, other vehicles combined carry about 3½ tons of cargo per hour. Vehicle utilization is low, as indicated by the figures for September 1969 below:

Type of Vehicle	No.	Number Utilized	% of Utilization
Forklift Trucks	215	166	77
Tractors	51	24	47
Trucks	115	82	71
Mobile Cranes	23	11	48
Total	404	283	70

As 332 vehicles out of the total 404 are less than four years old (most are only one or two years old), considerable improvement should be possible. Better supervision and control is necessary and this is likely to be achieved with the introduction of a two-shift, and later a limited three-shift system, for all categories of personnel.

Labor

3.12 The wharf labor force of about 800 men works an eight-hour day shift. About 40% remains in the port throughout the night, one half working, the other half resting alternately. All night hours earn overtime pay and are followed by a 24-hour off-duty period. This is a long standing arrangement. The inefficiency of this system was pointed out by NEDECO in a 1965 report, by an ECAFE team in 1965 and by a Government Port Adviser in 1968. Each of these studies advocated radical changes in the organization of port labor. It is considered that introduction of a two-shift system could increase labor productivity by 25-30%. In Singapore where wharf labor worked a similar extended one-shift system, introduction of a two-shift system in 1964 improved gang productivity by 28%: a limited third-shift system was introduced in 1967. The present system at Bangkok is costly to the economy and should be capable of being improved. During negotiations PAT agreed to employ management consultants acceptable to the Bank, to study the feasibility of adapting PAT's present cargo-handling methods to a multiple shift system. PAT further agreed to take the necessary steps to implement the consultants' recommendations in consultation with the Bank not later than January 1, 1972.

3.13 Ship labor is obtained through private stevedoring companies and the shipowners' agents consider that the present level of competition results in satisfactory cargo-handling at reasonable cost.

3.14 Relations between employers and employees in the port are generally good. There are no labor unions in Thailand.

Dredging

3.15 Due to inefficient dredging operations and poor dredger maintenance by PAT's Marine Department, the bar channel has not been maintained to proper depths, width and alignment. Until a few years ago, dredging was done by the existing port dredgers under a contract and the channel was maintained to designed dimensions. Dredging output over the bar channel decreased steadily since dredging reverted to a departmental responsibility. It is essential that dredging operations be more effectively carried out with the existing dredgers by adopting modern techniques and increasing the dredgers' operational availability by improved maintenance. PAT agreed during negotiations to employ a qualified and experienced dredging expert for this purpose under terms and conditions satisfactory to the Bank.

E. Future Development

3.16 Both long and short-term goals should be considered when planning future port development. In the long term, the entrance channel to the Bangkok port is a serious limitation to port growth, as it can only accommodate ships of 8.5 m maximum draft (10,000 to 12,000 tons) and vessels cannot pass each other. It takes about four hours to negotiate the channel to the Klong Toi wharves and, depending on the tide, waiting periods can be substantial. The number and size of ships calling at Bangkok is therefore limited. In view of the excessive investment as well as maintenance costs involved no appreciable improvement of depths in the channel is practical. As the country's economy grows, a new port with access to deeper water will be required on the Gulf of Thailand to obtain the benefits of using larger ships. However, such a port would not replace but supplement Bangkok, which is expected to continue as the country's main port and commercial center for at least another two decades. Medium-sized ships will continue in service for many years and it will take time for the pattern of trade to shift to a port such as Sattahip which is presently used only for military traffic or a new port at Laem Krabang which is now being studied. In the short term, an immediate need to increase port capacity at Bangkok exists, as shown by the economic analysis in Chapter 4.

3.17 The Government, in November 1968, appointed NEDECO to study long term port development requirements in Thailand. In an interim report of May 1969, NEDECO compared the following three alternatives:

(a) all future expansion and construction of berths to be at Bangkok;

(b) extension of berths at Bangkok in combination with construction of a new deep-water port at Laem Krabang; and

(c) extension of berths at Bangkok in combination with the existing deep-water port at Sattahip.

3.18 NEDECO's economic analysis indicates the need for serious consideration of the development of a second deep-water port in Thailand, and favors Laem Krabang over Sattahip. This choice seems to undervalue the potential of the existing facilities at Sattahip and underestimates the total investment required for development at Laem Krabang. In addition, the traffic growth projected by NEDECO appears too optimistic and the level of port congestion resulting from each alternative is based on over-simplified assumptions. The analysis leading to NEDECO's choice should therefore be reviewed. During negotiations the Government agreed to consult with the Bank before proceeding with any further major port development and to review all reports prepared by consultants on the location and construction of port facilities in consultation with the Bank.

4. ECONOMIC EVALUATION

A. Introduction

4.01 Expansion of Bangkok port is urgent. Surcharges from 10% to 15% were imposed by the maritime conference in 1967 because of congestion at the port. These surcharges (Table 1) cost Thailand almost $4 million during the six peak months of 1967. Various short-term measures were taken to ease congestion: more use was made of private facilities, more cargo was handled in the stream, more handling equipment was purchased and quay maintenance was deferred. By early 1968, congestion was reduced and the surcharges had gradually been removed.

4.02 The measures taken had added no actual physical capacity and, although most military traffic is now handled away from Bangkok, the total traffic has reached the 1967 level. The traffic growth expected, or even a change in ships' arrival patterns, could easily recreate the 1967 congestion levels. The ever-present threat of congestion and of surcharges remains and port expansion is urgently required to reduce congestion and cargo-handling costs to reasonable limits.

B. Traffic

4.03 In 1969[1/], approximately 1,900 general cargo vessels called at Bangkok. Of the 2.6 million tons of general import cargo, largely high-value machinery and equipment, 2,260,000 tons were handled at the Klong Toi wharves. About 150,000 tons were diverted to private wharves and 190,000 tons were unloaded at midstream anchorages because of congestion. Import traffic growth at Bangkok port is shown in Chart 1. To remove the distortion in traffic growth patterns caused by the buildup of U.S. military activities in Southeast Asia in 1965, a growth trend was arrived at, based on imports from 1951 to 1965. Statistical analysis indicates that over the 1951-1965 period, import tonnages grew steadily at about 6% per annum.

4.04 After a rapid increase in 1965 and 1966, import traffic tonnage remained almost constant from 1967 to 1969. In view of the scaling down of U.S. military activity in Southeast Asia and Thailand's increasing trade deficit and resulting balance of payments problem, the present import trade slowdown is expected to last until 1973, with traffic expected to grow at only about 2.5% per annum. After 1973, traffic is assumed to attain its pre-1965 growth rate of 6%. While these forecast growth rates are based on past and present trends, they are tentative. For the economic evaluation, an analysis was carried out utilizing traffic growth rates ranging between 1% and 5% for the slowdown period which, it was assumed, may end as early as 1971 or as late as 1975. After the levelling off, a growth rate ranging between 5% and 8% was used. The probability of various import traffic patterns within this range is given in Annex 3.

1/ Unless otherwise stated, years used in the economic evaluation and in the related annexes, tables and charts are fiscal years (Oct. 1 - Sept. 30).

4.05 Transit traffic to Laos, which amounted to 52,000 tons in 1969, is of minor importance and has been assumed to continue growing at its past trend of 8% per annum, to a maximum of 80,000 tons.

4.06 Exports from Bangkok amounted to five million tons in 1969. The bulk of this cargo consisted of rice and tapioca, exported ex-lighter in the stream, and maize, exported from silos. Because most exports are well adapted to lighterage operations their bulk will probably continue to be handled in the stream or from privately-owned silos. The export cargo loaded at the Klong Toi wharves, for the most part livestock, wood and general cargo, amounted to only 33,000 tons. However, in view of the effort to diversify exports, the volume to be handled at Klong Toi will probably increase rapidly. For this evaluation, exports have been assumed to grow at a yearly rate of 15%. No attempt has been made to refine this estimate because of its low sensitivity.

C. Methodology

4.07 Although the urgency of expanding Bangkok port or the necessity for diverting traffic is clear, the size, timing and choice among expansion alternatives is less straightforward. This evaluation considered four alternatives:

I - A minimum investment which would provide additional lighterage to meet traffic growth.

II - A project which would provide two deep-water berths and two lighterage berths.

III - A project which would provide four deep-water berths and two lighterage berths.

IV - A project which would provide six deep-water berths and two lighterage berths.

A choice among these alternatives requires an accurate evaluation of the congestion costs associated with each of them. At Bangkok, evaluation of this cost was complicated by the possibility of traffic diversion from the deep-water berths at Klong Toi to the midstream lighterage facilities and/or private wharves. This complication necessitated the use of a simulation model. The model used is similar to that developed for the East African Port Project appraisal (Report PTR 8a, June 9, 1969).

4.08 The analysis was further complicated by the uncertainty of some of the elements of the problem, such as the growth rate of imports mentioned above and the proposed two-shift system for labor. The time required to introduce the shift system, as well as the impact it will have on labor productivity, is difficult to determine. These uncertainties will greatly affect port capacity.

4.09 There are a number of sources of uncertainty on other parameters (Annex 3). The most important is the possibility that the military port of Sattahip, now used by the U.S. military, will be turned over to the Thai

Government and possibly transferred to commercial use. This possibility has been ruled out in the immediate future since the U.S. is still using the port and a Thai Cabinet decision provides that, should the port be released, it would be transferred to the Thai military and not be available for commercial use. This decision, however, may be reviewed within the Government. Should congestion increase again at Bangkok, the military would certainly be under pressure to transfer Sattahip to commercial use since military usage cannot justify the need for a port of this size. Should the transfer to commercial use occur, traffic patterns would be considerably changed and a sizeable amount of traffic would be diverted to Sattahip.

4.10 In view of these uncertainties, the economic evaluation has been made within a probability framework. In practice, the cost/benefit probability analysis and the port operations have been carried out simultaneously in a combined simulation. The model is described in some detail in Annex 4.

D. Economic Analysis

4.11 The traffic projections discussed in paras. 4.03-4.05 apply to the port of Bangkok as a whole. The amount of import traffic which will actually use Klong Toi wharves is a function of port investments, improvement in port operations, and the availability of Sattahip port. The simulation takes these factors into account and the results show the traffic which will utilize Klong Toi wharves under varying circumstances (Table 2).

4.12 Briefly, the model selects random values for each of the variables which have been assigned a probability distribution, then proceeds with a detailed analysis of port events and operations, such as ship arrivals, ship assignment to berths, and cargo-handling. The resulting data, such as ship-waiting time or tonnage handled, are consolidated on a yearly basis and the cost of each year of port operation is computed. This cost includes ship time cost and cargo-handling cost as well as the port investment. In cases where the port of Sattahip has been used, the cost of transporting the cargo to Bangkok is included. Each year from 1973 through 1980, the simulation is repeated for each one of the four investment alternatives.

4.13 The output of the model for each simulation is therefore four streams of total yearly costs, one for each alternative. On the basis of these streams of undiscounted yearly costs, it is possible, given an opportunity cost of capital which is also selected randomly, to compute a cumulative present cost up to any given year. Table 3 gives the average values of the yearly undiscounted costs obtained in the 75 simulations carried out and Table 4 gives the average value of the corresponding cumulative present cost up to any given year. The stream of net benefits corresponding to each of the project alternatives have been expressed as the difference between the cost stream of the minimum investment alternative, and the cost stream of the project alternative under consideration.

4.14 As noted earlier, the simulation horizon in the economic analysis has been limited to 1980. After 1980 the benefits resulting from the project have been assumed to remain constant. There are at least two reasons for doing this. (i) By 1980, new investments will be required to accommodate the additional traffic. Because the simulation does not include these investments or the savings to be derived from them (not yet fully analyzed), the "with" and "without" costs to the economy would then be unrealistically high. The benefits resulting from such an exercise would be inaccurate and, in addition, would not reflect the actual economic justification of the project. (ii) By 1980, the bar channel may well become a bottleneck in further port expansion at Bangkok. Thus, there is the possibility that after this date, any additional traffic will be diverted to a second port.

4.15 The cost/benefit analysis considers fully the possibility of Sattahip's availability as a function of the level of port congestion. The final result is a weighted combination of cases in which the port becomes available and cases in which it does not. Clearly, the probability of the port's availability varies with the alternative tested. In the case of two berths, congestion rises rapidly and the probability assigned to a transfer to commercial use by 1980 is about 70%. In the case of six berths, congestion remains low and the probability of a transfer by 1980 is found to be less than 15% (Table 5).

E. Project Size and Timing

4.16 In carrying out a comparison between alternatives, the total costs to the economy (investment cost and handling cost and ship time in port cost) of each alternative were used, rather than computing rates of return on incremental investment costs.

4.17 Table 4 indicates that over the coming 25 years, the expected present value of the costs to the economy of Alternative III is about $15 million lower than Alternative II. Chart 2 indicates that in the center part of the range of possible outcomes, the four-berth alternative (III) considerably reduces the probability that a given total present value cost will be exceeded. In addition, the two deep-water berth alternative (II) yields a fairly large probability that total port costs will reach a level greatly exceeding the expected value. The four-berth alternative (III) therefore, is preferable to the two-berth alternative (II).

4.18 Table 4 and Chart 2 also indicate that over the next 25-year period, six berths (IV) would cost less than four berths (III). However, proceeding immediately with the construction of six deep-water berths would be premature. As Table 3 shows, the expected additional investment of $5.9 million necessary to go from four to six berths would yield an expected first year saving of only US$0.37 million or about 6% of the investment cost. Since the opportunity cost of capital is assumed to be about 12%, these US$5.9 million invested elsewhere in the Thai economy would yield about

US$0.70 million return. In effect, it appears that given the present level of information, the two additional berths would not be justified, on the average, before 1977. The savings resulting from this two-year postponement would more than offset the additional cost incurred in project construction in two phases and considerably reduce its uncertainty.

4.19 Using the same argument, the US$5.5 million expected additional investment required to go from two to four deep-water berths yields an expected first year saving of US$0.61 million, which for an opportunity cost of capital of 12% is about equivalent to what the US$5.5 million would yield if invested elsewhere in the economy. It is therefore justified to proceed immediately with construction of four deep-water berths (Alternative III).

4.20 Construction of four deep-water and two lighterage berths (Alternative III) therefore appears to be the optimum investment size at this time and forms the basis of the proposed project. This alternative has a high rate of return averaging about 20%. As Chart 3 shows, the rate of return varies within a wide range but there is an 80% probability that it will remain between 14% and 28%.

F. Conclusion

4.21 Construction of four deep-water berths and two lighterage berths is found to be the best port investment to solve Thailand's immediate port expansion requirements, yielding a rate of return of about 20% over 20 years. Further expansion may, however, be required in the late seventies.

4.22 An additional conclusion of the cost/benefit analysis is the rapid payback period of the project. Table 6 shows that, on the average (which in this particular case is the same as the best estimate), for an opportunity cost of capital between 10% and 14%, according to the probability distribution of Annex 3, the investment cost would be paid back in eight years, i.e., in 1981. Even under the extreme assumption that the investment is not used after 1981, it would therefore still, on the average, be economically justified. This constitutes a further justification for limiting the simulation to 1980, and, more important, confirms that the project is acceptable as a short-term investment (para 3.16). The economic justification is therefore quite independent of the possibility of a second deep-water port being made available or constructed since, by the time this port is ready for use (say in 1979), the project would, on the average, be almost fully paid back (Table 4).

5. THE PROJECT

A. Description (Map 3)

5.01 As a result of the preceeding evaluation, the project should consist of four deep-water and two lighterage berths to be located downstream of the existing Klong Toi wharves. The deep-water berths would each be about 185 m long with a depth alongside of 8.5 m; the lighterage berths would each be about 100 m long with a depth alongside of 3 m. The berths would be equipped with two transit sheds and ancillary facilities. The project also includes (i) consultants' services for detailed engineering and supervision of construction; (ii) expert assistance for dredging operations and cost accounting; and (iii) the services of management consultants for the improvement of cargo-handling operations. The project is part of PAT's five-year development program (1970-1975).

B. Cost Estimate and Financing

5.02 The total estimated cost of the project is ฿ 436.8 million (US$21 million equivalent) with a foreign exchange component of US$12.5 million equivalent. A summary of the estimate follows and details are given in Table 7.

Item	Baht Million			US$ Million		
	Local	Foreign	Total	Local	Foreign	Total
1. Construction of four deep-water and two lighterage berths, two transit sheds and ancillary works	150.0	205.0	360.0	7.21	10.09	17.30
2. Consultant's fees for engineering and supervision during construction	4.16	18.72	22.88	0.20	0.90	1.10
3. Assistance of experts in dredging, and cost accounting and of management consultants for cargo-handling operations	0.84	7.48	8.32	0.04	0.36	0.40
4. Contingencies of about 12% (6% for quantities and 6% for prices)	21.8	23.80	45.8	1.05	1.15	2.20
TOTAL	176.80	260.00	436.80	8.50	12.50	21.00

The cost of the engineering work proposed is based on known costs of labor and materials in Thailand and includes approximately 12% for contingencies. about 6% for quantities, and 6% for prices. The foreign exchange required is about 60% of the total estimated cost. PAT will provide local currency costs of the project.

5.03 In addition to expenditures on the proposed project, PAT plans an expenditure of ₱ 479 million on Capital works such as offices, staff quarters, sheds, extension and improvement of port roads, cargo-handling equipment and harbor craft as part of its five-year (1970-1975) development program. PAT will meet these expenditures from its own resources.

C. Procurement

5.04 Tender documents for engineering work have been prepared and bids will shortly be invited from prequalified bidders. Contracts for construction and supply will be awarded on the basis of international competitive bidding in accordance with Bank guidelines. PAT will be responsible for execution of the project.

D. Disbursement

5.05 Construction is expected to start by October 1970, the beginning of PAT's fiscal year, and the project should be completed by December 1973. However, two deep-water berths and two lighterage berths should be ready for use by January-February 1973. Disbursements will be made on the basis of actual payments made to contractors, consultants and experts. Assuming loan effectiveness at the end of August 1970, estimated expenditures are:

	(₱ Million)			Foreign Exchange US$ million Equivalent
Fiscal Year	Total	Local	Foreign Exchange	
1969	0.30	0.30	-	-
1970	3.50	0.30	3.20	0.15
1971	120.00	45.00	75.00	3.60
1972	173.00	70.00	103.00	4.95
1973	112.00	50.00	62.00	3.00
1974	28.00	11.20	16.80	0.80

No retroactive financing will be necessary. Any surplus funds available on completion of the project will be cancelled.

E. Engineering Consultants' Services and Assistance by Experts

5.06 During negotiations PAT agreed to retain engineering consultants acceptable to the Bank for detailed project engineering and work supervision during construction.

5.07 The services of a dredging expert are required to help PAT apply modern dredging techniques. The expert will also make recommendations for an improved system of dredger maintenance in order to keep the equipment in an efficient state of repair (para. 3.15).

5.08 An accounting expert is required to assist PAT's Accounts Department in improving its costing system, introducing adequate budgetary control and revising the tariff structure and rates so as to base them reasonably on the cost of services rendered (para. 3.04).

5.09 Management consultants are required to study the feasibility of adopting a multi-shift labor system so as to improve efficiency and productivity of cargo-handling and related port operations.

F. Construction Schedule

5.10 NEDECO has recommended extension of the Klong Toi wharves in three stages of two deep-water berths each so that the facilities can be used as soon as they are constructed. The tender documents were prepared accordingly. Completion of the first two stages of the work, which forms the project, is expected some three years from the date of commencement.

G. Other Investments

5.11 In addition to the investment programs described in paras. 5.02 and 5.03 PAT's development program over the next five years includes further capital expenditures amounting to over ฿ 264 million for items such as realignment of the bar channel, construction of a further two berths at Klong Toi and the procurement of a floating crane and a dredger. These items are premature and not presently justified. During negotiations assurances were obtained from PAT that no expenditure will be incurred on such large capital works, or procurement, without Bank agreement.

6. FINANCIAL ASPECTS

A. Rates and Charges

6.01 PAT's rates (Annex 5) have remained virtually unaltered during the past 10 years. Compared with the port of Singapore, these rates are generally high, particularly as basic labor rates of pay are lower in Thailand. Virtually all exports leave Bangkok via private wharves or river anchorages. No choice is given for imports as, with few exceptions, unloading at PAT's wharves is mandatory.

6.02 There is no statutory requirement as to adequacy of the rates and charges. PAT is empowered to fix rates provided they are between the maximum and minimum determined by the Council of Ministers. The Council's directive, now in force, permits variance of up to 25% from the existing level.

6.03 Because of PAT's inadequate costing system (para. 3.04) some rates are unrealistic. During negotiations PAT gave an undertaking that its tariff structure and rates would be revised to be reasonably based on costs.

B. Earnings

6.04 Details of revenue and expenses for fiscal 1965 to 1969 inclusive are shown in Table 8. Although traffic remained static during the last three years of this period, expenses increased and revenue declined. A 15% pay rise in 1968 for wharf labor and substantial increases in personnel raised labor costs. Additional transit sheds and open storage areas were constructed and mechanical equipment purchased; consequently depreciation and operating costs rose. This improvement of port facilities increased the speed of cargo handling and reduced overtime and certain revenues decreased because of the shorter time spent by vessels alongside wharves.

6.05 PAT's operating revenues for fiscal 1969 totalled ฿ 248 million and operating expenses including depreciation were ฿ 165 million, giving a net operating revenue of ฿ 83 million and an operating ratio of 67% which is satisfactory. Interest expense was negligible at ฿ 0.8 million. Total debt service amounting to ฿ 6.8 million was covered 18 times. The return of net operating revenue to net fixed assets in use was high at 18.5%.

6.06 Financial forecasts of earnings are based upon traffic projections contained in Table 2 and on PAT's current rates and charges. Detailed forecasts to 1975 are given in Table 8 (Revenue and Expense Accounts), Table 9 (Cash Flow) and Table 10 (Pro Forma Balance Sheets). The bases and assumptions used in the financial projections are given in Annex 6. Operational results are summarized below:

(₱ Million)

	Actual 1969	1970	1971	1972	1973	1974	1975
Operating Revenue	248.3	262.9	273.7	285.5	307.6	337.8	362.5
Operating Expenses excluding Depreciation	139.4	151.5	158.7	166.5	183.8	205.9	220.2
Depreciation	26.2	28.3	31.4	33.4	37.4	44.4	48.4
Total Operating Expenses	165.6	179.8	190.1	199.9	221.2	250.3	268.6
Net Operating Revenue	82.7	83.1	83.6	85.6	86.4	87.5	93.9
Interest Income	17.8	10.5	6.5	4.8	4.3	5.0	7.2
Net Revenue	100.5	93.6	90.1	90.4	90.7	92.5	101.1
Interest Expense	0.8	2.6	4.8	9.7	15.2	17.9	18.1
Net Income	99.7	91.0	85.3	80.7	75.5	74.6	83.0
Times Interest Covered	125X	36X	18X	9X	6X	5X	5.6X
Total Debt Service	6.8	9.0	8.5	9.7	15.2	17.9	27.3
Times Debt Service	18X	13X	14X	12X	8X	7.6X	5.5X
Financial Rates of Return on Net Fixed Assets in Use	18.5%	15.8%	12.8%	11.7%	9.5%	7.6%	7.6%
Debt/Equity Ratio	3/97	2/98	8/92	15/85	18/82	18/82	17/83
Operating Ratios	67%	68%	70%	70%	72%	74%	74%

6.07 Between fiscal 1969 and 1975 operating revenues and expenses are expected to increase by about 46% and 62% respectively, the steeper rise of the latter being largely due to anticipated increases in wages; also the heavy capital investment program will cause depreciation expense to rise by 84%. Consequently, although net operating revenue is expected to increase slightly each year from 82.7 million in 1969 to ₱ 93.9 million in 1975 the operating ratio will increase from 67% to 74% and the rate of return on net fixed assets decrease to about 7.6%. A great deal will depend upon the results of introducing two and limited three-shift working on the wharves. To handle the increased cargo up to 1975 and adequately man the increases in shifts, some labor recruitment will be necessary. This, coupled with increases in rates of pay during the period is expected to raise labor costs by 43%. The increased shifts, however, together with improved methods and supervision of working, should raise labor productivity by some 30% and this benefit has been taken into account in estimating the extent of increases in the labor force. If present working methods, low mobile equipment utilization and labor productivity levels continue, by 1975 the cost of wharfinger operations per ton of cargo could be expected to rise by over 40% whereas the rise should not exceed 19% if the improvements suggested in paras. 3.11 and 3.12 are carried out. It is also important that a sound costing system be installed as soon as possible to provide adequate control over costs and a reliable basis for the continuing review of port rates (para. 3.04).

C. Finances

6.08 The current financial position of PAT is sound (Tables 9 and 10). At September 30, 1969, fixed assets, after providing for adequate depreciation, totalled ₱ 663 million and cash in hand, at banks and with the Government amounted to ₱ 304 million. Long-term debts were low at ₱ 30.3 million of which ₱ 10.1 million is outstanding from two previous IBRD loans. The remainder is Development Loan Fund finance. The debt/equity ratio was 3/97. Fixed Assets values are reasonably realistic.

6.09 During the fiscal period 1970 to 1975, interest and debt service coverage will be ample. The debt/equity ratios are good, the highest being 18/82 in 1973 and 1974 thereafter improving to 16/84 in 1975 when repayment of the proposed loan commences. A summary of PAT's pro forma balance sheets during the period is given below:

	As of September 30 (₱ million)					
	1970	1971	1972	1973	1974	1975
ASSETS						
Current Assets						
Cash in Hand, at Bank and Government	168.8	125.1	106.5	106.7	132.0	192.7
Miscellaneous	21.0	22.5	25.0	28.0	29.5	31.0
	189.8	147.6	131.5	134.7	161.5	223.7
Fixed Assets						
Total Fixed Assets after depreciation	855.0	1,022.5	1,194.5	1,305.5	1,347.5	1,337.5
Suspense Item						
Technical Assistance	0.3	1.1	5.2	8.3	-	-
TOTAL ASSETS	1,045.1	1,171.2	1,331.2	1,448.5	1,509.0	1,561.2
LIABILITIES						
Current Liabilities	14.0	14.5	16.0	17.5	18.0	19.0
Long-Term Debts	24.5	93.1	193.3	252.3	266.0	253.5
Equity	1,006.6	1,063.6	1,121.9	1,178.7	1,225.0	1,288.7
TOTAL LIABILITIES	1,045.1	1,171.2	1,331.2	1,448.5	1,509.0	1,561.2
Debt/Equity Ratio	2/98	8/92	15/85	18/82	18/82	16/81

6.10 Projected cash requirements and sources of funds for fiscal years 1970 to 1975 are given in Table 9 and summarized below, distinguishing between years prior to, during and after the period of the IBRD Project construction:

	Fiscal 1970-1975 (฿ million)			
Cash Required	Pre-IBRD Project 1970	During IBRD Project 1971-1974	%	Post-IBRD Project 1975
Capital Investments-IBRD Project	2.2	426.0	53	-
Other	219.5	219.5	27	40.0
	221.7	645.5	80	40.0
Technical Assistance Under IBRD Loan	1.3	7.0	1	-
Debt Service	9.0	51.3	6	27.3
Changes in Working Capital	0.2	4.5	1	0.5
Appropriation to Government and Staff Bonuses	28.7	95.6	12	21.0
	260.9	803.9	100	88.3
Cash Available				
Cash Available at Start of Period	304.6	168.8		132.0
Less Cash Available at end of Period	168.8	132.0		192.7
	135.8	36.8	5	(60.7)
Net Operating Revenues and Depreciation	111.4	489.7	61	142.3
Investment Income	10.5	20.6	3	7.2
Total Own Resources	257.7	547.1	69	88.8
IBRD Loan	3.2	256.8	31	-
	260.9	803.9	100	88.8

6.11 During this period the total cash available is not expected to fall below ฿ 106 million, which is adequate.

6.12 The PAT Act, 1951, as amended, provides the Thai Government considerable latitude in determining the extent to which PAT surplus funds are to be paid over to the Thai Treasury. Current practice is for PAT to transfer to the Government 25% of its annual net revenue, after allowing for loan interest; assuming this continues during the period 1970 to 1975 such payments will range between ฿ 24.9 million and ฿ 18.7 million annually. PAT's annual capital expenditure and its power to borrow money are subject to Council of Ministers' approval. Annual operating budgets are submitted for the Council's information only. Should PAT's revenue be insufficient to meet operating expenses, depreciation and bonus, and should PAT be unable to obtain funds from other sources, the deficiency shall be met by the State. Contingency and expansion reserve requirements are however, expressly excluded from this State commitment in the Act.

6.13 During negotiations PAT undertook to achieve a financial rate of return on net fixed assets in use equal to not less than 8% p.a. and not to incur long-term debt unless net cash revenue is and will remain at least 1 3/4 times the maximum debt service requirements.

6.14 It was also agreed during negotiations that PAT will continue to maintain adequate insurance cover on its assets for such risks and amounts as are consistent with good commercial practice.

7. RECOMMENDATIONS

7.01 During loan negotiations agreement was reached on the following principal points:

The Government agreed

(a) to appoint at least one person with experience in a commercial management capacity to PAT's Board (para. 3.03);

(b) to maintain the access roads to the port and to construct an additional access road not later than December 31, 1973 (para. 3.09);

(c) to consult with the Bank before undertaking further major port development and to review all consultants' reports on the location and construction of port facilities in consultation with the Bank (para. 3.18);

PAT agreed

(d) to appoint an accounting expert (paras. 3.04 and 5.08); management consultants (paras. 3.12 and 5.09); and a dredging expert (paras. 3.15 and 5.07);

(e) to retain consultants for engineering and supervision of construction (para. 5.06);

(f) not to incur capital expenditure on large capital works or procurement without Bank agreement (para. 5.11);

(g) to establish new rates and charges based upon costs (para. 6.03); and

(h) to achieve an adequate financial rate of return and to limit debt service commitments. (para. 6.13).

7.02 The proposed project constitutes a suitable basis for a Bank Loan of US$12.5 million equivalent to PAT for a period of 20 years, including a four-year grace period.

July 13, 1970

ANNEX 1

THAILAND

APPRAISAL OF THIRD BANGKOK PORT PROJECT

Particulars of Previous Railway and Highway Loans

Three railway loans were made to Thailand:

(a) 35-TH for US$3.0 million, October 1950;

(b) 128-TH for US$12.0 million, August 1955;

(c) 280-TH for US$14.6 million, April 1961;

and four highway loans:

(a) 341-TH for US$35.0 million, June 1963, but reduced to US$25.0 million in July 1964 and to US$22.5 million in July 1968 at the Government's request;

(b) 455-TH for US$36 million, June 1966;

(c) 535-TH for US$29 million, May 1968;

(d) 626-TH for US$23 million, June 1969.

The three railway loans and the first highway loan have been fully disbursed and work was satisfactory. The second, third and fourth highway loans are in progress and the quality of the work is good.

February 24, 1970

THAILAND

APPRAISAL OF THIRD BANGKOK PORT PROJECT

Bangkok Port Facilities

Bangkok port facilities consist of 92 wharves, landing places, and finger piers, extending over a considerable distance along the river. In addition, there are 33 midstream anchorages and mooring buoys at different locations in the river (Map 2).

The most important facilities are the Klong Toi wharves, comprising ten berths of a total length of 1,660 m and related water areas in front of these wharves are under the control of and operated by PAT.

The limits of the port are from Memorial Bridge to the pilot vessel at the entrance of the Bangkok bar, a distance of 66 km.

During recent years PAT has considerably increased its cargo storage capacity and improved roads inside and leading to the port area. The present covered and open storage areas are:

	Open Storage Areas	91,900 m^2
Nine	Transit sheds	37,300 m^2
Three	Back-up transit sheds	47,400 m^2
One	Three-story warehouse	7,400 m^2
Ten	Single-story warehouse	12,700 m^2
One	In-transit warehouse	4,000 m^2
One	Military warehouse	4,000 m^2
One	Dangerous cargo shed	800 m^2
	Total	205,500 m^2

This provides 66 m^2 of shed and open storage per linear meter of wharfage which is considered more than adequate for present traffic.

The roads within the port area are in good condition and are spacious enough to provide good traffic access in the future.

July 13, 1970

PAT owns and operates 12 semi-portal cranes, 23 mobile cranes, some 215 forklift trucks, 37 towing tractors, 14 tractor trucks, 10 vans and 115 trucks. It also has 12 tugboats with static pulling capacity varying from 1.5 tons to 23 tons, four survey boats, two water and oil barges, three mud barges, four hopper-suction dredgers, one clamshell dredger, one bucket dredger and seven river launches.

Two floating cranes, each of 125 tons lifting capacity, owned by private companies are available in Bangkok.

There are 526 lighters with cargo carrying capacity ranging from 20 to 370 tons, owned and operated by 58 private companies in Bangkok.

There are four dry docks in Bangkok, two owned by the Bangkok Dock Company. One is capable of accommodating ships up to 110 m long and the other, ships of up to 100 m. The other two, owned by the Bang Thai Company are capable of accommodating ships up to 50 m and 38 m in length, respectively.

February 24, 1970

THAILAND

APPRAISAL OF THIRD BANGKOK PORT PROJECT

Assumptions of Cost Benefit and Risk Analysis

ITEM	BEST ESTIMATE	NATURE OF UNCERTAINTY	PROBABILITY DISTRIBUTION
A. Construction cost			- Stage construction uncertainty
1. 2 Berths	$15.2 Million	Quantities	Uniform on range $14,900,000 - $15,450,000
2. 4 Berths	$20. 6 "	Prices	Uniform on range $20,450,000 - $20,750,000
3. 6 Berths	$26.358 "	Additional cost of stage construction	
			- Price and quantity uncertainty The variations around the above estimates have been assumed to be normal with a mean of 0 and a standard deviation of 7.8%. The price and quantity uncertainty have been assumed correlated for all 3 projects alternative.
4. Distribution of construction cost of 2 berths over construction period	40% 1st year 60% 2nd year	not taken into consideration	
B. Traffic			
5. 1969 General Cargo Traffic	2,576,000 t	None	
6. Estimated Laos transit traffic in 1969	46,000 t	"	
7. 1969 Export traffic	33,000 t	"	
8. Growth rate of general cargo traffic during recession period	2.5%	Economic development trend	- Stepwise rectangular: Probability — Growth Range 20% — 1% - 2% 50% — 2% - 3% 20% — 3% - 4%

ANNEX 3
Page 1

ITEM	BEST ESTIMATE	NATURE OF UNCERTAINTY	PROBABILITY DISTRIBUTION
Traffic (cont.)			
			10% 4% - 5%
9. Growth rate of General cargo traffic after recession period	6%	Economic development trend	- Trapezoidal on range 5% to 8% with uniform probability between 5.5% and 7%
10. Last Year of recession period	1973	" "	- Discrete Probability / Year 5% / 1971 20% / 1972 40% / 1973 25% / 1974 10% / 1975
11. Growth of Laos transit traffic	8%	not considered	
12. Growth of Export traffic	15%	"	
Availability of Sattahip			
13. Release by U.S. Army	before 1973	Political Situation in Southeast Asia	- Discrete: 80% chance that Sattahip will be released by the U.S. by 1st October, 1972. 20% that it will never be released.
14. Transfer of the port to commercial use given that it has been released by the U.S.	not estimated, Built in simulation	Political Situation in Thailand	- Stepwise rectangular, function of the congestion in Bangkok: Probability / Range of Average Ship Waiting Time 0% / 0 - 1 hour 5% / 1 - 3 hours 25% / 3 - 9 hours 50% / 9 -15 hours 75% / 15 -21 hours 90% / over 21 hours

ITEM	BEST ESTIMATE	NATURE OF UNCERTAINTY	PROBABILITY DISTRIBUTION
15. Military cargo still going through Sattahip after its release	150,000 tons per year	Lack of information	- Uniform between 100,000 t and 200,000 t per year.
D. Ships			
16. Number of ships in 1969	1300		
17. Growth rate of the number of ships	Half of the Growth rate of tonnage	size of ships	- Not considered
18. Value of a ship day	$2100	- Size of ships - Ship operating costs	- Trapezoidal on range $2000 - $2500 with uniform distribution between $2050 and $2200
Productivity of Labor			
19. Gross tons per gang hours in 1969 at Klong Toi	5.7	-	
20. % improvement in productivity as a result of introducing a shift system in Klong Toi	30%	Efficiency of a shift system	- Stepwise rectangular
21. Duration of the transitional three years stage for the introduction of a shift system		Labor problems	- Discrete

Probability	Range of productivity increase
5%	0 - 10%
20%	10% - 20%
45%	20% - 30%
20%	30% - 40%
10%	40% - 60%

Probability	Duration
0%	1 year
30%	2 years
50%	3 years
15%	4 years
5%	5 years

	ITEM	BEST ESTIMATE	NATURE OF UNCERTAINTY	PROBABILITY DISTRIBUTION
22.	Gang productivity in private wharves	5.2 t/hour	not considered	1) During the transitory stage the productivity is assumed to grow linearly from 5.7 tons to the value defined in 20.
23.	Gang productivity in the stream	5.2 t/hour	"	
24.	Gang productivity at Sattahip	7.5 t/hour	"	
25.	Average number of gangs per ship in Bangkok	5.5	"	
26.	Average number of gangs per ship at private wharves	4	"	
27.	Average number of gangs per ship in the stream	5	"	
28.	Average number of gangs per ship at Sattahip	3.7	"	
F.	Others			
29.	Transport cost from Sattahip to Bangkok	$2.5 per ton	Type of vehicle to be used and vehicle operating cost	- Triangular on range $2 - $3
30.	Cargo handling cost in the stream	$1.55 per ton	Uncertainty on operating cost of lighters	- Trapezoidal on range $1.30 to $2.15 - Uniform distribution between $1.50 and $1.65
31.	Cargo handling cost at deep water berth	$.50 per ton	Not considered because only relevant variable is the difference between	

ITEM	BEST ESTIMATE	NATURE OF UNCERTAINTY	PROBABILITY DISTRIBUTION
Productivity of Labor (cont'd)			
		handling cost in the stream and on the quay.	
32. Opportunity cost of capital	11.5%	Economic statistics	- Trapezoidal on range 10% - 14% - Uniform distribution on range 11% - 12%

July 13, 1970

THAILAND

APPRAISAL OF THIRD BANGKOK PORT PROJECT

Simulation Model

1. The simulation model comprises two parts: the port simulation proper and the cost analysis. The former simulates the berthing of ships and their unloading at Klong Toi wharves as well as imports at private wharves or in the stream. It indicates ship waiting time, berthing time and place. These indications are then fed into the cost analysis part of the model. The simulation is repeated for the first 8 years of the project life and for the four alternatives studied. In the following, "simulation" will mean a complete set of simulations for the eight years and the four project alternatives. This simulation is repeated many times to yield an estimate of probability distribution of the internal rate of return, payback period and present value cost of the project. Following are details on the model, the data and the operation of the model.

The Model

2. The port simulation proper is divided into three steps. The generation of ship arrivals, the assignments of ships to a berthing place, and the loading and unloading of ships.

3. The generation of ship arrivals is at random according to a pattern of arrivals derived from a statistical analysis of the port's data. The ship arrival calendar is generated yearly; the same arrivals are used for all four alternatives. The ships are then assigned tonnages, again at random, according to observed distributions. Because of the low volume of exports, no distinction has been made between imports and exports. The total tonnages handled annually are determined at random according to the probability distribution of the growth rate described in Annex 3. Finally the ships' draft is selected also according to a probability distribution function of the total yearly tonnage and the total number of ships.

4. The next step consists of looking for an empty berth. If there is no berth at Klong Toi, the model is programmed to look for a private berth compatible with the ship's size or, if none is available, for a mooring point where the ship could be discharged by lighter. If there is no berth or mooring point available, the ship must take its turn on a waiting list, which may or may not have other ships already waiting. The next event may be either a new ship arrival or a ship departure. In the case of a ship departure, a berth (or lighterage point) becomes available and, in due course, is ready to receive a new ship from the waiting list. In the cases where Sattahip is available, ships are preassigned to either Bangkok or Sattahip. In addition in this case, when waiting time at Bangkok exceeds a maximum admissable level, ships are diverted to Sattahip.

5. Ship unloading is a function only of berth characteristics (surprisingly, port statistics show no correlation between weather and unloading rates). Each berth and lighterage point is assigned a certain productivity of labor for loading and unloading, representing the number of tons of cargo that a gang can handle in one hour. Multiplied by the average number of gangs working simultaneously on a ship, labor productivity gives the handling rate or the average number of tons of cargo which can be loaded or unloaded in one hour. Given the cargo tonnage to be unloaded, the handling rate leads to the time necessary to unload each ship and, therefore, the time at which the ship will be able to depart.

6. A critical element of the above computation is labor productivity. It is assumed that introducing a shift system at the Klong Toi wharves would result in improved productivity within a few years. At the beginning of each simulation we therefore drew a random figure for productivity increase and one for the number of years required to reach this productivity increase according to the distribution of Annex 3. We then make a linear extrapolation of the value of productivity during the transitory period corresponding to the introduction of the shift system.

7. Another critical element is whether or not Sattahip will be released for commercial use. This will depend mainly on the congestion level at Bangkok. At the end of each year, average ship waiting time at Bangkok is computed and the release of Sattahip during the following year is determined on a random basis according to a probability which is a function of current average waiting time. Once Sattahip has been released it remains available from then on. The release date of the port varies with average waiting time and therefore, with the alternative under consideration. If Sattahip is released, the model evaluates the percentage of the traffic it can absorb. Since the port is simple this is done in an approximative manner by assuming an acceptable berth occupancy factor corresponding to the number of berths at the port. Finally, in order to avoid infinite waiting time in the event the port is not expanded, it is assumed that, if berth occupancy of the facilities existing at Bangkok exceeds 95%, and lighterage berth occupancy exceeds 75%, and, if relevant, berth occupancy at Sattahip exceeds 65%, sufficient additional lighterage facilities would be provided to insure that the above berth occupancy is not exceeded. These berth occupancy factors have been derived by trial and error in such a manner as to keep waiting time within reasonable limits.

8. The costing part of the model is simple. First, all the costs to which a probability distribution is attached are selected randomly (Annex 3). The investment costs are introduced in the cost streams in the appropriate investment year. Total cargo-handling cost is then computed, for each year, on the basis of cargo tonnage handled at each location (a by-product of the ship assignment explained in paragraph 4). Ship waiting-time cost is also computed and introduced in the cost streams. Since the time the ship spends in the berth is a function of the berthing place, the corresponding ship cost is also computed and introduced in the cost streams. Finally, in the event Sattahip becomes available, the cost of transporting cargo to Bangkok is also taken into consideration.

Outputs

9. The outputs of each simulation are therefore a stream of costs for each project alternative. Each of these sets of cost streams is the result of a particular hypothesis as to the release of Sattahip, a particular investment cost, a particular traffic growth pattern, a particular ship day cost, and a particular cargo-handling cost; the present value computation is done using a particular opportunity cost capital. Finally, the pattern of arrival and the ship load distribution is a particular one for each year of the simulation. In addition, the model provides other information, in particular on ship waiting time, which is useful in following port behavior under any particular sets of circumstances.

10. The consolidated output of each simulation yields the probability distribution of each of the decision variables. The means of some of these variables are given in Table 2 through Table 6. The standard error as well as full probability distribution of each one of them is not given in this report but is also available.

Basic Data

11. Most of the basic data used in the simulation has been derived from analysis of detailed port statistics. The principal elements of the simulation, the pattern of arrivals and the tonnages carried by each ship, have been analyzed by classic statistical analysis using the chi-square test. It was found statistically acceptable to assume that arrivals were following a Poisson distribution and that both tonnages followed a third order Erlang distribution.1/ These hypotheses have, therefore, been adopted throughout the simulation. The distribution of maximum ship draft was found normal with a mean closely related to the total number of ships and the total tonnage handled.

12. The hypothesis concerning gang productivity and the gang application factor were derived by analyzing detailed port records of ship movements and labor deployment during 1969. The time between a ship's departure and the beginning of work on the next ship has been set at two hours, in accordance with information provided by the port authority. The number of ships serviced in any year which, under normal circumstances would be assumed at random about constant, has been kept growing at half the rate of the tonnage growth to account for the draft limitation in the bar channel. Traffic growth has been determined according to the forecast in Chapter 4 which is based partly on statistical analysis of the historical traffic trend.

1/ Confirming an analysis carried out in 1965 by the Asian Institute of Technology and published in the Journal of the Waterways and Harbors Division: Jones and W.R. Blumden. Ship turnaround time at the Port of Bangkok - Journal of the Waterways and Harbors Division, American Society of Civil Engineers, Vol. 94 - WW 2, May, 1968.

Operation of the Model

13. The first step in operating the model was its adjustment.. 1967 and 1968 data were used for this purpose and the model was calibrated to agree with the historical results. The major element of comparison was ship waiting time which, because of its high sensitivity, constitutes an excellent check point; another element was the ratio between the total tonnage handled at the Klong Toi berths, the private berths and that handled by lighterage. This calibration is somewhat complicated because, with the same data and the same probability distribution of arrival and ship loads, the total yearly waiting time produced by the simulation varied over a very wide range; this reflects different patterns of arrivals and ship loads within the distribution. In practice, the expected waiting time obtained at the end of the calibration was somewhat lower than that observed in 1967 and 1968 but well within the range of what can be expected. Since most data was derived from port statistics, the calibration involved slight variations in labor productivity, the gang application factor at private wharves and in the stream and limitation of the use of private wharves.

14. Once the model was calibrated it was used for the simulation proper. As a compromise between computer time requirements and the need to obtain statistically meaningful results, the analysis was carried out on a sample consisting of 75 simulations. This should be sufficient to insure reasonable accuracy if the expected costs and an acceptable accuracy of the standard deviation. It is too small a sample to insure good accuracy on the entire probability distributions of Charts 2 and 3. However, the accuracy of Chart 3 is sufficient to support our conclusions and should the curves of Chart 2 vary with a larger sample they would all vary in the same direction and, as our conclusions are based on the distance between them, they would not be affected.

15. In order to limit the amount of computer time, the simulation was run only for five months each year. As a result, the waiting time statistics for each year correspond to about 31 years of simulation.

February 24, 1970

THAILAND

APPRAISAL OF THIRD BANGKOK PORT PROJECT

PAT's Principal Rates and Charges as of Sept. 30, 1969

A. Charges against Shipowners or Ships' Agents

1. Channel Dues (inward passage only)

Vessels of less than 500 net reg. tons	Nil
Vessels of 500 to 1500 net reg. tons	฿ 1 per ton
Vessels exceeding 1500 net reg. tons	฿ 2 per ton

2. Wharf Rates

฿ 1 per vessel net reg. ton for each call not exceeding 72 hours, plus 25% for every subsequent 24 hours or fraction thereof. ฿ 500 per lighter per call.

3. Buoyage

฿ 100 per buoy per 24 hours or fraction thereof. ฿ 200 service charge per mooring, unmooring of a ship.

B. Charges against Consignees

4. Inward Cargo Landing Charges

Class 1	฿ 14 per metric ton	- most general cargo
Class 2	฿ 18 per metric ton	- beer, wines, spirits, tobacco, oils, dyes, china, textiles, etc.
Class 3	฿ 22 per metric ton	- dangerous and poisonous goods, chemicals, furniture, cement, ores and metals, etc.
Class 4	฿ 30 per metric ton	- vehicles, etc.

5. Inward Cargo Handling Charges

Class 1	฿ 30 per metric ton	- most general cargo
Class 2	฿ 40 per metric ton	- machinery, cement, chemicals, etc.

6. Outward Cargo Quay Dues

Class 1	฿ 1 per metric ton	- most general cargo
Class 2	฿ 1.25 per metric ton	- timber, gold and silver

7. Outward Cargo Handling Charges

Half rate of charges listed in 5 above.

8. Storage Charges

Holding of cargo in transit sheds is free for the first 72 hours after completing a vessel's discharge. Thereafter charges range from Ƀ 4 per ton per day during the first week to Ƀ 12 per ton per day during the ninth and subsequent weeks.

February 26, 1970

ANNEX 6

THAILAND

APPRAISAL OF THIRD BANGKOK PORT PROJECT

Bases and Assumptions Used in Financial Projections

1. That the military port of Sattahip will not be used for commercial (non-military) cargo before September 30, 1975.

2. That the following major items, currently included in PAT's capital expenditure program, will not be undertaken during fiscal years 1970 to 1975:

ITEM	Amount Provides in PAT's Estimates (Baht millions)
a) Realignment of Bar Channel	99.0
b) Floating Crane	40.0
c) Dredger	10.0

3. That no expenditure will occur before September 30, 1975 on the construction of berths for PAT other than the four deep water and two lighterage berths provided for in the project.

4. That PAT will continue to appropriate to the Government of Thailand 25% of its revenue surplus after payment of loan interest.

5. That interest will be earned on cash surpluses at 5% per annum.

6. That a Bank loan will be made to PAT of US$12.5 million equivalent at 7% per annum for a period of 20 years including four years' grace.

7. That introducing two and limited three-shift working and improving supervision and operational methods on the wharves will raise labor productivity by 30% between fiscal 1970 and 1975 and this benefit has been taken into account in estimating the extent of increases in the labor force.

8. Provision has been made for a possible 10% wage and salary increase for clerical and administrative staff during 1970 and a further general increase of 10% to all PAT employees in 1974.

9. Financial forecasts of earnings are based upon PAT's current rates and charges and it is assumed that during fiscal 1970 to 1975 any rate adjustments consequent upon a review and relation to costs will not reduce the overall level of the rate structure.

March 18, 1970

TABLE 1

THAILAND

APPRAISAL OF THIRD BANGKOK PORT PROJECT

1967 Port Congestion Surcharge

Country of Origin	Average freight rate $ per B/L ton	Surcharge	% total imports	Approximative Cost for 6 months (000) US $
Japan	15	15%	36	1,013
Europe	36	15%	20	1,350
USA	n/a	$4.5/B/L Ton	16	900
Australia	27.5	10%	3	206
Taiwan	8	n/a	3	n/a
Hong Kong	8	15%	2	60
Others	n/a		20	n/a
			100	3,733

Source: Bangkok Shipowner's and Agent's Association

1968 Custom Statistics

Mission Estimate

February 26, 1970

THAILAND

APPRAISAL OF THIRD BANGKOK PORT PROJECT

Expected Commercial Traffic Forecasts 1/

(in 000 tons)

(Fiscal Years Ending Sept. 30)

	ACTUAL		FORECAST								
	1968	1969	1972 2/	1973	1974	1975	1976	1977	1978	1979	1980
I. Total Traffic											
General Cargo Imports	2,504	2,575	2,769	2,904	3,032	3,206	3,392	3,618	3,852	4,074	4,304
Laos transit traffic	41	53	67	72	78	80	80	80	80	80	80
Exports	30	33	50	58	66	76	88	101	116	134	154
Total 3/	2,575	2,661	2,886	3,034	3,176	3,362	3,560	3,799	4,048	4,288	4,538
II. Distribution of traffic per location											
A. Assuming Sattahip may be released:											
A1 - Alternative I											
Klong Toi Wharf	2,241	2,321	2,405	2,450	2,499	2,569	2,635	2,707	2,797	2,850	2,894
Private Wharf	208	150	196	188	195	210	228	245	274	299	314
In the Stream	126	190	285	274	275	302	334	372	441	561	737
Sattahip 4/	-	-	-	82	199	270	350	459	513	563	591
A2 - Alternative II											
Klong Toi Wharf			2,405	2,709	2,821	2,924	3,041	3,178	3,241	3,279	3,363
Private Wharf			196	115	137	155	176	199	222	234	263
In the Stream			285	177	207	235	263	300	327	341	374
Sattahip 4/			-	-	13	50	80	117	243	402	468
A3 - Alternative III											
Klong Toi Wharf			2,405	2,709	2,994	3,125	3,272	3,435	3,575	3,698	3,814
Private Wharf			196	115	67	89	105	131	163	183	210
In the Stream			285	177	120	142	173	211	254	287	315
Sattahip 4/			---	---	---	9	15	32	73	137	224
A4 - Alternative IV											
Klong Toi Wharf			2,405	2,709	2,994	3,253	3,422	3,611	3,790	3,962	4,115
Private Wharf			196	115	67	42	51	73	106	126	150
In the Stream			285	177	120	71	93	127	172	208	241
Sattahip 4/			-	-	-	-	-	-	-	23	80
B. Assuming Sattahip is not released for commercial purposes:											
B3 - Alternative III											
Klong Toi Wharf	2,241	2,321	2,405	2,709	2,994	3,132	3,285	3,450	3,604	3,769	3,913
Private Wharf	208	150	196	115	67	89	107	132	165	190	220
In the Stream	126	190	285	177	120	143	176	213	257	294	326

TABLE 2

1/ Excluding export traffic handled in the stream of coastal traffic.

2/ The simulation was not undertaken for 1970 or 1971.

3/ Discrepancies between this total and the total per alternative result from the small size of the sample used in the simulation.

4/ These figures represent average tonnages between cases in which Sattahip is released for commercial use and cases in which it is not with diverted traffic at 0. The level of commercial traffic in Sattahip with port used for commercial purposes may be obtained by reading this table in conjunction with Table 5.

February 10, 1970

TABLE 3

THAILAND

APPRAISAL OF THIRD BANGKOK PORT PROJECT

Expected Yearly Costs of Various Project Alternatives

(000 US$)

Year	Alternative			
	I-No Project	II-2 deep water berths and 2 lighterage berths	III-4 deep water berths and 2 lighterage berths	IV-6 deep water berths and 2 lighterage berths
1971	—	6,155 1/	6,155 1/	6,155 1/
1972	—	9,233 1/	9,233 1/	9,233 1/
1973	11,209	9,376	14,844 2/	14,844 2/
1974	12,045	10,069	9,458	15,322 3/
1975	13,520	10,949	10,109	9,737
1976	14,601	11,945	10,848	10,380
1977	16,332	13,598	11,965	11,246
1978	19,404	16,589	11,965	12,249
1979	21,748	19,418	14,972	13,457
1980 - 1993	24,454	23,986	17,602	15,058

1/ Construction cost only.
2/ Including US$5,468 million construction cost.
3/ Including US$5,864 million construction cost.

February 26, 1970

TABLE 4

THAILAND

APPRAISAL OF THIRD BANGKOK PORT PROJECT

Expected Cumulative

1969 Value of Various

Project Alternatives

(000 US$)

Year	I Minimum Investment Alternative	II 2 deep water berths + 2 lighterage berths	III 4 deep water berths + 2 lighterage berths	IV 6 deep water berths + 2 lighterage berths
	Alternative			
1971		4,930	4,930	4,930
1972		11,548	11,548	11,548
1973	7,187	17,561	21,169	21,169
1974	14,103	23,345	26,501	29,917
1975	21,063	28,978	31,701	34,925
1976	27,767	34,473	36,692	39,699
1977	34,484	40,074	41,623	44,333
1978	41,642	46,182	46,530	48,851
1979	48,833	52,593	51,484	53,302
1980	56,069	59,685	56,676	57,753
1981	62,548	66,035	61,345	61,737
1982	68,350	71,721	65,516	65,305
1983	73,546	76,812	69,251	68,500
1984	78,199	81,371	72,595	71,361
1985	83,367	85,454	75,590	73,923
1986	86,100	89,110	78,273	76,218
1987	89,444	92,385	80,675	78,273
1988	92,439	95,318	82,826	80,113
1989	95,123	97,945	84,753	81,762
1990	97,526	100,297	86,480	83,239
1991	99,680	102,405	88,026	84,562
1992	101,609	104,293	89,411	85,746
1993	103,338	105,984	90,651	86,808

February 26, 1970

TABLE 5

THAILAND

APPRAISAL OF THIRD BANGKOK PORT PROJECT

Probability Distribtution of the Release Date of Sattahip as a function of the Project Alternative

%

Date	I Minimum Investment	II 2 lighterage & 2 deepwater berths	III 2 lighterage & 4 deepwater berths	IV 2 lighterage & 6 deepwater berths
1973	14.5	-	-	-
1974	18.5*	2.5	-	-
1975	13.5	5.5	1.5	-
1976	13.5	6.5	1.5	-
1977	14.5	5.5	2.5	-
1978	2.5	20.0	6.5	-
1979	2.5	25.5*	10.5	4.0
1980	-	6.5	14.5	9.5
Not before 1980	20.0	28.0	62.5	86.5

February 26, 1970

* Best Estimate

TABLE 6

THAILAND

APPRAISAL OF THIRD BANGKOK PORT PROJECT

Payback Period[1/]

Payback Period	Probability	
Less than 3 years	7%	
From 4 to 6 years	14.5%	
7 years	16.0%	
8 years	18.5%	(Best Estimate)
9 years	10.5%	
10 years	10.5%	
From 11 to 13 years	9.5%	
Over 14 years	13.5%	
	100.0%	

February 26, 1970

1/ Number of years after which the cumulative present value of the costs with the project is equal to the cumulative present value of the costs without the project.

TABLE 7

THAILAND

APPRAISAL OF THIRD BANGKOK PORT PROJECT

Cost Estimates of the Project

	Thai Baht million			US$ million		
	Local	Foreign	Total	Local	Foreign	Total
1. Construction of four deep-water and two lighter berths, two transit sheds and ancillary works						
(a) Preliminary	0.60	-	0.60	0.03	-	0.03
(b) Dredging	5.30	7.80	13.10	0.26	0.37	0.63
(c) Deep-water berths	36.00	72.00	108.00	1.73	3.46	5.19
(d) Lighterage berths	10.80	23.00	33.80	0.52	1.11	1.63
(e) Transit Sheds	28.10	42.20	70.30	1.32	2.04	3.36
(f) Klong Bridge	7.10	12.00	19.10	0.35	0.57	0.92
(g) Roads, open areas and railways	44.90	38.00	82.90	2.15	1.83	3.98
(h) Ancillary works including electricity, water supply, drainage, etc.	17.20	15.00	32.20	0.85	0.71	1.56
Subtotal1	150.0	210.0	360.0	7.21	10.09	17.30
2. Consultants' Fees for Engineering and Supervision during construction	4.16	18.72	22.88	0.20	0.90	1.10
3. Expert Assistance for dredging, cost accounting and management consultants for cargo-handling labor operations	0.84	7.48	8.32	0.04	0.36	0.40
4. Contingencies approximately 12% (6% for quantities and 6% for prices)	21.80	23.80	45.60	1.05	1.15	2.20
Total	176.80	260.00	436.80	8.50	12.50	21.00

July 13, 1970

THAILAND

APPRAISAL OF THIRD BANGKOK PORT PROJECT

PORT OF THAILAND AUTHORITY

Actual and Forecast Revenue and Expense Accounts
(Years ending September 30)

Thai Baht Million

	ACTUAL					FORECAST					
	1965	1966	1967	1968	1969*	1970	1971	1972	1973	1974	1975
Operating Revenues											
Wharf Rate	4.9	5.6	6.1	4.7	4.8	4.9	5.1	5.3	5.7	6.3	6.8
Channel Dues	11.8	14.8	14.1	14.5	15.4	16.1	16.9	17.7	18.6	19.5	20.5
Handling Charges	41.9	52.3	53.5	48.2	47.6	49.5	51.4	53.4	57.7	63.5	68.3
Landing, Storage and Overside Charges	96.5	122.9	173.4	176.0	159.7	170.2	177.1	184.4	199.0	218.8	235.2
Rentals	4.2	5.2	8.9	8.2	9.7	10.1	10.5	10.9	11.7	12.8	13.8
Miscellaneous	8.2	9.5	10.9	11.7	11.1	12.1	12.7	13.8	14.9	16.9	17.9
	167.5	210.3	266.9	263.3	248.3	262.9	273.7	285.5	307.6	337.8	362.5
Operating Expenses											
Operating Expenses	49.4	51.6	60.6	68.2	78.3	84.7	88.5	92.0	102.9	114.3	124.8
Administrative Expenses	33.1	36.6	40.7	46.5	46.3	51.8	54.2	56.5	61.9	71.6	75.4
	82.5	88.2	101.3	114.7	124.6	136.5	142.7	148.5	164.8	185.9	200.2
Bar Channel Maintenance Expenses #	-	-	13.9	15.3	14.8	15.0	16.0	18.0	19.0	20.0	20.0
Depreciation	13.2	14.3	16.9	22.2	26.2	28.3	31.4	33.4	37.4	44.4	48.4
	95.7	102.5	132.1	152.2	165.6	179.8	190.1	199.9	221.2	250.3	268.6
Net Operating Revenue	71.8	107.8	134.8	111.1	82.7	83.1	83.6	85.6	86.4	87.5	93.9
Interest Income	3.9	5.8	10.2	10.8	17.8	10.5	6.5	4.8	4.3	5.0	7.2
Net Revenue	75.7	113.6	145.0	121.9	100.5	93.6	90.1	90.4	90.7	92.5	101.1
Interest Expense	1.9	1.6	1.3	1.1	0.8	2.6	4.8	9.7	15.2	17.9	18.1
Net Income	73.8	112.0	143.7	120.8	99.7	91.0	85.3	80.7	75.5	74.6	83.0
Times Interest Covered	39x	71x	111x	110x	125x	36x	18x	9x	6x	5x	5.6x
Total Debt Service	8.8	9.2	11.3	7.1	6.8	9.0	8.5	9.7	15.2	17.9	27.3
Times Debt Service Covered	10x	13x	14x	20x	18x	13x	14x	12x	8x	7.6x	5.5x
Operating Ratio	43%	51%	50%	57%	67%	68%	70%	70%	72%	74%	74%
Return of Net Operating Revenue to Net Fixed Assets in Use	20%	29%	35%	27%	18.5%	15.8%	12.8%	11.7%	9.5%	7.6%	7.6%

* Subject to audit

\# Expense not borne by PAT prior to 1967

Source: Port of Thailand Authority
(Modified by Bank Staff)

February 10, 1970

TABLE 8

THAILAND

APPRAISAL OF THIRD BANGKOK PORT PROJECT

PORT OF THAILAND AUTHORITY

Forecast of Cash Flow
(Years ending September 30)

Thai Baht Million

	1969	1970	1971	1972	1973	1974	1975	Total 1970-1975	Percentage
A. CASH REQUIRED									
Capital Investments									
IBRD Project	0.3	2.2	116.0	170.0	112.0	28.0	-	428.2	
Other	155.3	219.5	84.5	37.0	38.0	60.0	40.0	479.0	
Total Capital Investments	155.6	221.7	200.5	207.0	150.0	88.0	40.0	907.2	78.6
Technical Assistance									
Dredging and Accounting Advisors provided in IBRD Loan		1.3	4.0	3.0	-	-	-	8.3	0.7
Debt Service - IBRD									
Interest	0.8	2.6	4.8	9.7	15.2	17.9	18.1	68.3	
Amortization	6.0	6.4	3.7	-	--	-	9.2	19.3	
Total Debt Service	6.8	9.0	8.5	9.7	15.2	17.9	27.3	87.6	7.6
Changes in Working Capital	-	0.2	1.0	1.0	1.5	1.0	0.5	5.2	0.5
Appropriation to Government	32.9	24.2	21.8	20.4	19.0	17.6	17.2	120.2	10.4
Board Members and Staff Bonus	5.9	4.5	4.4	4.3	4.2	3.9	3.8	25.1	2.2
Total Cash Required	201.2	260.9	240.2	245.4	189.9	128.4	88.8	1153.6	100.0
B. CASH AVAILABLE									
Net Operating Revenues	82.7	83.1	83.6	85.6	86.4	87.5	93.9	520.1	45.2
Depreciation	26.2	28.3	31.4	33.4	37.4	44.4	48.4	223.3	19.4
Investment Income	17.8	10.5	6.5	4.8	4.3	5.0	7.2	38.3	3.3
Change in Working Capital	26.0	-	-	-	-	-	-	-	-
Proposed IBRD Loan	-	3.2	75.0	103.0	62.0	16.8	-	260.0	22.5
								1,041.7	90.3
Cash Available at Beginning of Year									
Cash on Hand and at Banks and Ministry of Finance	344.2	295.7	159.9	116.2	97.6	97.8	123.1		
Thai Government Bonds	8.9	8.9	8.9	8.9	8.9	8.9	8.9		
Total Cash at Beginning of Year	353.1	304.6	168.8	125.1	106.5	106.7	132.0		
Total Cash Available	505.8	429.7	365.3	351.9	296.6	269.4	281.5	1,041.7	90.3
Cumulative Cash Position	304.6	168.8	125.1	106.5	106.7	132.0	192.7		
Decrease in Cash Position								111.9	9.7

Source: Bank Staff

February 10, 1970

TABLE 2

THAILAND

APPRAISAL OF THIRD BANGKOK PORT PROJECT

PORT OF THAILAND AUTHORITY

Pro Forma Balance Sheets
(As at September 30)

Thai Baht Million

	1969 (Subject to Audit)	1970	1971	1972	1973	1974	1975
ASSETS							
Current Assets							
Cash in Hand, Bank and Ministry of Finance	295.7	159.9	116.2	97.6	97.8	123.1	183.8
Thai Government Bonds	8.9	8.9	8.9	8.9	8.9	8.9	8.9
Accounts Receivable, Stores and Advances to Staff	20.7	21.0	22.5	25.0	28.0	29.5	31.0
Total Current Assets	325.3	189.8	147.6	131.5	134.7	161.5	223.7
Fixed Assets							
Total Fixed Assets	626.8	796.5	945.7	1,017.6	1,350.5	1,582.5	1,652.5
Less Accumulated Depreciation	169.9	199.8	232.8	267.8	306.8	352.8	402.8
Net Fixed Assets in Use	456.9	596.7	712.9	749.8	1,043.7	1,229.7	1,249.7
Works and Equipment in Progress	206.3	258.3	309.6	444.7	261.8	117.8	87.8
Total Fixed Assets	663.2	855.0	1,022.5	1,194.5	1,305.5	1,347.5	1,337.5
Project Item in Suspense - Less Amounts Written Off (Cost of Dredging and Accounting Advisors)	-	9.3	1.1	5.2	8.3	-	-
Total Assets	988.5	1,045.1	1,171.2	1,331.2	1,448.5	1,509.0	1,561.2
LIABILITIES							
Current Liabilities							
Accounts Payable and Deposits from Port Users	13.9	14.0	14.5	16.0	17.5	18.0	19.0
Long Term Debts							
Development Loan Fund	20.2	17.6	14.9	12.1	9.1	6.0	2.7
IBRD Loans	10.1	6.9	78.2	181.2	243.2	260.0	250.8
Total Long Term Debts	30.3	24.5	93.1	193.3	252.3	266.0	253.5
Equity							
Asset Appreciation	120.9	119.2	117.6	116.0	114.3	112.7	111.1
Contributions from Government	123.0	125.3	127.8	130.4	133.2	136.1	139.2
Reserve for Expansion	600.7	671.6	732.6	794.8	855.7	901.6	955.4
Unappropriated Revenue Reserve	99.7	91.5	85.6	80.7	75.5	74.6	83.0
Total Equity	944.3	1,007.6	1,063.6	1,121.9	1,178.7	1,225.0	1,288.7
Total Liabilities	988.5	1,047.1	1,171.2	1,331.2	1,448.5	1,509.0	1,561.2
Debt/Equity Ratio	3/97	2/98	8/92	15/85	18/82	18/82	16/84

Source: Bank Staff

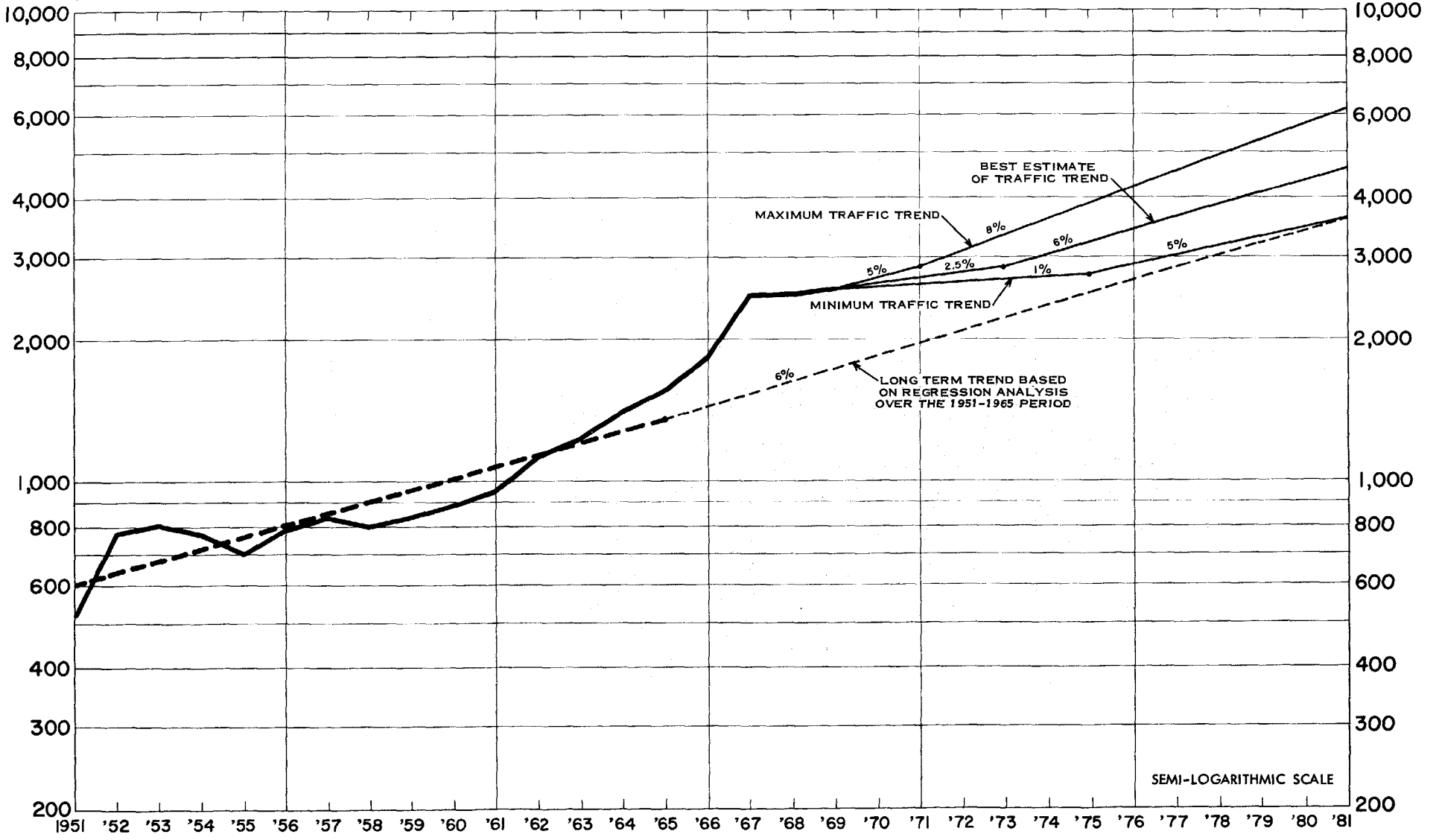
February 10, 1970

TABLE 10

THAILAND: APPRAISAL OF THIRD BANGKOK PORT PROJECT

GENERAL CARGO IMPORTS IN BANGKOK PORT TREND AND FORECAST

(THOUSANDS OF TONS)



ACTUAL TRAFFIC GROWTH
FORECASTED TREND
PAST TREND

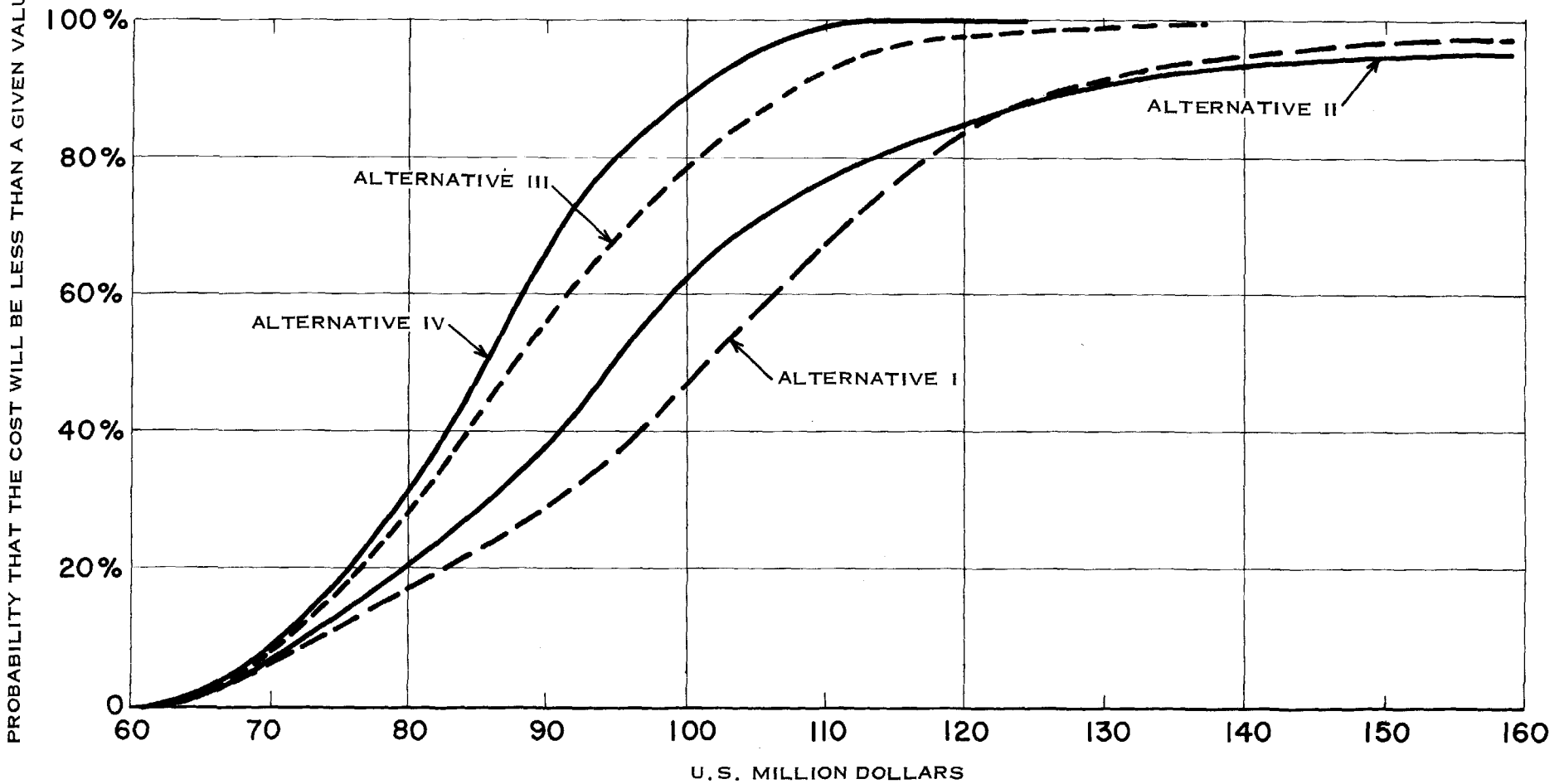
NOTE: CALENDAR YEAR FROM 1951 THROUGH 1960.
FISCAL YEAR THEREAFTER (OCT. 1 - SEPT. 30)

CHART 1

IBRD - 4797 (R)

THAILAND: APPRAISAL OF THIRD BANGKOK PORT PROJECT

PROBABILITY DISTRIBUTION OF THE TOTAL* 1969 VALUE OF THE TOTAL COST WITH EACH PROJECT ALTERNATIVE



ALTERNATIVE I – NO PROJECT
ALTERNATIVE II – 2 LIGHTERAGE BERTHS AND 2 DEEPWATER BERTHS.
ALTERNATIVE III – 2 LIGHTERAGE BERTHS AND 4 DEEPWATER BERTHS.
ALTERNATIVE IV – 2 LIGHTERAGE BERTHS AND 6 DEEPWATER BERTHS.

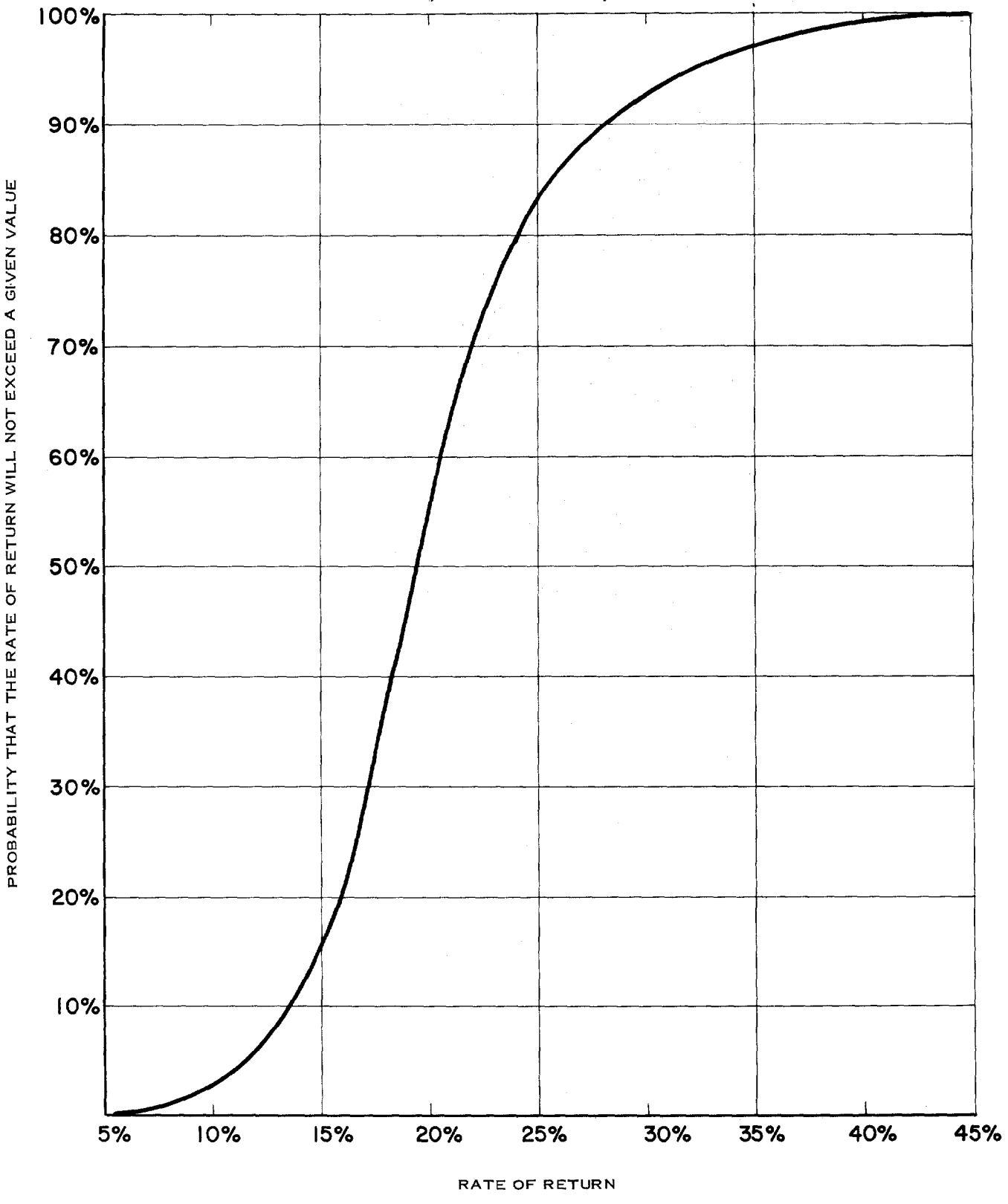
* FROM 1970 THRU 1993

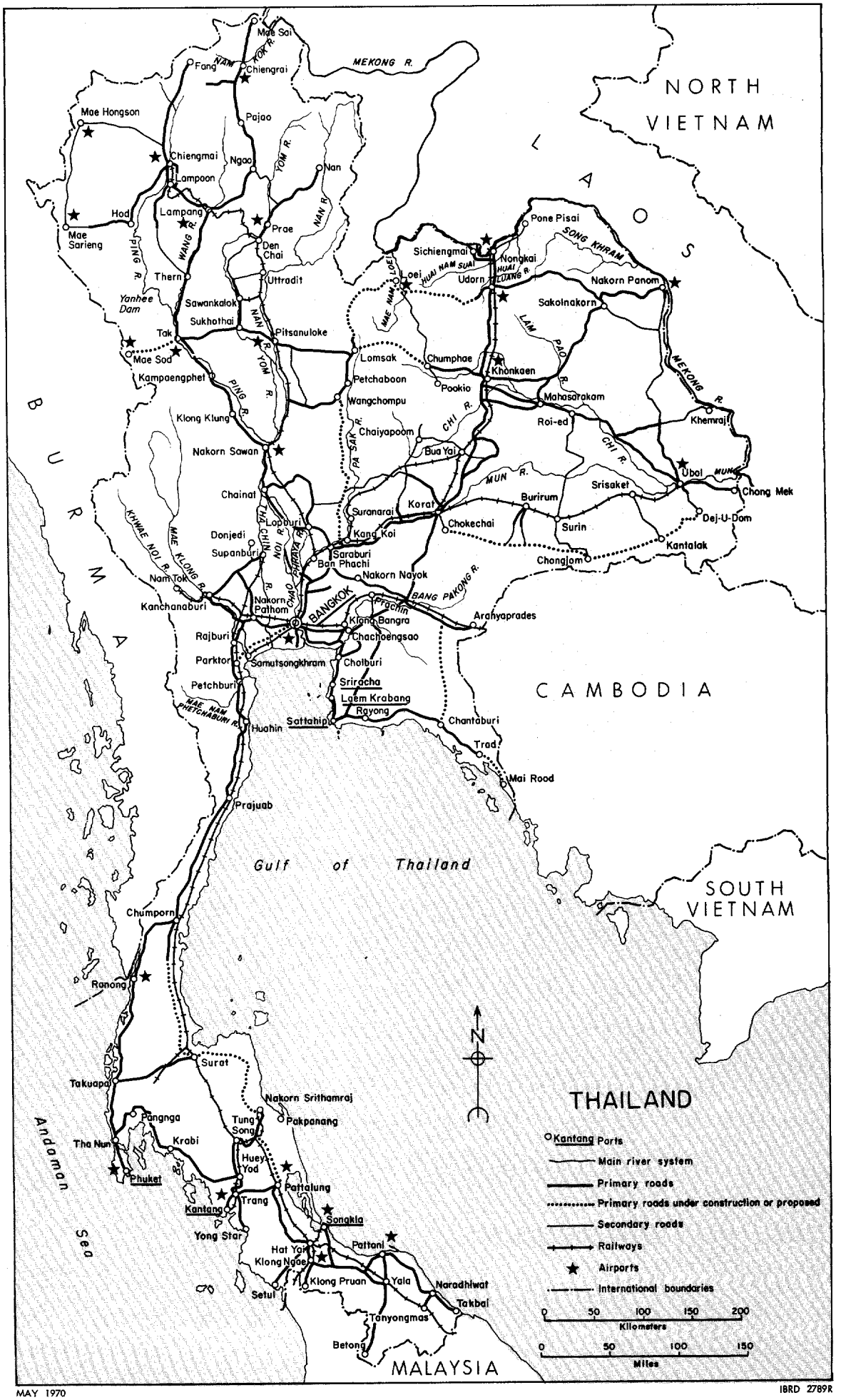
CHART 2

IBRD – 4799(R)

THAILAND: APPRAISAL OF THIRD BANGKOK PORT PROJECT

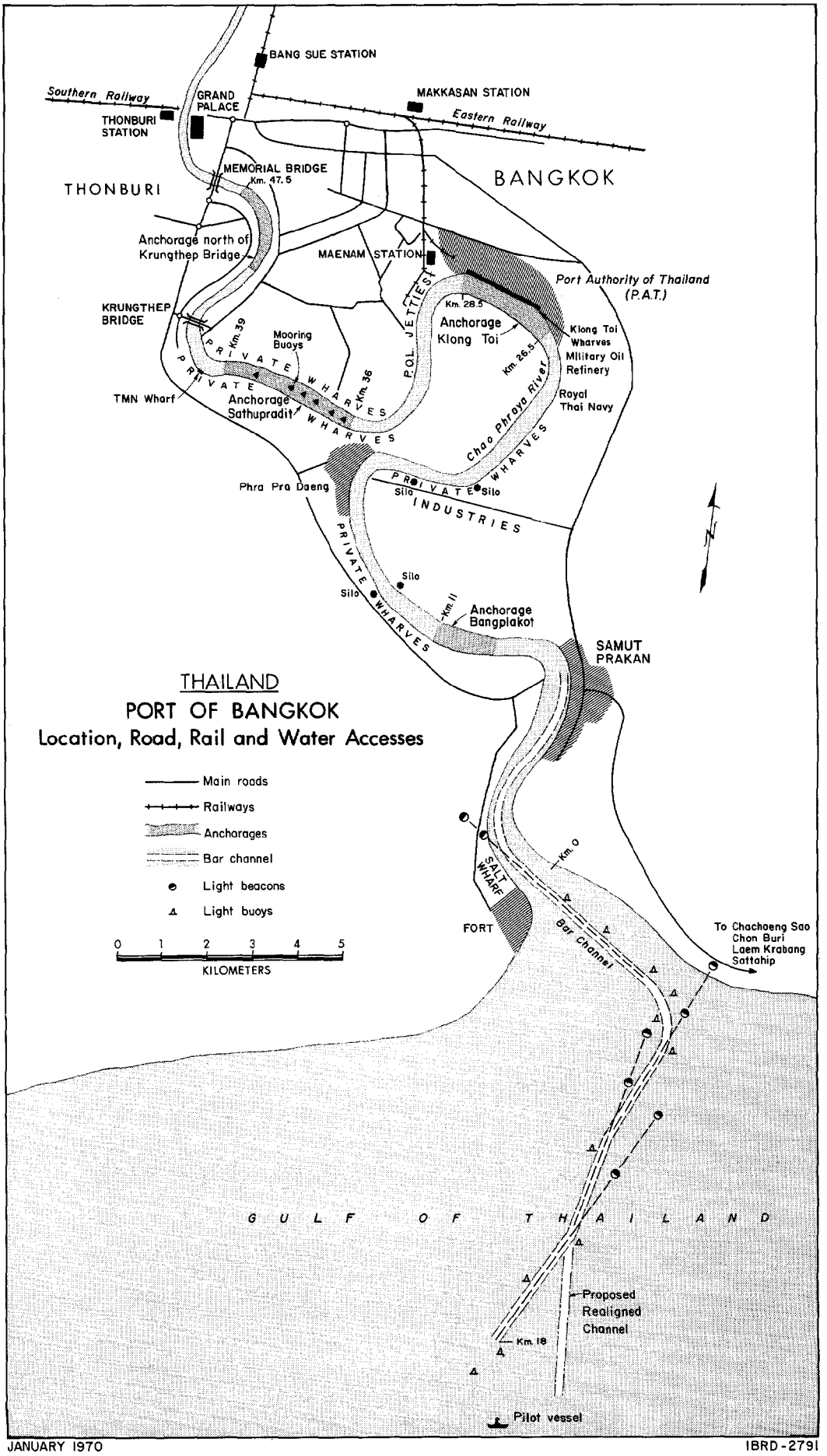
PROBABILITY DISTRIBUTION OF THE INTERNAL RATE OF RETURN (TWO LIGHTERAGE BERTHS FOUR DEEP-WATER BERTHS)





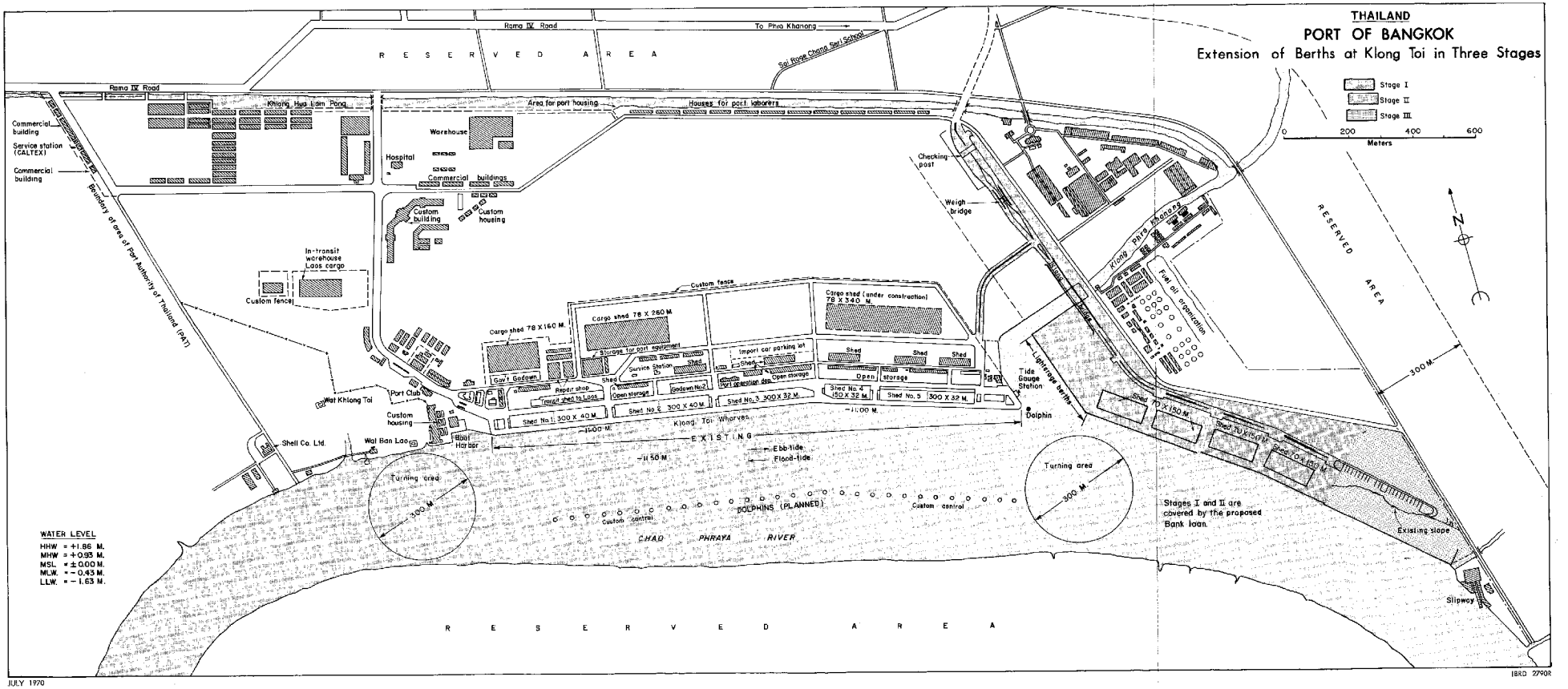
MAY 1970

IBRD 2789R


THAILAND
PORT OF BANGKOK
Location, Road, Rail and Water Accesses
Main roads
Railways
Anchorages
Bar channel
Light beacons
Light buoys
0 1 2 3 4 5
KILOMETERS
BANG SUE STATION
Southern Railway
GRAND PALACE
THONBURI STATION
MAKKASAN STATION
Eastern Railway
MEMORIAL BRIDGE
Km. 47.5
THONBURI
BANGKOK
Anchorage north of Krungthep Bridge
MAENAM STATION
Port Authority of Thailand (P.A.T.)
KRUNGTHEP BRIDGE
Km. 39
Mooring Buoys
PRIVATE WHARVES
Km. 36
POL JETTIES
Km. 28.5
Anchorage Klong Toi
Klong Toi Wharves
Km. 26.5
Military Oil Refinery
Chao Phraya River
Royal Thai Navy
TMN Wharf
Anchorage Sathupradit
Phra Pra Daeng
Silo
INDUSTRIES
Km. 11
Anchorage Bangplakot
SAMUT PRAKAN
SALT WHARF
Km. 0
FORT
Bar Channel
To Chachoeng Sao
Chon Buri
Laem Krabang
Sattahip
GULF OF THAILAND
Proposed Realigned Channel
Km. 18
Pilot vessel

MAP 3

THAILAND
PORT OF BANGKOK
Extension of Berths at Klong Toi in Three Stages



WATER LEVEL

HHW = +1.86 M.
MHW = +0.93 M.
MSL = ±0.00 M.
MLW. = −0.43 M.
LLW. = −1.63 M.

JULY 1970

IBRD 2790R