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VOLUME II

OVERALL CONCEPT STUDIES

PART 1 - PORT PLANNING STUDIES

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VOLUME II

PART 1

1.0 STUDY OF VESSEL TYPES

1.1 INTRODUCTION

The continued increase in vessel size has created needs that port authorities find hard to meet. Whereas a new ship is designed, built and dispatched to sea in two years' time or less, port improvements on a reasonable scale take approximately five years. There is a considerable time lag between the two events.

Though naval engineering is not, at least in theory, completely free to increase the size of ships — for, the larger they are, fewer ports can handle them — it has been leading the process, forcing ports to adapt themselves to the new requirements of modern boats as regards draft, turning space, and auxiliary and support services.

The main reason for the increase in ship size lies with the application to marine transportation of the law of increased returns. The cost of ship building and operation increases relatively less with size, and building costs per ton of deadweight decline sharply with the increase in size.

1.2 CONVENTIONAL CARGO SHIPS

Table 1/1 shows the evolution of conventional cargo ships in this century, as exemplified by the size of a typical cargo boat in regular service. It should be noted that, as far as the draft is concerned, the increase was rather conservative.

Gains in volume capacity were obtained by means of increased lengths and particularly larger beams. The economy in draft size with regard to capacity was due to the use of lighter materials and to welding, instead of riveting, the steel plates. Gains in speed resulted from more effective engines and from the fact that the welded haul was 15% less resistant to motion.

If the increase in freighters size has not been sharper, it is because greater loading capacity means a longer stay at port.

As regards competition from container carriers in those sea routes where cargo plays a more relevant part, the conventional freighter will be preferred for the more voluminous and less valuable cargoes, which are unsuitable for other types of ship.

The reduced supply of break bulk cargo for freighters will have some effect on freighters dimensions. Less valuable, heavier products may impose slightly larger drafts.

At present, the Brazilian Merchant Marine does not have any special ships for modulated cargo. Conventional freighters will thus enjoy a more favorable competitive position in the Brazilian traffic and should grow somewhat in size, but not much, due to the need to maintain a relatively large operational flexibility as regards port diversification.

On an international level, most of the general cargo which is traded between industrialized nations, with traffic volumes relatively balanced at both ends, shall be hauled in container carriers. Here the importance of the conventional freighter will decrease.

The average ship size for general break bulk cargo ranges at present from 12,000 to 15,000 tdw, though a considerable amount of orders are still being placed for 9,000 tdw. The largest, 22,000 tdw freighters in service, which represent the limit in their category, are approximately 605 feet long and have an 82-foot beam and a 35-foot draft.

For the reasons pointed out above, the conventional freighters and those for break bulk cargo and containers, which handle the smaller and less intense traffic, are limited in size by the capacity of the ports which will handle them.

The large number of small ports sets a limit to the size of these boats and restricts the useage of container carriers. These freighters, therefore, must not be longer than 700 feet, with a 90-foot beam and a 30- to 35-foot draft.

1.3 CONTAINER CARRIERS

In maritime economics, the increased returns gained through larger ship capacity are positive only to the extent that the operational costs per ton/mile are not absorbed by a proportionately longer stay at the port. This is the basic reason for the increased use of the container system and of ships specialized in handling containers.

The world trade in general cargo should continue to grow during the next decades. In sea routes of large cargo volume and freight profitability, which are somehow balanced in both directions, the container carrier will gradually replace the conventional freighter. Theoretically, the increase in size of the container carrier is comparable, in economic terms, with that of the bulk carriers, but their traditional orientation and the restraints of cost and distribution system, heavier still than in the case of bulk shipments, will prevent further attempts at hugeness.

A serious obstacle to size increase is the need for frequent services, for high-priced cargoes require fast and continuous transportation. Though the use of large and fewer specialized ships is more economical than that of a fleet of small units, the average duration or the mathematical expectation of the user's waiting time for the next departure is considerably higher, which reduces its attractiveness. However, larger carriers may be employed through the establishment of consortiums and pools of operators who would rationally organize the exploitation of a given traffic. In this sense, and depending on the specific characteristics of each route, container carriers may grow somewhat in size in the future.

While the increase in their length and width may give rise to certain port problems in terms of widening access channels and turning basins, their drafts, which should increase at a lower rate, will not bring any insurmountable problems.

The process of general cargo containerization, which started during the 50's, is being gradually accelerated. During the late 60's, there appeared the third generation of ships specialized in this kind of transportation. These ships were first designed and built to carry containers all the way up from the keel. Their loading capacity is generally for 1,000 to 1,200 ISO 20-foot containers, and their speed is from 21 to 25 knots.

Many of these ships incorporate certain technological advances, such as ramps for vehicle access and side openings for moving modulated cargo.

Their dimensions are generally in the range of 600 to 720 ft. in length, with an 80- to 95-foot beam. Contrary to tankers, whose draft increases with the size, the majority of these ships still have the same draft as conventional freighters, 28 to 33 feet deep, as shown in the following table.

Company	Characteristics of Ship			
	Length (ft)	Beam (ft)	Draft (ft)	Speed (knots)
Atlantic Container Lines	646/695	86/92	29/28	22/25
American Export Is Brandsew Lines	610	78	27	20
Farrel Lines	668	90	33	22
Matsow Navigation	719	95	31	23
Moore-McCormack Lines	620	90	31	25
United States Lines	700	90	28	25
Transamerican Trailer Transport	700	92	28	26
Sea Land Service	944	105	34	33

These new ships' tonnage varies between 11,600 to 23,000 tdw. However, giving too much importance to tonnage as an indicator of size may lead to somewhat distorted ideas about the haulage capacity of these boats.

The container carriers of the Atlantic Container Lines, for instance, rated at 14,200 tdw, have a volume capacity of nearly two million cubic feet. This, in terms of ship dimensions, would be equivalent to a conventional freighter of almost 35,000 tdw.

In 1973, approximately 388 container carriers were operating in international routes. The largest of them was the Sea Land Galleway, rated at 27,130 tdw, whose dimmensions are shown in the above table.

The future size prospects of these ships do not indicate a significant increase, though they should, at least throughout the 80's, incorporate substantial technological innovations. It is difficult to forecast what changes will occur in container carrier length and beam. We may, however, assume that these ships will be longer and wider than the present ones, with a minimum increase in draft. A sound estimate suggests that the largest among them will not be longer than 950 to 1,000 feet, with a width of 110 to 115 feet, and a draft of 33 to 35 feet. This ship would have a loading capacity equivalent to 3,000/3,500 20-foot containers, and a speed higher than 35 knots.

The low density of general cargo will cause the difference in draft to be considerably smaller between the loaded and the unloaded ship.

1.4 BARGE CARRIERS

A variation of the container carrier is the barge carrier, an overseas transportation presented in two versions — the Lash, "Lighter Aboard Ship," and the Seabee, "Sea Barge Carrier." In March, 1969, 16 of these ships were being ordered, 14 in the U.S. and 2 in Japan. In 1973, the World Ports magazine announced the contract for the 100th Lash ship. Both types haul loaded barges which they collect from and launch at sea. Theoretically, they dispense with mooring and can operate in the open sea, thus avoiding the bottlenecks and maneuvering problems which plague the majority of ports.

The Seabee is 720 feet long, 106 feet wide and has a draft, when loaded, of 33 feet. The Lash type is 324 feet long, 100 feet wide, and has a draft of 28 feet when loaded. Their speeds are 20 and 23 knots, respectively.

1.5 PASSENGER SHIPS

The "Queen Elizabeth's" retirement from traffic in 1968 was the starting point of a reverse in the growth of the so-called "superliners" for passenger transport.

These ships tend to become smaller and less numerous. This is due to the continued increase in the cost of operating these ships, and to the airlines' ever-growing competition.

The remaining maritime services will continue to concentrate on the traditional ports, and the overseas transportation of passengers will gradually decline. The recreational cruise will replace other purpose trips in the remaining traffic.

Thus, future passenger ships will be cruise-oriented, and their draft should not go above 30 feet. Those few which are designed for overseas travel may be slightly larger. The main point is that, since no significant change is expected to occur in passenger ships, ports will not meet much difficulty in the future, since many of them were equipped in the past to handle large vessels.

1.6 OIL TANKERS

Stimulated at first by the Suez Canal shutdown, and later by the continued growth of the world's oil demand, the discovery of new reserves and the quick progress in the building and operational technology, the size of oil tankers has grown violently during the last few years. Where ports are concerned, though a few were marginalized in the process, the growing use of open-sea terminals and the building of deep-water mooring facilities have seemed to solve the problem of handling these ships.

The increase in oil tanker size was far greater than expected. Y. Watanabe, a Japanese expert, predicted in 1965 that ships built by the then known methods would reach the maximum of 500,000 tdw. Already in 1967, the "Idemitsu Maru" oil tanker of 209,000 tdw proved to be economically advantageous in the route between the Persian Gulf and Japan. Compared at the time with an 80,000 tdw unit, it represented a 38% reduction in operating costs, and, in relation to a 40,000 tdw unit, a gain of 59%.

A 200,000 tdw oil tanker has a draft of 17.9 meters, and those of 300,000 tdw, operating at the Banty Bay terminal in southwestern Ireland,require a 30.4 meter depth, and thus have no access to the North Sea.

Many orders were placed for oil tankers in the 200,000 to 250,000 tdw range as a result of the Suez Canal shutdown. Operating the Persian Gulf-Europe route at a 25% lower cost than the 75,000 tdw units, these tankers were specifically designed to sail the Canal in ballast if only it is dredged slightly deeper. At present, the Canal allows for the passing of ships up to 70,000 tdw and 38-foot draft, completely loaded, or of 140,000 tdw ships in ballast. The plans for widening and deepening the Canal will give access to 200,000 tdw ships with a 71-foot draft when loaded, or to any other size ship now in traffic, when unloaded. It should be noted that a one-way crossing of the Canal represents a saving of 10% per ton/mile for a 250,000 tdw ship in relation to a round trip around the Cape of Good Hope.

The shutdown of the Canal, though it has brought about an increase in the average size of oil tankers, worked as a partial stabilizer in the trend toward hugeness, with the exception of those routes to and from open-sea terminals or fiords, as in the case of Bantry Bay.

Already at present oil tankers are in operation with a capacity larger than 450,000 tdw. However, the rapid size growth of this type of ship marginalized many shipyards and somehow limited its supply. Still other restrictions exist against its continued growth. The Panama Canal does not allow for passage of ships larger than 60,000 tdw, and a great portion of the continental platform areas are outside the reach of units larger than 300,000 tdw with a draft of 24.9 meters or more. These areas include the English Channel, the southern part of the North Sea, the Baltic Sea, large stretches of the White Sea and the accesses to the North Sea, to the port of New York, and to the La Plata River ports.

We thus may conclude that the largest ships in the world will be the first actually overseas vessels, since they will surpass the depth limits of the continental platform.

Table 1/2, showing the distribution of the world's fleet according to size, and Graph 1/1, which shows the distribution of oil tankers, indicate a large concentration of orders in the 225,000/300,000 tdw range and in the 300,000-and-up range. This means that these larger ships will clearly prevail in the future composition of the fleet. As for the latter group, while there are only 12 units at present with a total of 4.2 million tdw, contracts have already been signed for building another 180 units, equivalent to 65.8 million tdw. As regards the Brazilian fleet, orders have been placed for 276,000 tdw units for PETROBRAS, whose largest ship at present has a capacity for 116,500 tdw.

It should be noted that the largest VLCC's (Very Large Crude Carriers), operating in 1973 between the Persian Gulf and Japan, have a capacity for 484,000 tdw. Though projects exist for up to one-million-ton units, it is believed that they are unlikely to be built due to growing worries in regard to ocean safety and the pollution hazards which these ships represent to the communities using them. The largest on order at present, for the Shell Oil Company, have a capacity of 540,00 tdw, according to the Fair-play International magazine (nº 38 of February 21, 1974).

The enormous dimensions of these ships are supposedly due to the fact that, in such a special traffic, their economic advantages are greater than anywhere else.

In fact, if we assume similar conditions of itineraries, contract, financing and exploitation expenses, a 325,000 tdw tanker has a cost per hauled ton 30% lower than that of a 100,000 tdw unit. However, in comparison with a 130,000 tdw unit, the reduction in the transportation cost is only 10%, and this difference decreases in proportion to the increase in the size of the compared ship, until all cost savings are equivalent to the additional expenses, in terms of fixed installations, transhipping, etc., required for the operation.

The Shell company itself, outfitter of the previously mentioned 540,000 tdw oil tankers, recognizes the fact that, with the two units ordered, there will be only a 10% advantage over the transportation costs it would have if four 270,000 oil tankers had been built. In spite of the apparent savings provided by the large haulage units, it seems that, nowadays, the most popular oil tanker sizes are in the 125,000/250,000 tdw range. This latter size seems to represent the critical point where the ratio twd/capacity for transportation is smallest.

As regards the future, we believe there is sufficient reason to think that one-million tdw oil tankers will be a reality before 1980, as demonstrated by the "Delta" project being studied by the Onassis group. The intermediate size tankers, specially those between 80,000 and 250,000 tdw, will act as distributors for the one-million tdw supertankers for shorter distances and for restricted ports. The largest demand, however, will probably be for the 250,000 tdw units.

Evidently, there will continue to be specially designed tankers which will attend to the circumstances prevailing in each country and region for the distribution of oil derivates, and whose features will depend, in each case, on the particular working conditions, but will not surpass 30,000 to 40,000 tdw capacity.

The above mentioned "Delta" project consists of a driving unit carrying the propelling engine and the mooring and support devices required for attachment of four modules, two on each side, with a capacity of 250,000 tdw each. These would be operated in a manner similar to the Lash system, and would be towed to the intermediate ports. This system would have the large advantage of not requiring adaptation of the unloading terminals beyond that needed for handling the 250,000 tdw modules, a size which is already common at many ports, while at the same time solving the problem of draft, since the driving unit would not have to enter these ports.

1.7 BULK CARRIERS

Though the basic stimuli acting upon oil tanker sizes in the direction of hugeness are the same as regards bulk carriers, there is a great variety of commercial routes, cargo types and available volume which cause the latter to remain at a lower average size. The multitude of different transportation tasks explains the diversity of projected size for this type of ship, which aims at maximizing operational flexibility. A particularly significant aspect in this regard is that industries supplied by these ships are located in the traditional port areas. This relative rigidity of location which prevails in the bulk market and, unlike the oil situation, the existence of few possibilities of new solutions for the problems of moving, transhipping and distributing the cargo, suggest that these ships will have to continue to use the traditional docks and that a certain balance must be kept between the economy gained with their size and the port improvements required.

As regards dimensions, the average length and beam of bulk ships increased more than proportionately to the draft size. Though it involves an additional transhipping cost, greater operational flexibility can be obtained through loading and unloading. This is a particularly significant fact because, in larger ships, greater draft reductions can be obtained by lightening the load than in smaller ships.

In several countries, port authorities try to stimulate partial loading and unloading by charging taxes based on the ship's draft, rather than on the registered tonnage. In addition, they may add surcharges for large draft ships which require the maintenance of an expensive access channel.

Table 1/2 and Graph 1/2, showing size distribution of bulk carriers, clearly indicate the forementioned fact, that is, the diversity of carrier size. The present fleet, however, has a predominance of relatively small units. 1,458 ships are concentrated in the 15,000/30,000 tdw range, totaling 32 million tdw, or 43% of the total. These ships are equally used for the transport of cereals, sugar, fertilizers, and small lots of ore and coal, operating with smaller ports which are not always equipped with special terminals to handle larger units. Orders placed with shipyards, though they include a not too small number of contracts in this range, are for a majority of 70,000 to 125,000 tdw sizes, particularly with regard to ore carriers (Table 1/2 and Graph 1/3). The Brazilian bulk carrier fleet is also made up of a large majority of ships up to 30,000 tdw, though vessels of 50,000 tdw and more, for ore transportation, are either in operation or are being ordered.

Based on these facts, it is estimated that these ships will not exceed the 400,000 tdw size limit, those above 100,000 being rather limited in number, even in the year 2000. These ships' dimensions should be as indicated below, following the historical trend observed in Table 1/4 and Graph 1/6, which show size and draft of bulk carriers.

(in feet)

tdw	Length		Width		Draft	
	min.	max.	min.	max.	min.	max.
15,875 (1)	567		78		33	
28,881 (1)	584		75		34	
50/95,000	715	825	95	125	35	45
100,000	820	875	125	130	45	50
130,000	-	-	-	-	52	53

1 Monterrey Bulk Carrier
2 Bonanza Bulk Carrier

1.8 COMBINATION SHIPS

Immediately below tankers, combination ships rate second as regards increase in size. The importance and popularity of OBO (Ore Bulk and Oil) and O/O (Ore and Oil) ships have increased lately. Indicative of this is the fact that, as early as in 1968, when only 20 units were ordered larger than 50,000 tdw, 16 were of the OBO type. At present, 154 OBO ships are in operation, totaling 15 million tdw, in addition to 193 O/O ships with a total of 20 million tdw, as shown in Table and Graph 1/5.

Orders placed indicate a preference for O/O ships in the 175,000 tdw range. In the opinion of shipbuilders, charterers and brokers, these ships should settle at a level of around 250,000 tdw in the next 20 or 30 years, with dimensions comparable to tankers of the same size.

1.9 COASTAL SHIPPING

Graphs 1/7 to 1/12 refer to the existing fleet only. The first series of histograms show the distribution of the number of units in each tdw range, and indicate their averages. The second group show the portion of the total which corresponds to each size range.

In the case of general cargo, there is a concentration of units around the 4,140 tdw average, and two others in the 1,000 to 2,000 tdw and 5,000 to 6,000 tdw ranges, the latter being the most representative in terms of total tdw. As regards ordering forecasts, there is a reasonable amount for ships of 3,000/6,000, though the largest amount is for the 9,000 to 10,000 tdw range for the combined transportation of general cargo and salt, as shown in Table 1/5. From these data it may be concluded that, taking into account the draft limitation of Brazilian ports, the size of freighters for coastal shipping should not exceed 10,000 tdw in the next few years.

In the case of bulk carriers, there is a great dispersion in terms of number of units among the several ranges, but, in relation to the total tdw, there is clearly a concentration in the 11,000 to 12,000 tdw range. However, ordering forecasts indicate that their size should grow, and estimates for the acquisition of units up to 25,000 tdw have been made. If we take into account the possibility of transferring part of the fleet operating in long routes to coastal service, we may assume that bulk carrier size should grow to 30,000 tdw, particularly when used for transportation of cereals.

For oil tankers, a small concentration of small units is found around the average between 10,000 and 11,000 tdw, where most of the existing tonnage is gathered. Future order estimates also indicate the outfitters' preference for units of this size. One must, however, recognize that some of the ships currently operating both in long routes and in coastal service (for cargo distribution) may be used for the latter only. It is thus reasonable to assume an upper limit of 55,000 tdw for tankers.

1.10

1.0 ROLL-ON/ROLL-OFF SYSTEM

There are several methods to move and transport non-bulk cargo, each with its advantages and disadvantages. What must be taken into account when analyzing these systems is that each specific traffic has its own characteristics and requires a different operational solution. The apparent advantage provided by a given technique on a given route may be a disadvantage on another. In addition, the transportation purpose, whether commercial or military, gives rise to a concept of not necessarily equal ships and auxiliary equipment.

For the determination of the most suitable and best type of operation for a given traffic, it is necessary to have a factual evaluation of several aspects, such as volume and frequency of movement, type of on-shore transportation available at each port, distances between ports, port characteristics, size, type and speed required for each ship and the cost of acquiring such ships, the terminal facilities and the equipment necessary for their operation.

The advantage of the roll-on/roll-off system is the fast movement of railroad cars and trailers using their own means to approach and leave the ship. This is particularly true of small railroad trains, where several cars are moved at the same time. In the case of trails, it isn't necessary to remove the tractor-truck before loading nor to attach it after unloading. The net result of this operation is the minimum effort required for loading and unloading ships, the shorter stay at the port and, consequently, a larger number of round trips per year. In addition, and unlike the container system, the roll-on/roll-of system avoids costly investments in port facilities (cranes, lift carrier, stockyards, etc.)

The misconception that the roll-on/roll-off system would be economical only for short-run trips came to an end as early as 1970. At this time, companies such as ACL -- operating from Europe to the U.S. East Coast -- and the PAD line -- from Australia to the West Coast of the United States -- started using this system.

The increased number of these ships side by side with the increase of container carriers indicate their capacity to compete with the latter in certain circumstances. On the other hand, orders continue to be placed for them at a steady rate, and a larger demand may be expected for port facilities that can handle them more adequately. In order to minimize these expenditures, new types of access ramps have been developed, which rendered the system still more independent from on-shore installations. It is interesting to note that, though there is a growth as regards ships specially designed for the transportation of automobiles and trucks, those exclusively for trains have been reduced lately. This may be due to the on-shore facilities that the latter require.

The lift-on/lift-off system for railroad cars does not show any advantage in comparison with the roll-on/roll-off system. Cars must be loaded and unloaded one at a time, which is a relatively slow process. The operation is less efficient, both for the ship and for the port. The alternative of equipping ships with deck cranes meets with technical difficulties and high costs. In addition, though such on-board equipment would make the ship more flexible from an operational viewpoint, increasing the number of ports that they could service, their conventional facilities would bring total yield below the point of economical operation. Such ships are certainly more suitable for military than commercial purposes, in view of their motional flexibility and a considerably faster operation than that of conventional systems.

The roll-on/roll-off system is particularly recommended for maritime transport services integrated with an on-shore system, minimizing the total door-to-door run.

In view of the above, it is important to define and determine routes and flow characteristics, so that the ship most suitable for a given traffic may be specified. Studies carried out in the United States (*), for instance, showed it was not advisable to adapt existing ships, because the loading, stability, speed and economic factors were inconsistent with the traffic requirements. The convenience of using lift-on/lift-off type ships was also investigated at the time, but the option was finally made to buildroll-on/roll-off ships.

1.10.1 AUTOMOBILE TRANSPORTATION

In the last decade there has been a considerable growth in the world fleet of boats specialized in transporting automobiles and commercial vehicles. This was partly due to an increase in demand, though this international trade grew faster than the production in many countries, with the exception of the U.S. and Canada, a fact which can somehow be attributed to the greater efficiency of the transportation. Transportation costs are so low on these ships that today vehicles imported by the U.S. are almost exclusively transported in this way.

Mass transportation of vehicles by boat first started during the 50's, when they were packed in boxes. But only during the 60's, when the technique of lift deck for vehicles was intro-

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(*) See "Roll-on/Roll-off Sea Transportation," Proceedings of a Symposium, 19th November 1956, National Academy of Sciences/National Research Council.

duced in naval construction, did this type of transportation increase considerably.

The German Volkswagem created the Wolfsburger Transport Gesellschaft.w.b.h. (Wobtrans) in order to rationalize the distribution of their production. This company is now one of the main charterers for this type of ship in the international market, and one of the decisive factors for the increased use of this process.

Mention should also be made of the shipping installations at Enden, which replaced those used initially by Wobtrans at the port of Bremen. Wallenius, a specialized Swedish company, has also held an extremely important position in the automobile trade during the last 15 years. With specialized terminals near Gothenburg Harwich, this company also dominates maritime transportation along the European coast; their large terminal for overseas export is located in Antwerp.

Brazilian coditions for distribution of the automotive production are similar to those in Europe, and we thus believe that benefits resulting from this system can be meaningful to us.

It seemes out of doubt that the automotive industry creates exceptional conditions for scale and conglomerate economies, which accentuate commercialization in certain production centers and emphasize the importance of economic problems at the distribution end. In the domestic market, this will make it difficult to decentralize production, now concentrated in São Paulo; the stability of the transportation market is thus insured, with demand tending to grow in view of the growth and distribution of income.

1.10.2 OPERATIONAL ASPECTS

The world naval construction industry can supply, at present, a variety of ships specifically built for the long distance transportation of automobiles and freight vehicles. Naval engineering has attached great importance not only to adapting and perfecting ships for this purpose, but also to a large variety of equipment designed and developed both for new constructions and for converting carrier ships of the RO-RO type.

Various equipment types, such as elevators, ramps, mobile convertibles for cars, doors and gates, have been specially built in order to solve the peculiar problems of shipping, storing and unloading vehicles. Maneuvering a large number of vehicles with gas in their tanks requires specific solutions as regards ventilation, fire protection and sub-division of the ships.

The advantages of the RO-RO type ship, which can be used for the transportation of either automobiles or trucks or a mixture of both, are its high speed and time saving, both at sea and at loading and unloading, which permits a considerable reduction of total round trip time. In addition, its short draft doubtless affords a great possibility of servicing a larger number of Brazilian ports.

A typical ship of this nature, in spite of its reduced size, can carry approximately 1,400 automobiles. It is equipped with eight decks for vehicles, an aft ramp and a side ramp on each broadside, which makes for great flexibility and speed in the car loading and unloading operations.

We give below the characteristics of the RO-RO type ship:

Length between perpendiculars	126m
Beam (molded)	20m
Depth of hold (to shelter deck)	13.5m
Depth of hold (to main deck)	7.3m
Draft	7.0m
Tonnage	5,400 tdw
Cruising speed	18.5 knots
Capacity for cars	1,400
Driving engine	diesel motor
BHP	10,000
Classification	ABS or LRS

This ship has three main cargo areas: a lower hold to the fore of the engine room, the area corresponding to the main deck, and the garage on top of the upper shelter deck, containing two lighter gage decks that are approached by means of fixed ramps from the shelter deck.

The main hold, located between the shelter deck and the main deck, is equipped with rising platforms divided into seven sections, which are driven by means of a lifting hoist and are hydraulically locked into a storage position. Two of the sections on each of these decks work as a mobile ramp, driven by a separate hoist. The lower hold is also equipped with similar mobile decks.

When the loading operation is performed through the ship's side ramps, the vehicles reach the main deck by means of the mobile ramp, coming from the garage deck. Internal transfer between decks is afforded by a fixed ramp, located by the aft door, which leads down to the lower hold, and by a ramp which connects the main deck to the shelter deck and is driven by a lifting hoist.

There are two ways in which the vehicles can approach the ship:

- through an aft door which is lowered to form a ramp, by means of which the cars can reach the main hold, where they are transferred to the lower hold and to the shelter deck, and from there to the garage decks;

- when the loading operation cannot be performed at the stern, a portable ramp of roughly 30 meters in length can be used, attached to either side of the ship and locked to a moveable lateral platform which is available at each broadside at the rear deck. The ship itself will carry this portable ramp (or two of them, one for each broadside), which allows for greater operational flexibility.

All the installation and dismantling operations required for the loading and unloading of vehicles can be entirely performed by the ship's crew and equipment, with no dependence on dock equipment or port personnel.

Using the lateral ramp, the vehicles reach the stern of the ship and move into the garage area in the shelter deck. From this level, they are sent to the upper decks or downwards, using the internal ramp. The upper deck platform, in its jutting position, permits the installation of the lateral loading ramp.

It should be noted that, if a pier is used that is adequately built to permit the simultaneous use of both ramps, it will be possible to have very fast loading and unloading.

Finally, the three rising decks allow for the transportation of larger, heavier and loaded vehicles because, when the platforms are retracted, the overhead clearance in the holds increases.

1.10.3 FINAL REMARKS

The use of the roll-on/roll-off system is thus thoroughly advantageous, particularly at a time when the sudden rise in fuel prices is leading to a revision of the transportation operational system, with a view to cutting costs.

Allowing for door-to-door transportation, practically dispensing with significant additional expenditures in port installations for handling specialized ships, and affording, by means of an effective integration of the highway system with maritime transportation, a reasonable saving in fuel which results in lower operational costs, this system will soon be implemented in Brazil, particularly as the coastal merchant fleet for general cargo is renewed.

As regards the Suape port, now being studied, the RO-RO ships, with their short draft and maneuverability, will permit greater utilization of the available resources in any of the areas under consideration.

1.11 THE LASH SYSTEM

1.11.1 GENERAL

The barge carrier (BC) system has been studied for some time by several entities all over the world, particularly in the U.S. and in Western Europe. The basic philosophy behind this system is to separate from the normal operation of the ship the handling of cargo which, in addition to being a slow process, depends on several unpredictable factors such as rain, traffic pile-up at the docks, manpower and equipment shortage, and the absence of suitable deep-water ports.

This separation is achieved by loading the cargo on barges which are stowed onto the mother-ship, thus constituting real holds that can be dettached from the rest of the ship. As a basic support component, a high capacity loading equipment must be installed on board to permit quick loading and unloading of the barges from their stowing place. Departing from this basic concept, various types of BC ships have been developed, among which the Lash, Seabee European Barge Carrier System (EBCG), Sea Barge Clipper, and the Barge on Board system (BOB). Of these systems, only two have operational ships at present: the Lash and the Seabee.

The Lash (Lighter Aboard Ship) system was developed by Friede & Goldman consultants in New Orleans. The mother-ship resembles a bulk carrier, and the barges are loaded and unloaded through a porch that travels on rails along the entire deck. The barges are stowed in several compartments called "cells," similar to those in container carriers. They may, in addition, be stowed on the deck itself. The first Lash ship, of 43,000 tdw and with a capacity for 73 barges, was built in Japan under a U.S. patent, held by Friede & Goldman, for Molash, a Norwegian shipbuilding company, and is being exploited by the Central Gulf, a U.S. company. It started operating in September, 1969, between the Gulf of Mexico and Western Europe, particularly in the London and Rotterdam (Rhine Basin) service.

The main benefits afforded by the Lash ships and other barge carriers in relation to conventional freighters are the drastic reduction of handling time at the port and the access of the ship's cargo to terminals located in inland navigable routes without the need for double cargo handling. They also permit the handling directly between the barges and the terminals at the final destination, without affecting operation of the ship proper.

The first of these advantages makes it possible for a carrier with 74 barges aboard, as is the case of those ordered by the Delta Lines, to be totally unloaded and reloaded, at both ends of the Brazil-Gulf route, in roughly 120 hours, or 5 days. If we add two more days for delays, maneuvers and visits on board by several entities, we have a maximum of 7 days at the port for handling up to 50,000 tons of cargo. For this amount, a general freighter would require a minimum of 40 days and an average of 60 to 80 days, and would still be dependent upon a number of outside factors, such as rain, traffic pile-up at port, equipment and storage area availability, etc. This is the reason why the general freighters have not kept up with the progressive growth of bulk carriers, and have stayed rather static in the 10,000 to 15,000 tdw range. The BC ship is almost totally independent from these factors, for the barges can be unloaded whether it is moored or anchored in still waters. Later, the barges permit the cargo to be handled at less deep sections of the port, which are usually less busy than the deeper sections.

The second advantage affords a reduction in the cargo handling costs in the following circumstances:

- if the cargo originates from and is destined to an ocean port, the handling in barge carriers requires less manpower than is necessary for the same operation in conventional freighters;

1.11.2 OPERATIONAL ASPECTS

We give below the operational features of the Lash ships, as apply to those ordered by the Delta Lines for the Gulf of Mexico-South America route.

CHARACTERISTICS OF SHIPS:

Total length (m)	272.29
Length between perpendiculars (m)	243.03
Molded beam (m)	30.48
Molded hold depth (m)	18.29
Maximum draft (m)	11.53
Minimum draft (m)	4.34
Maximum displacement (E)	57,100
Tons deadweight (t)	41,180
Capacity for baled cargo (m3)	49,830
Capacity of special cereal tanks (m3)	10,953
Capacity of diesel oil tanks (t)	112.72
Capacity of fuel tanks (t)	5,853.53
Capacity of potable water tanks (t)	776.74
Motor rating (HP)	32,000
Cruising speed (knots)	22
Number of crew members	32
Construction year	1973
Builders	Avondale, U.S.
Number of barges	(74)(89)
Number of 20-ft containers	288 (1,740)
Porch capacity (t)	454
Container crane capacity (t)	30

CHARACTERISTICS OF BARGES:

Total length (m)	18.74
Beam (m)	9.50
Depth of hold (m)	3.96
Maximum draft (m)	2.64/2.73 (fresh water)
Minimum draft (m)	0.61/0.62 (fresh water)
Capacity for baled cargo (m3)	555
Loading capacity (t)	370
Weight of barge (t)	87.2
Measurements of hold hatch (m)	13.4 x 7.9

The following should be clarified with regard to the above:

- the ship's initial capacity is for 74 barges and 288 containers of 20 feet each (244 x 244 x 6.06 m3); later, in case of growth of the containers movement, additional ship cells can be adapted to transport them, up to a total of 1,740, if it is found convenient to convert the entire ship to this system. Is only barges were transported, the ship's total capacity would be for 89 barges;

- the ship has a total of 16 holds, of which only the first 3 from the bow will be used for storing containers; the other 13 will house barges, stored in each hold up to a height of 41, two more being stored on deck;

- the theoretical handling cycle is 15 minutes per barge, but in practice this takes some 20 or 25 minutes, i.e., 2.5 to 3 barges per hour;

- the average load per barge will vary from 200 to 300 tons, which allows for an hourly production of 500 to 900 tons;

- the average useful load of a 20-ft container is 12 tons, with a maximum of 18 tons. The tare is around a 2-ton average, depending of materials used;

- the average container handling cycle is from 2 to 3 minutes, which permits an hourly production of 20 to 30 containers;

- the useful capacity of these ships is 29,000 tons, though total deadweight is 41,000 tons; 12,000 tons are reserved for fuel, fresh water, passive stabilizer and deadweight of barges and containers;

- as a barge normally will not carry more than 300 tons, its draft will actually be less than 2.4 m, which will make them more flexible for operating in inland routes;

- the loading and unloading of barges to and from the ship will be made with the help of tugboats, which will later take the barges to the docks or terminal for the cargo handling. The ideal rating power for tugboats to be used in this service is from 400 to 600 HP;

- the normal diameter of the turning basin required for turning ships with the help of two tugboats is 400 m, with a minimum of 350m. Without tugbaots, the ship will require a turning basin diameter of 700 to 800 m, depending on wind and tidal conditions;

- barges can be unloaded either with the ship anchored in undisturbed waters or moored to the dock, pending on berth availability or the shipowner's convenience;

- since barges have a small draft, they may use the less deep sections of the port, provided there is a porch- or auto-crane at the spot with a minimum 3-ton capacity in order to lift the three sections of the hatch lid;

- as the time for handling cargo at the ports depends little on local conditions and unpredictable factors, a more regular and precise frequency can be obtained than in the case of common freighters;

- as regards maneuvering, since the Lash is a rather long ship, with piles of barges on the deck and on the fore superstructure, it seems that visibility can become critical to the aft;

- some Lash ships are equipped with lateral tanks for transportation of bulks and cereals; however, these tanks can only be unloaded by suction, which makes them suitable for cereals only.

As regards the Lash barges, what is important to remark is their performance at sea. Since these barges' gage is smaller than that normally used for river navigation, they cannot be used in the open sea. In addition, unloading these barges with a Clam-Shell is a remote possibility, which will limit their use in bulk cargo transportation. For unloading with Clam-Shell, standards associations require double roof plating 12mm thick, while the Lash barges' plates are only 6 mm thick.

1.11.3 INFRA-STRUCTURE EXISTING IN BRAZIL FOR USE OF THE LASH SYSTEM

Brazilian conditions and situations are favorable for the use of the new system, as regards port infra-structure and inland navigable accesses.

The most important features, as far as our main ports are concerned, for servicing the Lash ships are the draft (harbor, access channel, turning basin, anchoring basin and docks) and anchoring size.

The major river basins presenting a significant cargo movement or navigability conditions adequate for use by the barge-carrier system are the Amazon Basin -- comprehending Brazil, Peru, Colombia and Bolivia -- the Lagoa dos Patos, and the river systems at Rio Grande do Sul and La Plata River (Argentina, Uruguay and Paraguay). The hydrographic basins of the Tocantins, Maranhão, Parnaíba, São Francisco, Doce, Uruguai and Paraná-Paraguai rivers were not considered. The last two, though considerably used for river navigation between Brazil and Paraguay, Argentina and Uruguay, do not represent a potential for long-run cargo transportation to other countries.

In view of existing c onditions in Brazil, the Lash system ships will not be able to operate with a draft longer than 9.5 m (31 feet), otherwise they will not be able to service the ports of Belém, Mucuripe, Paranaguá, Rio Grande and Buenos Aires.

The last two would be less restrictive, since they are end-of-the-line ports and the ships would reach them with a rather reduced draft. Belém and Mucuripe, however, which would be visited in the beginning of the trip, can only be reached with a maximum draft of 9.5m. Under these conditions, ships would have to carry only about 17,000 tons of cargo, assuming an average utilization of 59%, which may be considered reasonable for the start of operations.

As a basic point, the trend is to use short-draft facilities, which at represent have a high level of idleness and which, for this same reason, would be easily utilizable. The equipment for use in the general cargo operation are the same as for the conventional ships, but porch cranes or auto-cranes with a capacity for 3 tons are necessary in order to lift the three sections of the barges hatch.

Tugboats to be utilized are those existing at the various ports, which are in general sufficient for starting up operations, since they have more power than required (required power is from 400 to 600 HP).

A the Amazon Basin, shipowners will have no problems in utilizing the main river; in the affluents, however, they will be able to operate with partially loaded barges only, due to these rivers' depth. In this case, then, barges will carry from 70 to 200 tons, depending on depth and time of the year.

As regards the Lagoa dos Patos basin, the main inland ports (Porto Alegre and Pelotas) can easily be reached without any problems, because, though the winds in the region are rather intense, they are not so intense as to prevent navigation is higher-powered tugboats are used (above 600 HP) for tugging Lash barge convoys. As for the Jacuí and Taquaí river ports, these can only be reached after all the sluices have been completed, which should occur before 1975, permitting navigation for 2.5m draft. However, general cargo is scarce in this are for long-run shipping, the larger part being destined to Porto Alegre, Pelotas and Rio Grande. Almost all products originated here are solid bulks (wheat, soya beans, bales and fertilizers) which either are not for long-run shipping or will be shipped in special bulk carriers.

In the La Plata River basin, including the Paraná and Paraguai rivers in Argentinian and Paraguayan territory, navigability is good for barges, which can reach up to Assunción at atime time of the year with a 2.00 m draft, i.e., with 250 tons of cargo. The main problem, however, is the long distance, which would cause the ships to take 18 to 20 days for a Buenos Aires-Assunción round trip; it should be pointed out that these barges' size and rectangular shape do not make them any too suitable for river navigation. When forming a convoy, they are usually placed at the middle and not at the front, otherwise they might fall out of line or reduce speed.

1.12 ECONOMIC FACTORS ASSOCIATED WITH SHIP SIZE

1.12.1 INTRODUCTION

In dealing with the trend as regards size and type of ships, it was mentioned that the main reason for the increase in their size lies with the law of increasing returns applied to maritime transportation. It was also shown that the costs of building and operating ships increase relatively less as the size grows, and that the construction costs per ton of deadweight rapidly decrease with size.

The information below constitutes an empirical verification of this fact and concerns the various levels of operational costs of ships according to size. This information was gathered from available technical publications and from interviews with shipowners and cargo brokers operating in Brazil. In this sense, the figures shown refer mostly to operational conditions prevailing in Brazil at the time this study was carried out, though certain building cost components are based on international prices.

1.12.2 OPERATIONAL COST OF SHIPS

The operational cost of ships may be defined by the expression:

$$CT = C_k + C_{ARM} + C_{sg} + D_p + C_c,$$

where

C_k = capital cost (financing)
C_{ARM} = direct cost to owner
C_{sg} = insurance cost
D_p = port expenses
C_c - fuel costs.

APITAL COST (C_K)

f the ship is bought in Brazil, according to instructions ontained in Resolution nº 4390 issued by SUNAMAN, the capital financing) cost will be:

$$C_K = P \times 0.1006$$
$$p = \text{price paid by shipowner,}$$

where:

p was established per tdw and for each type of ship according to data published by the Shipping Statistics & Economics Magazine, January and February, 1974, assuming that the following average prices are valid for our purpose:

Type	Price per tdw
Bulk carriers up to 50,000 tdw	US$290,00
Bulk carriers 50 to 150,000 tdw	US$247,00
Combination ships, 50 to 150,000 tdw	US$200,00
Combination ships above 150,000 tdw	US$180,00
Oil tankers up to 50,000 tdw	US$200,00
Oil tankers, 50 to 150,000 tdw	US$200,00
Oil tankers above 150,000 tdw	US$180,00

DIRECT COST TO OWNER (C_{ARM})

The direct cost to the shipowner can be broken down as follows:

$$C_{ARM} = C_{trip} + C_{m/r} + C_{ab} + C_{ad}$$

where:

C_{trip} = manning expenses,
$C_{m/r}$ = cost of maintenance and repairs,
C_{ab} = fueling, lubricating and spare parts cost,
C_{ad} = administrative costs.

The average values for these items, obtained from navigation companies and agents, are as follows:

Size of Ship	Expense in US$ x 10^3				
	Crew	Maint.& Repairs	Fuel, etc.	Adm.	Total
Up to 50,000 tdw	260	180	150	90	680
50 to 150,000 tdw	280	220	180	95	775
Above 150,000 tdw	320	350	230	100	1000

INSURANCE (C_{sg}) AND PORT EXPENSES (D_p)

As in the previous cases, average insurance and port expenses were determined through contact with shipowners:

Ship Size	Yearly Insurance cost (USx10^3$)	Expenses at each port (US$/tdw)
Up to 50,000 tdw	2.50	0.30
50 to 150,000 tdw	8.00	0.12
Above 150,000 tdw	20.00	0.08

In determining port expenses per annum, it was assumed that ships would make 6 round trips per year, calling at a total of 15 ports.

FUEL COSTS (C_c)

Fuel consumption and respective cost levels were arrived at on the basis of installed horsepower and on type of power drive. In order to determine the installed horsepower for each size, a list was made of orders placed with shipbuilders, according to periodical surveys carried out by the Motor Ship magazine, including size and type of ship as well as horsepower for each case. Through regressive analysis, the following ratios between power (BHP) and tonnage were arrived at:

Bulk Carriers	BHP = 5,239 + 0.1716 ton
Ore Carriers	BHP = 2,526 + 0.1829 ton
Combination Ships	BHP = 11,565 + 0.1096 ton
Oil Tankers	BHP = 9,582 + 0.1096 ton

The price of 1,500-sec. "brunker" was taken at roughly US$75.00 per ton, with a consumption of 180 grams per BHP per hour for standard motors and the following total of operational days at sea per year:

Up to 50,000 tdw	250 days per year
50 to 150,000 tdw	300 days per year
150 to 300,000 tdw	330 days per year

1.12.3 OPERATING COST/tdw

Results obtained are yearly operating cost functions per type and size of hips, as follows:

Bulk Carriers up to 50,000 tdw

$$CT = 29.1740\ t + 680 + 250 + 4.5 + 0.0135\ (5239 + 0.1716\ t) \cdot (24 \times 250)$$

$$CT = 1354359 + 47.5736\ t$$

$$CT/t = \frac{1354359}{t} + 47.57 \text{ (operating cost per tdw)}$$

Bulk Carriers from 50 to 150,000 tdw

$$CT = 24.8482t + 1575000 + 1.80t + 0.0135\ (5239 + 0.1716t) \cdot (24 \times 300)$$

$$CT = 2084230 + 43.33\ t$$

$$CT/t = \frac{2084230}{t} + 43.33 \text{ (operating cost per tdw)}$$

Combination Ships from 50 to 150,000 tdw

$$CT = 20.12t + 1575000 + 1.80t + 0.0135\ (11565 + 0.1096t) \cdot (24 \times 300)$$

CT = 2699118 + 32.57 t

$$CT/t = \frac{2699118}{t} + 32.57 \text{ (operating cost per tdw)}$$

Combined Ships larger than 150,000 tdw

CT = 18.1t + 3000000 + 1.2t +).0135 (11565 + 0.1096t)(24 x 330)

CT = 4236530 + 31.02 t

$$CT/t = \frac{4236530}{t} + 31.02 \text{ (operating cost per tdw)}$$

Oil Tankers up to 50,000 tdw

CT = 20.12t + 930000 + 4.5t + 0.0135 (9532 + 0.1096)(24 x 250)

CT = 1706142 + 33.50 t

$$CT/t = \frac{1706142}{t} + 33.50 \text{ (operating cost per tdw)}$$

Oil Tankers from 50 to 150,000 tdw

CT = 20.12t + 1575000 + 1.8t + 0.0135 (9852 + 0.1096t)(24 x 300)

CT = 2506370 + 32.57 t

$$CT/t = \frac{2506370}{t} + 33.50 \text{ (operating cost per tdw)}$$

Oil Tankers larger than 150,000 tdw

CT = 18.1t + 3000000 + 1.2t + 0.0135 (9582 + 0.1096)(24 x 330)

CT = 4024507 + 31.02 t

$$CT/t = \frac{4024507}{t} + 31.02 \text{ (operating cost per tdw)}$$

1.12.4 OPERATING COST/tdw/ROUND TRIP

To arrive at operating cost per tdw per type of ship per round trip in similar operating conditions, it suffices to divide the above results by 6 (number of round trips assumed for calculation purposes). We thus obtain the following expressions, which generate the graphs attached.

Bulk Carriers

a) Up to 50,000 tdw = 7.92 + 225726 $(\frac{1}{t})$ US$ x tdw

b) From 50 to 150,000 tdw = 7.22 + 347372 $(\frac{1}{t})$ US$ x tdw

Combination Ships

a) From 50 to 150,000 tdw = 5.42 + 449853 $(\frac{1}{t})$ US$ x tdw

b) Larger than 150,000 tdw = 5.17 + 706038 $(\frac{1}{t})$ US$ x tdw

Oil Tankers

a) Up to 50,000 tdw = 5.58 + 284357 $(\frac{1}{t})$ US$ x tdw

b) From 50 to 150,000 tdw = 5.43 + 417728 $(\frac{1}{t})$ US$ x tdw

c) Larger than 150,000 tdw = 5.17 + 670751 $(\frac{1}{t})$ US$ x tdw

1.12.5 CONCLUSIONS

Operating cost drafts, shown below per ship size, demonstrate that costs decrease as the ship size increases until they reach a steady stage, when the curve becomes assymptotic to the horizontal axis. In other words, operating costs decrease regressively as the size grows, up to a point where marginal cost variations equal zero.

The graphs enables us to establish the following steady stage points, per type of ship:

1.13 DEFINITION OF SHIPS FOR PORT DESIGN

1.13.1 INTRODUCTION

At present, specifying ships for port planning purposes is is one of the most trying and seldom objective jobs, since a large number of subjective elements come into the analysis picture, while factors that are extraneous and unpredictable in the long run exert an influence upon maritime economics. The task is even more complicated in the case of the Suape port, due to the unpredictability of the industrial response to the new port and the planned infra-structure.

The following analysis is an attempt to define certain parameters which, in conjunction with the knowledge of the area's physical characteristics, will permit to coherently and rationally forecast which types of ship may, in the future, call upon the port facilities under study.

The available data for equating the problem, besides those concerning the physical nature of the region, are:

- knowledge of type and size trend of ships;
- knowledge of economic factors associated with ship size;
- knowledge of operational features of the fleet and its suitability as far as quality is concerned;
- knowledge of the current port construction technology and its economical and financial problems;
- knowledge of operating conditions (allowed draft, port facilities, etc.) in other Brazilian and world ports.

These items were separately studied, and an analysis of them enabled us to infer the following conclusions.

1.13.2 FREIGHTERS

In the first place, as regards conventional freighters, the trend is for their size to stabilize in the 15/22,000 tdw range, a trend which seems very reliable for designing purposes.

As for non-conventional cargo ships, particularly the container carriers, their size should not go beyond the 45,000 tdw mark, though, for the case in question, reaching a cargo volume compatible with this system does not seem feasible in the medium run. As regards special ships of the Lash type, since they can operate in the open sea, they dispense with further preocupation with on-shore facilities. The roll-on/roll-off ships, in spite of the fact that they operate internally, have a high cubic volume and, consequently, a relatively short draft, which permits handling at any area of the port being studied at a reduced cost.

1.13.3 BULK CARRIERS AND COMBINATION SHIPS

Where bulk carriers and combination ships are concerned, in the transportation of solid bulks, it is estimated that their size may reach up to 400,000 tdw. In this case, some consideration would have to be given in the project to the possibility of handling these ships. For internal access to the port, ships in the 125,000 tdw size range, considered as an average, are more suitable for the ends in view, while economic factors associated with the ship size should also be taken into account.

1.13.4 OIL TANKERS

Finally, as regards oil tankers and other ships for transportation of derivates, there is the following option, in the context of the flexible methodology of the project: assume the possibility of handling 450,000 tdw oil tankers, a size which is indicated by the economic factors associated with it, and consider that they would be at least as large as 135,000 tdw, in view of the Brazilian Merchant Marine characteristics. Where transportation of derivates is concerned, assume a size of 60,000 tdw.

1.13.5 SPECIAL FEATURES OF INTERNAL BASINS

It must, however, be admitted that an industrial complex with the Suape characteristics tends to be called on by bulk carriers, that is, receive a large amount of dry cargo, and a port with such features requires the provision for an area for a naval repair shipyard, whose activities take on a double sense -- an industrial activity proper, and a navigational support activity.

The frequency of dry cargo carriers and the availability of naval repair facilities will justify the possibility of using combination ships, which either call by in ballast or require mooring for unloading cargo for Suape.

In this case, the geometric dimensions to be considered for the turning basin and for the channels must provide for the handling of combination ships of 260,000 tdw, even if they are not fully loaded, or rather, with a load equivalent to 125,000 tdw ships, which is more compatible with the industrial scale foreseeable in Suape. This is tantamount to saying that draft would be that for 125,000 tdw ships.

The 260,000 tdw size is justified in view of the steady stage points of combination ships and the forecasts for the Suez Canal.

TABLE 1/1

GROWTH OF CONVENTIONAL FREIGHTERS

Vessel	Construction Year	tdw	Length (in meters)	Beam (meters)	Draft (meters)	Volume Capacity	Speed (knots)
Iromedon	1912	6.400	140	15,0	8,20	11.341	12
Agamemnon	1929	7.629	140	18,0	8,55	12.600	14,5
Anchises	1947	7.634	149	18,4	8,54	13.445	15,5
Menelaus	1957	8.523	151	19,9	8,82	14.228	16,5
Glenlyon	1962	11.918	166	23,0	9,14	16.337	20
Tiro SD-14	1974	15.000	141	20,0	8,33		15

Source: Sir Stewart Mac Tier, quoted by James Bird in "Sea Ports and Sea Terminals."

TABLE 1/2

WORLD FLEET

EXISTING AND ON-ORDER SHIPS BY TYPE AND SIZE

(in 1.000 tdw)

Type & Size	Existing Ships as of 11/30/73		On Order	
	Ships	tdw	Ships	tdw
Tankers	3.275	303.192.6	1.148	202.337.6
10/19.999	746	12.303.0	39	509.5
20/29.999	617	14.754.5	66	1.619.2
30/49.999	711	27.312.4	145	4.925.8
50/69.999	347	19.948.9	25	1.472.1
70/124.999	424	38.031.9	203	19.822.9
125/174.999	64	9.134.9	145	20.330.2
175/224.999	161	34.363.5	15	3.059.7
225/299.999	193	48.076.0	330	84.644.0
300.000 & up	12	4.262.5	180	65.874.2
Ore/Oil	193	20.021.2	54	9.423.6
10/29.999	26	532.8	—	—
30/69.999	42	2.235.5	—	—
70/124.999	58	5.122.0	10	1.061.6
125/74.999	40	5.958.8	30	4.309.9
175.000 & up	27	6.172.1	14	4.052.1
Ore/Bulk/Oil	154	15.023.8	57	6.445.6
10/29.999	3	81.8	—	—
30/69.999	30	1.731.4	5	245.0
70/174.999	81	7.330.2	39	4.167.1
125/174.999	40	5.850.4	13	2.033.5
175.000 & up	—	—	—	—

TABLE 1/2a

Type & Size	Existing Ships as of 11/30/73		On order	
	Ships	tdw	Ships	tdw
Ore Carriers	283	11.996.6	15	1.052.1
10/29.999	149	2.885.8	5	120.2
30/49.999	41	1.559.3	2	69.0
60/69.999	48	2.712.7	2	120.0
70/124.999	36	3.426.6	5	578.0
125.000 & up	9	1.412.2	1	164.9
Bulk Carriers	2.460	74.030.0	604	24.485.7
10/14.999	194	2.461.2	16	198.0
15/19.999	564	9.797.2	48	844.2
20/24.999	478	9.659.9	81	1.850.7
25/29.999	466	12.544.5	129	3.452.2
30/34.999	202	6.561.4	89	2.817.2
35/39.999	162	6.043.2	62	2.285.7
40/49.999	159	7.004.4	23	976.9
50/59.999	129	6.995.1	51	2.692.1
60/69.999	68	4.350.1	37	2.355.2
70/124.999	79	7.332.4	61	5.933.9
125.000 & up	9	1.280.6	8	1.079.6

Source: Shipping Statistics and Economics, nº 28 – December, 1973.

TABLE 1/3

BRAZILIAN COASTAL MERCHANT FLEET
EXISTING SHIPS AND ORDERING FORECAST BY
TYPE & SIZE

(in tdw)

Type & Size	Existing		Order Forecast[a]	
	nº	tdw	nº	tdw
Freighters				
0 – 1.000	82	335.327	33	240.444
1.000 – 2.000	6	5.304	–	–
2.000 – 3.000	16	21.562	–	–
3.000 – 4.000	6	14.474	–	–
4.000 – 5.000	18	58.784	7	24.500
5.000 – 6.000	13	73.130	5	31.800
6.000 – 7.000	7	43.687	–	–
7.000 – 8.000	6	44.737	1	7.400
9.000 – 10.000	2	18.996	18	168.100
10.000 – 11.000	1	10.933	–	–
16.000 – 17.000	1	16.300	–	–
Bulk Carriers	10	65.975	6	121.200
1.000 – 2.000	1	1.970	–	–
2.000 – 3.000	2	2.420	–	–
4.000 – 5.000	1	4.623	–	–
6.000 – 7.000	2	6.841	–	–
7.000 – 8.000	1	7.895	–	–
9.000 – 10.000	1	9.465	–	–
11.000 – 12.000	2	11.748	–	–
18.000 – 19.000	–	–	4	72.400
24.000 – 25.000	–	–	2	48.800
Oil & Chem.Tankers	18	185.429	6	27.803
0 – 1.000	–	–	1	850
1.000 – 2.000	2	3.410	–	–
2.000 – 3.000	1	2.000	3	6.600
9.000 – 11.000	7	73.604	2	20.353
12.000 – 13.000	5	62.000	–	–
14.000 – 15.000	3	44.415	–	–

SOURCE: MT, SUNAMAM – Study for Dimensioning Coastal Navigation Fleet, 1973.

TABLE 1/4

BULK CARRIERS

DRAFT ACCORDING TO SIZE

Construction Year	Name	tdw	Draft (ft)	Beam (ft)	Length (ft)
1959	Revere	17.693	25' 1"	60' 0"	604' 8"
1960	San Juan Exporter	18.308	31' 6"	68' 11"	532' 11"
1960	Clyde Ore	20.075	30' 10"	73' 10"	546' 0"
1960	Edward L. Ryerson	26 055	26' 6"	75' 0"	730' 0"
1962	Centauro	35.316	36' 1"	91' 10"	679' 0"
1962	Sonic	48.976	37' 11"	100' 5"	746' 1"
1963	Aristeides	50.055	38' 0"	100' 8"	735' 1"
1966	Cedros	170.418	62' 3"	142' 1"	995' 9"
1967	Alberto Lollighetti	44.477	38' 8"	93' 11"	709' 11"
1969	Agamenon	56.672	40' 2"	105' 10"	734' 9"
1968	Grischuna	60.639	42' 5"	102' 0"	742' 10"

TABLE 1/5

WORLD FLEET OF ROLL-ON/ROLL-OFF SHIPS

Year of Start of Operations		Yearly Total		Yearly Variation (%)	
		Number of Ships	NTR*	Number of Ships	NTR*
Up to	1950	–	–	–	–
From 1951 to	1955	18	34.413	–	–
From 1956 to	1960	44	64.133	–	–
	1961	17	34.468	–	–
	1962	16	22.091	– 5,8	– 33,6
	1963	11	10.544	– 31,2	– 54,0
	1964	36	47.098	+227,3	+345,7
	1965	39	65.528	+ 8,3	+ 39,5
	1966	59	129.650	+ 48,7	+ 97,6
	1967	51	120.115	– 12,1	– 7,3
	1968	49	104.076	– 3,9	– 13,3
	1969	49	111.349	0	+ 7,0
	1970	79	177.251	+ 61,2	+ 59,2
	1971	76	173.279	– 3,8	– 2,2

SOURCE: National Ports Council Bulletin – nº 2, Summer 1972.
(*) Net Registered Tonnage (NRT).

TABLE 1/6

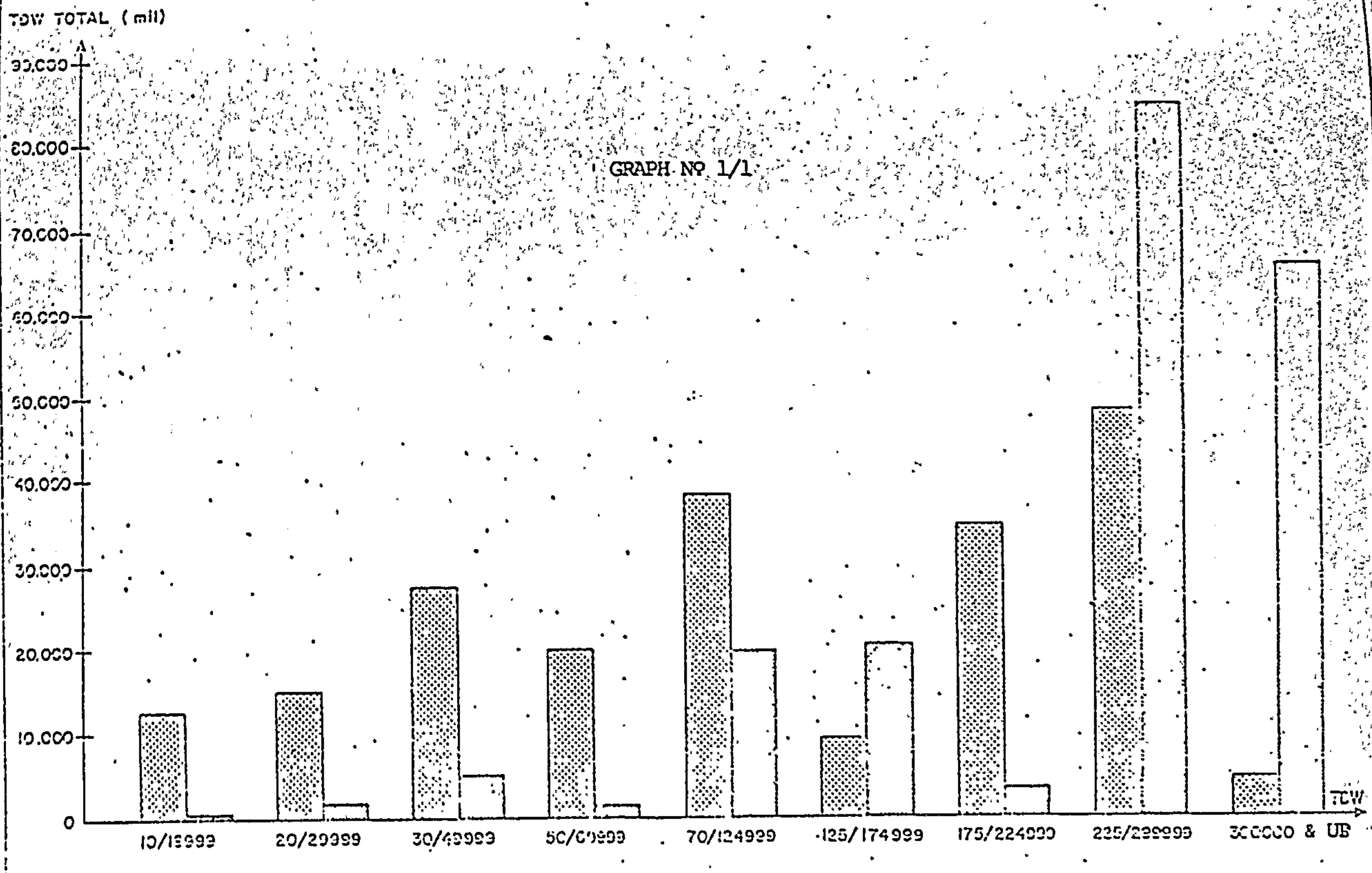
MAIN DIMENSIONS OF ROLL-ON/ROLL-OFF SHIPS

NRT(*)	Average					Variation			
	NRT	Length	Beam	Draft	Ratio Length/ Beam	NRT	Length	Beam	Draft Summer Load Line
0 to 249	185	207	40	10,2	5,18	—	—	—	—
259 to 499	351	244	43	12,1	5,67	90,0	17,9	7,5	18,6
500 to 999	730	294	51	14,2	5,76	109,0	20,5	13,6	17,4
1,000 to 1.999	1.507	368	60	16,0	6,13	106,4	25,2	17,6	12,7
2,000 to 2.999	2.521	401	62	16,8	6,47	67,3	9,0	3,3	5,0
3,000 to 3.999	3.475	418	64	17,2	6,53	37,8	4,2	3,2	2,4
4,000 to 4.999	4.405	442	66	17,8	6,70	26,8	5,7	3,1	3,5
5,000 to 5.999	5.662	477	69	20,5	6,91	28,5	7,9	4,5	15,2
6,000 to 6.999	6.567	532	78	24,9	6,82	16,0	11,5	13,0	22,0
7,000 to 7.999	9.606	663	91	20,6	7,29	40,3	24,6	16,7	14,9

Source: National Ports Council Bulletin — Nº 2, Summer 1972.

(*) Net Registered Tonnage.

GRAPH Nº 1/1



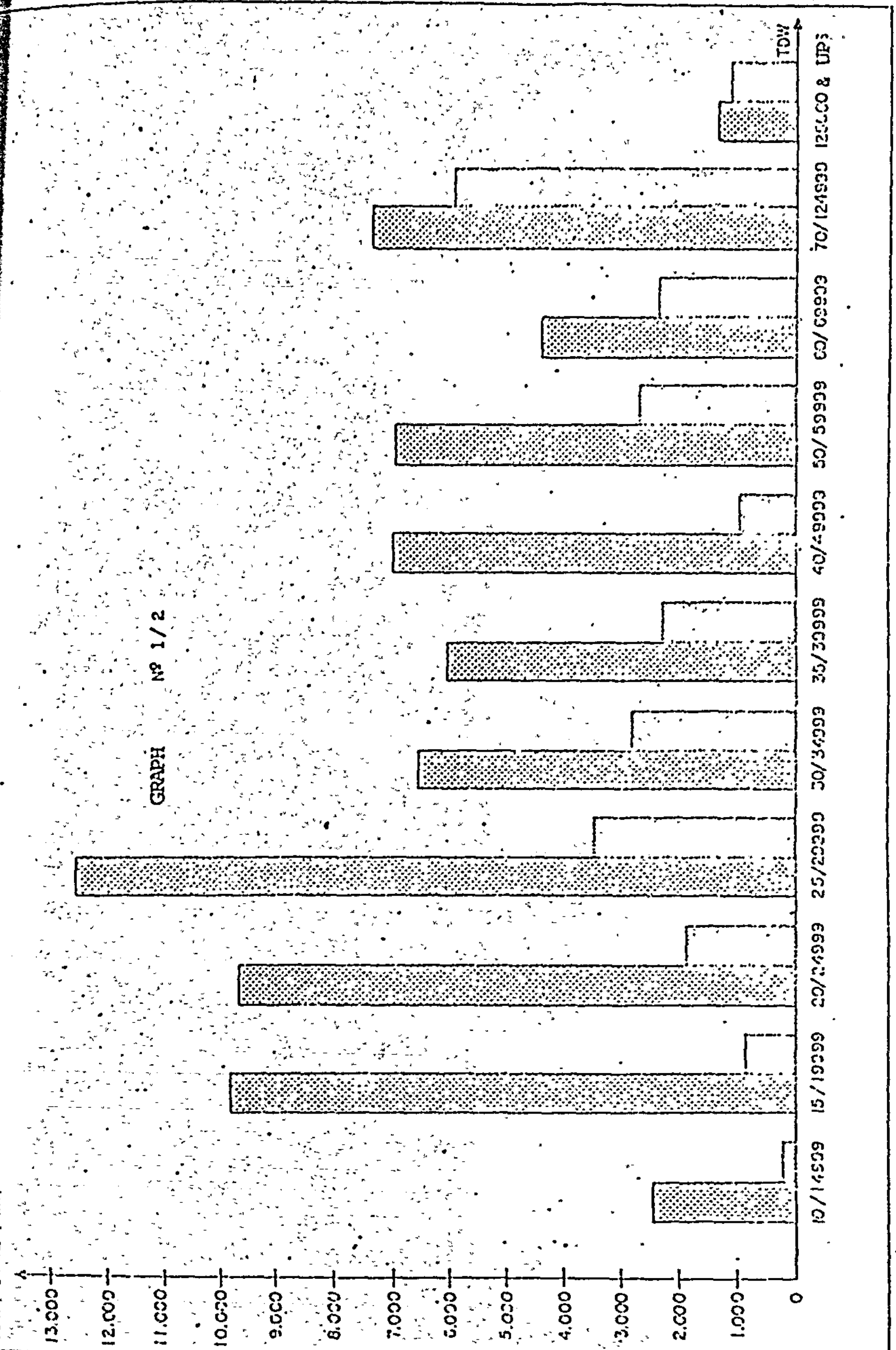
EXISTING SHIPS

ON ORDER

GOVERNO DO ESTADO DE PERNAMBUCO
COMPANHIA DE DESENVOLVIMENTO INDUSTRIAL
DE PERNAMBUCO

COMPLEXO INDUSTRIAL DE SUAPE

WORLD FLEET
DISTRIBUTION OF TANKER SIZES PER TOTAL
TDW



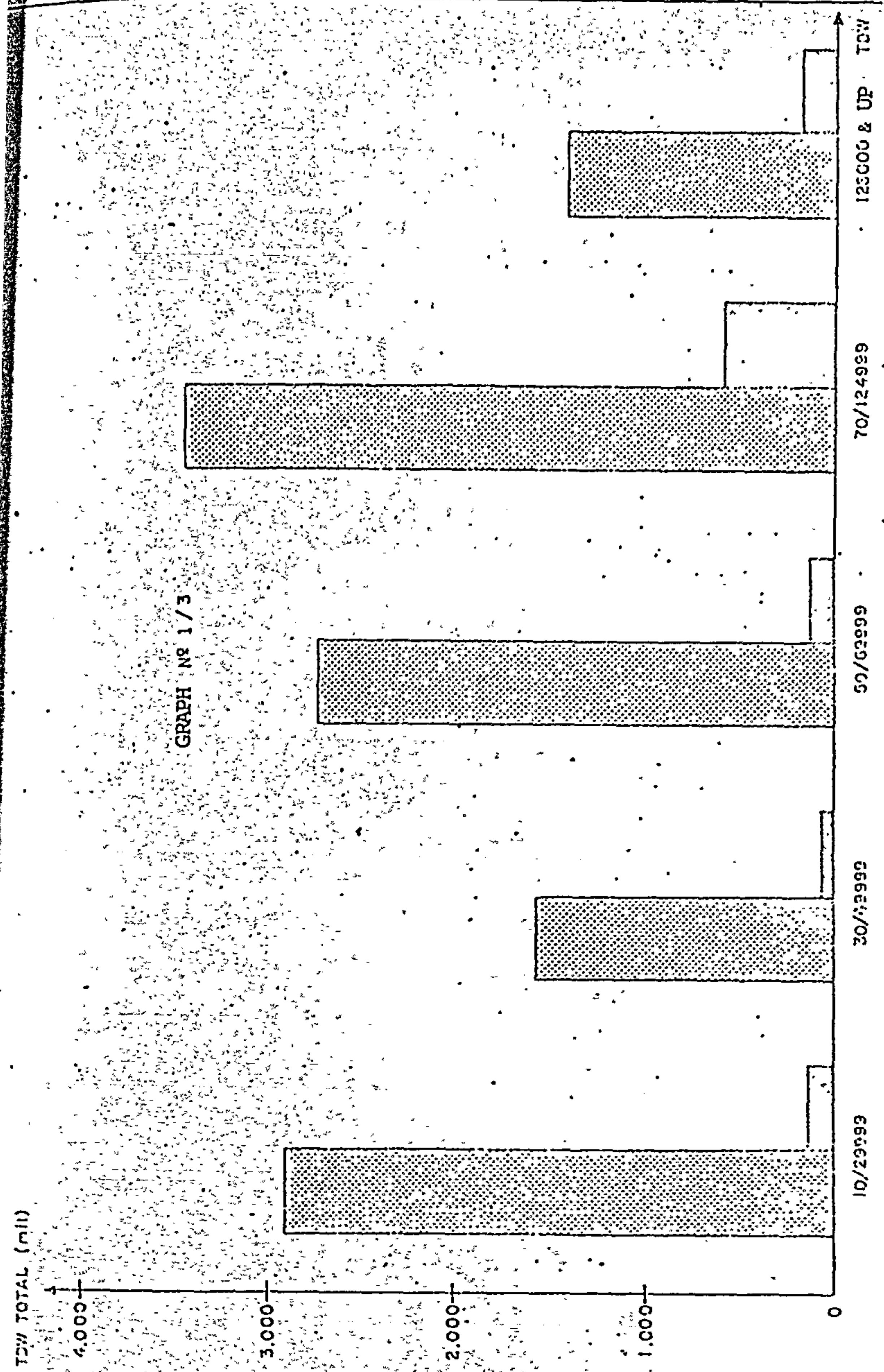
EXISTING SHIPS

ON ORDER

GOVERNO DO ESTADO DE PERNAMBUCO - [illegible]
COMPANHIA DE DESENVOLVIMENTO INDUSTRIAL
[illegible]

COMPLEXO INDUSTRIAL DE SUAPE

WORLD FLEET
DISTRIBUTION OF BULK CARRIER SIZES BY TOTAL TDW

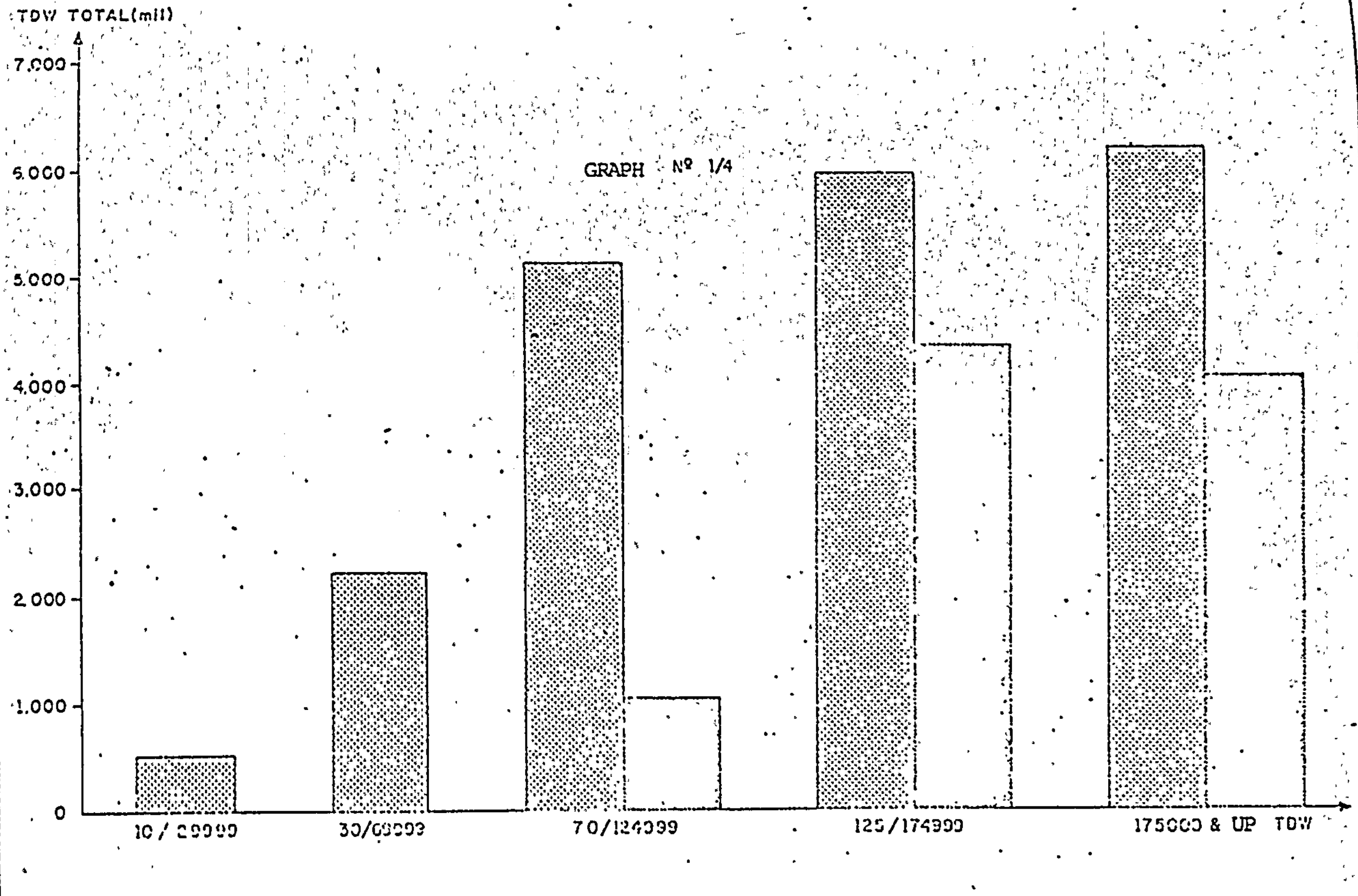


EXISTING SHIPS

ON ORDER

COMPLEXO INDUSTRIAL DE SUAPE

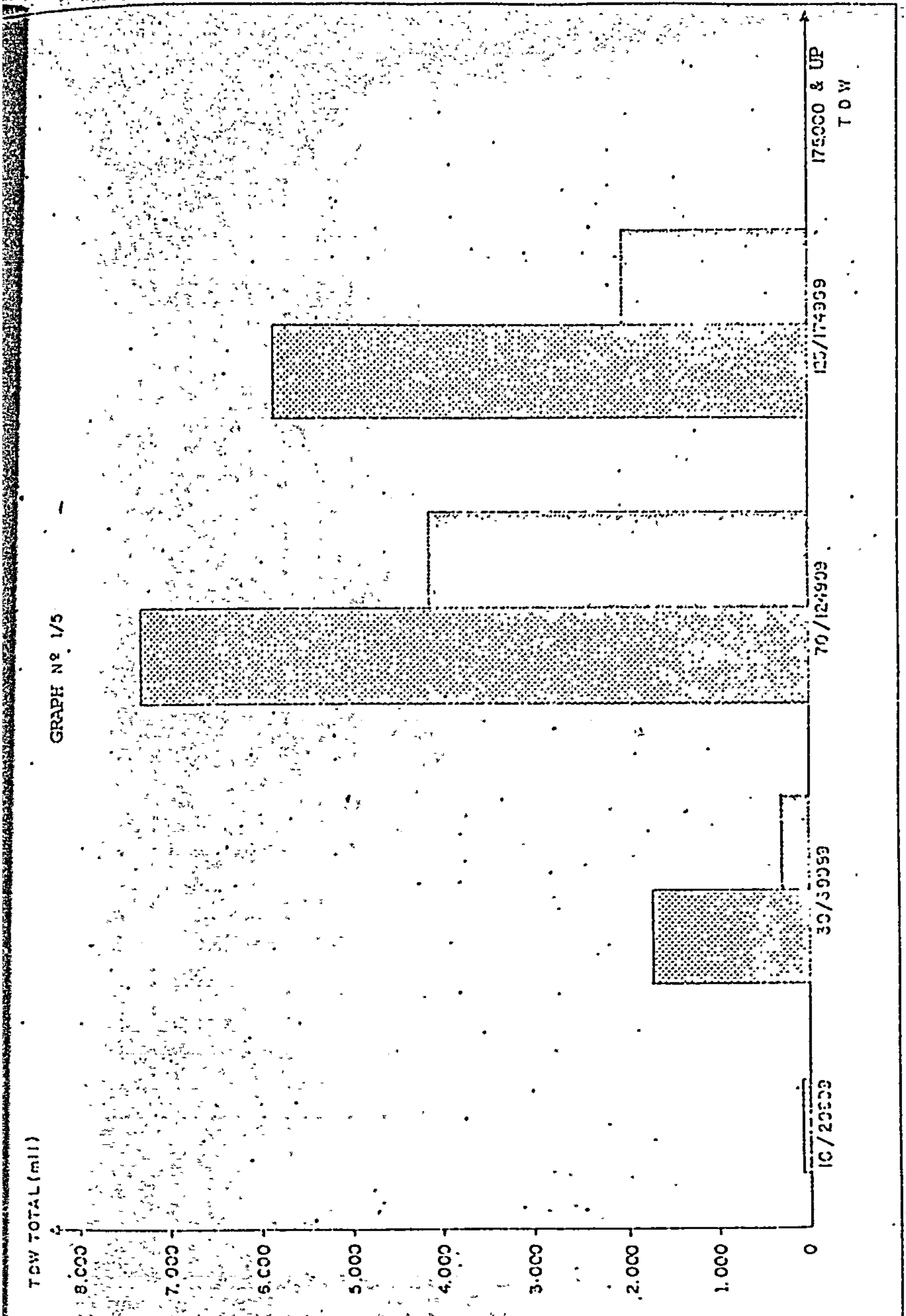
WORLD FLEET
DISTRIBUTION OF ORE CARRIER SIZES BY TOTAL TDW



EXISTING SHIPS

ON ORDER

WORLD FLEET
DISTRIBUTION OF ORE/OIL SHIP SIZES BY TOTAL TDW



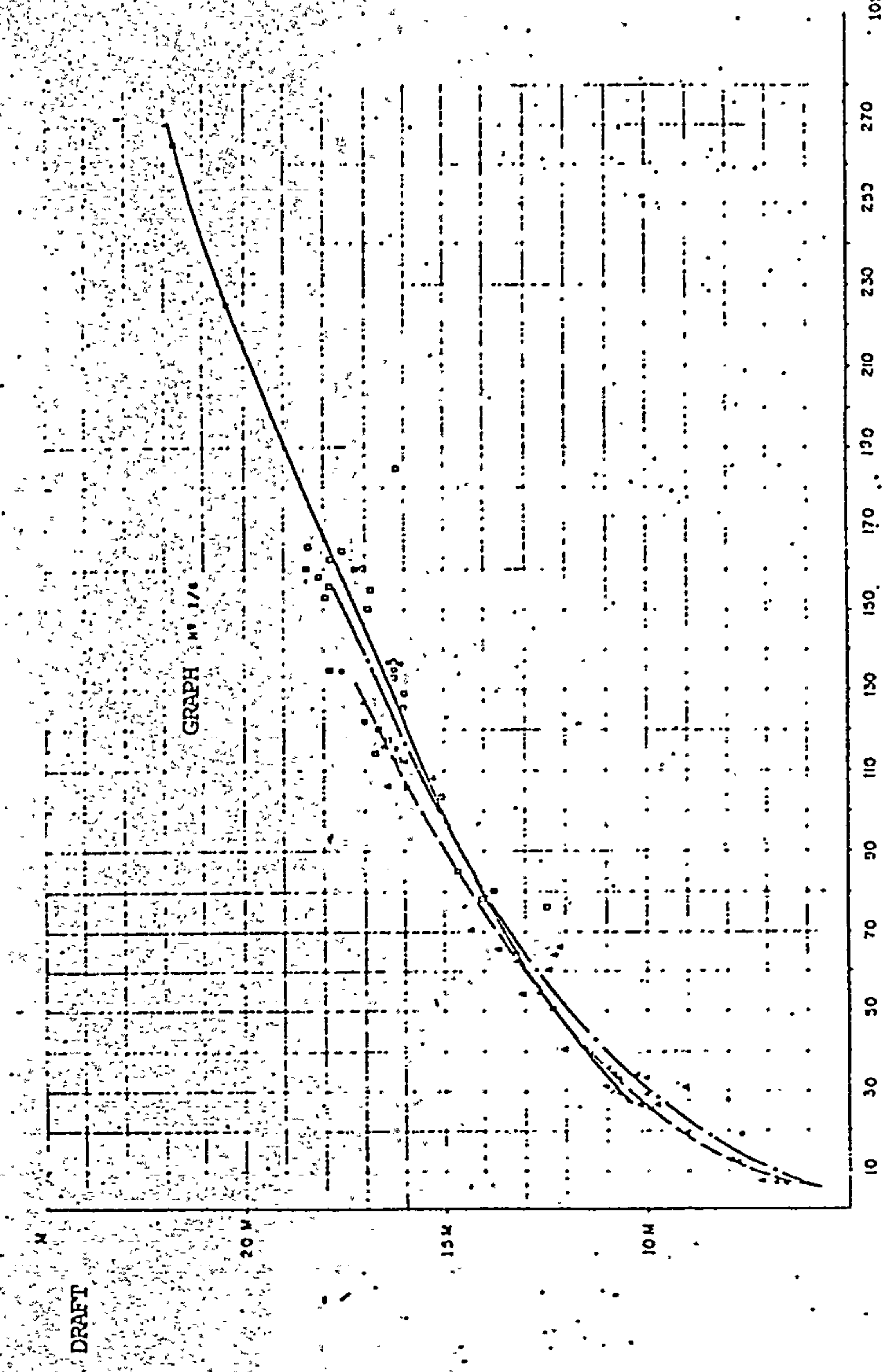
EXISTING SHIPS

ON ORDER

WORLD FLEET

DISTRIBUTION OF ORE/BULK/OIL SHIP SIZES

BY TOTAL TDW



—— COMBINATION SHIPS

-·-·- ORE CARRIERS

- - - BULK CARRIERS

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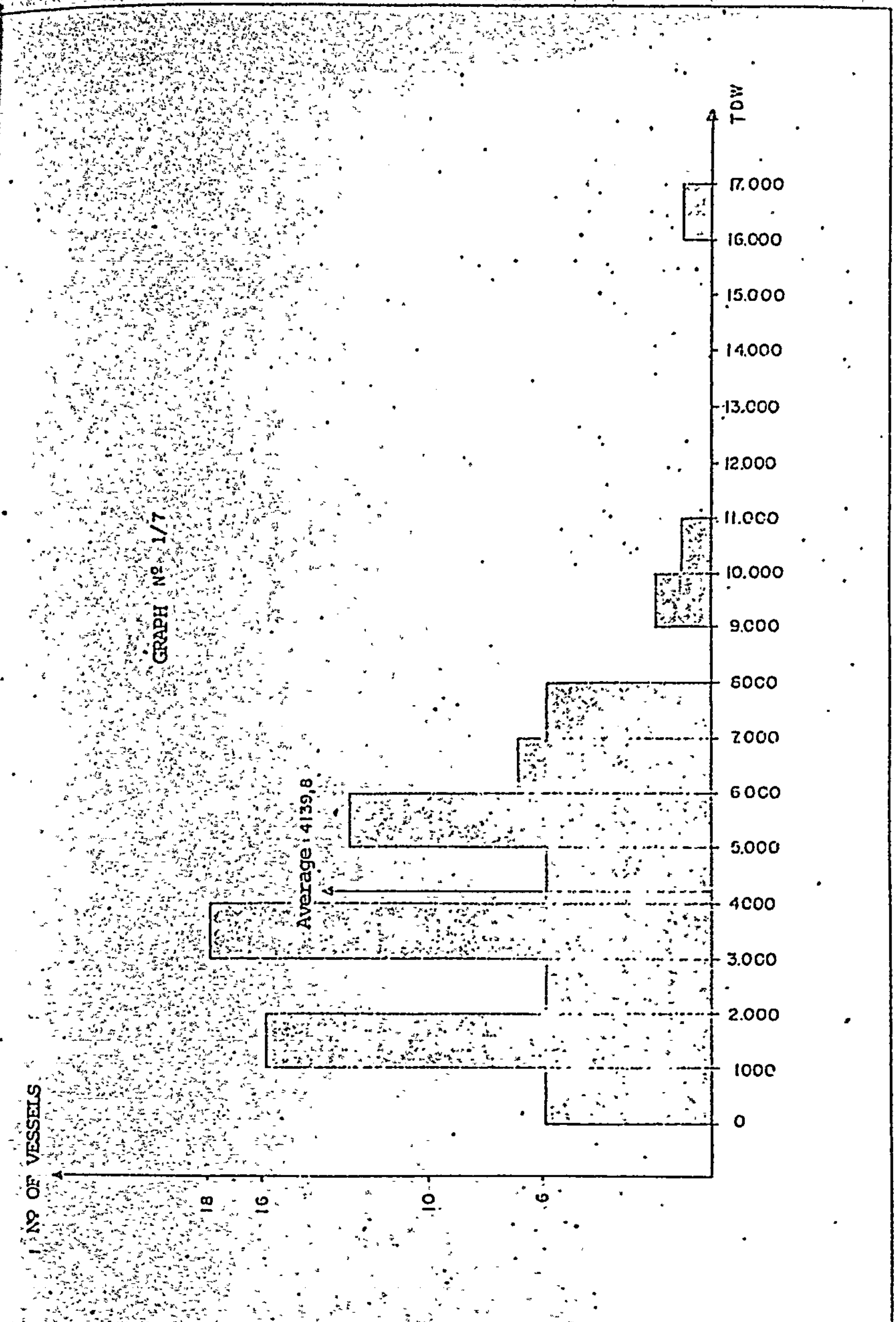
TRANSCON S.A.

GOVERNO DO ESTADO DE PERNAMBUCO

DE PERNAMBUCO

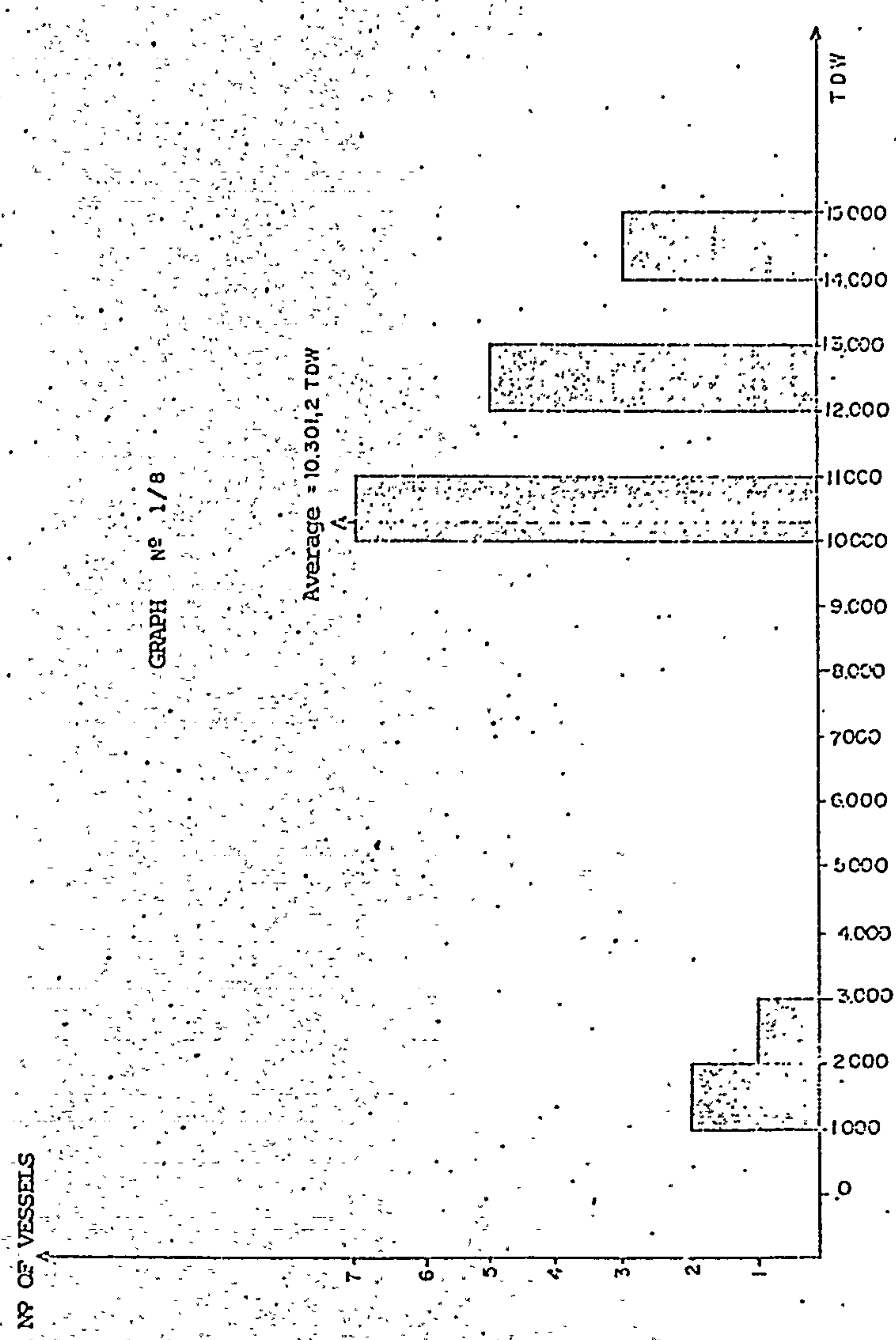
COMPLEXO INDUSTRIAL DE SUAPE

DRAFT OF BULK CARRIERS ACCORDING TO SIZE



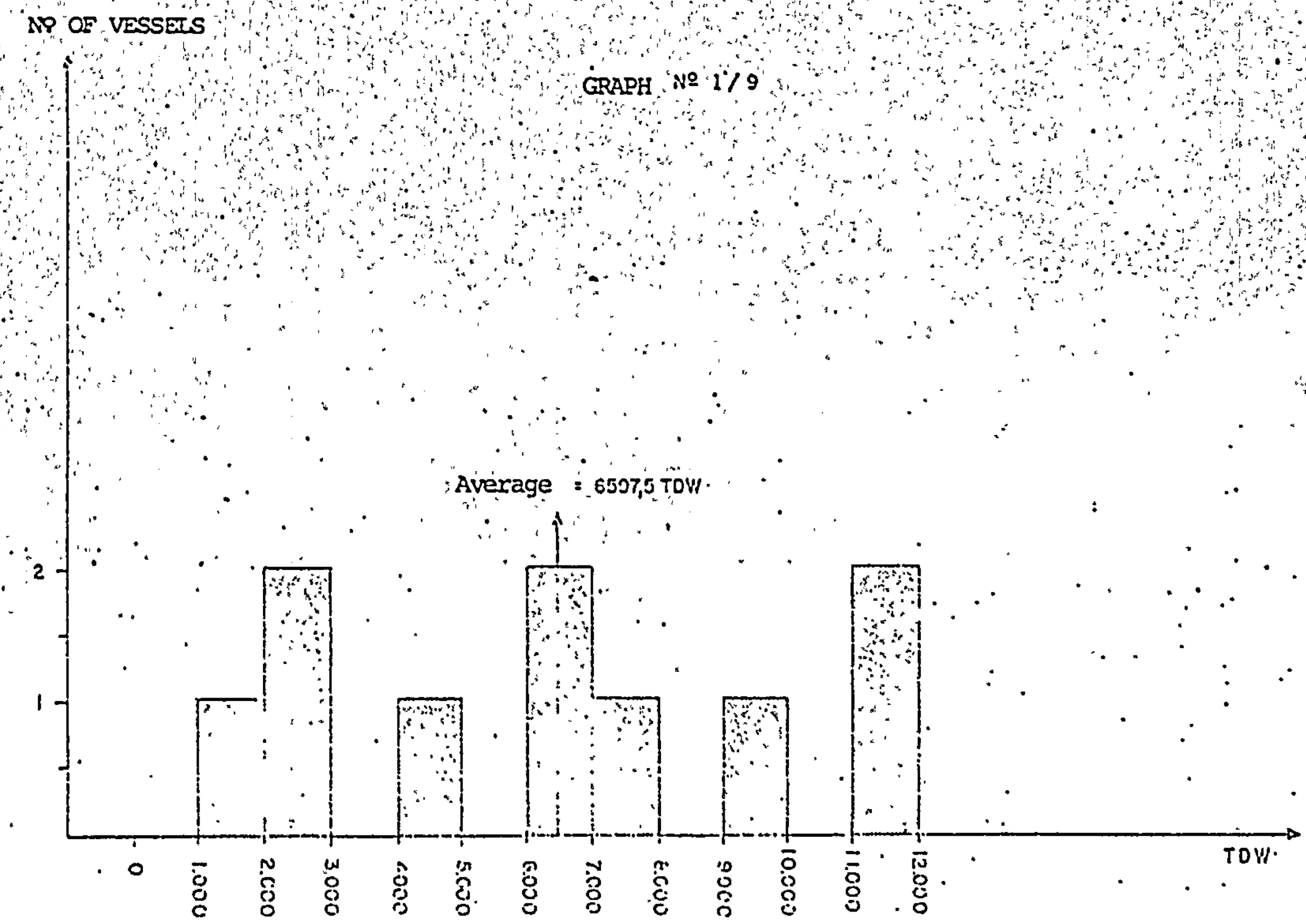
GOVERNO DO ESTADO DE PERNAMBUCO
COMPANHIA DE DESENVOLVIMENTO INDUSTRIAL DE PERNAMBUCO
COMPLEXO INDUSTRIAL DE SUAPE

BRAZILIAN COASTAL NAVIGATION FLEET
DISTRIBUTION OF GENERAL CARGO SHIP SIZES
BY NUMBER OF SHIPS

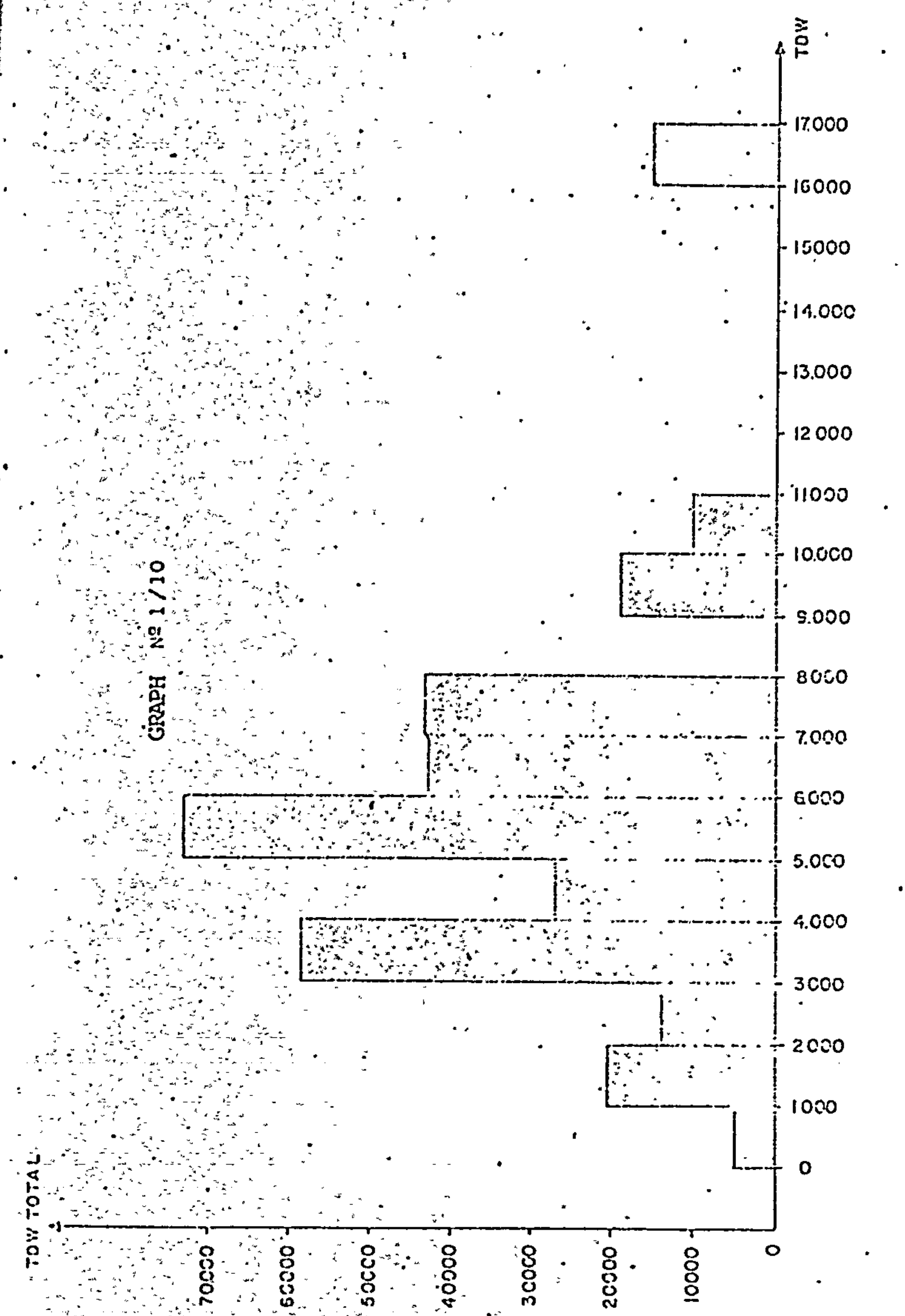


BRAZILIAN COASTAL NAVIGATION FLEET
DISTRIBUTION OF OIL TANKER SIZES BY Nº OF TANKERS

GRAPH Nº 1/9

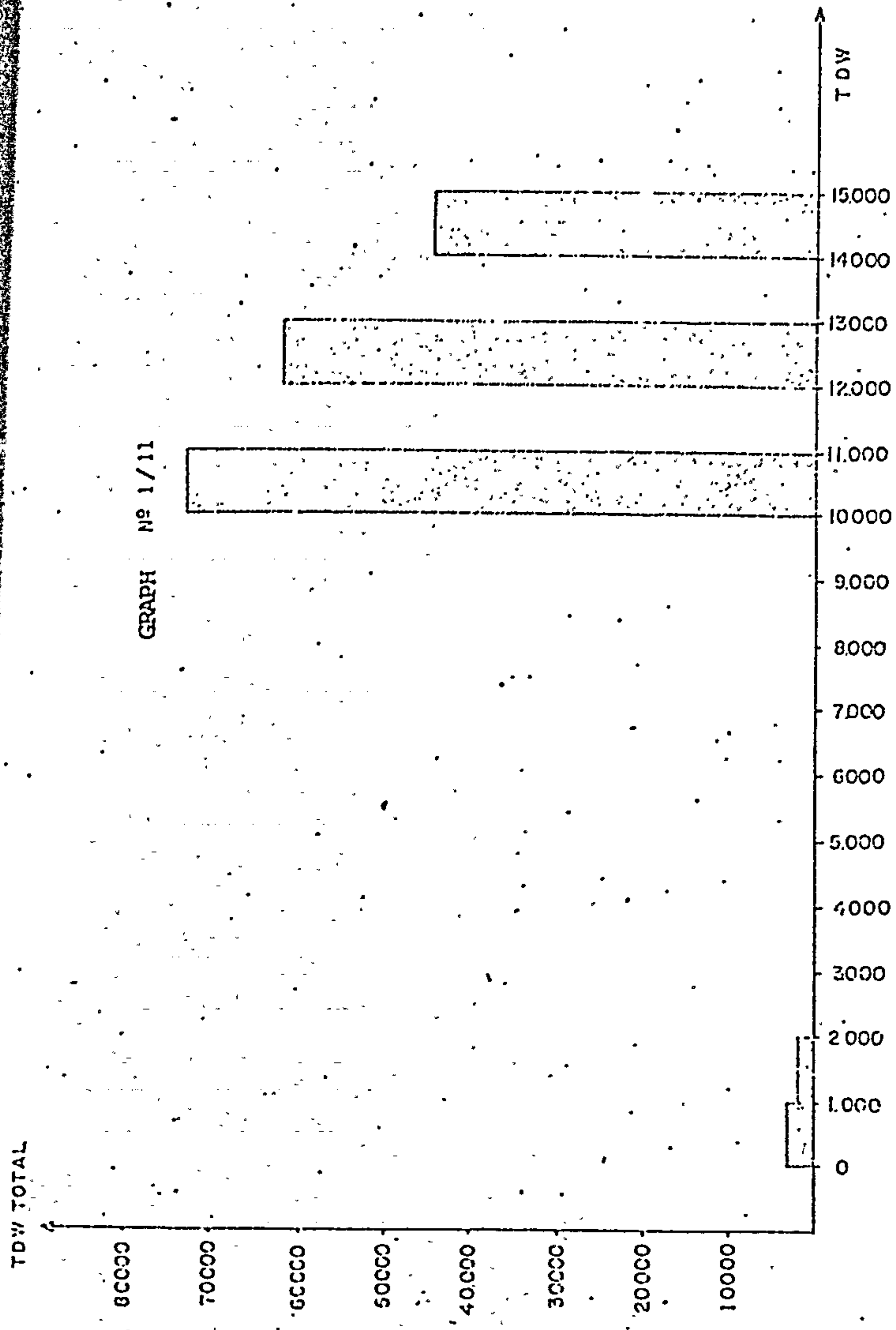


BRAZILIAN COASTAL NAVIGATION FLEET
DISTRIBUTION OF SOLID BULK SHIP SIZES
BY NUMBER OF SHIPS

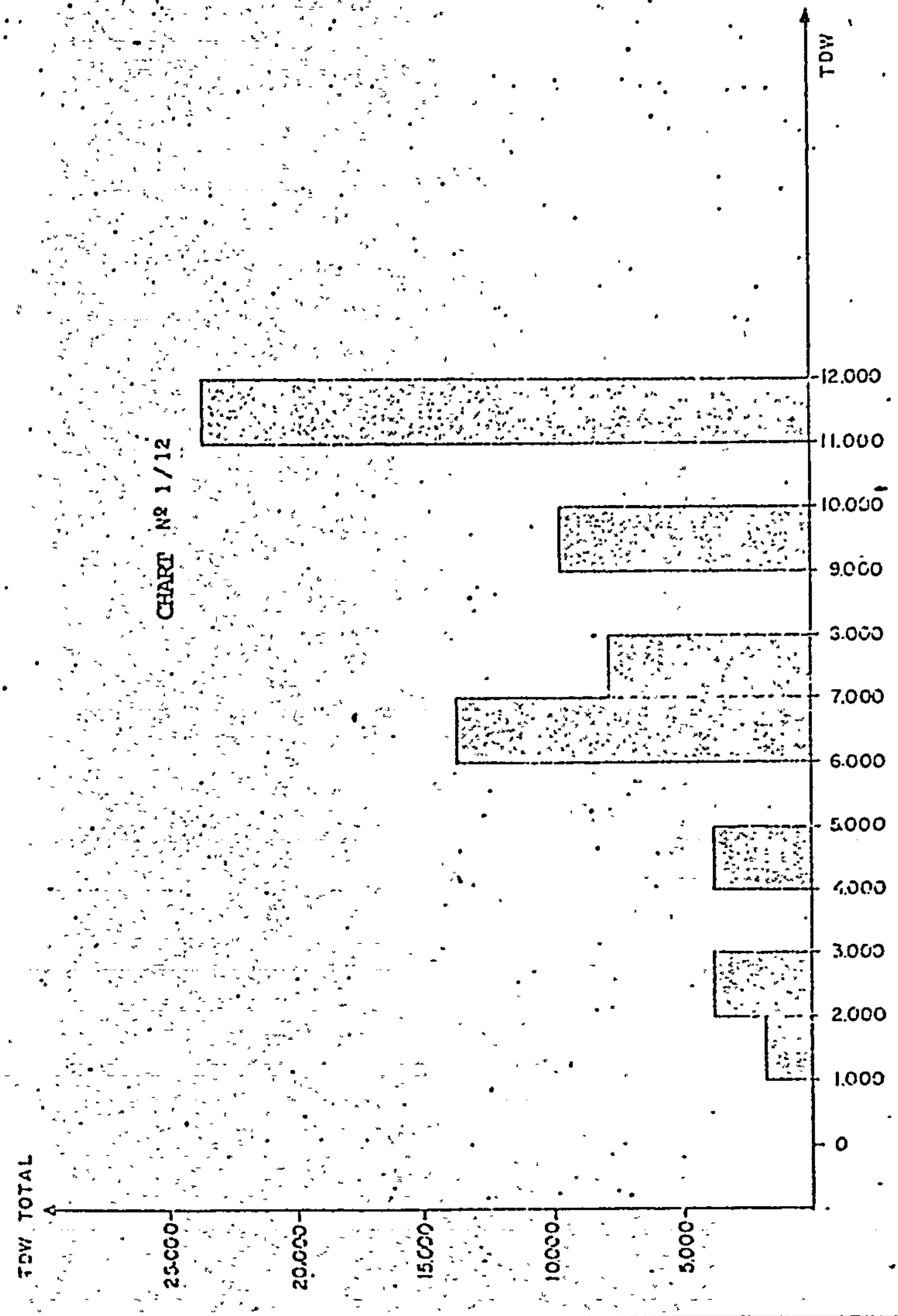


BRAZILIAN COASTAL NAVIGATION FLEET
DISTRIBUTION OF GENERAL CARGO SHIP SIZES
BY TOTAL TDW

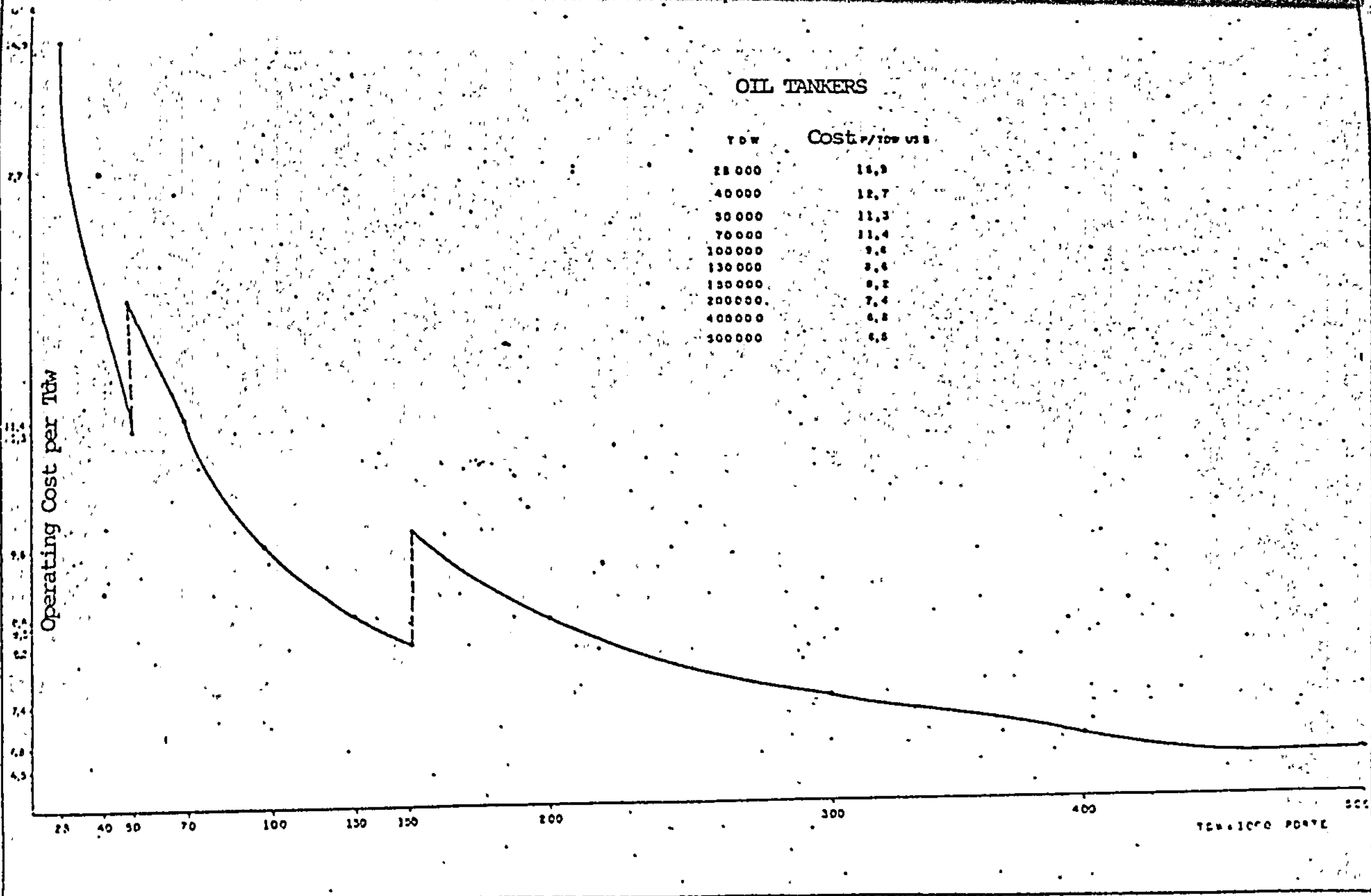
GRAPH Nº 1/11



BRAZILIAN COASTAL NAVIGATION FLEET
DISTRIBUTION OF OIL TANKER SIZES BY TO-TAL TDW



BRAZILIAN COASTAL NAVIGATION FLEET
DISTRIBUTION OG BULK CARRIER SIZES BY
TOTAL TDW



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TRANSCON S.A.

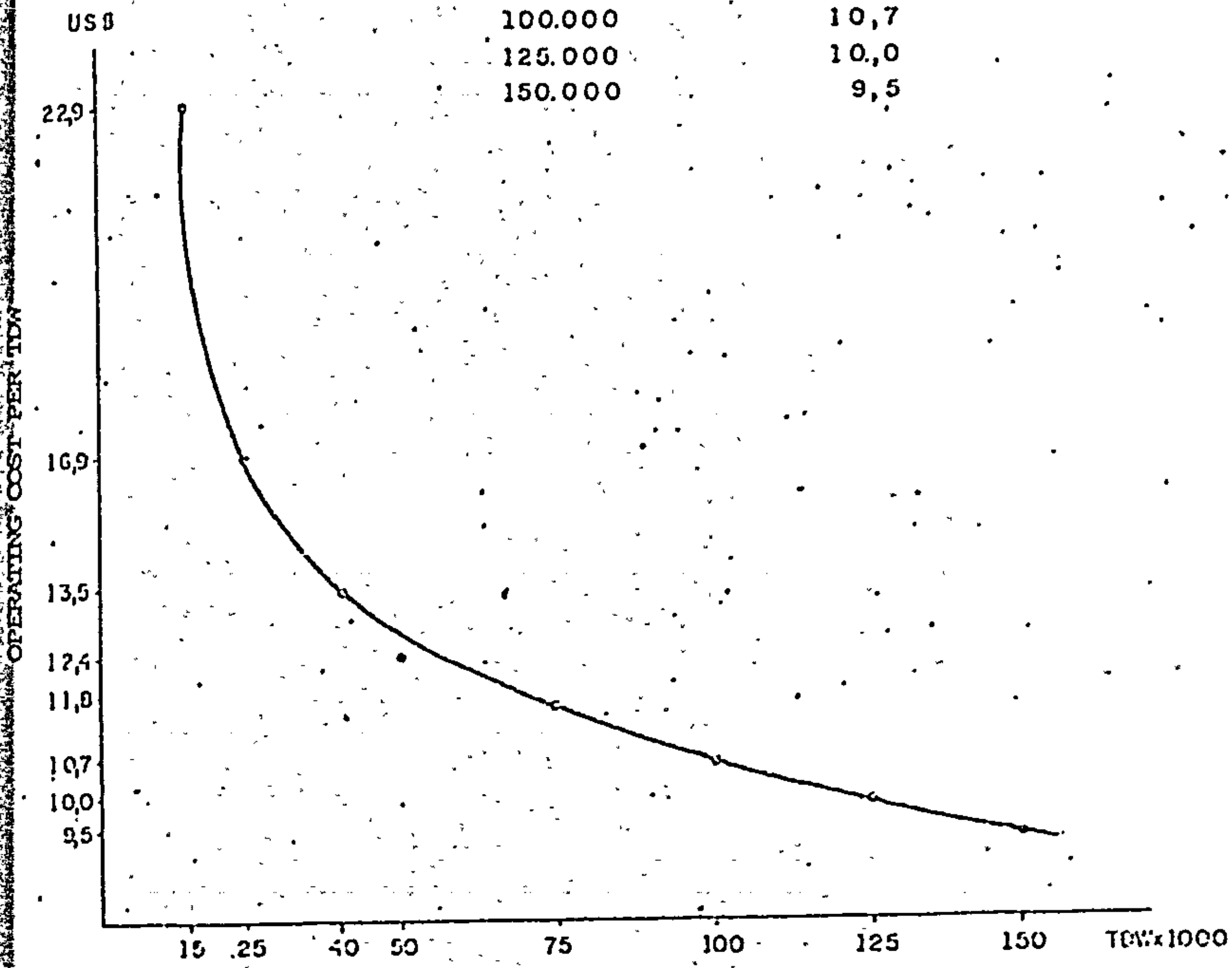
GOVERNO DO ESTADO DE PERNAMBUCO - PRAC
COORDENADORIA DE DESENVOLVIMENTO INDUSTRIAL DE PERNAMBUCO

COMPLEXO INDUSTRIAL DE SUAPE

OIL TANKERS
STEADY STAGES

BULK CARRIERS

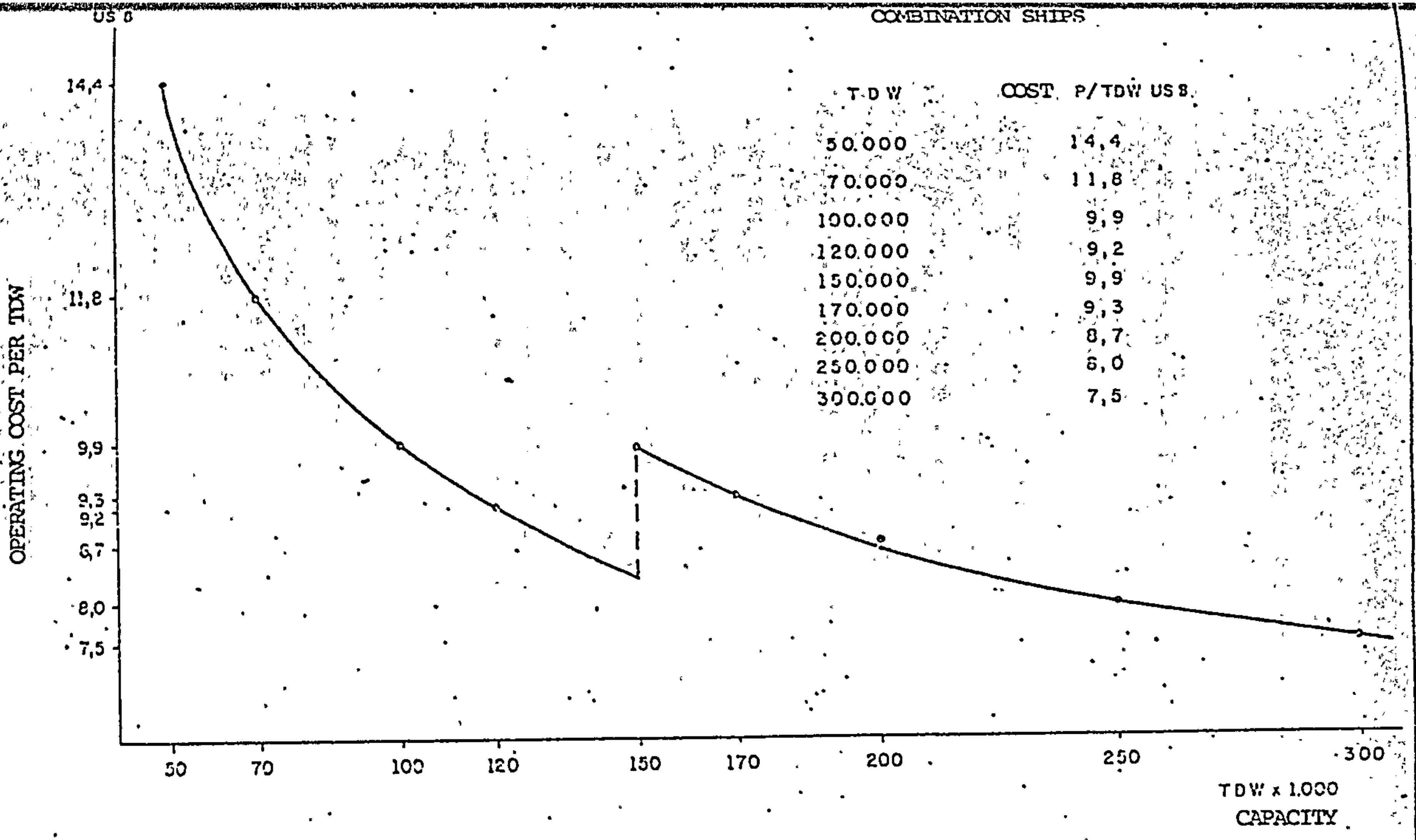
T D W	COST P/TDW US$
15.000	22,9
25.000	16,9
40.000	13,5
50.000	12,4
75.000	11,8
100.000	10,7
125.000	10,0
150.000	9,5



BULK CARRIERS
STEADY STAGES

COMBINATION SHIPS

T D W	COST P/TDW US $
50.000	14,4
70.000	11,8
100.000	9,9
120.000	9,2
150.000	9,9
170.000	9,3
200.000	8,7
250.000	8,0
300.000	7,5



COMBINATION SHIPS
STEADY STAGES

TOMO II
PARTE I
2.0

2.0 SPECIAL FACILITIES CONNECTED WITH PORT ACTIVITIES

2.1 SHIP REPAIR ACTIVITIES

2.1.1 INTRODUCTION.

A port with Suape's characteristics, made up of a group of private terminals operating with large solid and liquid bulk carriers, not only has the possibility of growing into a large port for public or collective use, capable of exerting an influence upon the region, but will also tend to register a marked frequency of ships in a non-foreseeable future.

In relation to this expected frequency of ship arrivals at Suape, one should consider its geographical situation as regards navigation routes. The coast of Pernambuco holds a strategic South Atlantic position, as the point nearest to intense traffic routes which, originating in South Africa, head for the Northern Hemisphere (the U.S. East Coast, the Gulf of Mexico and Western Europe), in addition to being the South American point closest to the Strait of Gibraltar, the access way to the Mediterranean and the Suez Canal.

These facts point to the need for providing, in the Port Master Plan, for ship repair facilities as a navigational support and, in the Industrial Center Master Plan, to supply market potential indicators for such facilities as a service rendering activity of an industrial nature.

It should be noted that, in itself, the repairing job is a burden to the shipowner since it may interfere with the ship's operation -- hence the need for having it done quickly -- and represents a disbursement equal to the direct cost of the service, which calls for an economically well performed job.

Maintenance and repair work may be classified according to the requirements of qualified manpower, equipment and other available resources, as follows:

Group 1 - Jobs to be performed by the ship's own crew using tools, on-board materials and spares, equipment from its own shop and normally available manpower resources. They consist of reviews and or inspections, excepting "live work" below the water line, and conservation -- which is a part of preventive maintenance work -- plus certain "Repair" activities.

Group 2 - Jobs generally belonging in the "Voyage Repairs" category which are regularly performed in workshops having more resources than are available on board, using better qualified manpower than is usually available. These workshops may be more or less modest in terms of manpower and equipment when compared to other facilities on land, destined for operation of land equipment.

Group 3 - Jobs requiring equipment and manpower capable of performing responsible technical work in one or several specialties. This group is characterized by the need to resort to on-land workshops having the means to rate as outstanding in their type of activity: equipment, manpower and administration.

We should thus start with an analysis of the major navigation routes in order to have an idea of how Suape stands in relation to them, and to examine the problems involved in ship repair facilities proper.

2.1.2 MAJOR NAVIGATION ROUTES THAT ARE OF IMMEDIATE INTEREST FOR SUAPE - LONG-RUN NAVIGATION SYSTEM

Long-run navigation has distant features for the general cargo and bulk services. General cargo is transported by shipping companies that follow prefixed routes, with regular frequency and relatively stable freight rates. In contrast, movement of bulk cargo is greatly varied as a result of transportation market conditions and other factors outside the realm of navigational activities. In view of this, the theme will be treated separately for general cargo and bulk cargo.

A GENERAL CARGO

Long-run transportation services are in general organized and exploited by the so-called Freight Conferences (1). These are shipping companies associations for the purpose of attending to the traffic in a certain route. Their characteristics are a fixed freight rate applicable to all member companies and a minimum frequency of departures. We attach a list of all Freight Conferences operating to and from Brazil, their areas and sectional subdivisions, and respective shipowner members. We also attach a list of Long-Run Routes, as per SUNAMAM's Codification.

(1) There are also the so-called "Outsiders," which are navigation companies not affiliated to the Freight Conferences and which compete with them.

The next Table show the minimum frequency established for each route and vy Freight Conference.

B BULK CARGO

For ocean transportation purposes, bulk cargo is broken down into:

- liquid and gas bulks,
- solid bulks.

Liquid or gas bulks are those goods which are shipped without a packing of their own, in a liquid or gaseous state, inside tanks which are a part of the ship or are incorporated to the ship, and which are handled at ports by means of gravity or through pumping.

Solid bulks are those goods in a solid state which, when shipped without a packing of their own, afford conditions resulting in a substantial reduction of transportation cost, port handling being included in this cost.

The Tables at the end of this Chapter show the main flows of bulk cargo in Brazilian trade.

Crude oil imports and oil derivate exports are usually done by PETROBRAS ships. As regards solid bulks, DOCENAVE, a subsidiary of the Vale do Rio Doce Company, is responsible for almost all of this type of transportation under Brazilian flag. The other company authorized by SUNAMAM to handle solid bulk shipping in long-run service is Frota Oceânica Brasileira, the only private company in this field.

As for freights, these vary as a function of the transportation market and are subject to the law of supply and demand. They are sensitive to market conditions and the world situation, or they are limited, in certain cases, to the areas involved. Events such as the Suez shutdown, the wheat shortage in Russia (1963), the Korean War, etc., were responsible for 200% variations in bulk cargo freights.

In addition to freight variations, a shortage of means of transportation (bulk carriers) may also occur sometimes in the bulk shipping scene, bringing serious damage to foreign trade in those nations involved.

C MAJOR LINES AND FREIGHT CONFERENCES

From the analysis of Routes and Freight Conferences, it is seen that, with the exception of Loide Brasileiro's Route LA4, which has in Recife its starting and terminal points, all pass near Recife but do not dock there, for it is normally not one of their ports of call.

This is equivalent to saying that Recife is neither a terminal nor a port of call, except in sporadic instances.

Thus, when planning for ship repair facilities, this fact must be taken into account. The demand for such facilities is to be expected solely from the frequency of ships at Suape (assumed to be bulk carriers in their majority) or from the creation of a captive market with its own peculiar characteristics, capable of attracting ships en-route in the South Atlantic Ocean.

2.1.3 BASIC ECONOMIC INDICATORS FOR IMPLANTATION OF SHIP REPAIR FACILITIES IN SUAPE

This Section condenses all data deemed useful -- even indispensable -- in any decision making process with respect to the implantation of ship repair facilities, according to their size and the nature of their activities.

In order to render ocean transportation services, the shipowner makes some compromises for operating the ship. These compromises take on different aspects in geographically distant places, and result in a series of other compromises which mutually connect a vast number of entities.

Thus it is imperative that the operation be performed as exactly as possible, according to plan, or else the shipowner will suffer serious immediate and future damage. All obstacles to the task must be removed at the proper time, and the prevention or elimination of a material failure which may hinder or prevent the operation requires special attention, as can easily be seen. The maintenance and repairs activity deals with this important part of the operation, its major purpose being to guarantee the ship's opreratiyeness and reduce devaluation caused by material deterioration to a minimum.

In essence, the many facets of this activity aim at keeping the ship in good operating conditions or restoring it to good conditions because, if this is not done, the ship will inevitably decrease in value and experience complete failure, and will consequently stop operating.

Maintenance and repairs are essential activities because, excepting natural disasters, wreck, human failures, poor administration and labor disputes, only the physical failure can cause paralysis or retard the ship operation. Thus complete prevention of physical failures would result in perfect operation, if other facts did not occur, related with the forementioned unpredictable elements.

Group 4 - Jobs requiring dry-docking the ship and which can be performed only in shipyards equipped with suitable docks and ship ways.

The first three group of maintenance and repair jobs refer to work that can be performed in "workshops," whereas the main feature of the fourth group of tasks is that they require careening resources, i.e., a "shipyard." The latter may or may not have workshops capable of performing a large number of specialized tasks, but usually has invested in such equipment as enables it to perform the majority of jobs required by the ship.

In fact, while the ship is available for docking work, the shipyard can also perform "dead work," i.e., work above the water line, since the shipowner will find it convenient to save time and be spared the need to transfer the ship elsewhere after docking. Thus an establishment equipped with careening resources also has the resources needed to carry out the first three groups of tasks mentioned in this classification.

2.1.4 SOURCES GENERATING MAINTENANCE AND REPAIR WORK

a International Conventions, Classification Societies and Government Authorities

The shipowner's need to keep his ships in good shape and in good operating conditions is the basic source of maintenance and repair work. In addition to his voluntary decisions of an internal nature, the shipowner must submit to certain requirements from private and governmental sources, including those of the International Conventions of which his country is a member. The International Conventions' member nations cannot demand of other member nations anything beyond that which has been established in the convention, though they may do so in regard to non-member nations' ships and, obviously, in regard to their own flag ships.

The requirements that are voluntarily accepted by shipowners are normally those of Classification Societies, which regulate the design and construction of ships and follow them throughout their lifetime, making inspections and recommendations. The purpose of the Classification Societies is to assure the companies insuring the ship's hull, engine and cargo that a given ship is safe and seaworthy, and that its conditions make it a good insurance risk. In practice, the requirements of the various Classification Societies are about the same; all require a rather simple yearly inspection, a more severe dry-dock inspection every two years, and another periodical inspection every four years, which is much more in-depth than the others, usually referred to as re-classification.

Classification Societies required that the ship be dry-docked every two years, but suggest that this should be done on a yearly basis. Those shipowners that are better off economically, having in mind the loss of speed due to a dirty hull, often have their ship's "live work" cleaned every year. The biennial dry-docking and the quadrennial inspection represent a considerable disbursement for the shipowner and, in those years when they occur, maintenance and repair expenditures are always accrued.

b Other Sources Generating Maintenance and Repair Work

Another activity generating source are the ship's alterations and betterments. These betterments, which are introduced after the ship has begun operating, are left to the exclusive discretion and control of the shipowner, and often relate to details of the crew's comfort.

Disasters also contribute heavily to the repair market. As per data collected in the U.S., disasters add some 50% to the value of normal repair work performed by land facilities, while betterments contribute with approximately 10%.

2.1.5 DRY-DOCKING DEMAND CHARACTERISTICS

The demand for docking services has different features in the case of moderately sized ships and in the case of large sized ships for transporting liquid and solid bulks.

In the first case, docking facilities must be located in heavy traffic ports, particularly at terminal ports where ships are completely unloaded. These are the ports having local materials and manpower resources, since they are located in industrial cities where all kinds of facilities exist for ship maintenance and repair, and are often equipped with shipyards.

For large sized ships, however, due to tank cleaning and degassing requirements for oil tankers, docking resources are preferably located along the normal refueling routes away from unloading ports, so that tank cleaning can be performed during the trip, with a minimum of time loss and route deviation.

It should also be noted that, while there are special requirements that must be complied with as regards oil tanker docking, there are no such restrictions for the pure bulk carriers. These may dock at facilities primarily intended for oil tankers or at ny other convenient point.

Following the modern tank cleaning techniques, and in view of the high fixed costs of large sized ships and the ever more severe international restrictions against ocean pollution, modern tankers have their own resources for cleaning tanks during a trip, wastes being stored in contamination tanks for decantation. Once the oil has been separated from the water, the latter is pumped into the sea, the remaining waste being collected by a land facility for processing and disposal. There is no assurance that the current system will not be changed by some technological advance, but the most recent projects are based on the methods herein described.

It should also be understood that on-board decantation presents certain problems, since crude oil has a specific weight very close so that of sea water, and it is thus quite possible that international conventions may some day prohibit discharging the supposedly clean water into the sea. One should, however, recognize that inspection of oil tankers behavior on the high seas is probably an inefficient process.

Assuming that three to four days is a suitable time for the cleaning phase at sea, an interval which corresponds to approximately 1,000 to 1,500 sailing miles, the minimum distance is thus determined for the ideal location of dry docks for large sized oil tankers in relation to unloading terminals.

Other conditions, however, must be met if such a large and complex industrial facility is to be successful: the availability of qualified manpower and local resources in general, easy access to equipment and spares supply sources, diversification of production, etc.

The location of large dry docks, based primarily on proximity of traffic flow of oil tankers and sailing time from unloading terminals, is specifically designed for these tankers; however, the availability of these docks tends also to attract other bulk carriers, in spite of the fact that these, as we know, do not normally exceed 200,000 tdw and that their docking restrictions are not the same as for oil tankers, because they can be dry-docked immediately after unloading until just before the next loading operation, without cleaning problems or danger of explosion. This makes the bulk carriers docking analysis somewhat different from that of oil tankers. It should also be remembered that iron ore supply sources, a major transportation item for large sized ships, are less concentrated than oil supply sources at present; here the Middle East looms up above all other sources, which brings about the two dominating routes: Middle East-Europe and Middle East-Japan.

The reasoning behind dry-dock location applied to the first route also applies for the second; hence a dry-dock located at Singapore with equivalent conditions to those of the Lisbon dry dock on the other route.

The unquestionable advantage of locating large sized dry docks along oil tanker routes notwithstanding, many dry docks for tonnages adove 100,000 tdw are located in tradi-rional naval repair and construction centers. The attached Tables show that there are in the world 53 dry docks more than 256 meters in length which, if they are adequately pro-portioned, can handle ships larger than 100,000 tdw.

Of these dry docks, 37 are privately owned and 16 belong to the local government. Naval construction dry docks are not included in these lists, but some of those in the lists can be preferentially used for naval construction, particularly the less deep ones, which restricts their utility as main-tenance and repair docks.

Among all listed dry docks, very few meet ideal locating conditions. These few are the four dry docks in Lisbon, the one in Ghana and the one in Capetown, in the Northern Europe-Middle East route, and the dry docks at Curaçao and Singapore, on the other routes. The others can, however, be more frquently used by bulk carriers than by oil tankers, as well as for simultaneous dry-docking of smaller ships -- which, by the way, is what is currently being done at the large LISNAVE dry dock for one-million tdw ships, since there are no ships this large yet in the world. This dry dock was designed to permit docking outside of the central line, precisely for this kind of utilization.

Taking into account the possible shortage of conveniently located dry docks, shipowners plan their trips ahead of time, so that they can make arrangements with dry docks that are satisfactorily located in relation to the ship's route; for instance, an oil tanker normally used in the Caribbean-Brazil route, will try to load up in Lybia if its next docking cannot be done in Curaçao, so that it may dock on its way to Lisbon on that trip, making a reservation in due time.

For a shipowner to simply deviate his ship from the Europe-Middle East route for routine dry-docking in Brazil, his additional costs would include the loss of time, the travelling costs, operational costs, financial commitments related to the ship's value, and loss of income.

2.1.6 MAJOR TRAFFIC FLOWS AND SHIP SIZES

a Crude Oil

Crude oil flows in well defined routes due to the concentration of both supply and consumption centers. This fact, together with conditions having to do with tank cleaning to permit dockings, has a great bearing on the location of large dry docks to handle this size of ships.

Statistics available for crude oil permit us to identify the following great flows in the world (data for 1971, in thousands of barrels per day):

Oil Traffic Flow - 1971 - Thous.bbls/day

Origin	Destination						
	Western Europe	East & Asia	Africa	Western Hemisphere	USSR & Block	Total	Variat on 197
Middle East	7709	5660	557	941	77	14944	+ 16.3
U.S.S.R	980	40	80	10	-	1110	- 3.7
North Africa	3920	65	5	160	55	4205	- 6.0
Caribbean	345	75	27	3290	5	3742	- 1.8
Canada	-	-	-	1000	-	1000	+ 29.4
Western Africa	1258	20	-	520	-	1798	+ 13.0
Total	14212	5860	669	5921	137	26799	+ 11.7

SOURCE: International Flow of Petroleum and Tanker Utilization 1970/71 - Department of the Interior, U.S.A.

The above Table shows that the Western Hemisphere imports only 22% of the total world exports, while Europe imports roughly 53% and Japan imports as much as all of the Western Hemisphere.

This flow may be quantitatively and percentually altered by the discovery of new deposits (North Sea, Alaska, Angola, etc.) or by the re-opening the Suez Canal.

The current oil supply crisis in the United States evinced the problem of the high cost of transporting the product to that country which results from the utilization of medium-sized ships (in 1971, the average size was 47,000 tdw). The main restriction to the use of larger ships is that American terminals cannot handle deep draft ships, a fact which is bringing about the construction of terminals for large sized ships.

b Iron Ore

Iron ore flows, though somewhat more diversified than those of crude oil, can be identified in terms of large buyers (U.S.A., Japan and Western Europe) and large sellers (Brazil and Australia).

The 1970 world production was 753 million tons (a growth of 24% in relation to 1965), of which 224 million tons were shipped by boat, which represented a 60% growth in relation to 1965. The forecasted ocean transportation of iron ore for 1980 is 600 million tons, approximately 25 times as much as in 1970. Here also maritime transportation must expand, but the size of ships is more restricted by terminal characteristics than in the case of oil tankers.

The inevitable conclusion is that sea transportation demand for iron ore and oil will continue to grow, and that shipowners will continue to prefer large-sized ships, within the terminals' limitations. Even though a few types of ships, such as bulk carriers, for instance, show a trend towards establishing an upper limit for size, the dimensioning problem will always be in their minds because of the economic advantages afforded by larger ships. It should, however, be noted that large sized ships will not drive the smaller ones out of activity; there will always be local conditions to justify the existence of smaller ships, and a large number of them are now under construction.

2.1.7 BUILDING, MAINTENANCE AND OPERATING COSTS OF LARGE DRY DOCKS

a Building Costs

Through comparison of foreign data and information collected in Brazil, we may assume that a dry dock capable of handling up to 300,000 tdw ships will cost about $30 million. It will also be assumed, for preliminary estimates purposes, that the cost of building dry docks with other capacities varies with the 0.6th power of the volume, by analogy to the well known industrial correlation called the "0.6th power rule."

$$\frac{P}{P1} = \frac{L\ B\ D^{0.6}}{L1\ B1\ D1},$$

where

P1 = cost of 300,000 tdw dry dock
L1 B1 D1 = dimensions o 300,000 td- dry dock
P = cost of dry dock with L B D dimensions
P/US$ 30 x 60 x 10^6 = (L B D)/(350m x 55.6 x 11.4)

The cost of building dry docks whose other two dimensions are normally proportioned to the length (B/L = 0.150, D/L = 0.0325) may thus be expressed by the formula

$$P = K (L \cdot B \cdot D)^{0.6},$$

or, if we take the data referred to and the $30 million price for the 300,000 tdw dry dock,

$$P (US\$) = 790 L^{1.5},$$

where

P = cost of building dock, with equipment, in US$
L = length of dock in meters
B = width of dock in meters
D = depth of dock in meters.

This last formula gives us the following results:

Cost of Dry Dock Construction (US$)
($P = 790 L^{1.5}$ formula)

tdw	Length L (m)	Price US$1000	Width at mouth B (m)	Depth D (m)
100,000	266	18,300	42	8.7
150,000	305	24,100	43.5	9.9
200,000	330	27,400	52.5	10.7
250,000	345	29,300	54.9	11.2
300,000	350	30,000	55.6	11.4
350,000	360	31,300	57.2	11.7
400,000	370	33,300	58.9	12.0

b Dry Dock Maintenance Cost

Dry dock maintenance costs fluctuate considerably, whether they are floating or excavated docks, costs being lower in the latter case. By comparison, we may assume that the maintenance costs for a 300,000 to 400,000 tdw dry dock will be around $75 thousand per year, which represents 0.25% of the the cost of the dock. In this case, for a dry dock of length L whose three dimensions are normally proportiondd, maintenance costs may be expressed by the formula:

Dry dock maintenance cost per year:

$$M\ (US\$) = \frac{0.25}{100} \times 790\ L^{1.8} = 2L^{1.8}$$

where

L = length in meters.

c Operating Costs

Operating costs can be estimated at $2 thousand per week, or $100 thousand per year. This corresponds to a work force of 30 men/year, whose salaries and social benefits total approximately :45 thousand, plus electric power to operate the dock, which is about $100 each time, and materials, administration, etc.

These figures are quite safe. Even if we assume draining pumps of 200,00 m^3/hour capacity of 4,000 HP (2,940 kW), the energy consumption would still be below $100 per docking. For 50 dockings per year, total power consumption would be only $5,000.

d Remarks

The above elements concern the dry dock proper only. However, we must not think of the dry dock as an isolated facility, for then its profitability would be very doubtful.

As part of the services rendered by a shipyard, we must include those repairs performed suring the ship's stay at the dock, which greatly contribute to improve the investment's economy. However, the elements presented herein constitute a preliminary survey of the investment size and of the yearly maintenance and operating costs, so as to make it profitable.

2.1.8 FINAL REMARKS

Suape's location, in view of the economic indicators mentioned herein, may be favorable for the implantation of a large dry dock for repairing oil tankers on the Middle East-East Coast and Gulf of Mexico route and bulk carriers that will be loaded at the future Itaqui terminal and at Suape's terminals.

Due to its location at the extreme East of Brazil, the future shipyard will not compete directly with a similar facility on the Center-South coast as regards routine docking. However, where repairs in the case of disasters and ship modification are concerned, it is assumed to represent an alternative for those ships whose dimensions fit the new project.

We may also conclude from these indicators that the success of the enterprise will depend essencially upon the existence and conformation of a captive repairs market, guaranteed by the investor.. The dimensions of the industry, particularly as regards the size od the dry dock, also depend upon the demand, for the size of the ships to be handled will determine the dry dock size and, consequently, the size of the initial investment. The estimated frequency of dockings will determine the ratio of dock and other repair facilities utilization and, consequently, the economic and financial feasibility of the project.

It is thus important to clarify intentions and secure effective participation of groups of shipowners, equipment manufacturers and other interested parties so that a micro-economic study can be started, at company level, with regard to this activity. In planning the port, however, space provisions must be made for dry dock facilities, for the maneuvering of calling ships, and for the adequate draft for the ship size anticipated in the project.

As a minimum navigational support, facilities for performing the first levels of maintenance repairs on floating ships are considered indispensable for Suape.

TABLE 2/1a.

COMMERCIAL DRY DOCKS CAPABLE OF HANDLING SHIPS ABOVE 100,000 tdw

Sequence Number	Port	Country	C (m)	C(ft)	B (m)	B(ft)	P(m)	P(ft)	Owner
1	Lisboa	Portugal	520,33	1706' 0"	90,00	295' 0"	12,50	41' 0"	Lisnave
2	Sakaide	Japan	450,18	1476' 0"	72,00	236' 1"	11,06	36' 3"	Kawasaki Hvy Ind.
3	Osaka	Japan	406,67	1333' 4"	56,70	185'10"	8,95	29' 4"	Hitachi S.B. Eng. Co.
4	Malmo	Sweden	405,57	1329' 9"	75,26	246' 9"	7,42	24' 4"	Kockums Mek Verksta
5	Chiba	Japan	400,24	1312' 3"	72,03	236' 2"	12,51	41' 0"	Mitsui Shipbuilding
6	Sakaide	Japan	380,13	1246' 4"	62,00	203' 3"	8,44	27' 6"	Kawasaki Hvy Ind.
7	Sasebo	Japan	370,20	1213' 9"	70,03	223' 7"	15,00	49' 2"	Sasebo Hvy Ind.
8	Baltimore	U.S.(Atl.)	366,00	1200' 0"	61,00	200' 0"	11,54	38' 0"	Bethlehem Steel Co.
9	Lisboa	Portugal	360,00	1180' 0"	54,00	177' 0"	11,00	36' 1"	Lisnave
10	Capetown	South Africa	360,21	1181' 0"	45,14	148' 0"	13,72	45' 0"	South Africa Railways & Harbours
11	Nagasaki	Japan	350,24	1148' 4"	56,04	183' 9"	11,49	37' 8"	Mitsubishi Hvy Ind.
12	Nagasaki	Japan	350,24	1148' 4"	56,04	183' 9"	11,49	37' 8"	Mitsubishi Hvy Ind.
13	Lisboa	Portugal	350,22	1143' 3"	54,04	177' 2"	11,00	36' 1"	Lisnave
14	Yokohama	Japan	350,14	1143' 0"	59,93	196' 8"	9,15	30' 0"	Mitsubishi Hvy Ind.
15	Nagasaki	Japan	347,70	1140' 0"	39,24	128' 8"	9,94	32' 7"	Kawaminami Ind. Co.
16	Aioi	Japan	340,08	1115' 0"	56,04	183' 9"	8,01	26' 3"	Ishikawajima — Harima
17	Sasebo	Japan	340,02	1114'10"	51,35	168' 3"	15,33	50' 3"	Sasebo Hvy Ind. Co.
18	Belfast	Ireland	335,50	1100' 0"	50,32	165' 0"	11,56	37'11"	Belfast Harbour Co.

C - Length
B - Width
P - Depth

TABLE 2/1b

COMMERCIAL DRY DOCKS CAPABLE OF HANDLING SHIPS ABOVE 100,000 tdw

Sequence Number	Port	Country	C (m)	C(ft)	B (m)	B (ft)	P (m)	P(ft)	Owner
19	Hamburg	Germany	335,50	1100' 0"	55,99	183' 7"	9,15	30' 0"	City of Hamburg
20	Skaramanga	Greece	335,48	1099'11"	53,66	175'11"	9,25	30' 4"	Hellenic Shipyard
21	Liverpool	G.Britain	320,35	1050' 4"	36,60	120' 0"	13,80	45' 3"	Mersey Docks Harbor
22	Marseilles	France	320,25	1050' 0"	50,04	164' 1"	10,90	35' 9"	Port of Marseille
23	Kiel	Germany	310,62	1018' 5"	50,27	164'10"	6,00	19' 8"	Howaldtswerke Deutsche Werft
24	Rotterdam	Holland	307,59	1009' 0"	47,30	155' 1"	10,76	35' 3"	Dokew Werf Maatschapi.
25	Cingapura	Malasia	306,03	1005' 0"	39,20	130' 0"	13,65	44' 9"	Sembawang Shipyard
26	Greenoch	G.Britain	305,00	1000' 0"	44,22	145' 0"	11,28	37' 0"	Scott Lithgow Dry
27	Kobe	Japan	301,72	989' 3"	43,72	143' 4"	11,90	39' 0"	Mitsubishi Hvy. Ind.
28	Odense	Sweden	300,12	984' 0"	45,14	148' 0"	10,06	33' 0"	Odense Staal
29	Liverpool	G.Britain	289,75	950' 0"	42,70	140' 0"	10,12	33' 2"	Cammel Laird
30	Innoshima	Japan	284,21	931'10"	47,02	154' 2"	10,34	33'11"	Hitachi S. B.
31	Curacao	Curaçao	280,19	913' 8"	46,25	151' 6"	8,49	27'10"	Curaçao Drydock Co.
32	Chiaishi	Japan	279,79	917' 4"	47,28	155' 1"	8,03	26' 4"	Kurushima Dockyard
33	Nagasaki	Japan	276,81	907' 7"	41,73	136'10"	10,65	34'11"	Mitsubishi Hvy Ind.
34	San Francisco	U.S. (Pacific)	274,50	900' 0"	45,75	150' 0"	11,73	37' 5"	Bethlehem Steel
35	Chester	U.S.	268,70	881' 0"	42,70	140' 0"	8,23	27' 0"	Sun Shipbuilding Drydock Co.
36	Lisboa	Portugal	266,00	872' 2"	42,00	137' 0"	11,00	36' 1"	Lisnave

Source: Lloyd's Register of Shipping Appendix 1971/1972.

C - Length
B - Width
P - Depth

TABLE 2/2

MILITARY OR GOVERNMENTAL DRY DOCKS CAPABLE OF HANDLING 100,000 tdw SHIPS

Sequence Number	Port	Country	C (m)	C (ft)	B (m)	B (ft)	P (m)	P (ft)	Owner
1	Bremerton	U.S.	300,83	1103' 3"	45,90	150' 6"	16,22	53' 2"	U.S.Navy
2	St. Nazaire	France	350,14	1143' 0"	53,05	173'11"	13,44	44' 1"	French Government
3	Sydney	Australia	347,53	1139' 5"	45,02	147' 7"	12,35	40' 6"	Australian Navy
4	Kure	Japan	338,32	1100' 3"	42,70	140' 0"	13,00	42' 7"	Japanese Government
5	Los Angeles	U.S.(Pacific)	333,52	1093' 6"	43,03	141' 1"	13,44	44' 1"	U.S.Government
6	New York	U.S.(Atl.)	333,39	1093' 1"	43,69	143' 3"	12,53	41' 1"	U.S.Government
7	New York	U.S.(Atl.)	333,36	1093' 0"	43,67	143' 2"	12,53	41' 1"	U.S.Government
8	Norfolk	U.S.(Atl.)	335,19	1032' 5"	45,75	150' 0"	12,94	42' 5"	U.S.Government
9	New York	U.S.(Atl.)	333,06	1092' 0"	43,31	142'11"	14,44	47' 4"	U.S.Government
10	Philadelphia	U.S.(Atl.)	333,06	1092' 0"	43,67	143' 2"	13,27	43' 6"	U.S.Government
11	Philadelphia	U.S.(Atl.)	333,06	1092' 0"	43,67	143' 2"	12,20	40' 0"	U.S.Government
12	San Francisco	U.S.(Pacific)	333,06	1092' 0"	43,00	141' 0"	13,11	43' 0"	U.S.Government
13	Pearl Harbor	U.S.(Pacific)	331,92	1088' 3"	42,40	139' 0"	13,12	43' 0"	U.S.Government
14	Kure	Japan	314,15	1030' 0"	42,27	138' 7"	6,91	22' 8"	Japanese Government
15	San Francisco	U.S.(Pacific)	306,52	1005' 0"	37,20	122' 0"	11,28	37' 5"	U.S.Government
16	Tema	Ghana	277,35	910' 0"	45,45	149' 0"	8,54	28' 0"	Ghanan Government

Source: Lloyd's Register of Shipping Appendix 1971/1972.

C - Length
B - Width
P - Depth

2.2 FISHING ACTIVITIES

2.2.1 Characterization of Fishing Sector of Possible Interest to Suape

One of the most important characteristics of the fishing sector is that catching efforts tend to concentrate in those species noted for their large stocks or high economic interest. If the list of fish produced in Brazil is a large one, this is partly due to the greater variety of the tropical fauna, but also, to a larger extent, this results from the still important participation of craftsmanship. An analysis of the production, however, shows that industrial fishing is already concentrated around a much smaller number of species. Another trend of industrial fishing is fleet standardization.

Evidently, at the current transitional stage of fishing activities and due to the shipowners' inexperience, industrial fleets are still composed of a variety of ships which should disappear in the future.

We should also add that industrial fishing will inevitably concentrate around more adequate fishing centers.

These trends should govern the development of fishing in Brazil, since they are universal.

To this extent, a study of the probable growth of Northeastern fishing must not overlook such aspects, and should, by vocation, focus its attention upon the economically most important species in its area of influence.

Finally, it should be noted that Brazilian fish production owes as much to industrial fleets as to craftsmen; the latter will probably remain side by side with industrial fishing, with a decreasing participation, but not die away, as has been the case all over the world.

2.2.2 Breakdown of Sector for Study and Analysis

Since the purpose of this study is to define the type of fishing unit based in Recife and vicinities, as well as to evaluate future characteristics which will represent the evolution of this unit, we must consider it as a function of the variables which govern the growth of the fishing sector.

As we know, there is an ocean strip, located between parallels 23ºS and 29ºS, which divides the epi-continental and Brazilian sea, according to the occurrence of certain species of fish, in two large groups: that of fine fish and lobsters, and that of popular fish, which grow in large schools, and shrimp. From this strip northwards, up to the neighborhood of Camocim, species are caught that have a high commercial value; southwards, down to the Uruguayan and Argentinian coasts, the trawling, abundant fish are caught.

Since the spatial distribution of species is a function of practically unchanging ecological factors, peculiar to each hydro-economical region, fishing boat features are determined by these ecological characteristics.

We thus propose to breakdown the sector according to the type of boat and equipment designed as a function of each type of produce, as follows:

- fish trawling,
- shrimp trawling,
- entrapment fishing,
- line fishing,
- lobster fishing.

Of these five large groups, we are particularly interested in those concerning species typical of the Northeast, i.e., line fishing and lobster fishing.

Though not included in the above breakdown, the catching of tuna and related fishing certainly has the conditions for reactivation, since these species occur along the entire Brazilian coast, particularly at the Northeast, and can be caught on an industrial basis from a fishing center in Recife, a city which is quite suitable for this purpose.

2.2.3 Composition and Features of the Industrial Fishing Fleet in the State of Pernambuco

A Present Situation

According to the General Fishing Record (RGP) of the Superintendency for the Development of Fishing (SUDEPE) there are in Pernambuco 10 boats with a capacity for more than 20 tons of useful load. These fishing boats operate on a regular basis and, for the greater part of the year, concentrate in catching lobster and snappers, and eventually other species.

The next Table shows the main features of the Pernambuco fleet leading to their type classification with a view to the dimensioning of a future fishing center.

The mere analysis of this Table shows some discrepance in the way some of the boats' features are listed, probably due to the lack of care or ignorance, on the part of shipowners, as to the importance of these data.

In spite of this, the total registers afford certain conclusions which will serve as subsidy for this study.

Pernambuco industrial fishing boats of more than 20 tons capacity concentrate in catching lobsters and snappers, and operate on the continental platform and waters adjacent to the Western-Northeastern coast. Except for those boats built more than 10 years ago (only 2), the average age of the fleet is less than 4 years; even if the older 2 are included, the average is still below 7 years which, in comparison with the average useful life of a fishing boat (about 15 years), rates the fleet as one of recent construction.

As for the other technical characteristics of the fleet, we see that maximum length is 24.9 m and that minimum length is 15.8 m; the loading factor, obtained from the difference between gross and net tonnages, and calculated without consideration to the average density of the produce, which is 0.5, is a maximum of 60 tons and a minimum of 10 tons; maximum draft is 2.85 m, while the minimum is 1.5 m.

State of Pernambuco - Composition and Characteristics of Fishing Fleet, over 20 tdw capacity

Construction Year	Length (m)	Tonnage (t)		Maximum Draft	Type of Fishing	Fishing Grounds
		Gross	Net			
1971	21,95	95,44	70,00	–	Snapper/Lobster	Recife/Natal
1972	22,65	115,18	90,00	2,85	Line	NE
1969	18,90	49,76	25,00	1,70	Line	CE
1970	15,80	76,70	16,00	1,50	Lobster	NE
1970	15,80	26,31	16,00	1,50	Snapper/Lobster	NE
1970	23,00	120,00	60,00	2,00	Line	Recife/Fortaleza
1969	18,30	32,00	25,00	1,60	Trawling	Belem
1969	24,90	93,00	56,00	–	Line	High Seas
1971	21,95	95,00	70,00	–	Snapper/Lobster	Recife
1956	22,22	69,00	50,00	–	Line	High Seas

Source: GCP da SUDEPE

B Contour Conditions

Among the "laws" for the rationalization of industrial fishing, an important one is that which imposes the boat characteristics according to the spcies to be caught.

The fishing boat, being a means to catch fish, is designed to catch well. However, after the catch, it has the inevitable mission of transporting the produce to its base, an operation which it performs without the advantages of a merchant ship. To this extent, it may be concluded that fishing bases shouls be located as near as possible to the fishing areas.

A fishing base located in Recife could not objectively aim at catching any but those economically exploitable species, such as lobster, snapper and tuna, even though Recife's location is none too favorable in comparison with other Northeastern States, for the occurrence of lobster reaches its southern limit precisely around Recife's latitude.

As for snappers, Recife's position is also unfavorable, when we compare fishing results of Recife-based boats with those of boats operating, for instance, in Fortaleza or Salvador.

In view of these limitations, it must be concluded that the mainstay for the expansion of fishing activities in Pernambuco is tuna fishing, since, for this type of catch, Recife is in an advantageous position.

The unquestionable proof of what has been said above is the small size of the Recife-based industrial fleet, which is only 1% of the total industrial fishing fleet in Brazil.

2.2.4 Analysis of Sector Trends

A Basis for the Study

In an attempt to avoid a dispersion of efforts for the collection of data to establish a support for projecting the growth of the fishing sector in Pernambuco, we selected, after a careful analysis of available information and studies, the one titled "An Attempted Evaluation of Fishing Resources in Northeastern Brazil," by Professor Melquíades Pinto Paiva and others.

The importance of this study lies in a consistent analysis of the fishing resources in the Northeast, as well as of catching techniques employed for each species, and in the fact that the probable avenues for the expansion of Northeastern industrial and artisan fishing are conditioned in the study to the possibilities of rational exploitation of available stocks of the several species and to the technological advance of the sector.

The authors establish two alternatives in order to project 1980 fishing production: an optimum hypothesis, and a pessimistic one.

Though we do not intend to introduce a modification or subsidy to the above study, it is important, for an intermediate position, to establish a third hypothesis by simply adopting an average between the maxima and minima projected by the authors.

B Projections

In view of what was established in the section "Contour Conditions" above, the fishing production in the State of Pernambuco can be synthetically estimated, up to 1980, as a variable dependent upon available stocks, particularly those of lobsters, snappers and tuna fish, divided between artisan and industrial fishing.

As we have seen before, the projections refer to the total fishing in the Northeast, and they must be broken down in order to indicate the amounts of produce that can be handled by a Pernambuco-based fishing fleet.

The following Table thus shows the average for those hypotheses. We will later try to draw from this Table those amounts corresponding to the State of Pernambuco, in the case of intensified catching efforts which are economically viable for a Recife-stationed base.

Resumé of Estimated Fish Production in Northeastern Brazil up to 1980

(in tons)

Fish & Type of Fishing	1970	Pessimistic Assumption 1975	Pessimistic Assumption 1980	Optimistic Assumption 1975	Optimistic Assumption 1980
Industrial Fishing	21.730	26.770	28.520	64.970	92.720
Lobster	8.000	9.000	9.900	9.900	9.900
Tuna	1.300	1.300	1.300	15.000	30.000
Snapper	3.000	3 000	3.900	4.750	4.750
Whale	9.430	8.430	12.570	12.570	12.570
Shrimp	—	—	—	12.750	15.000
Sururu	—	—	—	7.500	15.000
Flying Fish	—	—	—	2.500	5.000
Artisan Fishing	101.700	122.600	141.700	248.190	343.530
Sea Organisms	42.400	54.800	67.200	115.200	141.600
Estuary Org.	24.300	32.800	39.500	80.490	96.930
Fresh Water Org.	35.000	35.000	35.000	52.500	105.000
Total	123.430	149.370	170.220	313.160	436.250

Average Assumption

Fish & Type of Fishing	1970	Average Assumption 1975	Average Assumption 1980
Industrial Fishing	21.730	57.065	79.050
Lobster	8.000	9.450	9.900
Tuna	1.300	8.150	15.650
Snapper	3.000	3.875	4.325
Whale	9.430	12.570	12.570
Shrimp	—	12.750(1)	15.500(1)
Sururu	—	7.500(1)	15.000(1)
Flying Fish	—	2.500(1)	5.000(1)
Artisan Fishing	101.700	185.395	242.615
Sea Organisms	42.400	85 000	101.400
Estuary Organisms	24.300	56.645	68.215
Fresh Water Organisms	35.000	43.750	70.000
Total	123.430	242.460	321.665

1 - Optimisc assumption only.

C Fishing Techniques Adopted

Among the fishing techniques adopted, we will mention here only those within the area of influence of the future port of Recife, that is, capable of profiting from a new base at the Port Complex of Suape.

These are concerned with lobsters, snappers and tuna fish. In industrial terms, lobster fishing has its major base in Fortaleza and, in a much lower scale, in Recife. It is performed by deep-freezing "shrimping" boats, with a preference for 342 HP boats with large holds of 40 to 60-ton capacity, which can keep the produce at minus 10ºC.

The same industrial lobster fleet is engaged, for approximately 4 months every year, in catching snappers on banks up to 400 miles away from Recife (the average distance of these banks is approximately 250 miles). In these circumstances, snappers are normally congealed whole and kept also at minus 10ºC, for processing (filleting) and re-freezing on shore.

This produce is considerably more abundant than lobsters, and about 40 tons can be caught on each 30-day trip.

Tuna fishing is more frequently carried out by means of deep trotlines, and can be successfully performed on the seas adjacent to Northeastern Brazil, particularly in the area between latitudes 20ºN - 20ºS, and longitudes 20ºW - 60ºW, which covers the Western and Equatorial zone of the Atlantic Ocean. Suape could thus be called upon to harbor a fishing base capable of handling, at least, medium-sized deep-freezing tuna fishing boats.

2.2.5 Possibilities for Expansion of the Pernambuco Fishing Fleet.

A The Lobster Fleet

In a confirmation of the conclusions arrived at by the above mentioned study of fishing resources in Northeastern Brazil, which indicate little possibility of growth of the regional lobster fleet, SUDEPE has recently issued Edit Nº 118, of March 6, 1974, establishing devices for protecting the species by limiting fishing periods and, at the same time, requiring lobster exploiting companies to apply for permission before expanding their activities.

It is thus impossible to forecast any significant growth for the lobster catching activity in Northeastern Brazil, particularly at the Southern limit of its occurence, which is the city of Recife.

B The Snappers Fleet

Traditionally, snappers are caught along the entire Northeastern coast, both by the artisan and the industrial fleet, to the extent, in the latter case, that they represent an alternate catch for lobsters.

Again based on the aforementioned projections, snapper catching cannot exceed, even in the optimistic hypothesis, the 5,000 tons per year range, that is, an addition of approximately 2,000 tons to the current levels. This means that the mere addition of 2 fishing units, exclusively devoted to snapper fishing, would practically absorb the entire production grown forecasted in the projections. An expansion of the Pernambuco fishing fleet is thus improbable on the basis of snapper fishing, though researches carried out in the long run may reveal the existence of added units.

C The Tuna Fish Fleet

Tuna and related fish is caught in tropical and temperate waters all over the Atlantic Ocean. During the period of 1970-1972, approximately 370,000 tons of these fish were caught. In spite of these sizeable figures, prudence demands that we consider only those amounts shown in the above mentioned projections, that is, of those specimens that come near the Brazilian coast and that can be caught only by menas of deep trotlines, due to the non-occurrence of superthermoclimatic schools.

We thus see that, based on the adopted projections, tuna fish is, in industrial terms, the only species whose production can be substantially increased.

2.2.6 Typification of the Tuna Fish Fleet

It remains, therefore, for us to typify the most adequate boat for tuna and related fish exploitation, assuming the possibility that it may be carried out from a base in Suape.

Due to the peculiarities of the species and the base location, a tuna fishing boat should be designed with a view to alternate snapper fishing. Since round trips are time-consuming, their duration never being less than 30 days, and in view of the consumer market requirements as regards the quality of the product, the intended boat must be equipped with a deep-freezing system. The deep-freezing equipment shall have a capacity to process up to 5 tons of produce per day, since the average journey's throughput is 3 tons of tuna fish or, in the alternate case, 5 tons of snappers.

We do not intend to create here a Brazilian model of tuna fishing boat, but only to adopt a model with the following major characteristics:

Length	34 meters
Hold Capacity	150 to 300 m^3
Crew	25 men
Motor power rating	400/500 HP

A boat with these characteristics could have a daily yield of about 2 tons of tuna, that is, 60 tons per month (per round trip of 30 days). Assuming that each boat would operate during 10 months per year, its yearly production would be 600 tons. We thus conclude that the optimum size of a tuna fishing fleet, intended to operate on the basis of the average data in the projections, would be around 25 units. This is based on the hypothesis that the Northeast cannot hold more than one tuna fleet with industrial characteristics.

2.2.7 Fishing Port Facilities for Suape

A Characteristics of Berths

Now that the alternatives for the possible growth of the Pernambuco fleet have been determined, we indicate below the characteristics for the berths intended for the access and docking of the fishing boats that may frequent a possible base in Suape.

As we have said above, an expansion of the Pernambuco production of fish is viable only, in industrial terms, on the basis of increased efforts to catch certain species of Thunnidiae which come near the Northeastern coasts and which can be captured by Suape-based boats.

For the year 1930, the average value of the adopted projections showed a tuna fish potential of approximately 15,650 tons per year, to be captured by about 25 medium-sized boats, capable of alternate snapper fishing.

since these boats, as they have been described, should have a draft of up to 4 meters, the berth depth must be at least 4 meters.

However, assuming technological changes or that the base might be called upon by foreign boats, motivated by conditions at the new port, and that these might reach 1,000 ton capacity, it would be convenient to have a 6-meter draft. Thus the fishing boat berths at Suape should have a minimum 6 meter depth, in addition to clearances related to tidal changes, pilot draft and silting allowances.

In view of the peculiarities of tuna fishing, which involves 30-day round trips, and of the 25-unit estimate, it may be concluded, through a mere study of the turnover of these boats that the docks for tuna fishing boats does not have to be longer than 200 meters. A dock of this size would permit simultaneous docking of 5 of the proposed type boats, or even the eventual docking of larger boats. These data are indicators of the size of fishing facilities which may be considered for Suape.

B Characteritsics of Port Facilities

As part of the port facilities indispensable to the operation of these boats, the estabslishment of a support infrastructure should be considered that permits building fishing boats, unloading fish, in addition to other maintenance and repair facilities, though these last two services can be rendered outside of the fishing dock area.

It is fundamentally important to have deep-freezing facilities where the tuna frozen on board can be stored and kept at a temperature of minus 20ºC.

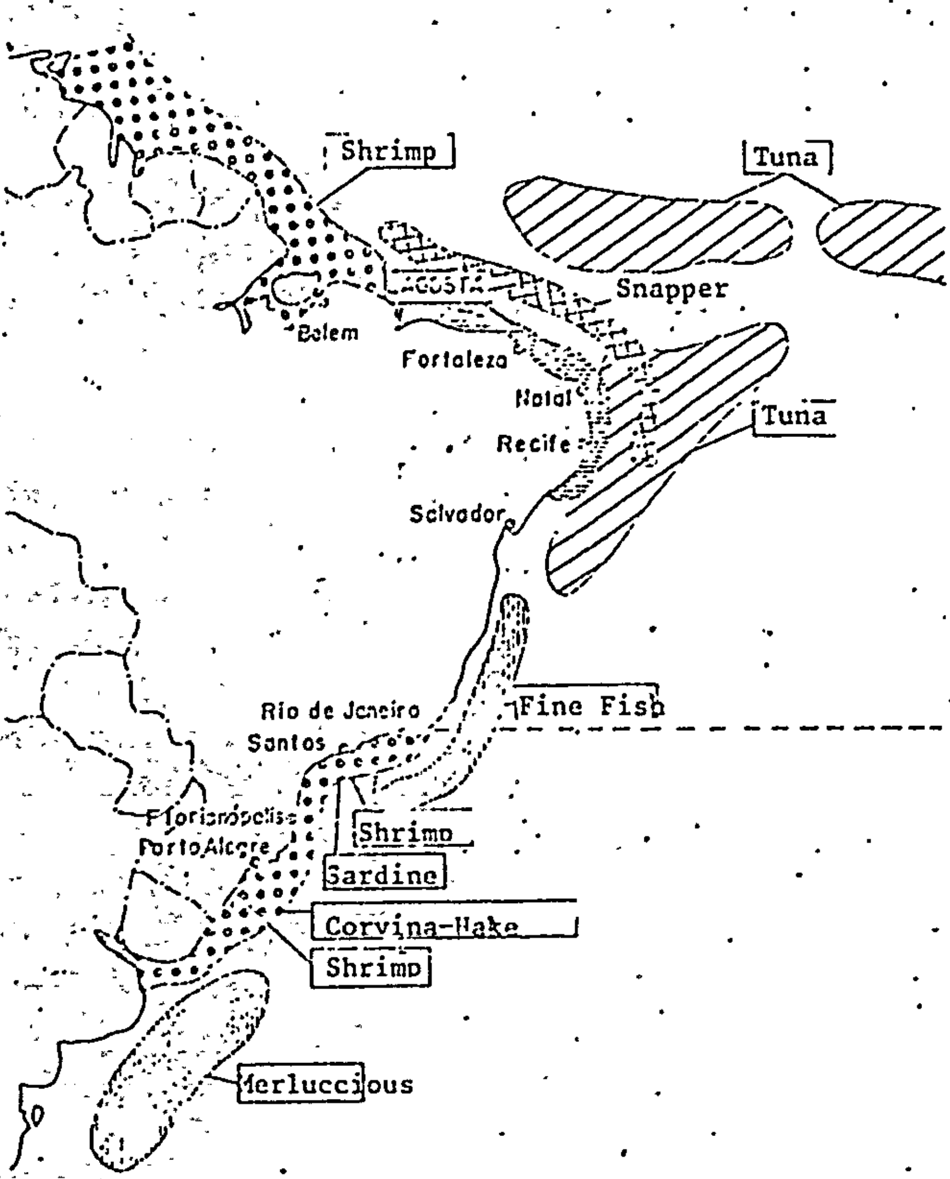
C Final Remarks

This study emphasized only the development of industrial fishing, since we believe the possibilities for expanding artisan fishing are rather limited.

However, eventual assistance programs to artisan fishing, such as PESCART, recently introduced by SUDEPE, are capable of changing, though in a small scale, the current structure of artisan fishing, increasing its catch capacity. In this case, if the artisan fleet of motor boats called on the Suape port, there would be no docking problems in view of the safe margins of the proposed sizes.

The approach adopted for artisan fishing is that it will be, as has happened all over the world, the matrix for industrial fishing.

Illustration nº 2.3/1



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GOVERNO DO ESTADO DE PERNAMBUCO
COMPANHIA DE DESENVOLVIMENTO INDUSTRIAL DE PERNAMBUCO

COMPLEXO INDUSTRIAL DE SUAPE

INCIDENCE OF FISH RESOURCES ON BRAZILIAN COAST

TRANSCON S.A.

TOMO II
PARTE I
3.0

3.0 PORT CONCEPT FOR SUAPE FROM AN INSTITUTIONAL VIEWPOINT

3.1 GENERAL

The areaintended for Suape's Industrial Complex is under the jurisdiction of the Port of Recife, administered by the State Government, and is a concession of the National Department of Ports and Navigable Routes.

The Industrial Complex generating pole is to be found in the port facilities that can be offered to industries which choose to settle there due to the possibility of installing private terminals for their exclusive use.

On the other hand, the advantages offered by local physical conditions in Suape and the difficulties now encountered by the Port of Recife where expansion is concerned, gave rise to a port concept for Suape as that of an area comprising the summation of private terminals plus an area for public utilization, complementary to Recife's facilities, to the extent that the advantages offered by Suape are more convenient that the establsihment of difficult and costly alterations in Recife.

The institutional aspects of the problem were examined in the light of current legislation, and a resulting line of action is proposed for adoption in the reconciliation of state and federal interests as regards implantation of the Complex.

3.2 BASIC PROFILE

From the viewpoint of the physical port, the construction of private terminals is visualized for Suape in order to handle the raw materials and the goods manufactured by industries to be installed there, as well as the construction of collective docks capable of meeting the needs of those users whose size and nature of activity does not warrant the operation of private, specialized terminals.

The projected Port Complex will be located some 40 kilometers south of the port of Recife, and is therefore under its jurisdiction. Promoting the venture is DIPER - Companhia de Desenvolvimento Industrial de Pernambuco, which is an organ of the State government, just as the latter is the concessionary of the Port of Recife, by force of authority contained in Decree nº 1995, of October 1, 1937, and in the contract signed on March 4, 1938, registered by the Union's Finance Court on March 29, 1938.

Such circumstances, besides eliminating any possible interest conflicts at the State level, do, on the contrary, promote their conciliation: once the Industrial Complex at Suape is a working reality, it will certainly coexist with the Port of Recife, providing the State Government with alternatives that will permit rational exploitation of both, with better results.

Having the above as a starting point, it behooves us to analyze the most suitable concept of the new Port Complex from an institutional viewpoint. The new port installations at Suape might, at first, be conceived as a mere extension of the administrative area of the Port of Recife, with a proposed reformulation of the Ministerial Edict which established its limits, as per the attached draft.

The above conception, however, would meet certain difficulties, for the mere extension of the Port of Recife's administrative area to include Suape would involve areas which are not specifically intended for use as ports, a fact which is outside of the spirit of current applicable legislation.

Another concept would be to have in Suape a port administration completely separate from the port of Recife; however, in such terms, the matter would run against the port policy established by the Federal Government and incorporated into the Decree-Law nº 794, of August 27, 1969, with alterations introduced by Decrees nºs. 939 and 1021, both of 1969. In fact, these legal documents authorize the Union to create companies for the exploitation of ports, terminals, and navigable routes, and recommend that, within one State, not more than one mixed capital society should be established.

Consequently, and bearing in mind that the Government of the State of Pernambuco not only holds the concession for the Port of Recife but is also the promoter of the Suape venture, nothing could be more just than to grant it the concession to exploi the Port Complex at Suape. However, in view of the reasons set forth above, and since it does not seem feasible or, at least, recommendable to have two entities in the same State for port exploitation (Recife-Suape), it is more accurate to defend the re-ratification of the Concession Contract for the Port of Recife, valid still for another 24 years, so that the area containing the projected facilities at Suape becomes an integral part of said concession.

With such a move, there will be no cogitation about a new port entity; Suape will be a mere complement to the present facilities at the Port of Recife, in such a way as to permit the handling of cargo and products on such a level as to satisfy the demand created by the State and regional development. The Administration of the Suape Port Complex would thus be an appendix to the Recife Administration, as per re-ratification of the current concession contract.

Once the Concession Contract has be rectified and ratified, the Ministry of Transportation can issue an edict assigning a new administrative area to the Port of Recife, which will replace that defined by Edict nº 5,128, of March 16, 1971, even though the new are is broken down in two parts, one in Recife and the other at Suape. It will be a situation similar to that which occurs in a State already having two or more ports that are incorporated in one mixed economy society, in compliance with the above mentioned Decrees. There will be only one administration, but services will be performed in two or more locations, depending on the number of existing ports.

The State of Pernambuco would thus build the access channels and the collective docks, warehouses, highway and railroad acesses, as well as the necessary infra-structure (electric power, water supply, sewage system, etc.), so as to secure operation of collective channels and private terminals.

As regards these specialized private terminals, their construction would be the onus of the respective industries, which are to use them to handle their raw materials and products. The State of Pernambuco will grant them the areas and sections necessary for this purpose; while it will be up to the companies to take all steps, through the Industrial Complex administration, not only related to approval of projects, but also for obtaining authority to operate the terminals.

Coherent with this line of reasoning, the State would receive from these companies, through the same Complex managing entity and in retribution to benefits offered (access channels, power, water, highway and railroad accesses, etc.), payment in company shares for the value of the land; the State would thus become a substantial shareholder of the several companies to be installed in the area, in addition to having the capital which the investments in infra-structure works represents.

In institutional terms, therefore, in order that the above idea may be put into practice, the following documents, presented below in draft form, will be necessary:

a proposal for re-ratification of the Concession Contract for the Port of Recife, for inclusion of the new port facilities at Suape;

b proposal for Concession of Land to industries planning to install themselves in the area of the Complex, with a definition of mutual rights and obligations for the State and the industry;

c proposal for the creation of a Public Enterprise by the Government of the State of Pernambuco for implementation of works at Suape's Industrial Complex, within the established criteria and priorities; this enterprise may later be changed into a mixed economy company to be installed in Suape, having the Government as its major shareholder.

Under these circumstances, the Government of the State of Pernambuco will be the large entrepreneur responsible for obtaining the Federal Government's approval for the mentioned proposals, for securing the internal and external financial resources in due time to insure the venture's development, and for coordinating all action for its materialization in contact with local and federal agencies, bearing in mind the importance of the venture to the economies of the State, the region, and the country.

From the point of view of port operation, the implementation of the above mentioned proceedings would permit the Federal Government, at its convenience and in compliance with Drecrees 794 and 1021, both of 1969, to institutionalize the Pernambuco Docks Company, a mixed economy society with capital integrated by the Federal Government and the entity administering the Industrial Complex which, by this time, might also be a mixed economy society, with the eventual direct or indirect participation of companies installed there. In this way the port facilities at Recife and Suape would be finally unified, in compliance with existing national guidelines.

3.3 PROPOSED DRAFTS

3.3.1 RE-RATIFICATION OF CONCESSION CONTRACT FOR THE PORT OF RECIFE

We give below the suggested measures to be taken for Ratifying the Concession Contract for the Port of Recife, in the form of a draft for an Edict to be signed by the Minister of Transportation, changing the area covered by the Administration of the Port of Recife so that it includes the Suape Port area.

Draft of Edict

The Minister of State for Transportation, in response to the request made by the National Department of Ports and Navigable Routes, and in accordance with proceedings nº MT-174, decides:

I To alter the limits of the administrative area of the Port of Recife, established by Edict nº 716, of September 12, 1967, issued by this Ministry, which henceforward shall include:

a the facilities at the Port of Recife encircled, to the East, by the Atlantic Ocean; to the North, by an East-West line 4 kilometers North of the Picão beaconhouse; to the West, by a straight line forming an angle of 23º50' with such East-West line and running 6 kilometers from said beaconhouse; and to the South by the banks of the Capibaribe and Beberibe rivers included within these limits;

b the facilities at the Suape port area encircled, to the North, by the Santo Agostinho mountain ridge; to the West, by Highway PE-60; to the South, by an East-West line running accross Cupe; and to the East, by the Atlantic Ocean.

II To maintain the same limits of the Port of Recife jurisdiction established in Item II of the above mentioned Edict.

III This Edict will be in effect on the date of its publication in the Union's Offficial Gazette.

3.3.2 ALTERATION OF CLAUSE III OF THE CONCESSION CONTRACT FOR THE PORT OF RECIFE

In view of the alteration in the administrative area of the Port of Recife suggested in 3.3.1, we give below the required alteration of Clause III of the Concession Contract for that port, authorized by Decree nº 1995, of October 1, 1937.

DRAFT FOR ALTERATION OF CLAUSE III OF CONTRACT AUTHORIZED BY DECREE Nº 1995, OF OCTOBER 1, 1937 AND REGISTERED BY THE FINANCE COURT ON MARCH 29, 1938.

CLAUSE III

For the duration of this contract and in order to meet present and future needs of the Port of Recife, the Government of the State of Pernambuco shall be entitled to the use and fruition of the already acquired land and of that to be acquired, by purchase or expropriation ordered either by this Government or by the Federal Government, as well as of the marine land including the sea coast and the Capiberibe and Beberibe river banks, contained in the area limited by: the Atlantic Ocean to the East; an East-West line, to the North, running four (4) kilometers of the Picão beacon; to the East, by a straight line forming an angle of 23º50' with the North-South line running two (2) kilometers from the beacon; and, to the South, by an East-West line running six (6) kilometers from the location and in the area intended for installation of the port complex in Suape, limited by the Atlantic Ocean in the East, by the Santo Agostinho mountain ridge in the North, highway PE-60 in the West, and by an East-West line running through Cupe, in the South.

3.3.3 CONCESSION OF PLOTS OF LAND AT THE INDUSTRIAL COMPLEX

Below is the suggested Standard Draft for concession of plots of land at the Industrial Complex.

- STANDARD DRAFT -

Concession of land plot in the Suape Industrial Complex made to .... in the form and under the conditions set forth in the clauses below:

CLAUSE ONE - The Government of the State of Pernambuco, concessionary of the Port of Recife, holding title to the land as per the State's Decree nº 2845 of June 2nd, 1973, and ... ., here represented by .... do hereby agree to the grant of use and fruition of a strip of land consisting of plot nº........ as per attached plan, which will be an integral part of this contract.

CLAUSE TWO - The land is intended for the installation of an industry for producing........................., whose construction must be initiated within .... time.

CLAUSE THREE - For the concession mentioned in the above clause, ... will pay to the Government of the State of Pernambuco, in ordinary nominal shares issued by the company, the amount of Cr$............ (............. ....) corresponding to the area of .... m2 plus value of improvements made in the area relative to infrastructure investments.

CLAUSE FOUR - This concession will be void if clause two is not complied with within the prescribed time, except if the reasons for non-compliance can be attributed to the State of Pernambuco and/or to the Federal Government.

CLAUSE FIVE - The construction work for the industrial facilities, as well as that for the private terminal, shall be to the account and responsibility of .... and in accordance with the master plan approved by the Government of Pernambuco for the Suape Complex, the company being responsible for all measures needed for the approval of such work by the competent agencies in compliance with current legislation.

CLAUSE SIX - Previous agreement by the competent agencies is necessary if .... decides to establish subsidiaries. Agreement will also be required for expansion and betterments of facilities deemed necesssary by .... at any time.

CLAUSE SEVEN - The assignment of the industrial installations and of the port terminal to third parties can only be carried out my means of the express authority of government agencies.

CLAUSE EIGHT - The port terminal is intended solely for the handling of goods destined to or resulting from the industry's activities, the handling of any good for third parties being forbidden.

CLAUSE NINE - Utilization of the port terminal can be initiated only after publication in the Official Gazette of the edict signed by the Minister of Transportation, granting the regular authority needed.

CLAUSE TEN - For the handling of its goods at the port terminal, ... recognizes the obligation to pay for port charges, to be established in an agreement which will be signed with the Administration of the Port of Recife, with the DNPVN as mediator.

Having agreed to the above clauses, both parties sign this contract, in the presence of the witnesses listed below.

(Place, day, month and year)

____
State Government

____
Industry

Witnesses:

____

____

TOMO II
PARTE 1
4.0

4.0 PORT CONCEPT FOR SUAPE FROM OPERATIONAL VIEWPOINT

4.0 PORT CONCEPT FOR SUAPE FROM OPERATIONAL VIEWPOINT

4.1 GENERAL

The installation of a completely new port at Suape, which will combine both private and public activities, requires an analysis of the legal implications and their reflex on operational systems, the reasons why the system did not evolve according to such legislation, so that a conceptual definition can be inferred for the projected operations at the new port.

The difficulties met at other ports would not be encountered at Suape in terms of a collective port, since port facilities there can be planned for the system recommended by the 1966 legislation and its corresponding regulation.

Suape can thus receive a pioneer treatment by means of an operational system with control unification and higher productivity.

4.2 LEGAL ASPECTS

The regulation of exploitation of port services is characterized by two basic eras — 1934 and 1966, while in 1945 a Decree-Law was issued which aimed at better defining warehousing services at organized ports.

Three Decrees, nºs 24,477, 24,508 and 24,511, the first dated January 22, 1934, and the second and third dated June 29 of the same year, defined what came to be called organized ports, as well as their assignments, the services they should render, the charging methods for such services and, finally, regulated utilization of port facilities.

The guiding principles of the port exploitation policy contained in such legislation were:

a - to consider the rendering of port and related services as the responsibility of port authorities — direct branches of the Federal Government, concessionaires or leasers of port facilities belonging to organized ports —, to whom the privilege was given to perform custom duty services, internal warehousing, and transportation between the several port facilities or at port railroads, and the permission to have third parties perform other work using their own personnel and equipment;

b - to subdivide port services in various work items, according to the several types of acticity, rigidly defining 12 of them, with a 13th capable of comprehending any other related to the 12, and which might eventually be left out;

c - to ascribe to each work item a method of charging for the services, according to parameters subject to variables connected with the nature of the activity (weight, time, volume, linear meter, etc.).

Thus one and only administration held in its hands the responsibility for performing a large range of services, which the law tried to define in all details that were, themselves, broken down into several types.

Such a method gave rise to a complex customs duty and control system which, in turn, brought about a difficult process of exchange of responsibilities that was often impossible to characterize.

The port operation of loading and unloading ships involves a large range of cargo handling tasks, from the moment the load arrives at the port facilities until it reaches its destination. This group of tasks is performed in the course of time and within the physical space of the port facilities by different work teams; because of this, those who are less familiar with the subject fail to grasp the operation's unity. This fact presided over the preparation of the above mentioned legislation, which subdivided the port operation in separate work units, and attempted to assign to each a different dimension and a consequently different tax for services rendered. Such partial sums were to be finally added up, now the shipowner and now the consigner being responsible for them, instead of charging the total to either one of the parties as the cost of one and only operation.

The party using the port does not care how the port operation is carried out; he is interested only in the cargo being transferred from the ship to its owner and vice-versa.

As a consequence of the system, the user never knows how much he will pay for the complete operation, since he has no previous knowledge of how it will be carried out and since it takes place in ways that are completely outside of his control.

The 13 work units which constitute the port operations as defined by the legislation are charged for as listed below, in their natural sequence in the operational flow.

SEQUENCE	TABLE	DESCRIPTION	UNITS	CHARGED TO
1	K	Towing	tons displaced	Shipowner
2	A	Port Utilization	tons handled	Shipowner
3	B	Mooring	m/day of docking	Shipowner
4	J	Port Equipment supply	m/day	Shipowner
5	I	Stowage of ship	tons	Shipowner
6	L	Water supply to ship	m^3	Shipowner
7	M	Auxiliary services	per task	Requisitioner
8	C	Longshoremen charges	kg/density of load	Consignee
9	D	Internalwarehousing	% ad valorem	Consignee
9A	E	Externalwarehousing	kg/period	Consignee
9B	F	Storage in general warehouses	kg/period/density of load	Consignee
9C	G	Special warehousing	m^2 / period, kg/period, etc.	Consignee
10	H	Auxiliary warehousing services	per task	Requisitioner
11	H	Transportation	kg/density of load	Consignee

As can be seen from the above natural sequence, the shipowner is made responsible for those charges related with ship handling (1 to 7), whereas the consignee is charged with the cost of those operations performed after the cargo is unloaded from the ship. At the same time, the operation of moving the cargo from the ship to the port facilities, or vice-versa, is broken down in two parts — one on board of the ship, performed by a work team (stowage), and the other on shore, carried out by a different team (longshoremen) under a different leadership — when actually there is only one operation performed by two different teams.

It was significant that, after the 1934 legislation was in effect, Decree-

Law nº 8,439, of December 24, 1945 was issued in an attempt to regulate warehousing services at organized ports, since the 1934 legislation left doubts as regarded definition of internal and external warehousing, among other things. This Decree was basically aimed at clarifying such doubts, but if failed short of such a goal; even to this day the subject is misinterpreted by administrators at many ports.

Much academic discussion has been going on as to what exactly is internal and external warehousing.

This legislation was basically devoted to distinguishing between goods destined for transit (receipt and prompt delivery) and for warehousing at the owner's convenience; the first were to be charged with internal warehousing, while the latter was to be charged with external warehousing. On the other hand, the law made no reference to goods in transit for export (see Article 9).

Decree nº 24,508, of 1934, defined internal warehousing as the safekeeping and preservation of imported goods, while external warehousing referred to national or nationalized cargo, either for import or for export, warehoused at the convenience of their respective owners, and included cargo handling inside the warehouse, from receipt to delivery.

Decree-Law nº 8,439, of 1945, had it that internal warehousing related to long-run and coastal navigation imports and to coastal navigation exports, booked for immediate shipment and stored in rooms adjacent to the docks (typical description of in-transit cargo), and that external warehousing related to domestic cargo warehoused at the convenience of the respective owners, the use of warehousing adjacent to the docks not being permitted , since these warehouses were intended for goods imported from abroad.

The Decree established exemption periods for warehousing charges, after which taxes would be charged according to regulations set forth in the Decree.

But, according to this Decree-Law, the basic distinction between the two types of warehousing lay particularly in the fact that it took place in adjacent (internal) or non-adjacent (external for export) to the docks.

The dubiousness and frailty of both pieces of legislation (of 1934 and 1945) are quite evident and generate different interpretations.

The 1934 decree included the handling of cargo in external warehousing areas in the warehousing charges proper, whereas the 1945 decree was silent on the subject and did not revoke Decree 24,508, of 1934; it revoked only provisions to the contrary.

Thus, while regulating exemption and charging forms, the 1945 decree introduced further doubts on the subject through the lack of a clear definition. Up to this day doubts subsist as to whether these warehousing charges relate to the distinction between internal and external areas, to in-transit or to not-in-transit cargo, or to both conditions.

Misinterpretations also occur with other work items, such as the transportation (whether charges cover an unloading or a loading operation), longshoremen's work (as regards load delivery to doors, sheds, etc., to the side of transporting vehicles or onto them), and so forth.

All this complex legislation, open to the most different interpretations, results exclusively from the preocupation of subdividing the work in its minutest components, and trying to give a rigid definition of each.

On the other hand, Decree-Law nº 5, of April 4, 1966, provided for greater flexibility by grouping stowage and longshoremen's work under the same category, called loading and unloading operation; it permitted the adoption of new ways of organizing services for greater efficiency, and allowed stowing companies or other third parties to performing the handling of goods, internal warehousing, transportation, and all other tasks assigned to the port administration.

The desired flexibility was extended to include the renting or leasing of land, warehouses and other port facilities to the users and other parties, as we see below:

> Art. 27 - Warehouses and other port facilities may be rented or leased to their users and other parties, preference being given for long-run renting or leasing to those willing to invest in the completion, expansion or equipping of facilities, except when contrary to the interests of national security.

This legislation established the priciples which would govern its regulation; the latter, however, already partly restricted the new flexibility, by determining the utilization of port administration personnel and equipment and payment of charges under Tables N and A to the port administration in the case of existing third party installations handling cargo originating from or destined to its hinterland.

> Art. 27 - sole paragraph - The regulation referred to in this article shall be governed by the following principles, among others:
>
> a) the handling of goods will be performed by stowing entities using, when necessary, port administration personnel and equipment;
>
> b) total or partial utilization of port facilities will depend on the contract, which may be for a fixed period of time or for the loading and unloading operation of ships;
>
> c) the collection and control of the Port Improvements Tax will remain the responsibility of the port administration and of the National Department of Ports and Navigable Routes, respectively; and,

d) stowing entities or third parties, when renting or leasing port facilities, will, wherever applicable, be subject to legal precepts which govern the administration of ports.

Art. 26 - Shippers or third parties may, when complying with the law, build or exploi port facilities referred to in Decree-Law nº 6,460, of May 2, 1944, regardless of yearly movement of goods, provided the construction brings no onus to Public Authorities nor affects national security, and that exploitation is carried out for self use.

§ 1 - In any case, the port administration whose hinterland (Decree nº 24,511 of June 29, 1934, art. 2, sole paragraph) the goods handled in such facilities are destined to or originate from, shall be entitled to the charges under Table N of port taxes, which shall be evaluated in accordance with the venture's economical conditions.

§ 2 - In addition to the charges mentioned in the above paragraph, the Port Administration shall also be entitled to those under Table N of port taxes referring to goods handled in such facilities, when these are located within the area under the Port Administration's jurisdiction as defined by the Ministry of Transportation and Public Works.

§ 3 - The above paragraphs apply to the already existing facilities.

Decree-Law nº 5 gave the DNPVN the power to authorize port administrations to remove goods stored in internal and external warehouses, at the expense of owners or consignees, to avoid overcrowding, and passed on to the Ministers of Transportation and Public Works (now Ministers of Transportation) the responsibility for determining initial and subequent periods of internal warehousing, as well as the percentages for its charging.

We thus see how reluctant the legislation was to allow for a high degree of flexibility. Now it gives, now it takes away. Now it tries to free port operation from the principles established by the 1934 legislation, now it upholds them.

The fact that the Decree-Law revoked only those contrary provisions and did not firmly define the principles that should govern port operation prevented it from being fully enacted down to the present day, although such principles were slightly clarified in its regulation contained in Decree nº 59,832, of December 12, 1966.

However, from the dominating preoccupation with personnel, resulted a definition in the regulation of the unified operation, from aboard the ship to the warehouse or other location assigned by the port authority, or vice-versa, the command of these port activities being attributed to the ship's commander or his substitute.

The idea of unifying the various operations in one only loading and unloading operation was also reinforced, and the concept of cargo handling was defined; loading and unloading operators were classified according to the necessary qualification, and not linked to specific operational areas, but rather to the desired degree of specialization.

As regards the receipt, delivery and handling of cargo in the warehouses, the regulation establishes that these should be done with the help of the port public workers or of personnel employed by the warehouse concessionaire.

We may thus conclude from the above that current legislation unifies the port activities of loading and unloading, under the command of the shipowners or their substitutes, from aboard the ship to the inside of the warehouse and vice-versa; such operations, which the law calls Stowage, are to be performed by one category of personnel, allocated in accordance with their qualification and specialization to the level required by the task, regardless of the area of operation (on board the ship or on shore).

And it sets forth that cargo handling inside the <u>warehouse</u> is to be done by the port public workers or by personnel employed by the warehouse concessionaire.

Once again the regulating decree revokes only provisions to the contrary, without specifically revoking Decrees nos. 24,508, of 1934, and 24,511, also of 1934, in their whole or part; thus, for lack of clarity in principle definition, the referred to privilege of port authorities, dictated by article 12 of Decree nº 24,511, for the performance of stowage and internal warehousing services, still prevails.

It should be noted that current port charges still reflect the complex system established by the 1934 legislation; Decree nº 59,832/66, which partially regulates Decree-Law nº 5/66, had no effect, except as regards payment of a productivity bonus to port public workers.

The hoped-for unification of operations and of their respective command, and the harmonious conjugation of intermodal transportation systems, are yet to be attained; the process is still being carried out along the lines of the 1934 legislation.

4.3 PORT FACILITIES

The comment made on legislation permitted us to have a glimpse of the policy aimed at, however meekly, since 1966, of simplification of the transportation link, through the greatest possible integration of those who participate in it. Toward this end, attempts were made to endow the system with enough flexibility to allow for the performance of port services by parties other than port authorities.

However, when leaving the performance of these services to third parties, the availability of port facilities must be ascertained; if these facilities are not leased on a task basis but for an indeterminate period of time, they would be scattered in the hands of many people and lose their collective character.

It is thus necessary that the facilities offered are sufficient to meet demand, in this kind of operation.

This is to say, for instance, that, if a certain portion of the docks at a given port has an average occupation rate of 30% per berth when it could have 60% without bottlenecking problems, leasing this portion would result in transferring to the leased berths part of the ships from other berths. It remains to be seen if this concentration will lead to an increase of the occupation rate at these berths on a level compatible with bottlenecking problems and, particularly, if the port has enough berths to use such criterium. If the opposite is true, that is, if the occupation rate per berth is high, leasing may reduce the rate in non-leased berths, but it should be noted that the rate would be still higher at the leased berths; this can be minimized by changing the haphazzard character of ship arrivals through adequate scheduling, which becomes possible to the extent that the renter of the facilities is the shipowner himself or another entity capable of adjusting such schedule to the proper utilization level of the leased berth.

The same leasing criterium may be justified for warehousing areas or to special facilities, to which the berths may or may not be closely connected.

However, whatever the solution, leasing is feasible only to the extent that there are facilities compatible with the system.

For s superficial visualization of available port facilities, we give below, having as source the DNPVN register, an estimate of the amount of berths at the principal ports, their front line warehousing areas (warehouses and storage rooms), and those of other rear lines.

SUMMARY OF PORT

FACILITIES

PORT	BERTHS	NUMBER OF FRONT LINE AREAS	NUMBER OF OTHER AREAS
Manaus	5	9	9
Belém	13	12	3
Itaquí	-	-	-
Mucuripe	5	2	-
Natal	3	3	-
Cabedelo	4	4	4
Recife	16	14	4
Maceió	3	2	2
Aracaju	1	-	-
Salvador	10	8	-
Ilhéus	4	5	-
Vitória	6	4	-
Niterói	2	2	-
Rio de Janeiro	47	25	7
Angra dos Reis	3	2	-
S.Sebastião	1	2	2
Santos	47	29	26
Paranaguá	18	8	16
S.Franc.do Sul	4	2	-
Itajaí	5	2	-
Rio Grande (*)	15	7	8
Pelotas	3	3	-
Porto Alegre	22	22	-

Source: DNPVN's Register
Note: (*) New Port only.

4.4 STRUCTURE OF CARGO HANDLING IN BRAZILIAN PORTS

Table 4.1 shows the structure of cargo handling at Brazilian ports, giving the percentage of cargo by type (solid bulks, liquid bulks and general cargo) at the various domestic ports.

Os the 34 ports listed, 15 handle mainly general cargo, there being a predominance of bulk solids in 9, and of liquid bulks in 7 of them.

The structure of cargo handling has ben evolving toward bulks, and it is noted that less than half of the listed ports show a proportion of more than 50% of general cargo handling.

We also give below the distribution, by port, of the amounts of cargo handled, corrected for density, which gives a more correct balancing for analytical purposes, the predominance of bulks being observed even after correction. However, if we leave out the ore cargoes, this predominance is not too great, in view of their density.

QUANTITATIVE DISTRIBUTION OF CARGO HANDLING AT PORTS, CORRECTED TO DISCOUNT DENSITY FACTOR

	000.000 t	DENSITY	000.000 TR
Ores	28,4	2,7	10,5
Coal	3,8	1,4	2,7
Other	7,6	1,6	4,8
Wheat	2,9	0,7	4,1
Liquid bulks	27,1	1,7	15,9
General Cargo	12,1	1,0	12,1
TOTAL	81,9		50,1

SOURCE: D.N.P.V.N.

TABLE 4.1

STRUCTURE OF CARGO HANDLING IN BRAZILIAN PORTS

((Percentages))

PORT	IMPORTS					EXPORTS					TOTAL		
	Solid Bulks		Liquid bulk	General Cargo	Total (1)	Solid Bulks		Liquid bulk	General cargo	Total (1)	Solid bulk	Liquid bulk	General cargo
	1º P.	2º P.				1º P.	2º P.						
MANAUS	02 T	01 A	37	35	75	-	-	16	09	25	03	53	44
BELÉM	04 A	03 T	35	36	78	-	-	-	22	22	07	34	59
ITAQUI	10 T	-	30	24	64	02 T	-	-	34	36	12	30	58
TUTÓIA	-	-	-	-	-	-	-	-	100	100	-	-	100
LUIZ CORRÊA	-	-	-	-	-	-	-	-	100	100	-	-	100
PARNAÍBA	-	-	-	48	48	-	-	-	52	52	-	-	100
CAMOCIM	-	-	-	-	-	-	-	-	100	100	-	-	100
MUCURIPE	13 T	-	52	15	80	02 A	-	06	12	20	15	27	53
ARACATI	-	-	-	-	-	-	-	-	100	100	-	-	100
NATAL	15 T	-	44	20	79	07 A	-	-	14	21	22	44	34
CABEDELO	10 T	-	39	10	59	-	-	01	40	41	10	40	50
JOÃO PESSOA	-	-	-	-	-	-	-	-	-	-	-	-	-
RECIFE	02 A	02 T	33	23	60	-	-	09	31	40	04	42	54
MACEIÓ	06 A	06 T	11	01	24	56 A	-	19	01	76	68	30	02
ARACAJU	01 T	-	-	-	01	-	-	99	-	99	01	99	-
SALVADOR	20 T	01 M	03	23	48	-	-	10	42	52	22	13	65
ILHÉUS	01 M	-	49	01	51	08 M	-	05	36	49	09	54	37
TUBARÃO	-	-	01	-	01	99 M	-	-	-	99	99	01	-

TABLE 4.1 - STRUCTURE OF CARGO HANDLING IN BRAZILIAN PORTS - (Continued)
(Percentages)

PORT	IMPORTS					EXPORTS					TOTAL		
	Solid Bulks		Liquid bulk	General cargo	Total (1)	Solid Bulks		Liquid bulk	General cargo	Total (1)	Solid bulk	Liquid bulk	General cargo
	1º P.	2º P.				1º P.	2º P.						
VITÓRIA	22 C	01 T	10	02	35	57 M	-	-	08	65	80	10	10
RIO DE JANEIRO	05 C	02 T	52	03	63	18 M	-	17	02	37	26	69	05
ANGRA DOS REIS	39 C	08 T	-	01	49	36 A	-	-	15	51	84	01	15
SÃO SEBASTIÃO (*)	05 A	-	-	68	73	-	-	-	27	27	05	-	95
SANTOS	25 A	09 T	27	14	75	06 A	-	01	18	25	40	28	32
PARANAGUÁ	01 A	-	30	02	33	43 A	-	-	24	67	44	30	26
ANTONINA	18 T	05 A	-	-	23	-	-	-	77	77	23	-	77
SÃO FRANCISCO	09 C	08 T	-	13	30	15 A	-	-	55	70	32	-	68
ITAJAÍ	04 A	02 T	63	02	71	03 A	-	-	26	29	09	63	28
FLORIANÓPOLIS	-	-	10	-	10	-	-	-	90	90	-	10	90
IMBITUBA	-	-	02	-	02	82 C	13 A	-	03	98	95	02	03
PORTO ALEGRE	48 A	02 T	01	21	72	05 T	02 A	10	11	28	57	11	32
PELOTAS	12 T	01 A	-	01	14	67 A	14 T	-	05	86	94	-	06
RIO GRANDE	13 A	-	29	07	49	09 T	05 A	18	19	51	27	47	26

SOURCE: D.N.P.V.N.

NOTE: (*) Does not include handling of liquid bulks by TEBAR.
(1) When the first and second products do not include class A (Other), the total may not correspond to the sum of the addends; in this case, the difference corresponds to the percentage of class A as third product.

G.S. = Solid bulks
G.L. = Liquid bulks
C.G. = General cargo
1ºP. = First product
2ºP. = Second product

M = Ores
C = Coal
T = Wheat
A = Other

4.5 CONCLUSIONS AND RECOMMENDATIONS

To the extent that shipowners, importers, exporters or perhaps even shipping agents, acting as shipowner representatives, begin to have their own or leased port facilities, to contract manpower for the operations of loading and unloading, using warehouses in the same way as they use ship holds, the work will necessarily become better organized, since it will be done under one and only leadership, and also as foreseen in the 1966 legislation, not yet enacted.

According to the type and nature of the cargo, the lease of areas and facilities for the total integration of transportation may be more convenient to shipowners, to exporters or to importers.

Tables 5.1 to 5.3 contain an analysis of the advantages and restrictions in the lease of warehousing areas and port services in general, by type and nature of cargo and by prospective leaser, for any Brazilian port.

Table 5.4 gives a summary of the results of this analysis.

The applicability of this operational concept (based on the very legislation of 1966 and later years) finds its major difficulty in the available port facilities and in the adaptation to this concept of the traditional port structures.

Traditionally, 2nd line warehouses are used almost exclusively for exports. The shortage of 1st line warehouses led to the necessary admission of import cargos into 2nd line warehouses, "bruising" the deep-rooted concept of traditional sectors.

Normally existing warehouses in Brazilian ports, either because they have high platforms in relation to the docks or because of their minimal dimensions, do not have the physical conditions for the application of this concept.

As port facilities are reformulated and adjusted to modern operational concepts, the 1966 legislation may find the groundwork necessary for its implementation.

Likewise, the formation of stowing enterprises, the incorporation of the operational categories (stowage and longshoremanship) into one and oly category (loading and unloading operators) meet with veritable barriers in physical and operational conditions.

In Suape, however, where facilities will be completely new, all conditions will exist for the easy application of this operational concept.

Toward this end, and as a result of the analysis of advantages and restrictions in leasing port areas by type of cargo and by lessees, we can infer for Suape the possibility of arriving at an operational and charging simplification.

It will be necessary to consider the warehousing which regulates port flow as an operational consequence, exempting it from charges for a compatible period in 1st line warehouses, then removing the cargo to 2nd line warehouses at the owners' expenses at the end of such period, when it will be subject to the charges.

Except in relation to salt, shipowners are not justified to lease port areas or facilities to operate with bulk cargoes; however, for general cargo, this is perfectly justified and should be aimed at as a major factor of stimulation maritime traffic in coastal shipping.

The leasing of areas and port facilities can and must be considered for exporters and importers, depending on each case, particularly where bulk cargoes are concerned.

As regards shipping agents, or brokers, the leasing of areas or facilities is not justified, except in certain cases and with much restriction.

The flow-regulating warehousing during traffic periods and at warehousing areas areas inside the ports, considered as a consequence of port operations, should not be directly remunerated. Beyond the limits of flow regulation, cargoes should then be removed to 2nd line warehouses, at their owners' expenses, as per 1966 legislation.

Warehousing areas for general cargo transported by coastal or long-run ships, in the zone adjacent to the docks, may be leased to shipowners or to a pool of shipowners, to whom the port authori-y should only charge a tax per tonnage per meter/month of occupied berth, at inversely proportional rates, that is, having decreasing values for the higher ranges of the recorded indices and increasing values for the lower ranges. These are the only taxes that should be charged by port authorities to the leasers of warehousing areas and facilities, and their value should be carefully studied for each case.

At the remaining areas of the collective port, leasing will occur, in the whole or in part, through mooring, the occupied areas being under the control of shipowners or their representatives, and utilization taxes being charged in terms of tonnage/meter/day at higher values than those for the permanently leased areas.

Utilization of cranes and other equipment belonging to the port administration should be contracted for per day of 24 hours or fraction of day, and equipment should be operated by the shipowners personnel or stowing company, duly licensed for such work and registered by the port authorities.

Security services at the warehouses should be left to the shipowners, and those at the port and free areas should be the responsibility of the Port Administration.

Special facilities for bulk cargoes in the area for collective use, when leased to third parties, should be charged for in the same way as port taxes charged to the lessees - importers and exporters.

Consequently, acting in this manner, the port administration in Suape (as in other ports where conditions permit it), should act in an executive manner only in those suppletory cases which correspond to random and sporadic stay of shipowners at the ports, services being contracted for with these in a like way, at higher rates, and operations being subcontracted for with stowing companies. Even here, however, the warehousing areas occupied by the cargo should remain, wherever possible, under the control of the shipowner's representatives.

The Port Administration should be responsible for preservation and maintenance services.

Cargo brokerage and booking of space aboard ships should be done directly by shipowners, using the leased 1st line warehouses; the interference of dispatching agents should no longer be permitted.

In this case, for the establishment of the occupation rates to be charged in the collective areas for berths offered, careful studies should be made as regards frequency of shipowners in Suape's collective areas.

The leasing of the collective area carried out in this manner shall imply that a previous analysis will be made of the economical and organizational structure of lessee shipowners, importers and/or exporters, who attend the port with a significant frequency, in order to determine their ability as entrepreneurs.

The basic condition for leasing the areas destined for collective use would be the attainment of total integration of modes of transportation, the lessee seeing to it that cargo is received and delivered from door to door.

The above recommended operational system should find, in 1st line facilities, areas the main purpose of which is the obtention of maximum operational speed.

This means that the 1st operational line is characterized by vast operational areas, warehousing buildings and other not much significant covered areas, plane facilities at the dock level, as near to it as possible, with no preoccupation with the utilization of warehousing areas, but with ample preoccupation with circulation areas, which should provide for great ease of movement.

2nd line facilities would have the opposite characteristics, that is, a maximum utilization of warehousing areas with only a secondary preocupation with operational speed.

The organization and training of cargo handling teams for loading and unloading may be considered as one of the implantation tasks for the Suape port facilities; it should avoid the traditional vices and should be based on the 1966 legislation.

TABLE 4/1 - SOLID BULKS

ANALYSIS OF ADVANTAGES AND RESTRICTIONS OF LEASING PORT AREAS BY TYPE OF CARGO AND LESSEE

A - Iron Ore

1 - SHIPOWNERS

Leasing by shipowners does not make sense, since there are many shipowners in a free international freight market, while the facilities are unified, in the hands of the port authority or exporter.

Even if coastal shipping traffic improves in the near future, leasing by shipowners would still not be justified, since there will always be only one facility for several shipowners, and the external market should be maintained, since it will not be replaced by the internal market.

2 - SHIPPING AGENTS

Leasing by shipping agents does not make sense for the same reasons and because of the fact that it is the international contracts that dictate procedures.

3 - EXPORTERS

Exporters practically already have their own storage areas. When there are several exporters, in view of the collective nature of the facility, the operation should be performed by the port authority, except if they form a pool and enjoy the advantages mentioned in 5. In any case, payment for occupation of storage areas, in the limits of flow regulation, is not justified.

4 - IMPORTERS

Importers should have the obligation and privilege of operations and storing areas in terminals of their own. For instance, Cosipa. In this case, the port authority should not interfere, except for charging for utilization of access channels to the port itself, only where these have been open and/or are maintenanced by port authorities.

5 - PORT ADMINISTRATION

The Port Administration should manage operations only in those cases where it is necessary to attend to several exporters, except in those ports where they form a pool for this purpose, in which case the need for Port Administration management ceases. In this case, the pool

TABLE 4.1 - SOLID BULKS

A - Iron Ore - (continued)

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becomes the facilities lessee, with a view to the mere amortization of the capital and formation of a fund for re-equipping and expansion. In any case, payment for occupation of storage areas, in the limits of flow regulation, is not justified.

REMARK - Iron ore is a specific subject, with its own characteristics, presenting only three aspects:

1) Export at Tubarão, where only the exporter has total control of the link.

2) Export at Rio, where APRJ manages the facilities. The solution suggested in 5 might possibly be adequate and satisfactory for Rio.

3) The case of coastal navigation importers, where the solution is outlined in 4.

TABLE 4.1 - SOLID BULKS

ANALYSIS OF ADVANTAGES AND RESTRICTIONS OF LEASING PORT AREAS BY TYPE OF CARGO AND LESSEE

B - Coal

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1 - SHIPOWNERS

Importers withhold and should withhold import terminals individually or in pool. As for export terminals, they shall be managed by port authorities or by pool of exporters. Thus, it wouldn't make sense for shipowners to manage terminal facilities.

2 - SHIPPING AGENTS

Leasing by shipping agents makes sense only in those cases of non-special facilities, where they can operate as substitutes of port authorities in that range of marginal demand which does not require special facilities. For instance, CDS (coal for CMG). Again there is no justification for charging warehousing fares, within the limits of flow regulation.

3 - EXPORTERS

Leasing by exporters occurs in the particular case of Imbituba, the only coal exporting port. They make an export pool, by formation of stockpiles. The operation is performed by the port authority, which coordinates the formation of the pool's stockpiles in the area of port facilities.

Once again the charge for occupation of warehousing areas within the limits of flow regulation is not justified.

4 - IMPORTERS

Importers should have the obligation and privilege of operating their own individualized facilities or collective (pool) facilities.

The port authority should not intefere at all with the operations, except for charging for utilization of channels, etc., in a manner similar to that suggested for iron ore.

TABLE 4.1 - SOLID BULKS

B - Coal - (continued)

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5 - PORT ADMINISTRATION

The Port Administration should manage operations only in those cases where the demand for services does not require special installations, that is, operation of marginal quantities, since, where demand justifies specific installations, operations should be managed by individual importers in their own or collective facilities. In no case is the charge justified for occupation of warehousing areas, within the limits of flow regulation.

REMARK - Coal is also a specific item, with its own peculiar treatment, and should, in the case of long-run transportation, be handled by importers in their own or pool terminals, in the case of collective facilities. In the case of coastal navigation, for exports, the port authority (as in the particular case of Imbituba) should coordinate the operation, which might be delegated to the pool; for imports, see the cases foressen in 4 and/or in 2.

TABLE 4.1 - SOLID BULKS

ANALYSIS OF ADVANTAGES AND RESTRICTIONS OF LEASING PORT AREAS BY TYPE OF CARGO AND LESSEE

C - Wheat

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1 - SHIPOWNERS

Leasing by shipowners does not make sense, since the wheat storage system, in commodatum (ensilage-milling), generally obviates the need for port warehousing and, where it occurs, it is initiated by port authorities, because of the nature of facilities, their specialization, investment size, etc.

2 - SHIPPING AGENTS

Leasing by shipping agents does not make sense for the same reasons in 1.

3 - EXPORTERS

The market is regulated by the Bank of Brazil, and coastal shipping is regulated by the crop flowage policy, according to regional demand, exporters not having to control port warehousing areas since they already have them for milling purposes.

4 - IMPORTERS

Leasing by importers does not make sense, as in 3, because the market is regulated by the Bank of Brazil.

5 - PORT ADMINISTRATION

It is up to the Port Administration to operate the system, keeping the necessary flow-regulating stock in port silos, which distribute the wheat to private mills, and charging taxes to pay itself for the operation, but not charging for warehousing within the limits of flow regulation. Implementation of port silos is subject to the size of wheat producing hinterlands, and not necessarily in all ports.

REMARK - As the Bank of Brazil withdraws from the current control, due to the self sufficience of the domestic production, the formation of pools of exporters and/or importers may be justified, for the operation of port silos, without any charges for flow-regulating warehousing.

TABLE 4.1 - SOLID BULKS

ANALYSIS OF ADVANTAGES AND RESTRICTIONS OF LEASING PORT AREAS BY TYPE OF CARGO AND LESSEE

D - Cereals and similar (1)

1 - SHIPOWNERS

Leasing by shipowners is not justified, since they haven't conquered the coastal shipping traffic, and are limited to the export market abroad, where several shipowners operate during seasonal periods.

2 - SHIPPING AGENTS

Leasing by shipping agents is not justified, since the operation of installations can only be attributed to exporters and/or port authorities, according to their level of qualification.

In this case, not even the interference of shipping agents for the engagement of cargo is justified, since international contacts for export are carried out directly by exporters.

3 - EXPORTERS

Leasing by Exporters occurs at certain ports, which already lease storage areas in 2nd line warehouses of port facilities. Exporters keep their own warehouses, outside of these facilities.

In some cases, operations are performed at the sole responsibility of the exporters themselves and, in other cases, they are managed by the port wuthority; therefore, there is no standardization of the matter, each case being adjusted to local and/or institutional conditions. In the case of many exporters and shortage of shipping facilities, pools were formed (as in Santos) for the operation and utilization of the areas.

Leasing of the entire complex (warehouses and operational services) is justified to large-scale individual exporters or pools, with a view to obtain scale savings in operational terms. (In these cases, operations must of necessity be performed by an outside stowing entity).

It is recommend, in these cases, to allow exporters the liberty to select the stowing entity offering the greatest advantages.

Management of port operations by port authorities is not justified in this case, and much less the charge for warehousing within the limits of flow regulation.

TABLE 4.1 - SOLID BULKS

D - Cereals and similar (1) - (continued)

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4 - IMPORTERS

Leasing by importers is not justified, since it is a matter of several importers limited to the instances of coastal shipping.

5 - PORT ADMINISTRATION

Leasing by the Port Administration is justified only in a suppletory manner, in the cases where no pool has been formed, in spite of the incidence of several small importers, and in the cases of such large installations that they can absorb the entire export demand. Even here, however, charging for warehousing within the merely flow-regulating limits is not justified.

REMARK - At present, with the exception of COTRIJUI (SERRANA) in Rio Grande, there are no special installations of the size required by the case in the several Brazilian ports.

Where similar projects are being developed, as in the case of Santos and Rio Grande, there are two options:

- management of facilities by port authorities (provided they can absorb the entire cargo handling), or
- management by the entity implementing the project, as in the case of COTRIJUI, where there is no room for interference by the port authority, except in charging for utilization of access channels and turning basins, when these are open and maintenanced by said authority.

In any case, within the limits of flow regulation, the charging for warehousing is not justified.

NOTE: (1) Includes corn, rice, chippings, pollards and various pellets.

TABLE 4.1 - SOLID BULKS

ANALYSIS OF ADVANTAGES AND RESTRICTIONS OF LEASING PORT AREAS BY TYPE OF CARGO AND LESSEE

E - Fertilizers

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1 - SHIPOWNERS

Leasing by shipowners is not justified, since it is a matter of several shipowners acting in a market linked to international contracts, for importing purposes.

2 - SHIPPING AGENTS

Leasing by shipping agents is not justified, for reasons similar to those indicated in the analysis of cereal cargo, this case being for importation and not exportation.

3 - EXPORTERS

Leasing by exporters is not justified as far in the future as we can see, since fertilizers are an import product.

4 - IMPORTERS

Certain importers already withhold and should, as much as possible, keep import terminals individually. Where they do not have one, they can lease, individually or in a pool, special or adapted port facilities.

5 - PORT ADMINISTRATION

The situation is similar to that analyzed in the case of cereals, with the only difference that here we deal with imports, not exports.

REMARK - At present, with the exception of Santos (Conceiçãozinha), there are no special installations at Brazilian ports, and the trend is for the production to replace imports of fertilizers by raw materials imports; the operations here will constitute cases similar to those of coal and liquid bulks.

TABLE 4.1 - SOLID BULKS

ANALYSIS OF ADVANTAGES AND RESTRICTIONS OF LEASING PORT AREAS BY TYPE OF CARGO AND LESSEE

F - Steel Mill Products

1 - SHIPOWNERS

Leasing by shipowners is not justified at present, since there are various Brazilian and foreign shipowners. As coastal shipping traffic improves, which is expected to happen by 1980, leasing might be justified to the extent that maritime transportation is performed by shipowners specialized in all types of bulk.

2 - SHIPPING AGENTS

Leasing by shipping agents is not justified, because the characteristics of the export market do not regulate the type of ship, space being booked on them according to the opportunity, there being, therefore, no specialization of agents as this type of cargo is concerned.

3 - EXPORTERS

This is a recent, expanding market, overloading ports not prepared for this type of operation, which requires extensive areas with ground support for large overloads, a detail which is not available in domestic ports. By the nature of the operations, since the cargos demand large areas and bring great overloads, the ideal would be the perfect co-ordination of the train-port-ship system; the best indication is for the exporter himself to perform such co-ordination, since he is the one who commercializes both the product and the freights. Hence, the leasing of areas and port facilities is justified to individuals or to pools, and so is the leasing of railroad cars, wherever possible, with the purpose of permitting, as much as possible, shipping operations directly alonside the ship. Particularly in this case, there should be no charges for warehousing within ampler limits of flow regulation.

4 - IMPORTERS

Leasing by importers is not justified, since this is eminently an export item; at the moment, imports are a random and sporadic fact, in small coastal shipping instances.

Once it is established as a coastal cargo item, as is projected for 1980, leasing still is not justified, since, in this case, it is cargo for diffused consumption.

TABLE 4.1 - SOLID BULKS

F - Steel Mill Products - (continued)

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5 - PORT ADMINISTRATION

Leasing by Port Administration is justified for the same reasons expounded in the analysis of iron ore cargoes.

REMARK - This being a recent market, and ports not being yet prepared and adequately equipped for such operations, becoming, in the medium run, one of the main products of the "general cargo" type, but being treated operationally like bulks in specific terms, more than any other, attention is justified toward integration of the link, the utilization in the form of lease to exporters of areas and facilities for individual or collective use taking on great importance. Another special emphasis must be given to the charging for permanence in storage flow areas, which, due to the nature of the cargo and its market value, should have wider limits, the necessary link co-ordination notwithstanding, particularly since it is expected to become an important item by 1980 in terms of coastal shipping.

TABLE 4.1 - SOLID BULKS

ANALYSIS OF ADVANTAGES AND RESTRICTIONS OF LEASING PORT AREAS BY TYPE OF CARGO AND LESSEE

G - Salt

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1 - SHIPOWNERS

Leasing by shipowners of their own export and import terminals or of port areas and facilities is justified, since the greater part of them are components of the entire link. In the case of utilization of port areas, the cost of warehousing within the limits of flow regulation should not be charged.

2 - SHIPPING AGENTS

Leasing by shipping agents is not justified, since these usually are the shipowners themselves, otherwise the criterium indicated in 1 shall prevail.

3 - EXPORTERS

Since we are dealing with coastal shipping for export, and since the majority of exporters are components of the link, their having their own terminals is justified. The same justification applies when they are limited to the condition of exploiters, for their leasing port areas and installations, individually or in pools. No charges should be made for warehousing within flow-regulating limits.

4 - IMPORTERS

Leasing by importers who are an integrating part of the complete link is justified by the same criteria pointed out in 1 and 3. In other cases, utilization of areas and facilities is justified individually or in pools. No charges should be made for warehousing within flow-regulating limits.

5 - PORT ADMINISTRATION

Leasing by Port Administration is justified, for the same reasons expounded in the analysis of iron ore cargoes, this applying also to importers.

REMARK - Salt is a specific matter, for which the link is already better integrated than for other cargoes; therefore, installation of own terminals is justified here more than elsewhere, otherwise the lease of port areas and facilities is justified. However, the impropriety of industrialization or beneficiation in port areas and facilities should be emphasized; these should be utilized exclusively for purposes of cargo transfer, except in the particular case of own terminals, where the port-industry complex is acceptable, and in the case of availability of port areas (rare in Brazil).

TABLE 4.1 - SOLID BULKS

ANALYSIS OF ADVANTAGES AND RESTRICTIONS OF LEASING PORT AREAS BY TYPE OF CARGO AND LESSEE

H - Sugar

1 - SHIPOWNERS

Leasing by shipowners is not justified, for here we are dealing with several shipowners with freights linked to international contracts.

2 - SHIPPING AGENTS

Leasing by shipping agents isn't justified either, because IAA, together with Cacex, holds complete control of the producing and exporting market, with no interference from shipping agents.

3 - EXPORTERS

We already have a pool for exports, formed by Cacex and IAA, co-ordinated by a committee, which provides for total control, from the production level to the export trade. Whenever new port terminals are implanted, their absolute control will always be in IAA hands.

4 - IMPORTERS

Leasing by importers is not justified, since this is a export product.

5 - PORT ADMINISTRATION

Leasing by Port Administration is not justified, for the reasons indicated in 3. As new terminals are implanted, management of port facilities by the Port Administration is not justified. The charging of a port tax must be limited to utilization of port only, and only where there is opening and maintenance of access channels, turning basins and approachable docks. In these cases, taxes should cover amortization and maintenance expenses only.

REMARK - Since this is a new product where bulks are concerned, and because there is total control, from production levels to commercialization and in the entire transportation link, co-ordinated by the IAA/Cacex committee, any newly installed terminal must be operated by IAA, as in the system already adopted in Recife.

TABLE 4.1 - SOLID BULKS

ANALYSIS OF ADVANTAGES AND RESTRICTIONS OF LEASING PORT AREAS BY TYPE OF CARGO AND LESSEE

I - Sulfur

---

1 - SHIPOWNERS

Nihil

2 - SHIPPING AGENTS

Nihil

3 - EXPORTERS

Nihil

4 - IMPORTERS

Nihil

5 - PORT ADMINISTRATION

Nihil

REMARK - At present, roughly 260,000 tons are imported, with a great concentration in one specific port; the product, therefore, is not very significant for our purposes. However, projections for 1980 indicate importation of approximately 700,000 tons, which may be concentrated in a few ports, which would then make it significant. In this case, the implantation of import terminals must be oriented toward leasing and management by importers, individually or in pools. We leave out the specific form of leasing, since this is a product that has yet to be established in the market.

TABLE 4.1 - SOLID BULKS

ANALYSIS OF ADVANTAGES AND RESTRICTIONS OF LEASING PORT AREAS BY TYPE OF CARGO AND LESSEE

J - Manganese Ore

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1 - SHIPOWNERS

Leasing by shipowners is not justified, even with growth of coastal transportation for the supply of steel mills, in spite of the fact that it is a specialized type of transportation, due to the nature and location of facilities which, as those for domestic coal, are under the control of exporters and importers.

2 - SHIPPING AGENTS

Leasing by shipping agents makes sense only in those cases already mentioned in the analysis of coal cargoes.

3 - EXPORTERS

Leasing by exporters, even with growth of coastal traffic, will continue to occur in only one case - Santana do Macapá - unless other deposits are found. In the case of Macapá, the exporter already has total control of the link up to the loading aboard the ship, owning the port areas and facilities.

4 - IMPORTERS

The same justifications presented in the case of coal.

5 - PORT ADMINISTRATION

The same justifications presented in the case of coal.

REMARK - We are dealing here with a specific cargo, having its own characteristics, similar to those of domestic coal, but with possibilities of conquering coastal shipping by boat, in case the demand brought about by the increase in the steel production so determines it.

TABLE 4.2 - LIQUID BULKS

ANALYSIS OF ADVANTAGES AND RESTRICTIONS OF LEASING PORT AREAS BY TYPE OF CARGO AND LESSEE

A - Oil and Derivates

---

1 - SHIPOWNERS

Nihil

2 - SHIPPING AGENTS

Nihil

3 - EXPORTERS

Nihil

4 - IMPORTERS

Nihil

5 - PORT ADMINISTRATION

Nihil

REMARK - The problems relating to terminals and tank storage are under the direct or indirect interference of Petrobrás and/or CNP. There are some Petrobrás terminals, under complete operational control of the company. In these cases, taxes charged by port authorities are not justified, except where there are channels and basins open and/or maintenanced by the latter. Similar justification applied to the case of private terminals, where port auhtorities do not interfere with the operation. In the cases of facilities belonging tp the port administration, the formation of pools should be stimulated as much as possible, with a view toward operation or leasing on an individual basis, depending on the situation. No warehousing tax should fall upon tank storage within flow-regulating limits.

TABLE 4.2 - LIQUID BULKS

ANALYSIS OF ADVANTAGES AND RESTRICTIONS OF LEASING PORT AREAS BY TYPE OF CARGO AND LESSEE

B - Vegetable Oils

---

1 - SHIPOWNERS

Nihil

2 - SHIPPING AGENTS

Nihil

3 - EXPORTERS

Nihil

4 - IMPORTERS

Nihil

5 - PORT ADMINISTRATION

Nihil

REMARK - Here the amounts do not show any large scale port movement at present, nor do the amounts projected for the near future justify any alternative other than keeping operational management under the port administration, always with the same criterium of not charging warehousing within the limits of flow regulation. Since it occurs only at certain ports and is concentrated on one or few exporters, its transportation being the specialty of one or fe shipowners, it is to these (exporters or shipowners) that tanks and/or special facilities may be leased, or areas may be granted for the installation of new ones.

TABLE 4.2 - LIQUID BULKS

ANALYSIS OF ADVANTAGES AND RESTRICTION OF LEASING PORT AREAS BY TYPE OF CARGO AND LESSEE

C - Chemical Products

1 - SHIPOWNERS

The same comments in I-F as to justification of leasing by shipowners can be applied here.

2 - SHIPPING AGENTS

Leasing by shipping agents may come to be justified, in those cases where there may be a union of interests on the part of a large number of importers, or even of exporters or terrestrial transporters, provided this can represent an operational simplification along the line.

3 - EXPORTERS

Leasing is justified in Santos and Salvador by exporters concentrated on these ports, to the extent that, even with industries in the interior, they come to manage the transportation system up to the ship.

4 - IMPORTERS

Leasing by importers, since this cargo is for diffused consumption, with production centers in São Paulo and Bahia, is not justified, except at those ports where the importer plays a significant role and takes upon himself the total management of the transportation system up to the ship.

5 - PORT ADMINISTRATION

Leasing by port administration is justified, to the extent that importers, exporters or even terrestrial transporters do not play a role that justified leasing by them.

REMARK

In terms of long-run importation, this is a declining product cargo, in view of substitution of local production for imports. In terms of coastal shipping, Santos and Salvador will loom as exporting outlets, for consumers scattered along the coast. Since this is a product for which it is difficult to form a pool -- though, in the future, with national production, pools may be formed -- the trend might be for leasing by exporters (at production centers) or terrestrial transporters. The difficulty in forming a pool tending to disappear, its formation should be stimulated at the ports connected with significant consuming centers.

TABLE 4.3 - GENERAL CARGO

ANALYSIS OF ADVANTAGES AND RESTRICTION IN LEASING OF PORT AREAS BY TYPE OF CARGO AND LESSEE

1 - SHIPOWNERS

Leasing by shipowners of warehousing areas and of mooring berths and stowing services may be justified to the extent that the volume of cargo handled at the port and the frequency of ship arrivals recommend it, and the port capacity permits it.

In the case of container terminals, total operation by a pool formed by shipowners specialized in container transportation is justified.

2 - SHIPPING AGENTS

Leasing by shipping agents is justified only to the extent that they can congregate several small shipowners, acting then in the manner commented in 1, since they can divide a large warehouse in areas compatible with the handling of cargo in each warehouse without mixing the cargo of different shipowners inside the warehouse.

3 - EXPORTERS

Leasing is justified by exporters having a significant volume for the port, to the extent that such leasing represents better concentration of areas and better utilization of same. This solution is conducive only to a more economical use of areas, but it does not bring other benefits in terms of port operations, due to the intervenience of other entities (stowage, shipowner and port wuthority), therefore not providing total link simplification.

4 - IMPORTERS

Leasing by importers is not justified, since we are dealing here with various importers of diversified cargo through different shipowners. Leasing would imply managerial confusion and would hinder identification of responsibilities in cargo handling results, besides not contributing to unification of treatments along the link.

5 - PORT ADMINISTRATION

Leasing by port administration is justified only in a suppletory way and, even so, in those random cases which do not come under the scope of coments in 1 and 2. By random cases we mean those shipowners who only eventually call at the port, and those of deep-frozen cargo, since there are differences between the freezing systems of Brazilian and

TABLE 4.3 - GENERAL CARGO - (continued)

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foreign shipowners and their cargoes. The nature of the facilities and the above mentioned facts justify total operation by the port authority. Again in these cases there is no justification for charging for warehousing within the limits of flow regulation.

REMARK

The problem of leasing warehousing areas and/or port services for general cargo involves three aspects, as far as obtention of operational unity of the link is concerned: leasing of mooring berths, warehouses and stowing services. The leasing of warehousing areas, implicating berth utilization, has the advantage of operational ease due to their contiguity, in addition to reducing operational costs. However, only the availability of berths can permit their being compromised, which will vary from port to port. The leasing of stowing services is something to be attributed directly or indirectly to the shipowner, with a view to attaining unification of operational responsibility. In imports, the leasing of warehousing areas must be taken as a means of permitting the carrier (shipowner) to deliver the transported cargo to the consignee's door. In this manner, the shipowner will promote the dispatch of the cargo through customs and will provide for highway transportation to the consignee's address, with a view to link unification. The shipowner should not be permitted to charge for warehousing. In the cases of abuse on the part of the consignee, where established limits have been surpassed, the shipowner will have the cargo removed to warehouses for delayed cargo, belonging to the port authority, who is then entitled to make the primitive charge for warehousing and for costs of cargo removal. As regards exports, the system has the advantage of permitting ship space to be booked reasonably ahead of time at the warehouses themselves, which will allow for a better distribution of the cargo along the warehouse, as if it were stowed in the ship's hold, permitting stowage planning in such a way as to provide good operations, both in stowing services (at the shipping poin) and in disstowing (at destination).

Here again the shipowner should not be permitted to charge for warehousing, since advantages gained (both in imports and in exports) by the shipowner, through reduction of operational costs (suppression of checkings,etc.) and of costs related to a longer stay of the ship at the ports, already constitute a benefit justifying any cost resulting from the proposed system. When, for failures in the ship scheduling, the cargo stored in the warehouse is eventually not shipped, or for other reasons outside of the exporter's control, no additional charges will be made, the shipowner having, in his turn, the advantage of not being charged for the warehousing. A similar system should be adopted by shipping agents, in the cases indicated in 2, port authorities being assigned operation of the marginal, suppletory range of other cases, as indicated in 5. An adequate methodology should be carefully studied, particularly as regars leasing of warehousing areas connected with mooring berths.

TABLE 4.4 - SYNTHESIS OF THE ANALYSIS

SOLID BULKS

TYPE OF CARGO	SHIPOWNERS	SHIPPING AGENTS	EXPORTERS	IMPORTERS	PORT ADMINISTRATION	OBS.
Iron Ore	No sense	No sense	Justified individually or in a pool	Fully justified	Justified only when exporters are not organized into a pool	
Coal	No sense	Justified with serious restrictions	Justified provided organized into pool	Fully justified	Justified in marginal cases or when importers are not organized into a pool	
Wheat	No sense	No sense		No sense	Justified	
Cereals and similar	Unjustified	Unjustified	Justified individually or in pool	Unjustified	Justified in marginal cases only and when exporters are not organized into a pool	
Fertilizers	Unjustified	Unjustified	Unjustified	Justified individually or in a pool	Justified in marginal cases and when importers are not organized into a pool	
Steel Mill products	Not justified at present but may be considered for future coastal shipping cases	Unjustified	Justified individually or in pool	Unjustified	Justified in marginal cases and when exporters are not organized into a pool	

TYPE OF CARGO	SHIPOWNERS	SHIPPING AGENTS	EXPORTERS	IMPORTERS	PORT ADMINISTRATION	OBS.
			SOLID BULKS			
Salt	Justified provided they integrate the entire link (shipowner and producer)	Unjustified	Justified individually or in a pool	Justified individually or in a pool	Justified in marginal cases and when importers or exporters are not organized into a pool	
Sugar	Unjustified	Unjustified	Justified in the hands of IAA	Unjustified	Unjustified in terms of bulk facilities	
Sulfur						(1)
Manganese Ore	Unjustified	Justified with restrictions	Already leased	Fully justified	Justified in marginal cases and when the various importers are not organized into a pool	
			LIQUID BULKS			
Oil and Derivates						(2)
Vegetable Oils					Justified until concentrations of demand justify leasing by shipowners, importers or exporters	(3)

TYPE OF CARGO	SHIPOWNERS	SHIPPING AGENTS	EXPORTERS	IMPORTERS	PORT ADMINISTRATION	OBS.
			LIQUID BULKS			
Chemical Products	May come to be justified. Unjustified at present	May be justified with restrictions	Justified provided they control the link up to the ship	Unjustified, unless in cases where concentration occurs at a given port	Justified with restrictions	(4)
			GENERAL CARGO			
	Fully justified in the case of large shipowners	Justified with restrictions	Justified in very particular cases	Unjustified	Justified in marginal cases, suppletorily	

(1) Not considered due to the fact of being an insignificant product at the moment. In the future, leasing to individual importers or pool of importers may be justified.

(2) Products under the direct or indirect control of Petrobrás and/or CNP, there being no justification for third parties.

(3) Low demand products; should be analyzed by extension of treatment as significant concentrations occur.

(4) A cargo which may play an important role in coastal shipping.

TOMO II
PARTE I
5.0

5.0 PORT CONCEPT FOR SUAPE

5.0 PORT CONCEPT FOR SUAPE

5.1 BASIC OPTION

In the Study of the Port Concept for Suape, two basic ideas were initially compared: that of the construction of an Artificial External Port, following the conventional guidelines for this kind of work, and much in accordance with generally adopted trends in Brazilian ports, and that of an Excavated Port, of the kind more commonly used in Europe.

The option had already been established at the time the Proposal for the Studies was prepared, pointing out considerable advantages for the Excavated Port solution, since nature had endowed the region with a cordon of reefs parallel to and sufficiently distant from firm land, which acted as a veritable protective structure, a shelter inside which peaceful conditions existed for installaing a port.

There was the initial fear, motivated by comments generally made, that the zone sheltered by the reefs might have a rocky bottom, a fact which would prevent the economical performance of the excavation work required to give access to the larger ships. The studies that could then be carried out, and observations carefully made on the spot, convinced TRANSCON that the Excavated Port solution was more and more justified, and toward that end was their proposal developed.

This guideline having been established, and since the creation of an Industrial Complex as intended, the need arose for a breakdown of the adopted option: either a collective port facility would be built, as the converging point for all cargo destined to or coming from the various industries, or private terminals would be provided for these industries, the collective portion of the port being reduced to a minimal length which would serve to handle certain specialized cargo and would be offered those industries whose volume of cargo handling did not justify building a private terminal, and also, in the case of large industries, for handling cargo assigned to them during the construction and assembly periods.

Studies made at the time pointed to the economical and operational advantages of the private terminal solution for the several manufacturing concerns which, though having to build their respective mooring points, were assured the possibility of a considerable saving in maritime freight costs and of avoiding sizeable expenses with the transportation and handling of raw materials needed in their processing work, from the port to their plants and in the shipping of their manufactured products. The economies realized by these industries where maritime freight is concerned are based on the fact that they are able to schedule the arrival of ships carrying the raw materials they require or their manufactured products, eliminating waiting time and the resulting demurrage surtaxes, and reducing the time of loading and unloading operations. As an immediate result, there is the fact that the industry would then be elligible to the premium offered by freight charts, known as "dispatch money."

All this being considered, the basic assumptions were established for the Suape port concept, that is, the adoption of an excavated port with private terminals and a collective docking section, for handling sugar, alcohol, molasses and vegetable oil shipments, as well as for unloading and shipping wheat, capable of handling Roll-on/Roll-off ships and Lash and Sea-Barges in its initial phase, with ample conditions for expansion.

5.2 DEVELOPMENT OF ALTERNATE STUDIES

Once the Suape port option was established, studies for the port aligment were carried out. The work started with the idea of taking advantage of the routes afforded by the Massangana and Tatuõca rivers, particularly the latter, and of cutting an opening in the reefs, in the area practically opposite to the confluence of the two rivers, but keeping the existing bar next to the Cape of Santo Agostinho. Figures 2xx-A, B and C show the variations of this theme which were studied, always with the idea of giving special attention to the utilization of the Tatuõca river route as the main port channel, while utilization of the Massangana river was restricted to the section nearer its mouth.

The development of hydrographic and geophysical studies, which showed the occurence of a higher rocky bottom in the Tatuõca river area, caused the study to turn in the direction of utilizing this river only at the section nearer the mouth, and of aligning the port according to a main channel pointing to the middle of the Tatuõca island. The port entrance was still to be through an opening in the reef line, as in the previous solution; Figures 2xx-D, E and F show the alternatives which were then studied.

The nature of the terrain crossed by the Tatuõca river put an end, from then on, to the idea of utilizing this river in the Suape port alignment, particularly in its upstream section, due to the economic difficulties in performing dredging work there to give the channel the necessary depth for navigation; this, however, did not prevent this land from being integrated in the landfilling areas of the port, on both sides of the port's center-line.

The existence of the Manẽ Velho and Ipojuca rivers, oriented in the same direction of the route on the Tatuõca island, caused them to be considered also for the port's center line, and gave rise to a new alternative to the problem, shown on Figure 2xx-G, where, for the first time, the notion is introduced of closing the present bar and cutting two entrance ways: one opposite the point where the Massangana and the Tatuóca rivers meet, another facing the confluence of the Manẽ Velho and Ipojuca rivers. This solution created better conditions for industries settling in the projected Industrial Complex, since a larger number of them would have a direct access to the sea.

This alternative aimed at exploiting the parallelism between channels and tried to obviate the difficulties met by the geophysical work in the Tatuóca river by reaching it with the South channel upstream only, where a geological fault affords good properties. However, in view of the difficulty of having two opennings, both from the hydraulical and economic viewpoint, the one-opening solution was again examined, with the analysis of the one-channel exploitation alternative, centered in the Tatuóca island, as shown in Figure 2xx-H.

Getotechnical research work that continued to be done showed the existence of extensive sandstone layers in the center line of the projected channel, which would cause serious difficulties in construction by dredging, and thus the contemplated alternative was completely invalidated; the previous alternatives were re-examined, now with the port channel oriented toward the Massangana river bed. Hence the study represented by Figure 2xx-I which, though it facilitates dredging work for opening the channel, was still subject to the same restrictions as the similar alternatives.

As field studies progressed, it was found that the Ipojuca river might provide for quite favorable conditions for port development, and this brought about the alternative shown on Figure 2xx-J. This, however, meant going back to the problem of two entrances for the port, near two isolated basins (those of the Massangana and the Ipojucá rivers), an important landfill area being obtained between them by filling the existing basin opposite to the "barreta" (small bar of the harbour). Although the arrangement was an interesting one from the viewpoint of landfill utilization, the very grave inconvenient remained of dividing the port in two different blocks and of requiring two access channels.

As the utilization of the Ipojuca river was already considered important, at this stage, for the Industrial Complex Maximum Occupation Plan, and in order to sidetrack the problem of two port entrances, a new alternative was studied, shown in Figure 2xx-K; here the Ipojuca river is made to flow into the utilizable section of the Tatuóca river, and the existing bar is widened.between the end of the reef line and the Cape of Santo Agostinho, so as to form the port entrance there. The location of the filled areas at the port was considerably more valuable in this alternative, with the filling of an important track near the reef line, but there were doubts in relation to the hydraulic problem of discharging the Ipojuca river into the final stretch of the Tatuóca, including port traffic problems in such a channel, the length of which was now increased.

The idea of having the port center line coincide with the Ipojuca river route was still convenient and a new alternative was examined, shown in Figura 2xx-L; here the two por entrances were kept, but the basins formed in front of each were interconnected by a channel located immediately next to the reef line. The basic orientation in this alternative was to concentrate at the basin facing the Ipojuca river those industries requiring the use of larger ships, while the basin facing the Massangana river would only meet this requirement at the beginning of the port channel.

In addition to the problem of requiring two entrances for the port, this alternative had the further restriction of allowing navigation of small ships only in the channel connecting the basins opposite the port, such as those vessels for internal traffic; thus, a ship carrying cargo for two different manufacturers located one in each area would have the leave the port and return to it through the other entrance.

In order to solve this situation, a new alternative was examined, represented by Figure 2xx-M; this, however, did not remove the main objections that could be made against the successive project studies.

Nevertheless, the problem was sufficiently ripe at this stage; the basic premises were the utilization of the Massangana and of the portion of the Tatuóca river nearest to the confluence, as well as of the Ipojuca river, the entrance to the port being located at one point only, midway between the two hydraulic basins.

Based on these conditions, and with the support of the then well advanced field studies, the final port concept for Suape was developed.

5.3 FINAL CONCEPT OF THE SUAPE PORT

From the results of hydrological and geophysical studies made in the Suape area, and bearing in mind the various alternate solutions examined for a port project in the region, successively proposed and criticized as described above, the final port concept was arrived at.

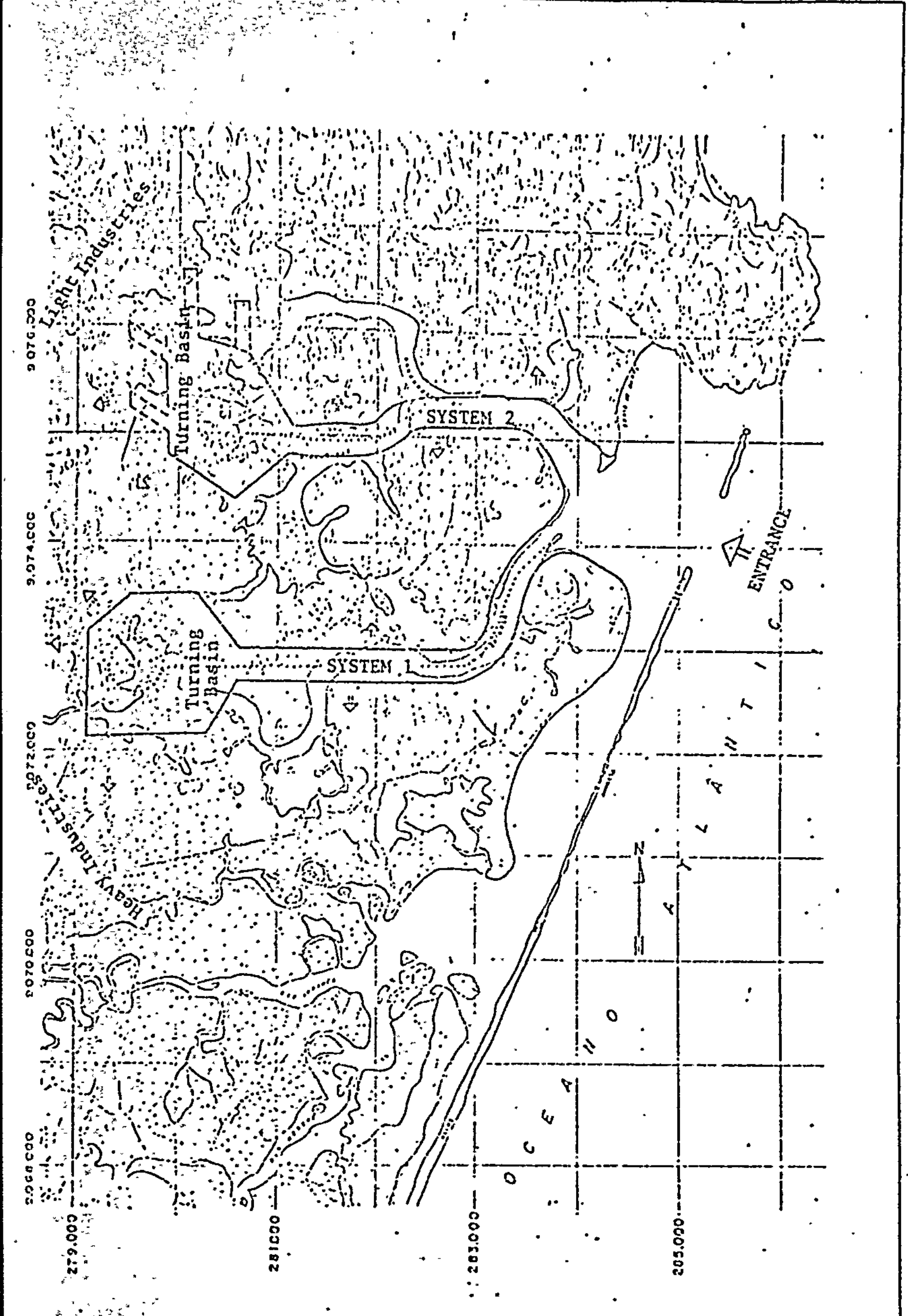
Access will take place via one entrance only, located near the present "barreta", next to which an ample basin will be initially dredged to a depth of -19.372 m in relation to CNG's zero, so as to allow for operation of ships up to 135,000 tdw. The two channels built along the Ipojuca and Massangana center lines will lead into this basin, one at each side, both with a depth equal to that of the respective basin; however, this depth decreases as the channels go inland, precisely because the ships that will operate at the extremity of the basins will be progressively smaller.

The port's Maximum Occupation Plan will be carried out in two stages, the first of which will be broken down into two phases which will be finished in 1980 and 1987, respectively.

During the first phase of the project's first stage, the port access basin will be dredged deeper, as well as part of the Massangana basin and the fore-harbour area and the basin created at the mouth of the Tatuóca river, and a channel will be dredged to a smaller depth for ouflowing of the Ipojuca river water; also projected for this first phase are the port protection work, the opening of the entrance, the closing of the present bar from the extremity of the reefs to the Cape of Santo Agostinho, in addition to dredging of the access channel and the building of an artificial beach, between the Northern breakwater protecting the port and the Cape of Santo Agostinho.

During the second phase of this stage, the port access basin will be dredged further, as well as the internal channels in the direction of the Massangana river basin and the pre-harbour area, whose depths will be enlarged, according to the project.

At the end of the second phase of the first stage, the acess basin, the pre-harbour area, the section of the North channel (Massangana) upt to Area III, and the basin at the mouth of the Tatuoca river will be dredged to depths required by the project, permitting the handling of ships of up to 125,000 tdw for the fertilizer plant and sugar terminal, up to 60,000 tdw for the wheat facilities, and up to 135,000 tdw for the cement export plant and oil import for the refinery.

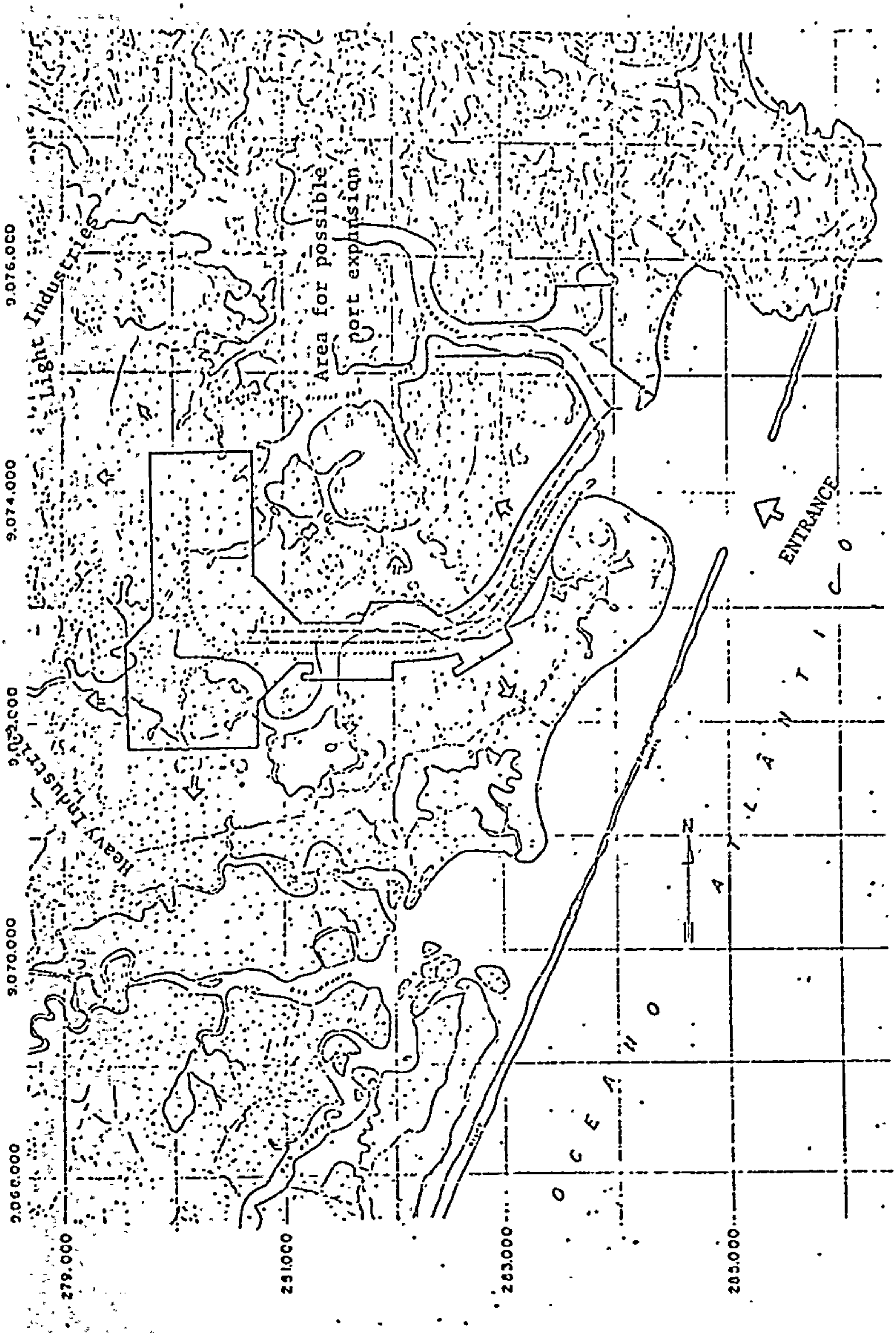


	Length	Width	Depth	Ship Type
System 1	[illegible]	[illegible]	[illegible]	[illegible]
System 2	[illegible]	[illegible]	[illegible]	[illegible]
Basin 1 Dia. 525m				
Basin 2 Dia. 450m				

Area 100ha Area 150 ha

diper

PRELIMINARY DRAWINGS FOR PORT CONCEPT STUDY



ESCALA GRÁFICA

.... Shallow draft ships

———— Medium draft ships

- - - - Deep draft ships

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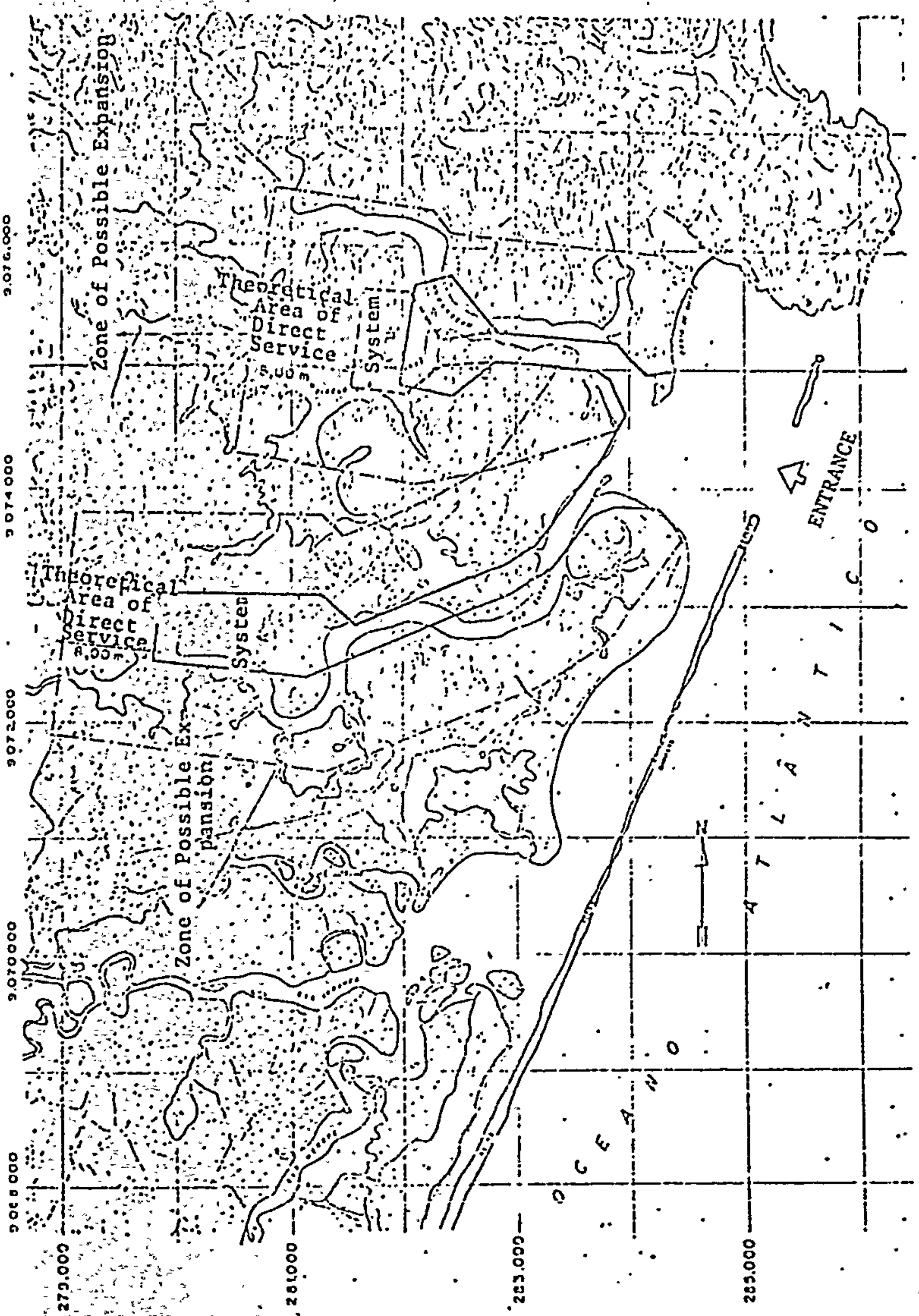
DE PERNAMBUCO

PRELIMINARY DRAWINGS FOR PORT CONCEPT STUDY



ESCALA GRAFICA

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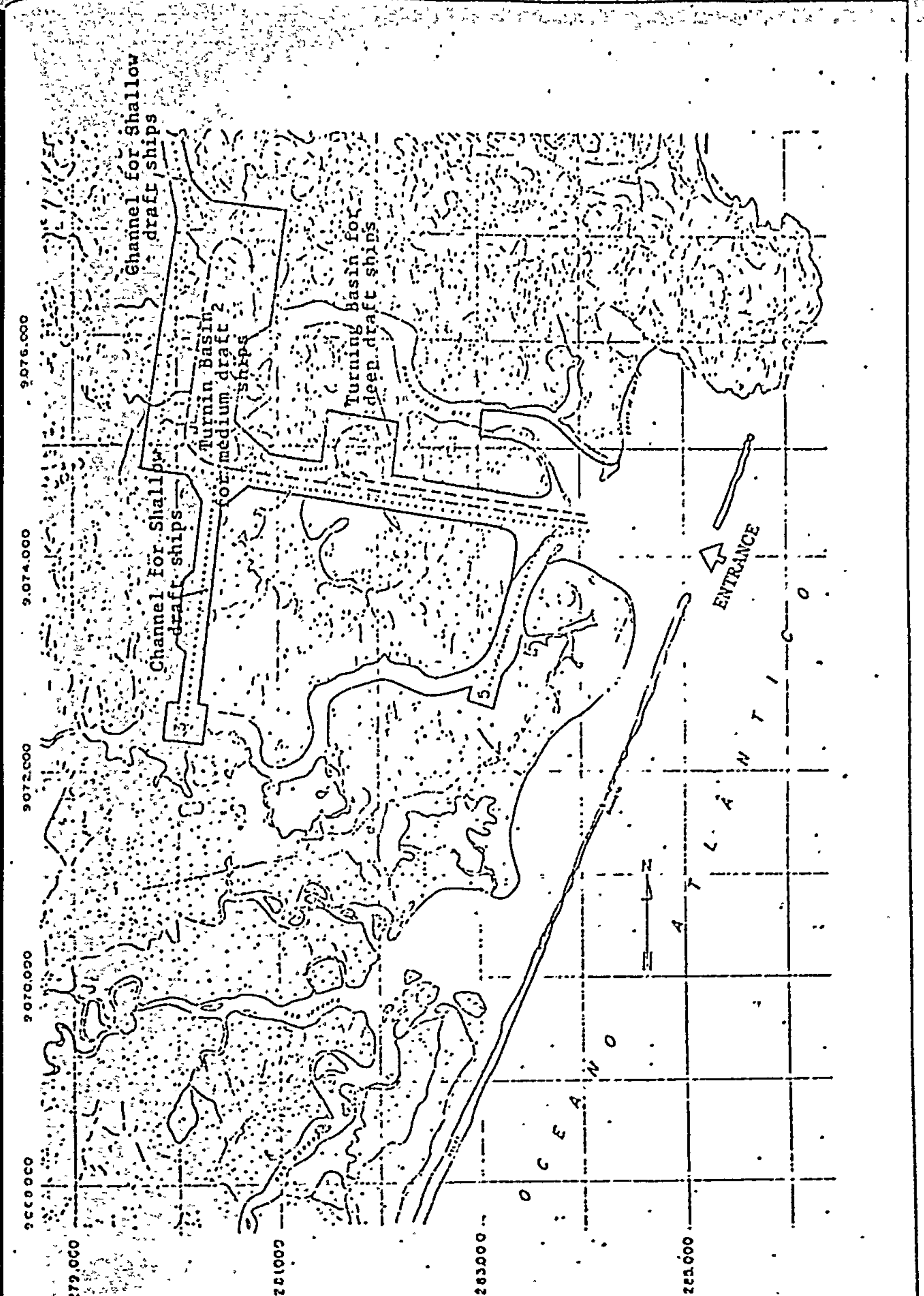
TRANSCON S.A

GOVERNO DO ESTADO DE PERNAMBUCO – [illegible]
COMPANHIA DE DESENVOLVIMENTO INDUSTRIAL DE PERNAMBUCO.
COMPLEXO INDUSTRIAL [illegible]

PRELIMINARY DRAWINGS FOR PORT CONCEPT STUDY

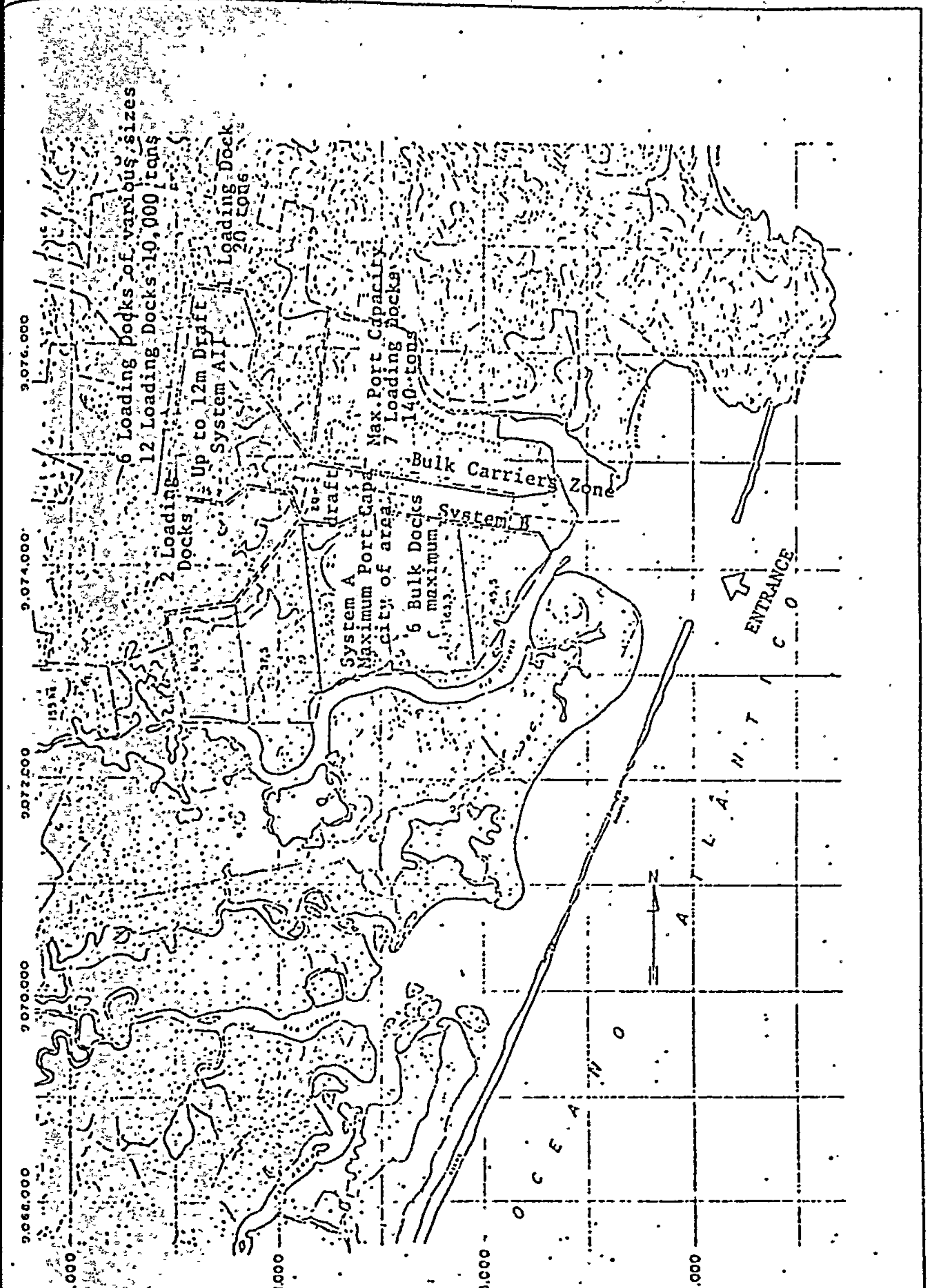


Turning Basin for deep draft ships
Waiting & Turning Basin for med.draft ships
Turning Basins for shallow draft ships
Avantages:
Turning basin serves area of good industrial use
Basin occupies flooded areas
Direct circulation of ships
Port perimeter of good utilization
Possibility of expansion.

diper

PRELIMINARY DRAWINGS
FOR PORT CONCEPT STUDY

...Shallow Draft Ships -.-.-Medium Draft Ships ----Deep Draft Ships



	Syst.A	Syst.B	Total
Dredging vol. (m3)			
Filling vol. (m3)			
Utilized dredg. vol (%)			
Dock perimeter (m)			
Usable ind'l area (ha)			
Max. nº of ships			

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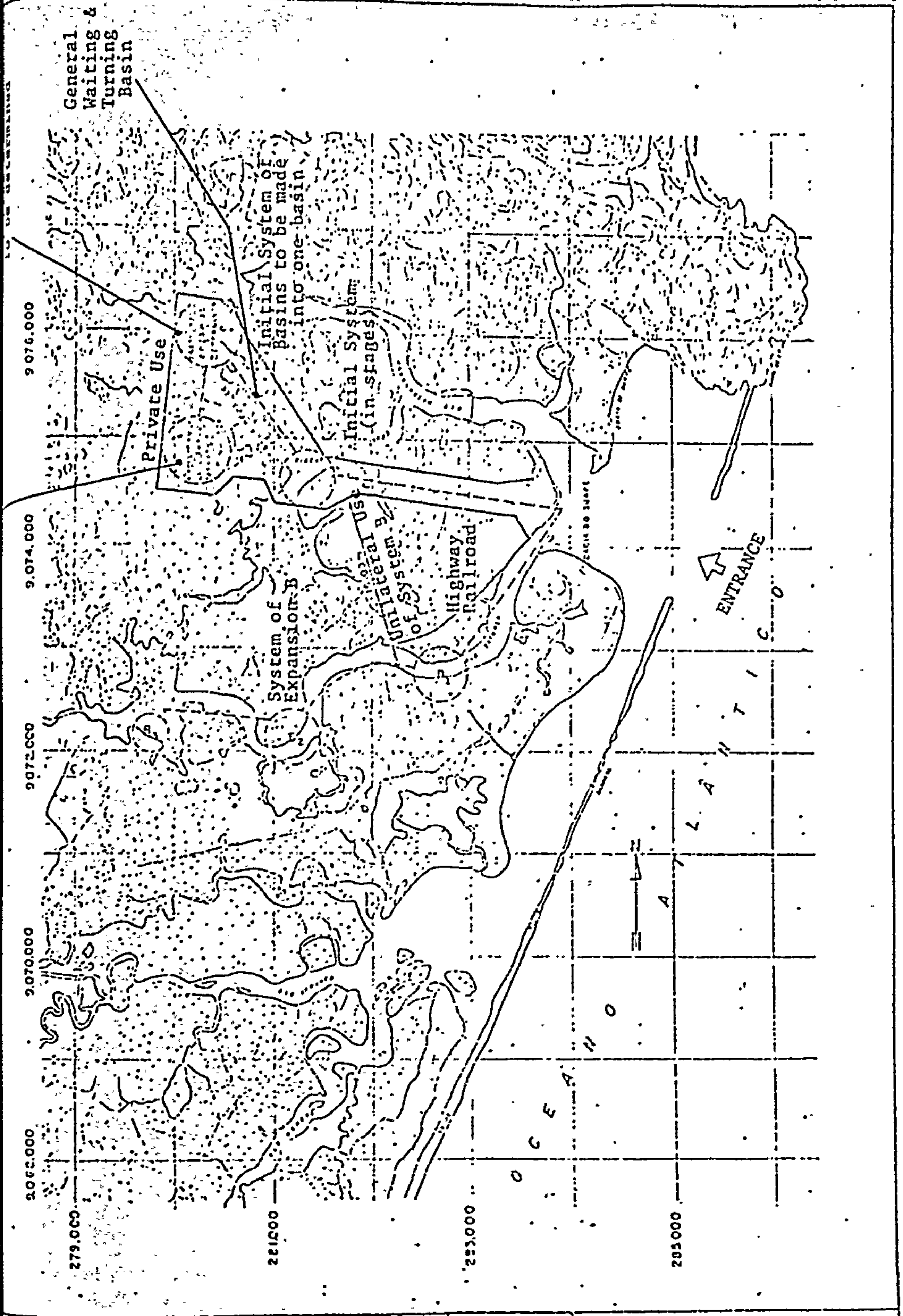
DE PERNAMBUCO

PRELIMINARY DRAWINGS FOR PORT CONCEPT STUDY



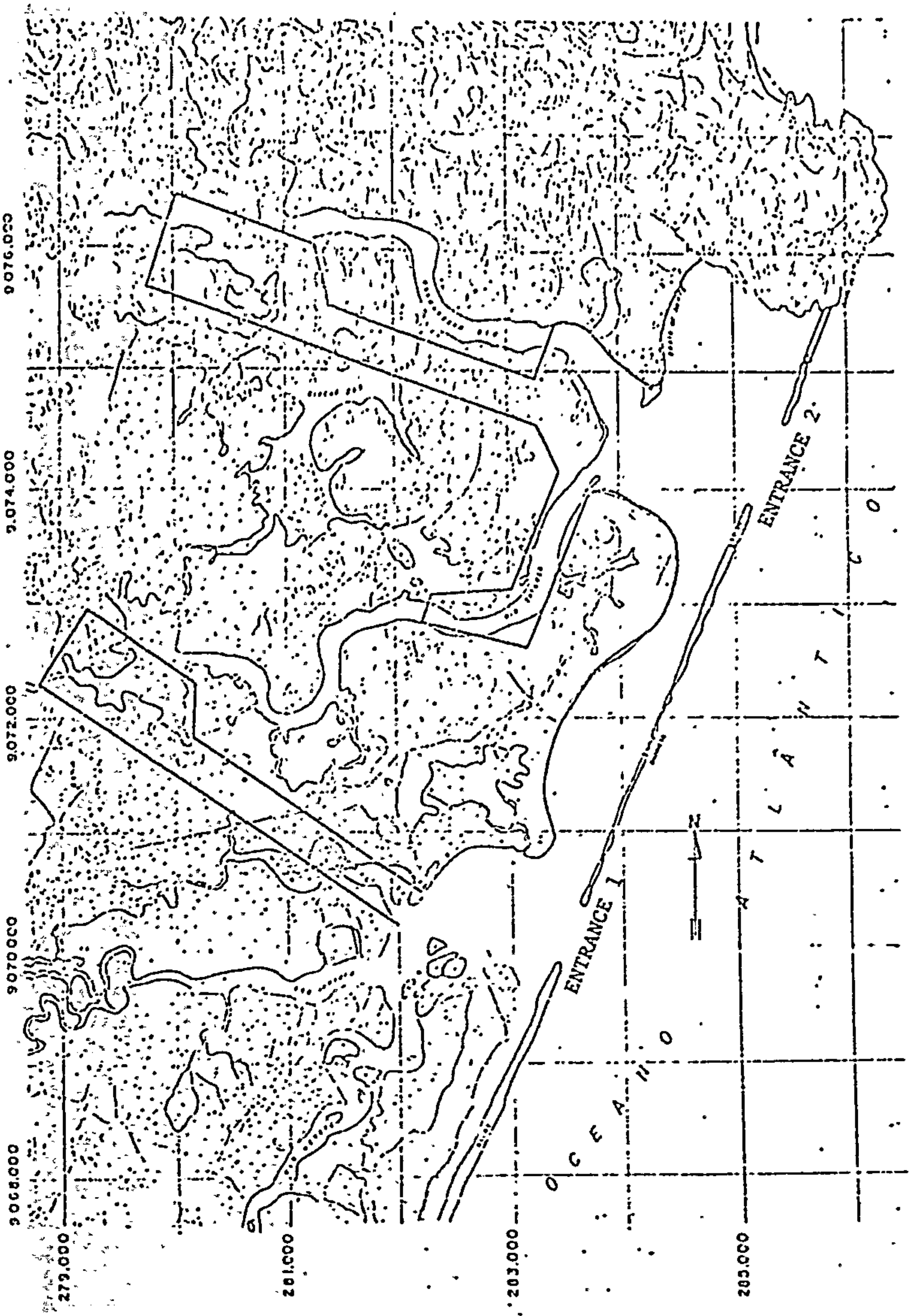
CONSTRUCTION STAGE 1:
- Maximum flebility of ship and industry type will have to be the <u>strategy</u> of the complex.
- Perimeter modulation of maximum utilization.

diper

TRANSCON S.A

COMPLEXO INDUSTRIAL DE SUAPE

PRELIMINARY DRAWINGS
FOR PORT CONCEPT STUDY



ESCALA GRÁFICA

Useful Industrial Area. est.4,410 ha
Port Area. est.375 ha
Total Area. 4,785 ha

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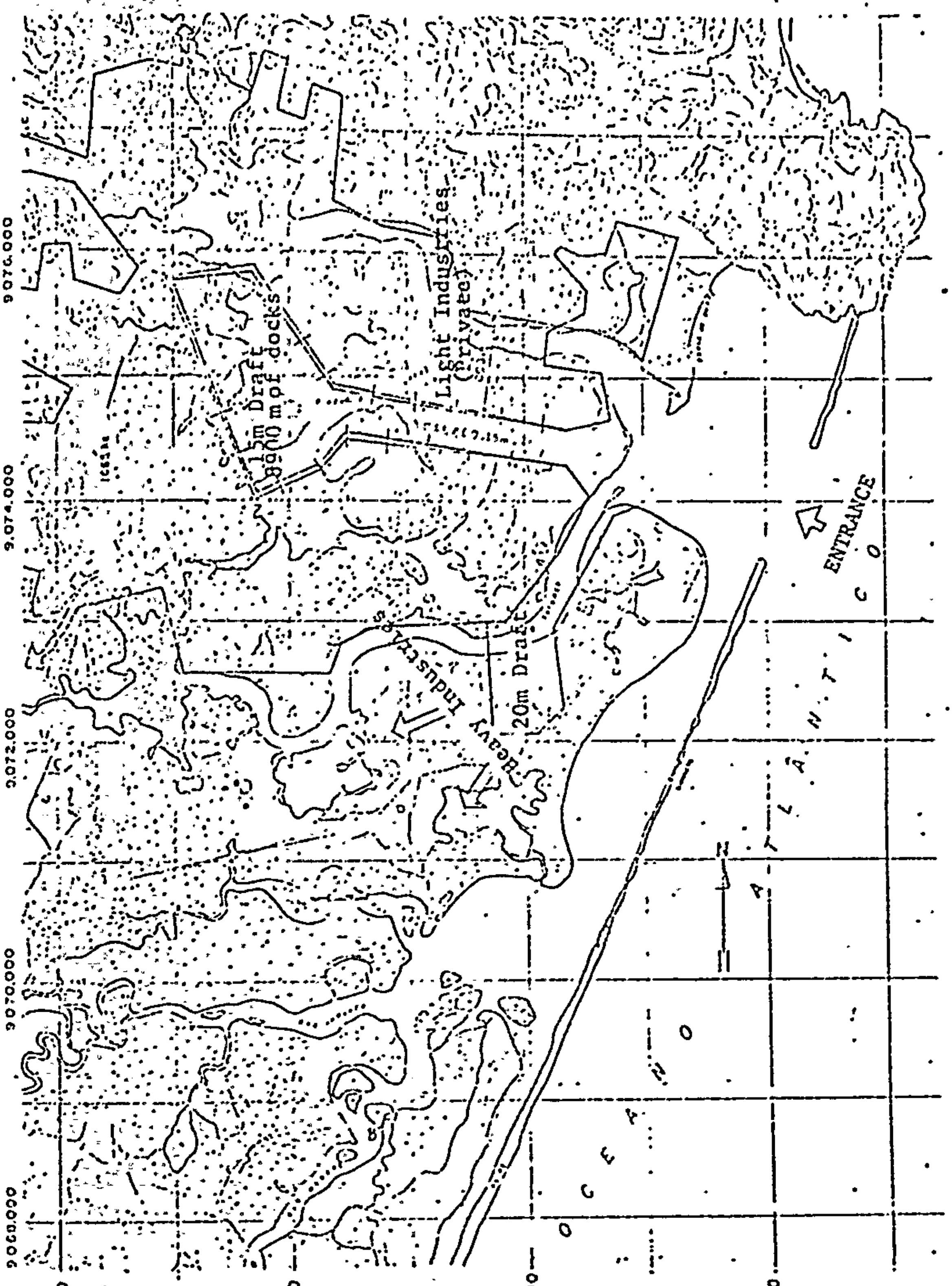
TRANSCON S.A

COMPLEXO INDUSTRIAL DE SUAPE

PRELIMINARY DRAWINGS
FOR PORT CONCEPT STUDY



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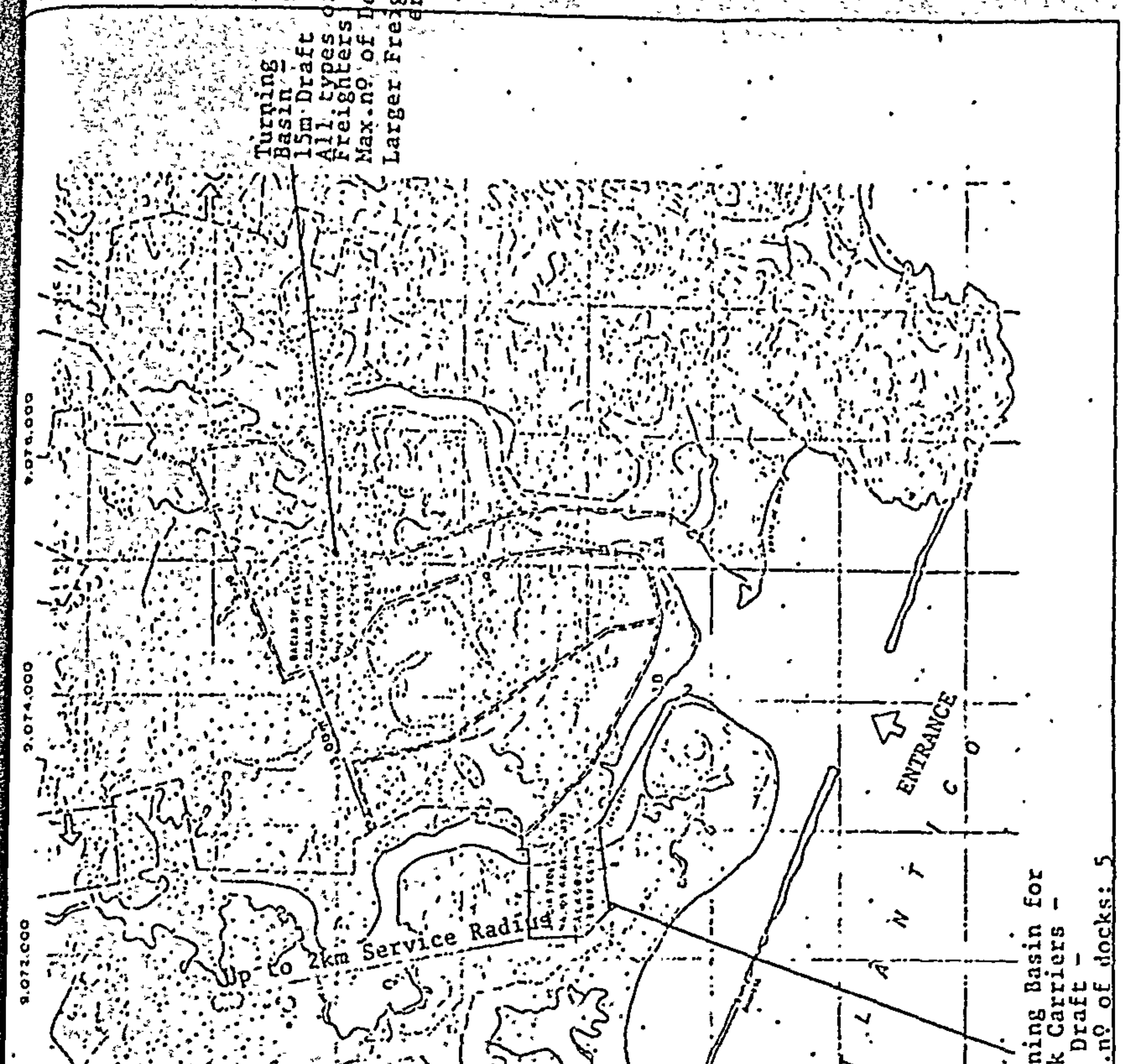
TRANSCON S.A

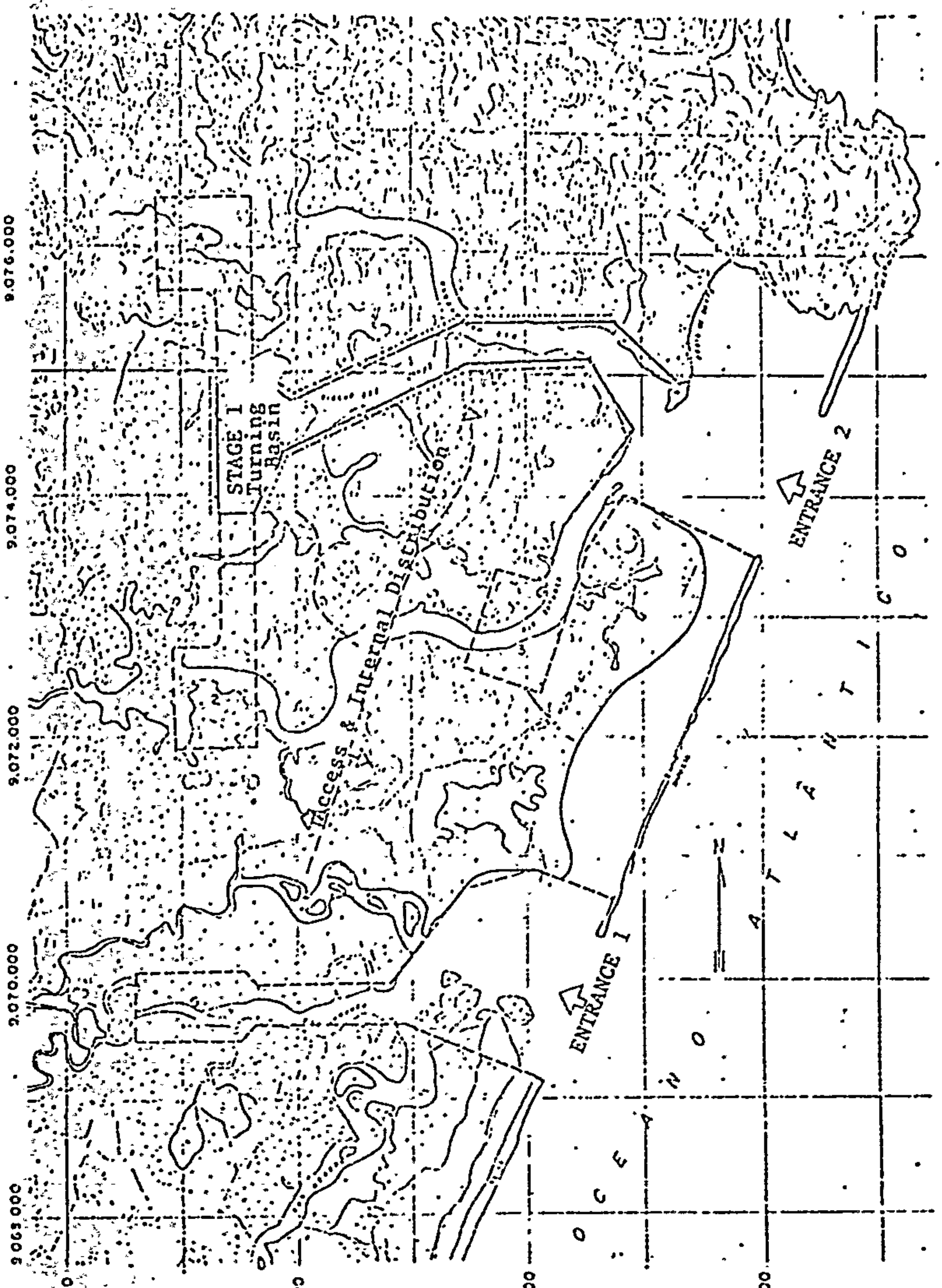
PRELIMINARY DRAWINGS
FOR PORT CONCEPT STUDY



stem A:
Dredging vol.: 23,989,000 m3
Fill volume: 3,980,000 m3
% Dredging vol.utilized: 1,7%
Dock perimeter: 9,450m
Useable Industrial Area. 1,499.5 ha
Ind,Area/Dock length ratio = 10,477.9m
Max.nº of ships. 40
stem B – Indeterminate.

diper

PRELIMINARY DRAWINGS
FOR PORT CONCEPT STUDY



ESCALA GRÁFICA

ssibilities of Stage 1:
Private Docks for Industries -.-.-.
General Cargo Docks -..-..-..-
Docks for Distribution of Raw Materials to industries not directly related to the port .....
Shipyard

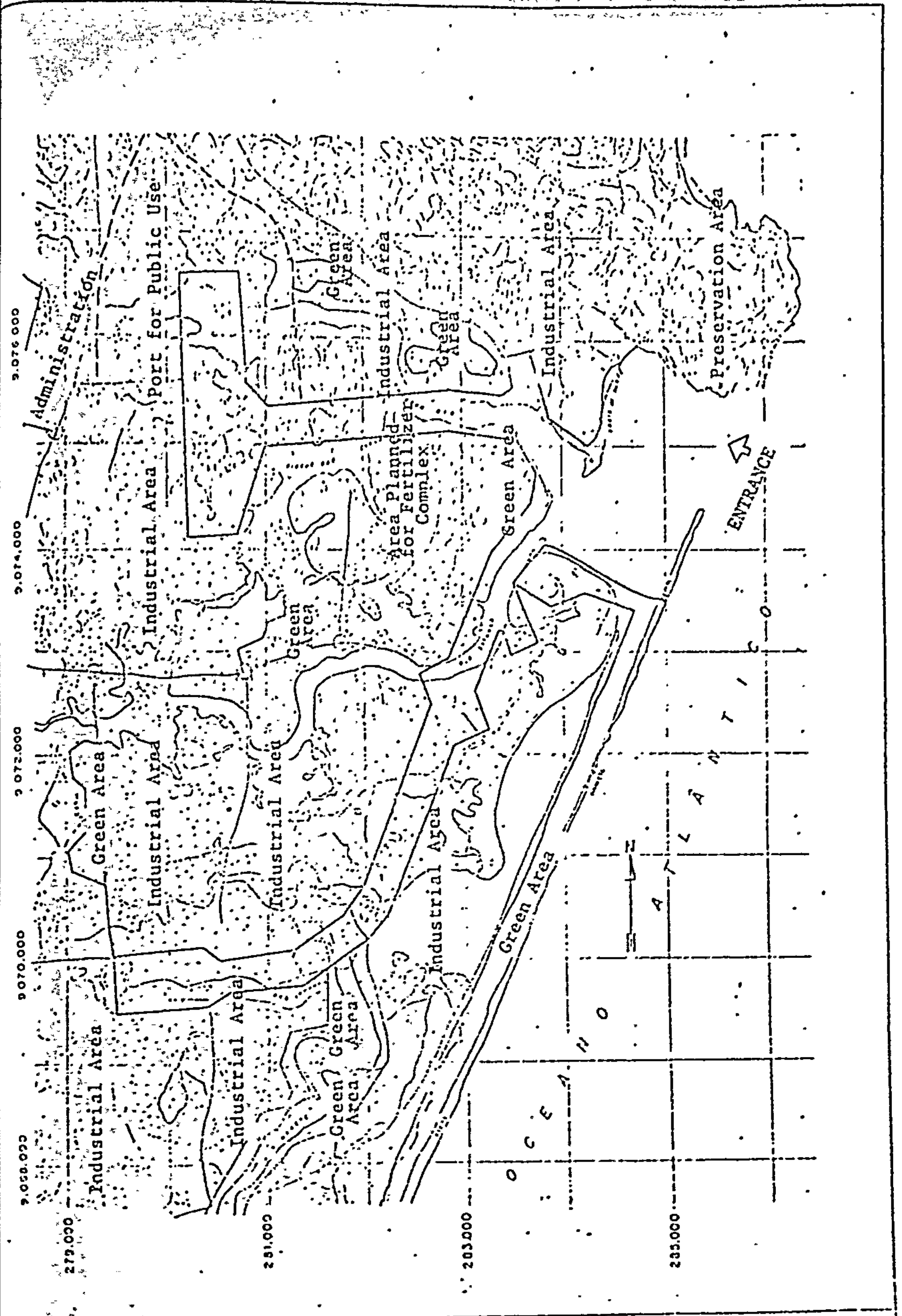
nstruction Stages:
Establish priorities 1,2,3,4,5 according to demand.

diper

TRANSCON S.A

COMPLEXO INDUSTRIAL

PRELIMINARY DRAWINGS FOR PORT CONCEPT STUDY



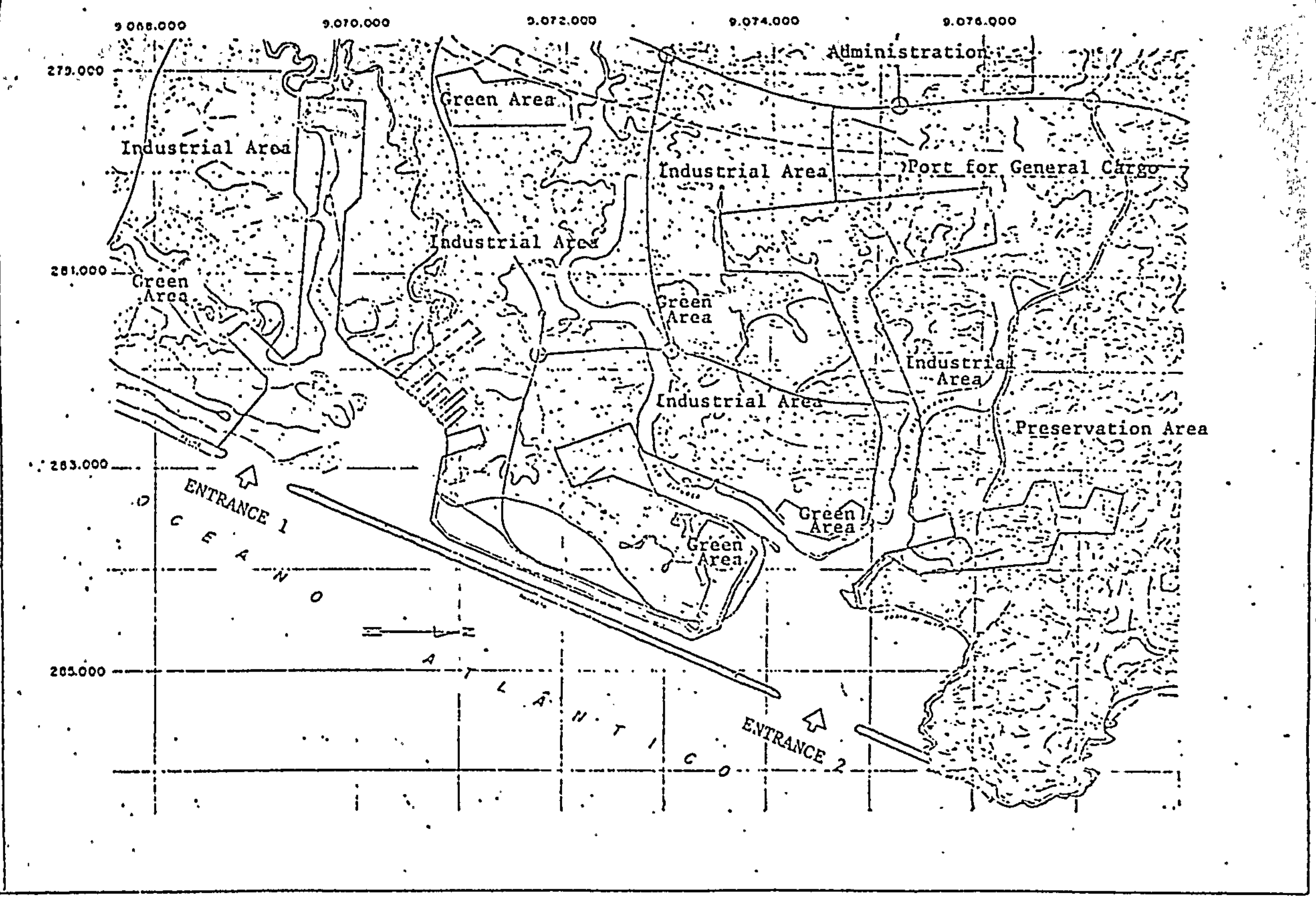
ESCALA GRAFICA

diper

TRANSCON S.A.

DE PERNAMBUCO

PRELIMINARY DRAWINGS
FOR PORT CONCEPT STUDIES



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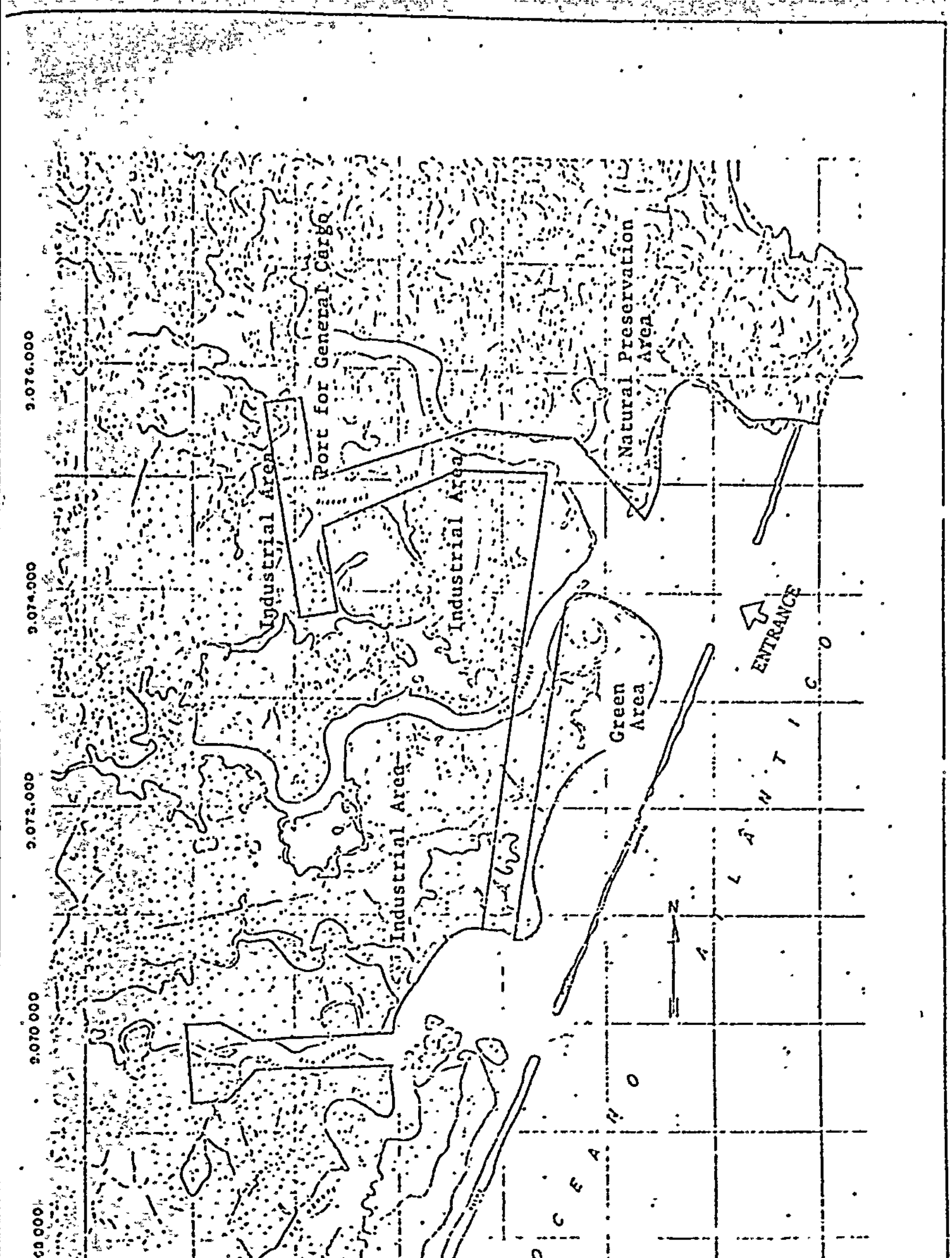
TRANSCON S.A.

GOVERNO DO ESTADO DE PERNAMBUCO
DE PERNAMBUCO
COMPLEXO INDUSTRIAL DE SUAPE

PRELIMINARY DRAWINGS
FOR PORT CONCEPT STUDY



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PRELIMINARY DRAWINGS
FOR PORT CONCEPT STUDY

TOMO II

PARTE I

6.0

6.0 CRITERIA FOR DIMENSIONING CHANNELS AND BASINS

6.0 CRITERIA FOR DIMENSIONING CHANNELS AND BASINS

Special attention was given to to the problem of dimensioning channels and basins for the Suape port. Since the pertinent technical literature is not rich enough to provide for immediately applicable parameters, a study was developed for each particular case.

The characteristics selected for the Suape Port, which will enable it to handle large sized ships, are not, on the other hand, such as to permit utilization of experience at other domestic and foreign ports. We thus tried to start with a definition of the type of ship likely to operate in the region at the most economic conditions, and a study of their features and prospective size growth. From the study of these features, and taking in consideration the conditions under which navigation will take place in the various areas, the depth and width at the various sections of internal and external channels were defined, as well as the curvature radii connecting these sections, the overwidths to be allowed for in curved sections, and the dimensions of turning basin circles and of the fore-harbour area.

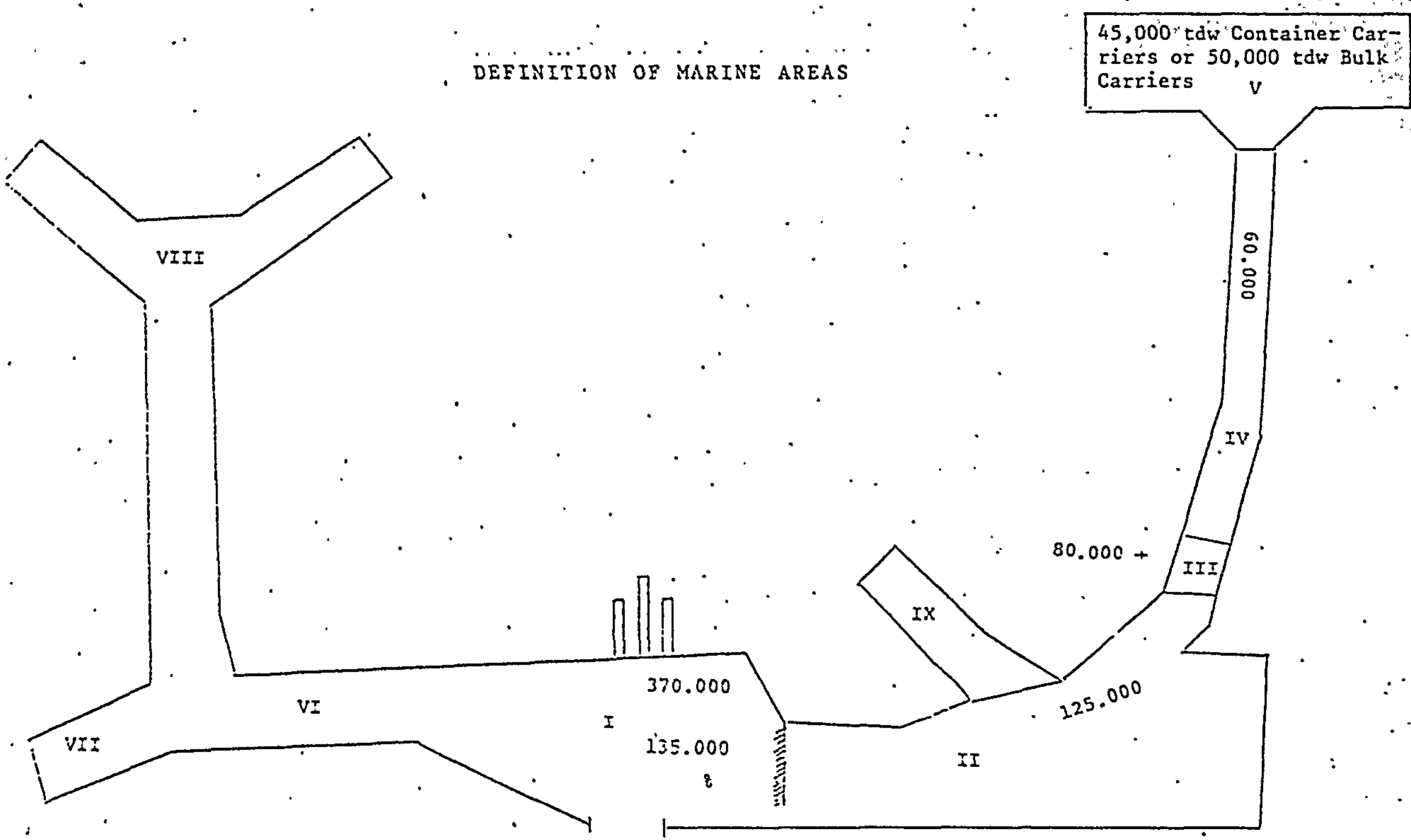
On the basis of these elements, the acess channel, the internal channels, the turning circle and the fore-harbour were dimensioned.

6.1 DEFINITION OF WORKING AREAS

In order to define the different working areas, the Plan for Maximum Occupation of the Port was taken as a basis, for its internal part, and the location, nature and size of the various industries to be installed at the Suape Industrial Complex were examined. Nine areas were consequently selected, numbered I to IX, shown in Figure 2-XXXIV attached, which also shows the corresponding cross sections.

Taking into account the characteristics of each industry and the area's hydrographic conditions, it was possible to reach a definition of the type of ship which should operate there, always with a view to the largest units to be utilized.

DEFINITION OF MARINE AREAS



6.2 TYPICAL SHIPS FOR EACH AREA

In order to identify the typical ship for each area, a combination of the largest ships likely to operate in a given area was examined, so that the port dimensioning could be able of handling them all.

AREA I - PORT ENTRY

ALTERNATIVE A

The plan is to create conditions that will permit the eventual handling of 370,000 tdw ships, fully loaded, among tankers, bulk carriers and combination ships, for unloading next to the shipyard and for docking, in view of the interest shown by the group concerned.

Basic dimensions of 370,000 tdw ships:

Tankers:	L = 366 m	B = 61 m	C = 23.6 m
Bulk Carriers:	L = 393 m	B = 59 m	C = 21.1 m

Typical ship for Area I - Alternative A:

L = 393 m	B = 61 m	C = 24.6 m

ALTERNATIVE B

This alternative aims at creating conditions for the handling of ships destined to transportation of cement (export) and oil (import).

In the case of cement, in view of the projection of 9,000,000 tons for the year 2005, the use of 260,000 tdw ships would bring about a frequency of one ship per week. The analysis of the graph, however, shows that the difference between this ship's operational costs and those of 125,000 tdw ships is of little significance.

In addition, the utilization of 260,000 tdw ships for the transportation in question would require a larger volume of dredging and higher costs of flow-regulating warehousing.

These factors point to the advisability of using 125,000 tdw ships for transportation of cement, except in case of construction of the shipyard for the purpose mentioned in Alternative A. This criterium is confirmed by the more even balancing of oil-cement and phosphate rock-cement.

As for oil transportation, the Study for Definition of Ships for Projects indicated a minimum size of 135,000 tdw, in view of the characteristics of the Brazilian merchant fleet.

This ship was consequently selected as representative of Area I in this alternative, since combined ships of this size could also take care of cement transportation.

Basic dimensions of 135,000 tdw ships:

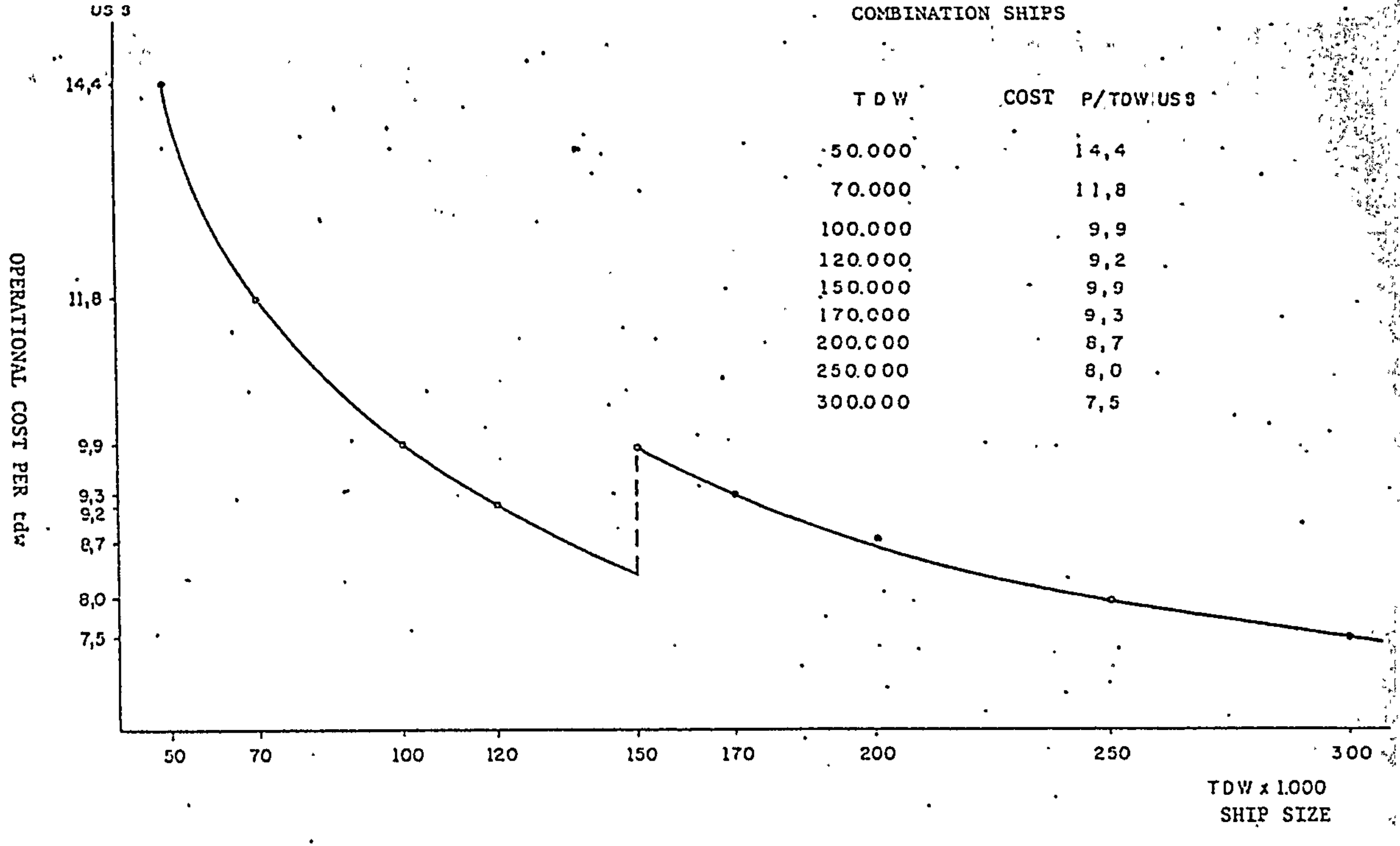
Tankers:	L = 277	B = 45	C = 16.5
Bulk Carriers:	L = 285	B = 41	C = 16.2

Typical ship for Area I, Alternative B:

L = 235	B = 45	C = 16.5

Adoption of the typical ship of Alternative B will provide for dimensions capable of handling transportation of the cargo pro-

jected for Area I, until clear interest is shown in the construct-
ion of a shipyard capable of handling ships up to 370,000 tdw.



T D W	COST P/TDW US $
50.000	14,4
70.000	11,8
100.000	9,9
120.000	9,2
150.000	9,9
170.000	9,3
200.000	8,7
250.000	8,0
300.000	7,5

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GOVERNO DO ESTADO DE PERNAMBUCO
COMPANHIA DE DESENVOLVIMENTO INDUSTRIAL DE PERNAMBUCO

COMPLEXO INDUSTRIAL DE SUAPE

STEADY STAGES
OF COMBINATION SHIPS

TRANSCON S.A.

AREA II

This area was planned for loaded 125,000 tdw bulk carriers, which are within the economical range and would cause fewer soil mechanics problems. However, in view of the possibility of a large attendance of bulkier ships calling for naval repair services, the handling of semi-loaded ships of up to 260,000 tdw was considered, which are equivalent to ships with a draft equivalent to 125,000 tdw.

Basic dimensions:

Bulk Carriers 260,000 tdw - L = 356 m B = 52 m C = 19 m
Bulk Carriers 125,000 tdw - L = 278 m B = 40 m C = 15.3 m

Typical ship for the area:

L = 356 m	B = 52 m	C = 15.3 m

AREA III

Considered as a transition between areas II and IV, this area should handle bulk carriers of up to 80,000 tdw, which are in the intermediate operational cost range (see graph on page 10).

Basic dimensions of 80,000 tdw bulk carriers:

L = 240 m B = 34 m C = 13.3 m

Typical ship for area III:

L = 240 m	B = 34 m	C = 13.3 m

AREA IV

The restrictive factor here is the difficulty in dredging the intermediate zone, near the inflection point, brought about by indications of drilling work nº 17, which detected very consistent clay layers at depths of 12 and 13.3 m. This would correspond to maximum drafts in minimum waters of around 12 m.

On the basis of this, the typical ship for area IV was assumed to be of the 63,000 tdw PANAMAX type, with a draft of 12.2 m.

Basic dimensions of 63,000 tdw bulk carriers:

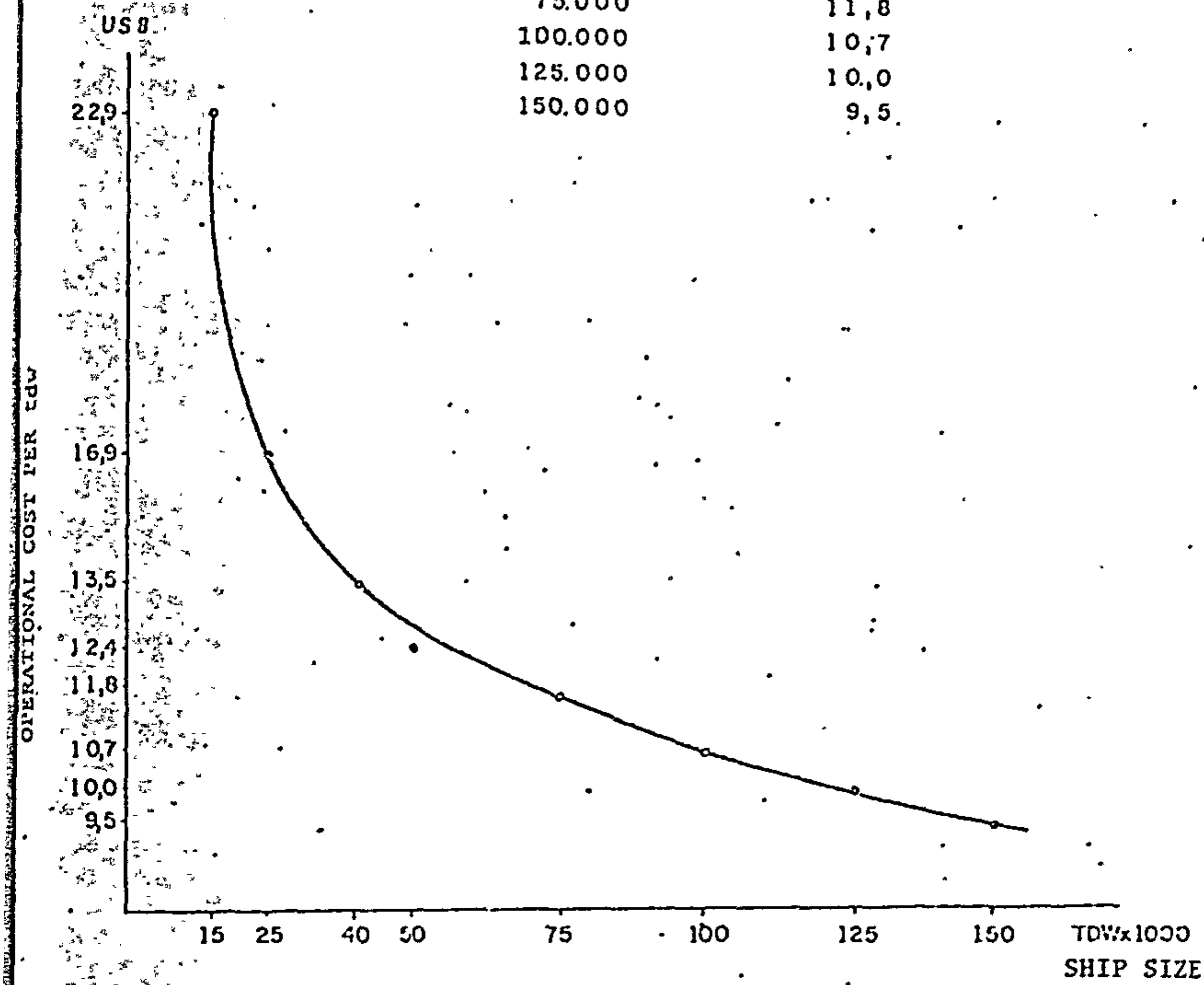
L = 218 m   B = 31 m   C = 12.2 m

Typical ship for area IV:

L = 218 m   B = 31 m   C = 12.2 m

BULK CARRIERS

T D W	COST P/ TDW US$
15.000	22,9
25.000	16,9
40.000	13,5
50.000	12,4
75.000	11,8
100.000	10,7
125.000	10,0
150.000	9,5



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TRANSCON S.A.

GOVERNO DO ESTADO DE PERNAMBUCO – [illegible]
COMPANHIA DE DESENVOLVIMENTO INDUSTRIAL DE PERNAMBUCO

COMPLEXO INDUSTRIAL DE SUAPE

STEADY STAGE
OF BULK CARRIERS

AREA V

The limits here will be those required by 45,000 tdw container carriers, whose draft correspond to 50,000 tdw bulk carriers. This size as indicated in the Studies for Definition of Ships for Projects as the limiting range for container carriers.

Basic dimensions:

45,000 tdw container carriers:	L = 280 m	B = 35 m	C = 11.5 m
50,000 tdw bulk carriers:	L = 206 m	B = 29 m	C = 11.5 m

Typical ship for area V:

L = 280 m   B = 35 m   C = 11.5 m

AREA VI

This area is considered as part of the zone connected with metal works, and should permit operation of ore carriers in the 135,000 tdw range, which correspond to the FRONAPE and DOCENAVE combination ships. However, conditions here should provide for plan facilities for handling 260,000 tdw ships, in a manner similar to that adopted for area II.

Basic dimensions:

135,000 tdw ships:	L = 285 m	B = 40.8 m	C = 16.2 m
260,000 tdw ships:	L = 356 m	B = 52 m	C = 19.2 m

Typical ship for area VI:

L = 356 m   B = 52 m   C = 16.2 m

AREA VII

This area is destined to the future use of ships for oil derivates, and the typical ship is assumed to the 60,000 tdw oil tanker.

Basic dimensions:

60,000 tdw oil tanker: L = 220 m B = 33 m C = 12.8 m

Note: 260,000 tdw vessels in the area would sail on ballast.

Typical ship for area VII:

L = 220 m	B = 33 m	C = 12.8 m

AREA VIII

This area is intended for attendance by smaller bulk carriers, in the most economic range among them, and the typical ship is assumed to be the 50,000 tdw vessel.

Hence, the typical ship for area VIII has the following dimensions:

L = 206 m	B = 29 m	C = 11.5 m

AREA IX

This area is intended for small ships of the bulk carrier type, whose cargo would me mostly destined to the fertilizer unit and raw materials for the aluminum plant.

For this area, 250,000 tdw bulk carriers are assumed, since this is the trend of ships belonging to the Brazilian merchant fleet, and is therefore adjusted to the main raw materials for the aluminum plant.

Basic dimensions:

25,000 tdw bulk carriers: L = 165 m B = 22 m C = 9 m

Typical ship for area IX:

L = 165 m	B = 22 m	C = 9 m

SUMMARY OF TYPICAL SHIPS

AREA	DIMENSIONS OF TYPICAL SHIPS			REMARKS
	L	B	C	
I - Alt.A	393	61	24.6	WITH SHIPYARD
I - Alt.B	285	45	16.5	WITHOUT SHIPYARD
II	356	52	15.3	
III	240	34	13.3	
IV	218	31	12.2	
V	280	35	11.5	
VI	356	52	16.2	
VII	220	33	12.8	
VIII	206	29	11.5	
IX	165	22	9	

6.3 CRITERIA AND DEFINITION OF DEPTHS FOR INTERNAL AND EXTERNAL AREAS

There are no clearly defined recommendations for determining the gross pilot draft (see Fig. 3.1). Bulletin nº 16 of the Permanent International Association of Navigation Congresses (PIANC) covering the 1973 Ottawa Congress, reports on the Executive Committee Resolution which recommends upholding a definition until further knowledge is gained on the subject. It does, however, indicate that limits of up to 10 and 20% of the maximum draft should be adopted for the gross pilot draft in access channels.

For the present case, pilot draft components were taken at the values available for this study, with a view to the above recommended limits:

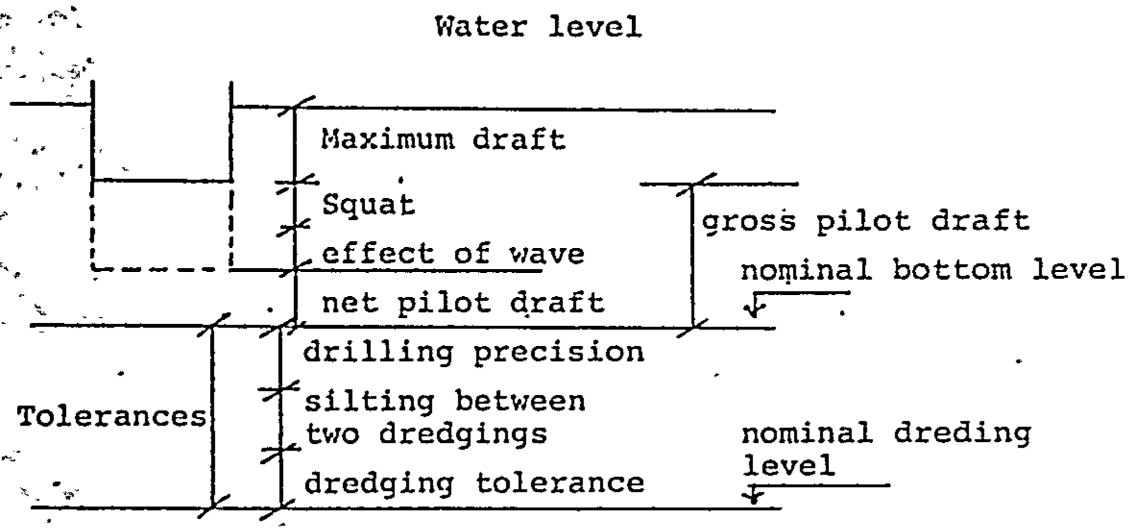


Fig. 3.1

6.3.1 DETERMINATION OF SQUAT

For internal areas, where ship speeds would be in the neighborhood of 5 knots, the minimum value of 0.3 m indicated in the referenced bibliography will be assumed. For external areas and for area I, ship speed will be assumed to be 10 knots, which would require a maximum squat value of 1.30 m.

6.3.2 HEIGHT OF WAVE EFFECT

Observations made at Le Havre with 500,000 tdw ships, under the effect of waves of 4 m amplitude and 8 sec. period, showed that the vertical motion of the ship caused by the wave had a height of between 0.40 and 0.85 m (PIANC, Bulletin 16).

The matter is still a controverted one, and the Executive Committee of that Congress restricted itself to recommending that further knowledge on the subject should be waited for; attention, however, was called to the effect that the period and amplitude of waves had on such motion. According to the Committee, significant motion should occur with long periods, even when amplitudes are small. Likewise, for constant periods, the motion varies in a manner visibly proportional to the amplitude. The indicated ranges show 6 to 10 sec. periods as being the least important, 15 sec. periods being more significant.

On the basis of the Le Havre observations, and considering that Recife waves have an amplitude of 3.30 m and a period of 10 sec., a tolerance of 0.85 m is assumed for the effect of waves in external areas.

6.3.3 NET PILOT DRAFT

The referred to PIANC Executive Committee recomends that a net pilot draft of 0.50 m for sandy bottoms and 1.00 m for rocky bottoms should be assumed.

6.3.4 TOLERANCES

A variation of 2 to 5% of the maximum draft will be assumed for the tolerances shown on Fig. 3.1.

Having registered the criteria used for the purposes of the preliminary design which will govern the Master Plan, we give below the project's depths in the various areas.

AREAS	(1) MAX. DRAFT OF TYPICAL SHIP (m)	(2) SQUAT (m)	(3) EFFECT OF WAVE (m)	(4) NET PILOT DRAFT (m)	(5 = 2+3+4) CALCULATED GROSS PILOT DRAFT (m)	(6 = 5÷1) CALCULATION CONTROL (%)	(7) TOLERANCES (7.1) (m)	(7.2=7.1÷1) (%)	(8 = 1+5+7) NOMINAL DEPTHS (m) (***)	REMARKS
ACCESS CHANNEL										
Alt. A	24,60	1,30	0,85	0,50	2,65	10,77	0,70	3	28,00	(*)
Alt. B	16,50	1,30	0,85	0,50	2,65	16,06	0,70	4	20,00	(**)
AREA I										
Alt. A	24,60	0,30		0,50	0,80	5,28	0,60	2,5	26,00	
Alt. B	16,50	0,30		0,50	0,80	7,87	0,60	3,6	18,00	
AREA II	15,30	0,30	-	0,50	0,80	-	0,30	2	16,50	(***)
AREA III	13,30	0,30	-	0,50	0,80	-	0,30	2	14,50	
AREA IV	12,20	0,30	-	0,70	1,00	-	0,20	2	13,50	
AREA V	11,50	0,30	-	0,50	0,80	-	0,20	2	12,50	
AREA VI	16,20	0,30	-	0,50	0,80	-	0,30	2	17,50	
AREA VII	12,80	0,30	-	0,50	0,80	-	0,30	2	14,00	
AREA VIII	11,50	0,30	-	0,50	0,80	-	0,30	2	12,50	
AREA IX	9	0,30	-	0,50	0,80	-	0,20	2	10,00	

(*) - Approximately 27.95 to 28
(**) - Approximately 19.85 to 20
(***) - Depths refer to hydrographical zero.

6.4 CRITERIA AND DEFINITION OF THE WIDTHS OF ACCESS AND INTERNAL CHANNELS

6.4.1 BASIC METHODOLOGY

Determination of width for one-way traffic, sensitivity study for two-way traffic and final adjustment of width for handling smaller ships on both ways, and larger ships in one way, with definition of respective tdw.

6.4.2 ACCESS CHANNEL

As the minimum width of the access channel in the external area, with traffic in one way and without the help of tugboats, the 20th International Navigation Congress (Baltimore, 1961) recommended that it should 3 to 4 times the beam (B) of the project's ship.

On the other hand, the International Commission of Oil Tankers recommended (PIANC Bulliettin 16) that it should be 5 times the width of the beam.

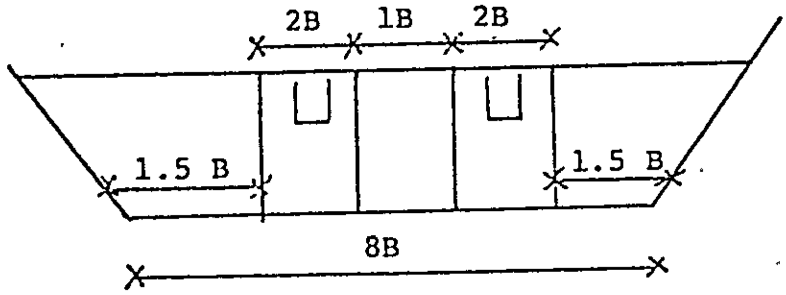
Using the International Commission of Oil Tankers recommendation, and pre-establishing for Suape that two-way traffic is not needed for large ships, we will have for access channels in the external area:

- Alternative A (with shipyard): 5B = 5 x 61 m = 305 m
  Alternative B (without shipyard): 5B = 5 x 45 m = 225 m

In the case of two-way traffic, the U. S. Army Engineers, in their "Tidal Hydraulics" - Engineeering Manuals - EM-1110-2-1607 - August, 1965, recommends that the width of the access channel should be from 6 to 7 B.

The International Commission for Oil Tankers (PIANC Bullettin 16) believes that there should be no two-way traffic for super-tankers in order to avoid the hydrodynamic phenomena of interaction. It pointed out, however, that, according to observations made at the Europort (Rotterdam), with a port access of 350 to 400 m, it is possible for super-tankers to cross with smaller ships, at distances of 75 to 100 m between their broadsides, without causing these phenomena.

Assuming that large ships will not cross each other in the access channel, we conclude that, by adopting a width of 225 m, and considering that it corresponds to <u>8 B</u> for two-way traffic, obtained from studying the figure below, wehere we used 2 B for navigation sections, 1B for tolerance between these sections and 1.5 B for protection of slope, it is possible for two ships to



cross with a maximum beam of 28 m.

For this size of beam, we will have, under the most unfavorable conditions of two ships crossing:

30,000 tdw oil tankers,
50,000 tdw bulk carriers
15,000 tdw freighters.

It should be noted that, when assuming 8B for the width of the access channel, we are establishing safer conditions than those established by the U. S. Army.

By building a channel with a width of 305 m, two-way traffic is possible for two 80,000 tdw oil tankers, two 100,000 tdw bulk carriers, or two 30,000 tdw freighters, sailing in opposite directions.

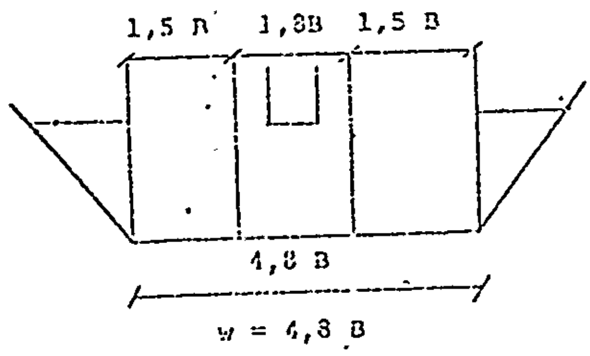
6.4.3 INTERNAL CHANNELS

There are no express recommendations relating to the width of internal channels with mooring at the banks.

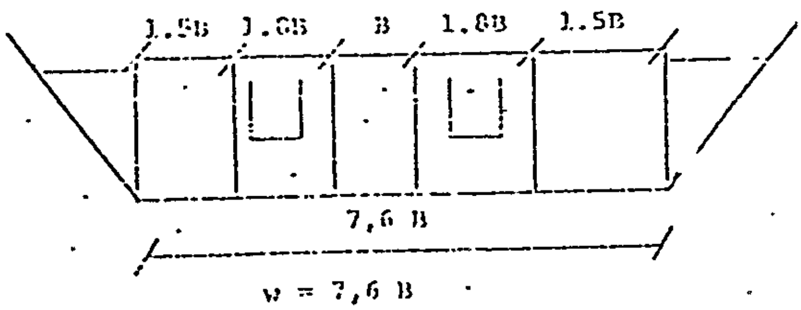
However, tests made with a reduced scale model for dimensioning the new Panama Canal can be used for extrapolation. The results of these tests are mentioned in the book "Harbour Entrance, Channels and Turning Basins," by Hay, D., published in the January 1968 issue of "Dock and Harbour Authority." On the basis of these results, we arrived at the following typical sections.

I) Without mooring at banks.

Ia) One-way traffic:

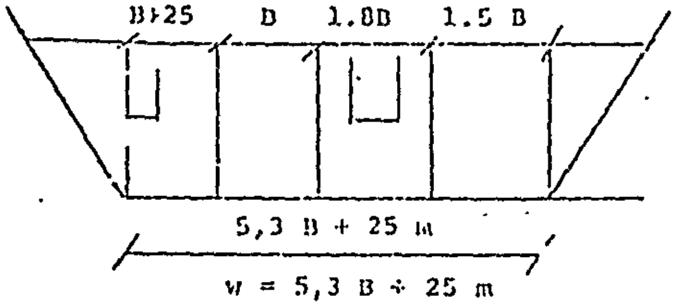


Ib) Two-way traffic:

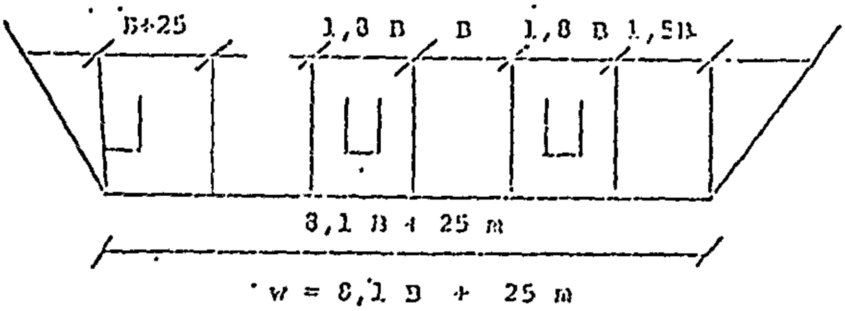


II) With mooring at one of the banks.

IIa) One-way traffic:

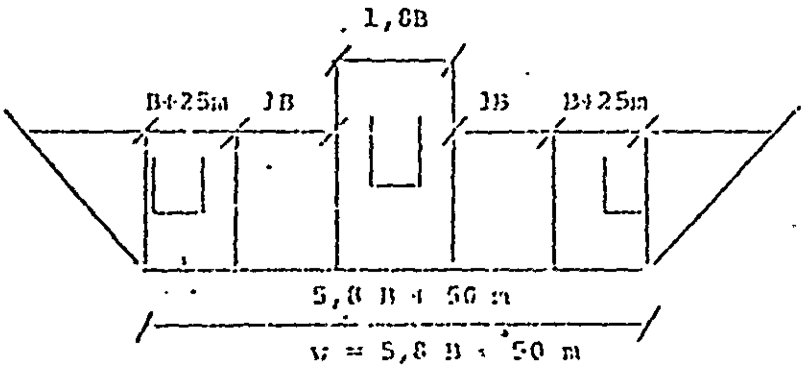


IIb) Two-way traffic:

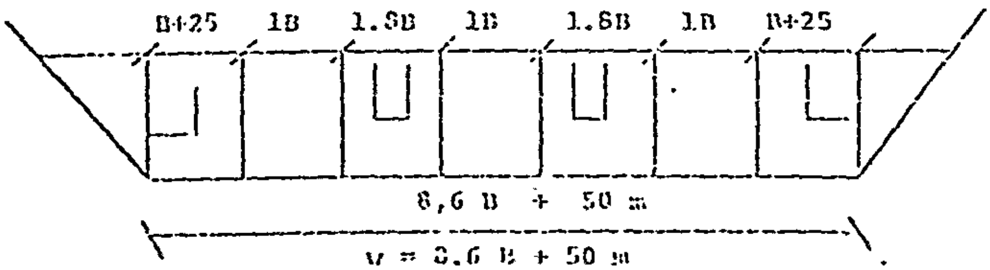


III) With mooring at both banks.

IIIa). One-way traffic:



IIIb) Two-way traffic:



The above sections pressuppose:

NAVIGATION STRIP OF 1.8 B

1 B clearance between navigation strips, or between navigation strips and mooring.

Mooring strip of B + 25 m, the 25 m resulting from the need of area for operating barges, tugboats, cranes, etc.

From the above, the summary table below is obtained for dimensioning internal channels:

SUMMARY TABLE OF WIDTHS FOR INTERNAL CHANNELS

	ONE-WAY TRAFFIC	TWO-WAY TRAFFIC
Mooring on both sides	w = 5.8 B + 50 m	w = 8.6 B + 50 m
Mooring on one side	w = 5.3 B + 25 m	w = 8.1 B + 25 m
No mooring	w = 4.8 B	w = 7.6 B

For sizing the channel in a given area, there are two possibilities.

In the first, the typical ship's beam is larger than the beam of the typical ships of subsequent areas. In this case, the dimensioning takes into account all ships, moored and in traffic, as typical ships.

In the second, the typical ship's beam is smaller than the beam of the typical ship of the subsequent area. Then, the larger beamed ship is considered as in traffic, and the smaller ones are considered as moored. In this case, clearances are calculated for the larger beamed ship.

From the above considereations, the following widths result for internal channels, with practical adjustments for each case:

AREA	TYPICAL SHIP B (m)	WIDTH W (m)
II (1)	52	320 (3)
(2)		250
III	34	250 (4)
IV	31	240 (5)
V	35	250
VI	52	320 (6)
VII	33	260 (7)
VIII	29	210
IX	22	180

(1) Mooring on both banks.

(2) No mooring.

(3) In view of the small atteandance of 260,000 tdw ships, these were considered in traffic, with one 125,000 tdw ship moored on each bank.

(4) Since the typical ship for area D is wider than that for area III, we assumed one area D ship to be in traffic, and one area III ship to be moored at each bank.

(5) One area V ship was assumed to be in traffic, and one area IV ship to be moored at each bank.

(6) Same as item 3.

(7) This being a turning area for area VI unloaded ships, one area VI ship was considered as in traffic, and one area VII ship as moored at each bank. Since this area is intended for oil derivate carriers no allowance was made for barges.

With a view to standardizing as much as possible the widths of the channels, the values shown on the table below were adopted, the maximum ship beam being indicated for each area for ships that might sail both ways at the same time.

AREA	WIDTH OF CHANNEL w (m)	BEAM b (m) (1)
II	320	28 ↔ 50,000 tdw bulk
III/IV/V	250	20 ↔ 20,000 tdw bulk
VI	320	28 ↔ 50,000 tdw bulk
VII	250	20 ↔ 20,000 tdw bulk
VIII	210	16 ↔ BARGES
IX	180	15 ↔ BARGES

(1) $b = \dfrac{w - (B + 25) \times 2}{6.6}$

6.5 CRITERIA AND DEFINITION OF CURVATURE RADII, OVERWIDTH, TURNING AREAS AND FORE-HARBOUR

6.5.1 CURVE RADII

A - Curve Radii at the Access to the Port

According to recommendations of the International Comission for Oil Tankers (PIANC Bulletin 16), the curvature radius for external channels, without the aid of tugboats, should be equal to 5 L (L = length of the ship), unless the ship is subject to strong winds or transversal currents capable of causing significant drifting.

On the other hand, Per Bruun, in his "Port Engineering," page 20, 1973 edition, points out that "...when a change in direction is necessary in the channel, the majority of navigators prefer a series of tangential curves connected by small curves. It has been suggested that, for a maximum deflection angle of 30º, the length of the tangents should not be less than 305 m and the radius of connecting curves should not be greater than 914 m."

Considering that the central angles projected for the access to the internal area are greater than that indicated by Bruun, but that transversal currents are weak, and considering also that the orientation of the access channel coincides with the direction pf prevailing winds, we do not hesitate to adopt the recommendation made in the referred Bulletin 16 of PIANC. In this case, for the projected ships likely to sail into internal channels, the following radii result:

- For 260,000 tdw ships - 5L = 5 x 356 = 1,780 m
- For 135,000 tdw ships - 5L = 5 x 285 = 1,425 m
- For 125,000 tdw ships - 5L = 5 x 278 = 1,390 m

For 80,000 tdw ships - 5L = 5 x 240 = 1,200 m.

From the foregoing and from the geometric characteristics of the layout, we may assume a radius of 1,200 m, which will allow for direct access to internal channels of 80,000 tdw ships, without the aid of tugboats.

According to this criterium, there must be no direct access for larger ships; these will require maneuvering in area I in order to be able to enter the internal channels.

However, the forementioned Bulletin shows a turning circle diagram for 210,000 tdw ships with a diameter of 1,200 m, with the ship sailing at a speed of 6 knots, or 1,350 m diameter with the ship sailing at a speed of 15.5 knots. In relation to this criterium, it should be noted that the 1,200 m adopted for 80,000 tdw ships corresponds to twice the radius consideredthere for the turning circle of 210,000 tdw ships.

B Curve Radii at Internal Channels

As noted above, the forementioned Bulletin 16 gives a turning trajectory of 210,000 tdw ships with radii varing from around 960 m to 620 m, at a speed of 6 knots and on their own resources, the longer one corresponding to 2.9 L.

In view of the above remark, radii of 1,000 m at internal areas will permit similar maneuvering by 260,000 tdw ships at smaller speeds (2.9 L = 2.9 x 356 = 1,032 m).

Consiering that, in area VIII, there would be maneuvering by ships of up to 50,000 tdw, and by extrapolating the above consideration, we arrive at the adoption of a minimum radius of 2.9 L = 2.9 x x 206 = 597 m.

Note should also be made of the fact that the turning trajectory for 110,000 tdw registered in Bulletin 16 has a maximum radius of 807 m for a speed of 6 knots.

C OVERWIDTH

According to Bulletin 16, the overwidth should take in consideration the inscription of the ship in the curve -- expressed by L^2/BR -- and a non-quantified margin resulting from the trajectory's uncertainty, delay in ship's response to the pilot's command, in addition to visibility, central angle, winds and currents.

However, PIANC's Bulletin nº 5, of 1970, gives the following formula for dimensioning the overwidth:

$$\Delta B = \frac{3\alpha}{R} \times \frac{V^2}{C} \times \frac{L^2}{S}$$

where the several influencing factors are taken into account:

ΔB = increase in feet of channel width in curve
α = central angle in degrees
R = curvature radius in feet
V = ship's speed in knots
C = maneuverability index
L = ship's length in feet
S = visibility distance in feet

For the dimensioning of the overwidth at the curve of access to the port, the following values will be taken:

α_1 = 72°30' (central angle of curve of access to internal channel at the North)

α_2 = 110° (central angle of curve of access to internal channel at the South)

R = 1,200 m = 3,937 feet

V = 10 knots (at the most unfavorable conditions for access)

C = 2 (considered as good among maneuverability conditions: 1 = mediocre; 2 = good; 3 = very good)

L = 240 m = 787 feet (length of an 80,000 tdw ship)

S = 1 mile = 6,111 feet

For the overwidths, the formula gives us:

$\Delta_1 B$ = 85 m (overwidth for direct access to the North internal channel)

$\Delta_2 B$ = 155 m (overwidth for direct access to the South internal channel)

6.5.2 MANEUVERING AREAS

A Maneuvering Area at Area I

Two points must be considered in the dimensioning of this maneuvering area:

- a distance permitting large ships to halt immediately after entrance;

- maneuverability of these ships inside same.

The above mentioned Bulletin 16 gives maneuvering characteristics observed for 110,000 tdw and 210,000 tdw ships, without tugboats, and reveals the fact that there are no available data for ships larger than the 200,000/250,000 tdw VLCC's.

It points out that the stopping distance, at an approach speed of

4 knots with full steam reversion, is 1.8 L for all ship classes.

It does, however, give a calculation chart for 210,000 tdw ships, according to which the stopping distance at an approach speed of 4 knots with full steam reversion is 0.35 m, which corresponds to 2 L for this ship size.

The 1,000 m diameter for the maneuvering circle in Area I, indicated in the layout, shows that it corresponds to 2.5 times the length of the 370,000 tdw ship, and 2.8 times the length of the 260,000 tdw ship.

A comparison with the parameters in the aforementioned calculation chart shows that, for a 210,000 tdw ship, the distance of 1,000 m would permit it to stop with full steam reversion and without the aid of tugboats, at an approach speed of 5.5 knots.

In their recommendations, the Commission of Oil Tankers point out the convenience of having the maneuvering area inscribe a circle with a diameter of 2.3 L for operation without the aid of tugboats; however, they suggest that, for accidental or incidental cases where the use of tugboats is not possible, the diameter should be 3 L.

For 370,000 tdw ships, we would have: 2.3 L = 904 m.
For 260,000 tdw ships, we would have: 2.3 L = 819 m.

It should be noted that, for smaller ships, in the 100,000 tdw range, we would have:

For 135,000 tdw ships: 2.3 L = 655 m.
For 125,000 tdw ships: 2.3 L = 639 m.

Obviously, the greatest attention and care should be taken in the 370,000 tdw ship maneuvering, since the projected maneuvering circle would not meet the 3 L requirement pointed out above.

However, for 260,000 tdw ships, 3L would be equal to 1,068 m, which, though larger than the projected diameter, would be covered by the clearance existing near the shipyard.

B Maneuvering Area in Area II

Area II includes the Suape basin, which will serve two purposes:

- maneuvers for return of ships attending areas II and III; and
- fore-harbour.

C Maneuvering Area in Area V

The area provided for here should be dimensioned for container carriers.

Assuming the 2.3 L diameter indicated by Bulletin 16 of PIANC, there will be the need of a circle with minimum diameter of 644 m for maneuvering with the aid of tugboats.

6.5.3 FORE-HARBOUR

Though one of the aims of the study of the number of berths necessary for each industry is to minimize ship's waiting time, it is imperative that creation should be considered, in the overall complex of port facilities, of an area intended for the fore-harbour.

In this fore-harbour area, the various ships that are likely to operate there may await the visit of customs authorities, the naval police, and the port's health officials.

It is true that the private terminals, as adopted in the port's concept, generate very favorable conditions for minimizing the fore-harbour area, but nevertheless it should exist and be available for eventualities.

In the special case of the Suape Port, the fore-harbour was located in Area II, where the needed surface, shelter, depth, ease of access and bottom nature conditions can be found.

Dreding work to take place there will give the area a depth of -14.872 m in relation to CNG's zero, in the first phase of the first stage, and a depth of -17.872 m in the second phase.

The fore-harbour area can easily take in four of the largest ships projected for operating at the port, a number which is deemed perfectly compatible with the estimated traffic for the port.

The anchorage of ships in this area should, for better utilization of the available space, be done by mooring, at prow and stern, to the existing buoys, preventing the ships from moving about and tracing a turning circle due to tidal variations.

6.6 CRITERIA FOR PHASE DEFINITION IN THE FIRST STAGE

6.6.1 ANALYSIS BY AREA

AREA I

This area includes the oil and cement terminals.

With the handling of 8,000,000 tons forecasted for 1980, we have assumed that, during that year, 135,000 tdw ships already would call at the oil terminals.

ince the ships intended for oil transportation could be of the combination type, and consequently make a return trip with cement, it was established that Area I should handle 135,000 tdw ships throughout the entire stage.

AREA II

The larger ships in this area will handle transportation of phosphate rock.

A comparison between the projected amount of phosphate rock handling and of the ships that are likely to transport it indicated the following stock turnover:

YEAR	SHIPS (tdw)		
	30,000	60,000	125,000
1984	8	4	2
1985	17	8	4
1986	25	12	6
1987 to 2005	33	16	8

6.6.2 PHASE DEFINITION

PHASE I
Start: 1980

The access channel and Areas I, II, III and IV should be dredged so as to be able to handle the following ships as of 1980:

AREA	SHIPS (tdw)	TYPE	DEPTH (m)
Access Channel	135,000	Combination	- 20.0
I	135,000	Combination	- 18.0
II	60,000	Bulk Carriers	- 13.5
III	60,000	Bulk Carriers	- 13.5
IV	25,000	Bulk Carriers	- 12.0
IX	25,000	Freighters	- 10.0

PHASE II
Start: 1987

During this phase, area II should be dredged for servicing 125,000 tdw ships. All other areas, as well as the access channel, will remain unaltered.

AREA	SHIPS (tdw)	TYPE	DEPTH (m)
II	125,000	Bulk Carriers	- 16.5

On the basis of this table, and in view of the fact that cargo movement would grow rapidly until 1986 and would tend to level off by 1987, it was assumed that transportation would be made by 60,000 tdw ships until 1986, and by 125,000 tdw ships after 1987.

AREA III

The largest ships operating in this area will be used for wheat imports. According to data obtained at the source of these imports, ships coming from the U.S. would be in the 25,000/30,000 tdw range, and those from Canada would be in the 30,000/60,000 tdw range. A comparison between the additional dredging cost and the freight advantages of importing from Canada, or even from RGS, pointed to 60,000 tdw bulk carriers for this area, throughout the entire stage.

AREA IV

For this Area, the wheat terminal was projected for exporting to Northeastern ports via coastal shipping. In view of the limitation of these ports as regards draft (around 10 m), 25,000 tdw ships have been adopted for this transportation, throughout the entire stage.

AREA IX

Area IX is intended for small ships of the bulk carrier type, with less liquid cargo for the fertilizer plant, and for carrying raw materials to the aluminum plant.

25,000 tdw ships, of the bulk carrier type, were assumed for this area, in view of the trend for Brazilian merchant ships.