THE REPUBLIC OF INDONESIA

REPORT ON CONSOLIDATION PROGRAM SURVEY

OF ELECTRONIC NAVIGATION SYSTEMS

1974

OVERSEAS TECHNICAL COOPERATION AGENCY

JAPAN

PREFACE

The Government of Indonesia is planning to have electronic navigation systems established in waters along the coast of that country as part of its second Five Year Program beginning in 1974.

Since there is almost no technique available for preparing a master plan for the establishment, the Government of Indonesia requested that Japan study the appropriateness of conducting a preliminary survey and preparing a consolidation program and that Japan provide technical cooperation to prepare the master plan. In response to this request, the Government of Japan has sent a fact finding mission to Indonesia.

Indonesia is, like Japan, an island nation, with its shipping industry being the prop and stay supporting the economy of that country. In addition, it is located in such international waters as Malacca Strait and Lombok Strait. During the first Five Year Program of that country, efforts were concentrated on the consolidation of visual aids to navigation.

With the increase in the size and speed of vessels and in the amount of shipping in recent years, however, the safety of marine traffic has been called for more and more. The second Five Year Program has been prepared to establish electronic navigation systems such as Decca, beasons and transponders.

The present report has been compiled by the fact finding mission on the basis of the results of the field survey conducted by the mission during the period from 2nd December until 15th December 1973.

March 1974

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Director General
Overseas Technical Cooperation Agency

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1. SUMMARY

The intention of the Indonesian Government to materialize the present consolidation program was triggered fundamentally by the written report on the survey conducted by the Asia Development Bank (ADB). The consolidation of visual aids was completed during 1973 and now a program to develop electronic navigation systems is going to be inaugurated.

The present situation in Indonesia is, however, that no study is being made to determine which systems would be most suitable to meet the requirements of Indonesian shipping, whether or not the establishment of such sophisticated systems of high technology would promote the national interests and how engineers to operate such systems would be trained.

The fact finding mission requested that the Government of Indonesia provide them with information necessary to work out the most suitable systems to meet Indonesian needs. The mission explained the electronic navigation systems currently in use in Japan and made comments on the program presented by the Indonesian side.

According to the information furnished by the Indonesian Government, the number of merchant vessels of Indonesian flag is 1,851, of which 364 or one fifth are sailing vessels having no engine or electric power source. Fishing vessels are 5,391 in number, of which 4,817 are powered vessels including those with outboard engines, and others are sailing vessels. Accordingly, study should be concentrated not only on the electronic navigation systems for domestic shipping, but on such systems for foreign vessels as well.

The consolidation program prepared by the Indonesian side indicated that during the period from the fiscal year 1974 to the fiscal year 1980 six Decca Chains, ten medium-wave beacon stations and 15 radar beacon stations would be established with the total budgetary appropriations of 73,490 million rupiahs as construction expenses and 22,750,000 U.S. dollars (loan) for the purchase of equipments.

At the last day of the conference with the Japanese mission, the Indonesian side expressed their desire that the consolidation work of electronic navigation systems in Indonesia be carried out completely by Japan, from preparing plans to effecting construction.

2. BACKGROUND AND HISTORY OF THE FACT FINDING MISSION

The country of Indonesia consists of approximately 10,000 islands scattered across the equator in the vast sea area extending about 900 nautical miles from south to north and about 2,900 nautical miles from east to west. It covers a total area of 1,900,000 square kilometres, and its coast line extends to the length of approximately 400,000 kilometres.

Its economy depends on abundant lumber, mineral and agricultural products, and its major means of transportation is domestic shipping ramified over the water areas between islands. Particularly, in recent years the country has come to be spotlighted as a resource exporting country with the increasing foreign trade and development of marine resources and fishing industry. The interest of the general public in the ocean has been aroused rapidly. The number of vessels forming the Indonesian shipping is, however, still very small, and the navigation of these vessels and foreign vessels is not necessarily very safe and efficient in Indonesian waters.

As for aids to navigation, there are, as visual aids for coastal navigation, 624 lighted aids including 423 lighthouses and other aids and 201 lighted buoys, and 996 day marks including 579 day beacons and 417 buoys, but there is no electronic navigation aid system necessary for long and medium range navigation. The Indonesian Government has for some time in the past been hoping to have electronic navigation systems as early as possible, and for this purpose asked Japan to despatch a survey mission to Indonesia. Before despatching a survey mission, the Japanese Government desired to obtain information on the following matters:

-- Sea areas where Indonesia desires to have electronic navigation systems established and the order of priority in the establishment;
-- Channels, amount of shipping traffic and type of vessels in the vicinity of the same sea areas;
-- Statistics of marine accidents in the vicinity of the same sea areas;
-- Statistics of meteorological conditions in the vicinity of the same sea areas;
-- Maps and charts, as detailed as possible, showing coastal areas and islands in the vicinity of the same sea areas;
-- Type of fishing vessels, their home ports and fishing grounds;
-- Ports and harbours, access roads, and power supply in the vicinity of the same sea areas;
-- And such other information as is considered necessary.

Thereafter, the Indonesian Government strongly requested that Japan despatch a survey mission as soon as possible, and in response to this request the Government of Japan decided to send a fact finding mission for the purpose of:

-- Sounding the intention of the Indonesian Government as regards electronic navigation systems;
-- Explaining the electronic navigation systems currently in use in Japan;
-- Obtaining data and information;
-- Preparing a draft master plan.

3. MEMBERS OF THE FACT FINDING MISSION

Chief: Shigeyoshi Toyofuku, Electronic Navigation Aids Division, Navigation Aids Department, Maritime Safety Agency

Member: Shinobu Yoshida, Administrative Management Division, Administrative Department, Maritime Safety Agency

Member: Kimio Matsuo, Electronic Navigation Aids Division, Navigation Aids Department, Maritime Safety Agency

Member: Shichiro Ishii, Electronic Navigation Aids Division, Navigation Aids Department, Maritime Safety Agency

Member: Yuji Harada, Technical Research Division, Radio Regulatory Bureau, Ministry of Postal Service and Communications

4. ITINERARY OF THE MISSION

Sun 2 Dec 1973	Arrived in Jakarta
Mon 3 Dec 1973	Visited Japanese Embassy and OTCA Marine Transport Team for making visiting arrangements
Tue 4 Dec 1973	Conference at General Shipping Bureau, Ministry of Transport and Communications for study of the mission's itinerary The conference was attended by Director-General, Alwan Navigation and Equipment Bureau; Director-General, Planning Department, Sanperan Navigation and Equipment Bureau, Director, Communications Division, Manipute Navigation and Equipment Bureau; member, Navigation Aids Division, Sujoso Navigation and Equipment Bureau and Shoji Kaneko from OTCA. Indonesian Government intention for the consolidation program was sounded Observation trip to the Port of Tanjung Priok and Jakarta Coastal Radio Station
Wed 5 Dec 1973	Listened to explanation of the Indonesian program
Thu 6 Dec 1973	Explained the electronic navigation systems now in use in Japan

Fri 7 Dec 1973	Explained the electronic navigation systems now in use in Japan, continued from the previous day Paid courtesy visit to Mr. Nimpno, Director-General, General Maritime Bureau
Sat 8 Dec 1973	Left Jakarta and arrived in Denpasar Surveyed shipping traffic situation in the Strait of Lombok
Sun 9 Dec 1973	Surveyed shipping traffic situation in the Strait of Lombok Left Denpasar and arrived in Jakarta
Mon 10 Dec 1973	Explained electronic navigation systems in use in Japan and discussed program prepared by the Indonesian side
Tue 11 Dec 1973	Discussed the Indonesian program
Wed 12 Dec 1973	Prepared draft training program of operational personnel in Japan and discussed information provided by the Indonesian Government
Thu 13 Dec 1973	Explained training program and had final discussion
Fri 14 Dec 1973	Reported the result of conference to the Embassy and OTCA
Sat 15 Dec 1973	Returned to Japan

5. INTENTION OF THE INDONESIAN GOVERNMENT

Indonesia is composed of numerous islands, and its territory covers far wider area than Japan which is also an island country. Although aircraft are extensively used as a means of transportation between islands, it is obvious that marine transport is also very important for this country.

Because of the fact that Indonesia for one thing is blessed with abundant natural resources, however, the volume of shipping has been relatively small, and this fact seems to be attributable to the undue delay in the consolidation of aids to navigation in Indonesian waters and to the impediment in the economic development of the country. During the Five Year Development Program starting in 1969, therefore, efforts were made in providing visual aids to navigation, and now that the construction of such aids has come to be nearly completed, the Government of Indonesia intends to concentrate its efforts on the consolidation of electronic navigation systems for vessels.

There is at present no such system in Indonesian waters, and accordingly there is no data and information available to determine which systems would be most suitable and effective, what standard should be established in siting stations, and how much fund should be estimated for the construction, maintenance and administration of the stations.

The project was too large to set to work without making any definite program. It was also considered that the use of electronic aids to navigation would be the general trend of the world in the future. The intention of the Indonesian Government was to ask for technical assistance from a country well experienced in electronic navigation systems, and to have systems most adequate and suitable for use in Indonesian waters. Fortunately or unfortunately, there has been no such system in Indonesia, and this made it possible for the fact finding mission to prepare a program rather freely, having a view of the future trend of the world in this field. However, in view of the present economic strength of Indonesia, it is still a question if the possible adoption of such highly sophisticated systems as electronic navigation systems could lead to the promotion of national interests or how much profit could be expected from the investment in such systems. Indonesian ships will not be able to expect great benefit from their immediate use of such systems, under the current shipping situation in that country. It might be just foreign vessels that could derive great benefits from such systems. If so, it would be possible to levy fees for the use of systems from foreign vessels receiving benefits. Then it would be all right to collect fees from foreign vessels entering or leaving Indonesian ports, but what about other foreign vessels which are just transiting Indonesian waters. These questions hinder the promotion of the program.

In any case the Indonesian General Maritime Bureau considers that the consolidation of electronic navigation systems should be regarded as one of the most urgently needed measures and that the consolidation would promote the development of shipping industry of the country which, in its turn, would contribute to the Indonesian economic advancement. This also concerns the hydrographic survey program of Indonesia. The Government of Indonesia has decided to conduct hydrographic surveys of the straits of Makassar and Lombok with technical cooperation of the Hydrographic Department of the Japanese Maritime Safety Agency. In this connection, some types of electronic navigation systems should be established as guide-posts of the waterways. With the assistance of such electronic navigation systems, vessels which have hithertofore navigated close to islands could now operate safely on the open sea, and take the shortest course from one place to another. The program envisaged by the Indonesian Government includes the establishment of ten medium-wave beacon stations, 15 radar beacon stations and six Decca Chains. The greatest importance is being placed on Decca Chains, and the Government is contemplating giving the first priority to the Lombok and Makassar areas. In this respect, the relations with Malaysia and Singapore have been taken into consideration. To take a wide view of the matter, it would be desirable to study the establishment of the Makassar Strait systems under the cooperation of the three coastal countries of Malaysia, Singapore and Indonesia rather than the systems involving only

Indonesia. This concept of the Indonesian Government may be said adequate, but this does not necessarily mean that the Government sticks to the Decca system, considering it as the best system to meet the requirements. On the contrary, it means that if some other system is considered preferable in view of the worldwide trend in the future, the Indonesian Government may change its program to such other system.

The establishment of medium-wave beacon stations has been contemplated for one thing from the fact that the Safety of Life at Sea Convention (SOLAS) requires vessels of more than 1,600 tons engaged on international voyages to equip themselves with direction finding apparatuses. It is desirable that even a small vessel should carry on board a radio receiver to listen to meteorological information or simple direction finder, and this makes it important to have medium-wave beacon stations established.

As for the radar beacon stations, they are gradually on the increase throughout the world and that is why the establishment of this system has been included in the Indonesian program. Table No. 1 shows draft program presented by the Indonesian side.

6. ACTUAL SITUATION OF SHIPPING, AND CHANNELS IN INDONESIAN WATERS

Indonesia is a country composed of approximately 10,000 islands, and its economy may be said largely dependent on shipping. The actual situation is, however, that only about 1,350 steam vessels and sailing vessels of 100 tons to 1,000 tons are operating on domestic service between the islands as shown in Table No. 2. And there are only 439 vessels transporting lumber, ore or oil and 57 ocean-going vessels operating in the same area.

As shown in Table No. 3, the number of tankers has almost been doubled during the last five years in spite of the fact that other types of vessels showed no noticeable increase in number during the same period. In terms of tonnage, tankers increased by one million tons. Table No. 4 indicates that the Indonesian Government estimates an increase of the amount of domestic cargo and imports and exports twice as much in 1980 as what it was in 1970.

What should be noted is the fact that, as shown in Table No. 5, the amount of general cargo transported at sea in 1973 increased by about 50 per cent over the tonnage recorded in 1969 despite the fact that the total tonnage of cargo vessels decreased by about ten per cent during the same period. This means that the amount of cargo handled by each vessel increased due to the increase in ships' speed or, in other words, the improvement in operational efficiency of vessels. This trend will continue in the future.

Table No. 6 shows that the amount of cargo handled by both huge cargo vessels and tankers increased remarkably in the Lombok and Makassar straits area. When marine chart is completed in this area as a result of the hydrographic survey to be commenced in 1974, the operational efficiency of transiting vessels and vessels entering or leaving the ports along the sea area will be greatly promoted and the amount of cargo transported will also largely augment. Although it is vast, this area has many sunken reefs and small isles. In order to ensure the safety of navigation, therefore, it would be effective to have adequate electronic navigation systems throughout the area.

With respect to fishing vessels, it is understood that fishing vessels are transferring from sail to power, but when compared with those in Japan they are still much behind in modernization.

As for marine accidents, it may be said that there is little or no statistical information on them. The information submitted by the fact finding mission (See Table No. 9) represents only about 60 per cent of the presumed number of accidents, with details still unavailable. In the Malacca Strait area, there were six collision cases occurring during the past five years, and this was probably because there were many small craft crossing the channels. There were, however, many cases of stranding in the Lombok and Makassar Straits area perhaps due to insufficient charts and insufficient number of aids to navigation in the area. Because of this, almost all vessels navigate close to shores. The need for electronic navigation systems which would enable vessels to confirm their position in the offing is now fully recognized.

7. METEOROLOGICAL CONDITIONS

Indonesia is located directly under the equator, and the greater portion of its territory lies in the area between latitudes 05°N and 10°S. Unlike Japan, Indonesia has no changes of the seasons. It has the climate of mid-summer such as we have in Japan almost throughout the year. For this reason, there is no mist or fog which is generated by changes in temperature, etc. and which would form the factors for poor visibility. As indicated in Table No. 10, the days on which visibility was found to be less than two kilometres were only 0.6 per cent of the total number of days on which measurement was conducted. It can be said that there has been no storm nor wind of more than 25 metres per second that ever blew in this area. (This data has been obtained from the observation results recorded at airdromes, not at sea.)

When a radio station is constructed in Japan, there are regulations which require the station building or tower to be constructed so as to withstand the wind of 60 metres per second at the height of 16 metres above the ground. Actually, we have many typhoons in Japan with wind of the maximum momentary speed exceeding 60 metres per second. In many cases, therefore, excessive design is employed in building a huge tower or other tall structures. On the contrary, in Indonesia where the meteorological conditions are calm, it would be important to have a more economical design of buildings and towers.

8. STANDARD OF ELECTRONIC ENGINEERING TECHNIQUE

Generally speaking, the technical standard in Indonesia cannot be said very high. This is probably because it is only 20 or less years since this country became independent, and it is difficult to obtain many technical experts under the present situation where the various systems including the compulsory education are considerably backward, although efforts are being made by the Government to promote the educational standard of the nation.

The shortage of technicians of medium or higher standing is therefore keenly felt especially in the field of electronic engineering which is progressing very rapidly. In coastal radio stations which have opened recently, the shortage of radio operators is remarkable. In order to meet the shortage of engineers, the Government is making efforts to train personnel at its own training facilities, but it will require a certain period of time before the fruit of its efforts can be reaped. Thus, the lack of absolute number of expert personnel will continue for some time to come. Particularly, the shortage of radio engineers is serious. There are not many engineers who have graduated from the electronic engineering course at universities or senior high schools. They are too few in number to meet the demand from various fields of electronics.

If, in handling an equipment, the meer knowledge of the way of handling is enough to operate such equipment, then it would be possible to cover the shortage of engineers by training in Japan for five or six months those Indonesians who have a certain basic knowledge of electronic engineering. Such training would of course be necessary at any rate.

9. NEED FOR INTERNATIONAL ELECTRONIC NAVIGATION AID SYSTEMS

It is now almost a half century since radio wave came to be utilized by vessels in fixing their positions. During this period, electronic engineering has made a rapid progress, making possible the practical use of new systems one after another. In recent years, man-made satellites are being utilized in fixing positions at sea. The hyperbolic navigation systems which were developed during 1940's made it possible to measure positions far more accurately than the conventional direction finding systems with relatively great errors.

Position-fixing by electric wave has a great advantage in that it can be done at all times at sea far away from shore without being affected by weather conditions. Since the hyperbolic navigation systems such as Loran and Decca do not require any special skill on the part of personnel to operate, that is, they may be operated by anybody in fixing positions with ease and promptness, they have brought a sudden change in our concept of position-fixing systems. In other words, vessels now find it possible to have safe and most economical navigation because they can at all times have accurate position of their vessels even under adverse weather conditions. To cite an example of Japanese fishing vessels, they had before no other way than to depend on the sixth sense of an experienced skipper when they wanted to revisit the fishing ground which they had found. By using the Loran system, they can now easily locate such fishing ground. Inasmuch as the accurate position of a vessel can be fixed even under bad weather conditions, there is no wasting in navigation and the meeting between catcher boats and the mother ship can be facilitated. Thus, an enormous amount of fuel can be saved and the operational efficiency can be promoted. The expenses thus saved can more than make up for the expenses required for the purchase of a Loran receiver. It is not too much to say that there are no deepsea fishing vessels which are not equipped with Loran receivers. This greatly contributes to the safety of navigation of such vessels.

This rapid progress of navigation systems gains in importance with the increase in the amount of traffic incidental to the economic growth, and researches and development are going on to work out surer and more accurate systems. The requirements for the marine electronic navigation systems were agreed upon at the International Meeting on Radio Aids to Marine Navigation held in London in 1946, and at the same meeting the systems were classified into three groups: those for use in the ocean, those for coastal use and those for use in ports and harbours, and the standards for each group were shown.

Those for use in the ocean included Loran A and Loran C as most excellent systems, but at the present time the Omega System is regarded as the best navigation system. It is considered that Omega will continue to hold the position of an excellent unified worldwide system for some time to come. One other system comparable with Omega is a system using man-made satellites, but there has been no worldwide coordination about this system and it seems to take quite some time before this system is put to practical use.

If the Omega System is placed in full operation, vessels navigating in the open sea could always obtain their accurate positions, and thus their operational efficiency would be promoted, and if the vessels are regular liners, they could be assured of safe navigation because they will be able to establish accurate routes. Rescuing activities will also be facilitated in case of marine accidents.

Systems for use in coastal waters must be those with higher accuracy than those used in the open sea, and this is because marine traffic is more dense and navigation is more dangerous with sunken rocks in the waters close to shore. Loran C and Decca are regarded as suitable systems for use in these waters, but the present situation is that there is no worldwide unified system in use. Since the applicable area of this type of system is waters along the coast of a country, it is possible that the country chooses systems on its own idea, but from the standpoint of users of the systems, it is natural that unified worldwide systems are preferable.

The Decca System first started in Europe, and now is extending gradually to wider area. In the United States, however, there is a strong indication that some other system than Decca will eventually be adopted in that country. In Japan, consolidation is in progress with the Decca System. It is considered that the area where the Decca System is available will be expanded throughout the world in the future.

Medium-wave beacon stations are the oldest of all electronic aids to navigation. The accuracy of this system is not very high, but the system can be used easily by small vessels navigating in coastal waters. Its value as an aid to navigation to ensure the minimal safety of navigation should be recognized.

It is, however, extremely difficult to express the value of these electronic aids to navigation by numerical value. Even without this system, a skilled, excellent master would be able to steer his vessel along the economical and safe course. On the other hand, the existence of this system does not mean that the vessel can depend blindly on this system in navigating safely from the time when she leaves her berth until when she gets alongside the berth again. It is always the master who makes decisions on steering his vessel. And, if this is the case, does it mean that such system is not essential but better if available? Does it also mean that it would be more important to train mariners to be excellent masters? This idea dominated with tenacity in the Japanese shipping world for quite some time, and the furtherance of electronic navigation systems was more delayed with larger vessels. For fishing vessels whose biggest interest was in the amount of catch, it was more important to find their positions at sea easily and accurately than to save their face or to talk reason or theory. Therefore, they made the best use of all possible scientific instruments. Radar, Loran, direction finders, fish-shoal finders and other various types of electronic instruments were widely introduced. What a spectacular sight it was to see a small fishing vessel of less than 40 tons equipped with every and all latest electronic instruments! They are no longer required to conduct astronomical observations in finding their positions. Large merchant vessels and cargo vessels now cannot help recognizing the value of electronic systems as effective navigational aids. This trend permeated gradually through these vessels and today no one in the shipping world denies the great value of electronic navigation systems. This is of course the trend of the times caused by the scientific progress, but in the future there will be changes in the concept of navigation at sea. One indication of this is the advent of a vessel controlled by computers. In such vessel, electronic navigation system is utilized to the fullest extent, human power is reduced and efficient operation of the vessel is ensured.

Aircraft adopted electronic navigation systems with relative easiness since its history was not very long and its speed exceeded the extent of human control.

It may be said that at the present time the shipping world which has a long tradition is, though belatedly, following example of the aircraft world in adopting these systems.

The remarkable progress of aircraft has made the world become narrow and promoted interchange of individual persons. It has also helped increase flow of goods and enrich the life of people of the world. In this connection, the part played by marine transport is very important and this may justify the importance of consolidating electronic navigation systems to ensure safety of shipping transport.

10. MASTER PLAN

10-1 DECCA CHAIN

The mission studied a plan for positioning Decca stations in Indonesia with particular importance placed on the Lombok Strait and Makassar Strait area. The reasons for this were: the waterways in the area are relatively narrow, hydrographic surveys will be commenced in the area in the near future and the Indonesian Government is considering to give the first priority to these straits for establishing electronic navigation systems.

(Lombok Strait and Makassar Strait)

In preparing a positioning program, consideration was given to such arrangement that vessels can navigate as far as practicable on a single line of position from when they pass through Lombok Strait until when they come to the ocean west of Parepare, Celebes Island in Makassar Strait. However, there are many high mountains on Bari Island and Lombok Island -- particularly, there are volcanoes on Bari -- and it is considered the selection of station sites is not very easy.

In order to allow vessels to use the Decca system with adequate accuracy throughout the waterways, three chains would be appropriate, and each chain should be composed of four stations because, judging from the regular liner chart, there seem to be a considerable number of vessels navigating in the sea area east of Celebes Island. If importance is attached only to Lombok Strait and Makassar Strait, the establishment of a secondary station in the vicinity of Malamala could be commenced at a later date.

(Malacca/Singapore Strait and Sunda Strait)

There are many channels in the area lying between Jakarta and Singapore or Sumatra Island and therefore a chain suitable for this area has already been contemplated. As for Malacca Strait, another plan was considered in which a secondary station would be placed in Malaysia. Proposed locations of stations to be established in Indonesia were submitted to the Indonesian Government at the time of survey (See attached diagram).

All the foregoing plans have been prepared on the basis of chart published by the Hydrographic Department of the Japanese Maritime Safety Agency and the maps of one three millionth scale. It goes without saying that if we proceed with the programs as they are, detailed surveys must be conducted in the future. Table No. 11 indicates the standard construction schedule in Japan.

10-2 MEDIUM-WAVE BEACON STATIONS

Indonesia has no medium-wave beacon station for vessels. It has, however, 51 medium-wave stations (NDB) for aircraft use. The frequencies used by this system exist both above and below the band of frequencies for the medium-wave beacon stations for marine use, and users will be able to receive both frequencies by the same receiver.

In newly establishing marine beacon stations under the current situation, therefore, it is considered more beneficial for users to have them established, starting from the area outside the effective area of the medium-wave beacon stations for aircraft use because the effective area of aircraft beacon stations is available for marine users. Even in such case, stations should be built in the vicinity of the existing lighthouses for the convenience of maintenance and administration business.

From this point of view, we have tentatively decided on the possible sites of stations. The number of stations is as many as 14, from among which the priority could be determined (See attached diagram). Table No. 12 shows the standard schedule of construction in Japan.

10-3 RADAR BEACON STATIONS

Radar beacon stations are installations to serve for vessels equipped with radar as first observed beacons or obstruction beacons. A station in this system should be built at promontories or other places which radar finds it difficult to distinguish on the radar screen. This is confined to localities, and it would indeed be careless to select possible sites just on the basis of information available at the present time. In studying the siting of medium-wave beacon stations, the mission has picked six places where the mission thinks it better to have radar beacon stations (See attached diagram). Properly speaking, opinions of those vessels equipped with radar should have been asked or photographs of radar screen images should have been collected before the selection of possible sites. It is hoped that this matter should be studied in the future.

11. CONCLUSION

It is still a major question under the current circumstances in Indonesia if it is really necessary to have electronic navigation systems established in that country. The mission, however, considers it desirable and, to be more frank, necessary, to consolidate such systems in Indonesia, if, in the long run, that country intends to promote its shipping industry and its economic growth. It is obvious that electronic navigation systems will become more and more important for the shipping circles of the world, and it may be said that the Indonesian Government would be making a courageous decision if they recognized the importance of consolidating such systems, after probing fully into the general trend of the world.

For the maintenance and administration of these systems is required a high degree of technology, but so long as our recent observation of the actual state of operation and administration at coastal radio stations in Jakarta is concerned, there is nothing to worry about. However, full consideration should be given in the future to the training of expert personnel because many such experts will be needed to man these system installations.

In carrying out the present project, it is essential to conduct a thorough survey from the long-run point of view, prepare the schedule very carefully, and carry it out gradually according to the phases of economic development of the country. In this respect, it would be desirable for Japan from its stand as a shipping country and from its role in Asia, to provide as much assistance as possible, based on the experiences hithertofore obtained. The mission is quite sure that it is worthwhile to concentrate our efforts in implementing this project.

It might be added that at the last day of the conference, the Indonesian side expressed their hope that this project be carried out completely by Japan from preparing initial plans to effecting final construction.

Table No. 1-1

Long-range program for the consolidation of electronic aids to navigation in Indonesia (1975 ~ 1980)

1. Decca Chain (6 chains)

100 Rupiah ~ Approx. ¥70.-
Unit : Thousand

Classification	1975		1976		1977		1978		1979		1980		Total	
	Rupiah	Dollar	Rupiah	Dollar	Rupiah	Dollar	Rupiah	Dollar	Rupiah	Dollar	Rupiah	Dollar	Rupiah	Dollar
North Malacca Strait								3, 500			132, 140		132, 140	3, 500
Central Malacca Strait						3, 500			78, 140				78, 140	3, 500
South Malacca Strait						3, 500			78, 140				78, 140	3, 500
Lombok Strait		3, 500			130, 990								130, 990	3, 500
South Makassar Strait		3, 500			130, 990								130, 990	3, 500
North Makassar Strait				3, 500			130, 990						130, 990	3, 500
Total		7, 000		3, 500	261, 980	7, 000	130, 990	3, 500	*156, 280*		*132, 140*		681, 390	21, 000

Table No. 1-2

2. Medium-wave beacon station (10 stations)

Classification	1975		1976		1977		1978		1979		1980		Total	
	Rupiah	Dollar	Rupiah	Dollar	Rupiah	Dollar	Rupiah	Dollar	Rupiah	Dollar	Rupiah	Dollar	Rupiah	Dollar
Pu. Beras		70			2,400								2,400	70
Dimant Punt				70			2,400						2,400	70
Cape of China						70			2,400				2,400	70
Semarang								70			2,400		2,400	70
Jamuang Reef				70			2,400						2,400	70
Lombongan						70			2,400				2,400	70
Serutu		70			2,400								2,400	70
Cape of Mangkaliat								70			2,400		2,400	70
Great Dewakans								70			2,400		2,400	70
Nusanive								70			2,400		2,400	70
Total		140		140	4,800	140	4,800	280	4,800		9,600		24,000	700

Table No. 1-3

3. Radar beacon station (15 stations) (For one station, siting program has not been decided.)

Classification	1975		1976		1977		1978		1979		1980		Total	
	Rupiah	Dollar	Rupiah	Dollar	Rupiah	Dollar	Rupiah	Dollar	Rupiah	Dollar	Rupiah	Dollar	Rupiah	Dollar
Belawan Fairway		70			1,940								1,940	70
Batangnari Outerbar						70			1,940				1,940	70
Palombang		70			1,940								1,940	70
Cilacap						70			1,940				1,940	70
Rupat Strait		70			1,940								1,940	70
Jakarta				70			1,940						1,940	70
Surabaya				70			1,940						1,940	70
Sampit Outerbar				70			1,940						1,940	70
Hercules				70			1,940						1,940	70
Pegan Cuterbar				70			1,940						1,940	70
Kahayanbar						70			1,940				1,940	70
Siballd Bank						70			1,940				1,940	70
Ujung Pandang								70			1,940		1,940	70
Sorong								70			1,940		1,940	70
Total		210		350	5,820	280	9,700	140	7,760		3,880		27,160	980
Grand Total		7,350		3,990	272,600	7,420	145,490	3,920	168,840		145,620		732,550	22,680

Table No. 2

Statistics of Indonesian merchant vessels

Type of vessel	No. of shipping companies	No. of vessels	Gross tonnage	Remarks
Ocean-going vessel	6	57	570,000 ton	
Lumber, ore, oil transport vessel	14	439	1,422,000	
Coastal vessel	55	312	376,000	Those navigating in all areas of the Indonesian Archipelago.
Coastal vessel	261	679	95,000	Those of less than 500 tons, navigating within 200 nautical miles from port of registry.
Coastal vessel (Sailing vessel)	182	364	36,000	
Total	518	1,851	2,499,000	

Table No. 3

Changes by year in the amount of Indonesian merchant shipping for domestic transportation

Classification	1969	1970	1971	1972	1973	Remarks
Coastal vessel	418, 535 ton	381, 135 ton	345, 904 ton	317, 923 ton	376, 000 ton	Those navigating in all areas of the Indonesian Archipolago.
Coastal vessel	60, 700	90, 000	83, 000	86, 000	95, 000	Those of less than 500 tons, navigating within 200 nautical miles from port of registry.
Coastal vessel (Sailing vessel)	36, 000	36, 000	37, 000	36, 400	36, 000	
Tanker	548, 387	689, 588	858, 699	905, 000	1, 094, 000	Those owned by the Indonesian Government (PERTAMINA).
Total	1, 063, 622	1, 196, 723	1, 324, 603	1, 345, 323	1, 601, 000	

Table No. 4

Total amount of general cargo transported by sea in Indonesia

Unit : Thousand ton

Classification	Actual results in 1970							Estimates for 1980						
	Export & import			Domestic cargo			Grand Total	Export & import			Domestic cargo			Grand Total
	Import	Export	Total	Incoming	Outgoing	Total		Import	Export	Total	Incoming	Outgoing	Total	
Aceh	43.9	48.2	92.1	28.0	16.0	44.0	136.1	128.0	132.0	260.0	30.0	20.0	50.0	310.0
North Sumatra	317.8	553.7	871.5	303.0	147.0	450.0	1,321.5	884.0	743.0	1,627.0	734.0	520.0	1,254.0	2,881.0
Riau	114.1	114.7	228.8	284.0	293.0	577.0	805.8	164.0	385.0	549.0	220.0	200.0	420.0	969.0
West Sumatra	33.0	42.2	75.2	53.0	83.0	136.0	211.2	136.0	47.0	183.0	100.0	270.0	370.0	553.0
Jambi	27.1	79.1	106.2	93.0	40.0	133.0	239.2	39.0	190.0	229.0	300.0	20.0	320.0	549.0
South Sumatra	231.0	225.3	456.3	300.0	272.0	572.0	1,028.3	227.0	336.0	563.0	370.0	845.0	1,215.0	1,778.0
Lampung. Bengkulu	53.2	233.8	287.0	114.0	74.0	188.0	475.0	142.0	369.0	511.0	490.0	80.0	570.0	1,081.0
West Jawa	2,456.8	324.9	2,781.7	410.0	466.0	876.0	3,657.7	3,402.0	534.0	3,936.0	865.0	1,000.0	1,865.0	5,801.0
Central Jawa	240.9	170.3	411.2	60.0	158.0	218.0	629.2	899.0	458.0	1,357.0	475.0	120.0	595.0	1,952.0
East Jawa	616.0	647.2	1,263.2	437.0	876.0	1,313.0	2,576.2	1,346.0	1,010.0	2,356.0	815.0	1,120.0	1,935.0	4,291.0
Bali	0.4	5.3	5.7	65.0	61.0	126.0	131.7	133.0	32.0	165.0	80.0	220.0	300.0	465.0
West Tenggara Is.	1.6	13.9	15.5	51.0	33.0	84.0	99.5	105.0	10.0	115.0	75.0	50.0	125.0	240.0
East Tenggara Is.	-	1.2	1.2	44.0	21.0	65.0	66.2	175.0	26.0	201.0	30.0	50.0	80.0	281.0
West Kalimantan	62.8	113.0	175.8	145.0	55.0	200.0	375.8	165.0	197.0	362.0	300.0	90.0	390.0	752.0
South Kalimantan	15.6	62.3	77.9	142.0	73.0	215.0	292.9	83.0	134.0	217.0	350.0	270.0	620.0	837.0
Central Kalimantan	-	-	-	12.0	19.0	31.0	31.0	155.0	25.0	180.0	70.0	190.0	260.0	440.0
East Kalimantan	37.5	51.0	88.5	139.0	71.0	210.0	298.5	126.0	3.0	129.0	150.0	90.0	240.0	369.0
North Sulawesi	96.7	79.0	175.7	155.0	117.0	272.0	447.7	233.0	220.0	453.0	240.0	115.0	355.0	808.0
Central Sulawesi	-	-	-	56.0	42.0	98.0	98.0	90.0	30.0	120.0	120.0	70.0	190.0	310.0
Southeastern Sulawesi	-	-	-	37.0	43.0	80.0	80.0	94.0	5.0	99.0	20.0	150.0	170.0	269.0
South Sulawesi	97.7	90.3	188.0	121.0	238.0	359.0	547.0	289.0	155.0	444.0	130.0	345.0	475.0	919.0
Maruku	17.3	99.0	116.3	88.0	24.0	112.0	228.3	155.0	26.0	181.0	45.0	60.0	105.0	286.0
West Irian	42.5	13.7	56.2	-	-	-	56.2	344.0	10.0	354.0	50.0	50.0	100.0	454.0
Total	4,505.9	2,968.1	7,474.0	3,137.0	3,222.0	6,359.0	13,833.0	9,514.0	5,077.0	14,591.0	6,059.0	5,945.0	12,004.0	26,595.0

Table No. 5

Changes by year in the amount of domestic cargo transported by sea in Indonesia

General cargo

Classification	Amount transported	Gross tonnage of transport vessels	Remarks
1969	3, 295 thousand tons	515, 000 tons	
1970	3, 664	507, 000	
1971	4, 245	466, 000	
1972	4, 574	440, 000	
1973	4, 897	449, 000	

Oils

Classification	Amount transported	Gross tonnage of transport vessels	Remarks
1969	6, 044 thousand tons	548, 000 tons	
1970	6, 204	690, 000	
1971	7, 343	859, 000	
1972	8, 367	905, 000	
1973	8, 955	1, 094, 000	

Table No. 6

Number of vessels entering and leaving ports along the straits of Makassar and Lombok, and amount of cargo handled at such ports

Unit : ton

Name of port	Year	Cargo vessel						Tanker		Cargo vessel (of less than 500 tons, including sailing vessel)	
		Less than 1,500 tons		1,500 - 10,000 tons		More than 10,000 tons					
		No.	Amount of cargo	No.	Amount of cargo	No.	Amount of cargo	No.	Amount of cargo	No.	Amount of cargo
Benoa	1970	21	7,400	66	214,000	3	167,500	87	125,500	183	6,300
	1971	70	41,097	59	182,913	8	324,761	102	149,615	323	8,339
	1972	40	26,284	60	210,666	4	348,330	129	206,102	294	6,750
Ampenan	1970	118	47,854	141	613,204	15	263,759	2	9,353	673	51,394
	1971	191	84,539	100	440,702	19	350,688	10	85,707	603	44,581
	1972	221	66,063	89	375,615	17	341,201	8	54,081	555	47,658
Makassar U. Pandang	1970	324	195,372	579	2,734,196	208	4,353,314	66	464,172	2,465	140,641
	1971	378	259,168	637	3,196,849	228	4,980,357	94	668,189	1,925	118,954
	1972	343	254,510	692	3,464,002	206	4,784,053	143	735,565	1,770	124,533
Pare-Pare	1970	89	54,434	94	296,883	7	123,290	32	47,090	425	21,175
	1971	149	98,680	83	295,151			45	63,471	469	28,628
	1972	153	85,925	69	263,215	6	80,723	51	52,250	483	44,329
Donggala	1970										
	1971										
	1972	122	45,863	230	815,203	31	520,615			320	13,710
Balik Papan	1970	589	230,480	270	1,384,909	73	1,278,453	625	9,170,771		
	1971										
	1972	1,200	665,000	370	2,038,000	220	3,927,000	790	9,414,000	2,700	145,000
Samarinda	1970	474	148,445	470	3,122,608	58	641,402	42	65,604	199	7,634
	1971	794	286,635	552	3,811,371	128	1,400,924	51	68,359	94	3,991
	1972	910	339,958	481	9,586,902	243	9,449,597	60	95,019	121	13,697
Nunukan	1970	624	50,722	121	963,408	80	930,182	9	16,750	215	5,578
	1971										
	1972	2,028	112,620			125	1,305,300			300	4,980
Tarakan	1970										
	1971										
	1972	1,822	243,583	129	922,236	38	449,596			1,805	56,963

Table No. 7

Statistics of Indonesian fishing vessels

Area	Total No.	Powered vessel		Sailing vessel	Type of fishing		Remarks
		Outboard engine	Inboard engine		Trawl-net & others	Gill-net, small-scale dragnet & others	
Malacca Strait							
East Sumatra	900		900		561	339	
Riau	3, 671	1, 468	1, 619	584	151	3, 520	5 - 100 tons
Sulawesi Strait							
East Kalimantan	356	72	284		72	284	
West Sulawesi							
Central Sulawesi	4		4			4	
South Sulawesi	411		411			411	
Lombok Strait							
Bali	28	27	1			28	
Nuse Tenggara Barat	21	10	11			21	
Total	5, 391	1, 577	3, 230	584	784	4, 607	

Table No. 8

Fishing grounds and fishing ports in Indonesia

Area	Fishing ground	Fishing port	Remarks
East Sumatra (Strait Malacca)	Sea area extending from Karimun to Aceh	Pagurawan Tg. Balai Asahan Dodek Isl. Belawan Lho Suemawe Seneboci/Bagan Siapi[2] Tg. Pinang	
Makassar Strait			
Southeast Kalimantan	Sea area extending from Laut Is. to Samarinda	Kota baru Pegatan Balikpapan Samarinda	
South Sulawesi	Sea area along southern coast of Sulawesi	Ujung-Pandang	
Lombok Strait			
Bali	Sea area along southeastern coast of Bali	Benoa	
Lombok	Sea area along east coast of Lombok	Ampenan Lembar	

Table No. 9

Statistics of marine accidents

Classification	Malacca Strait		Makassar Strait		Lombok Strait		Total	Remarks
	Collision	Stranding	Collision	Stranding	Collision	Stranding		
1969	2		1				3	
1970	2	2	1	3		1	9	
1971				1		1	2	
1972	2		1	1		2	6	
1973						2	2	
Total	6	2	3	5	0	6	22	

Note: *Only 60 per cent of information has been available on marine accidents.*
As for sailing vessels, little or no information has been available.

Table No. 10

Visibility observation data (1960)

Observation point (aerodromes)	Latitude : Longitude		Times of observation			Remarks
			Less than 2 km	More than 2 km	Total	
Babang	05°52' N	95°19' E	5	5,116	5,121	
Banda Aceh	05 31 N	95 25 E	0	2,148	2,148	
Madan	03 34 N	98 41 E	45	8,715	8,760	
Tanjung Pinang	00 55 S	104 32 E	11	4,747	4,758	
Dabo	00 29 S	104 35 E	3	3,927	3,930	
Pangkal Pinang	02 10 S	106 08 E	14	4,774	4,788	
Tarempa	03 12 S	106 15 E	37	4,654	4,691	
Buluh Tumbang	02 45 S	107 45 E	29	4,586	4,615	
Pontianak	00 00	109 20 E	16	4,248	4,264	
Singkawang	01 05 N	109 40 E	52	5,072	5,124	
Bengkulu	03 52 S	102 20 E	1	2,727	2,728	
Padang	00 53 S	100 21 E	23	5,071	5,094	
Sibolga	01 33 N	98 59 E	205	3,455	3,660	
Jakarta	06 09 S	106 51 E	60	8,715	8,775	
Semarang	06 59 S	110 23 E	4	5,120	5,124	
Surabaya	07 13 S	112 43 E	4	8,651	8,655	
Denpasar	08 45 S	115 10 E	4	5,206	5,210	
Banjarmasin	03 27 S	114 45 E	49	7,473	7,522	
Balikpapan	01 16 S	116 54 E	11	5,111	5,122	
Tarakan	03 20 N	117 34 E	6	5,118	5,124	
Makassar	05 04 S	119 33 E	25	8,759	8,784	
Palu	00 41 S	119 44 E	1	2,749	2,750	
Waingapu	09 40 S	120 20 E	3	5,121	5,124	
Kupang	10 10 S	123 40 E	0	4,560	4,560	
Kendari	04 06 S	122 26 E	1	2,927	2,928	
Menado	01 30 N	124 50 E	22	2,888	2,910	
Ambon	03 43 S	128 05 E	2	5,478	5,480	
Jailolo	01 08 N	127 03 E	199	3,871	4,070	
Morotai	02 03 N	128 19 E	1	5,489	5,490	
Langgur	05 41 S	132 45 E	29	4,797	4,826	

Source of information: METEOROLOGICAL DATA OF INDONESIAN AERODROMES 1960

Note: 1. Aerodromes which are located close to shore have been selected from among those listed in the above-mentioned source of information.

2. Information given in the above table is for the calendar year of 1960.

Table No. 11

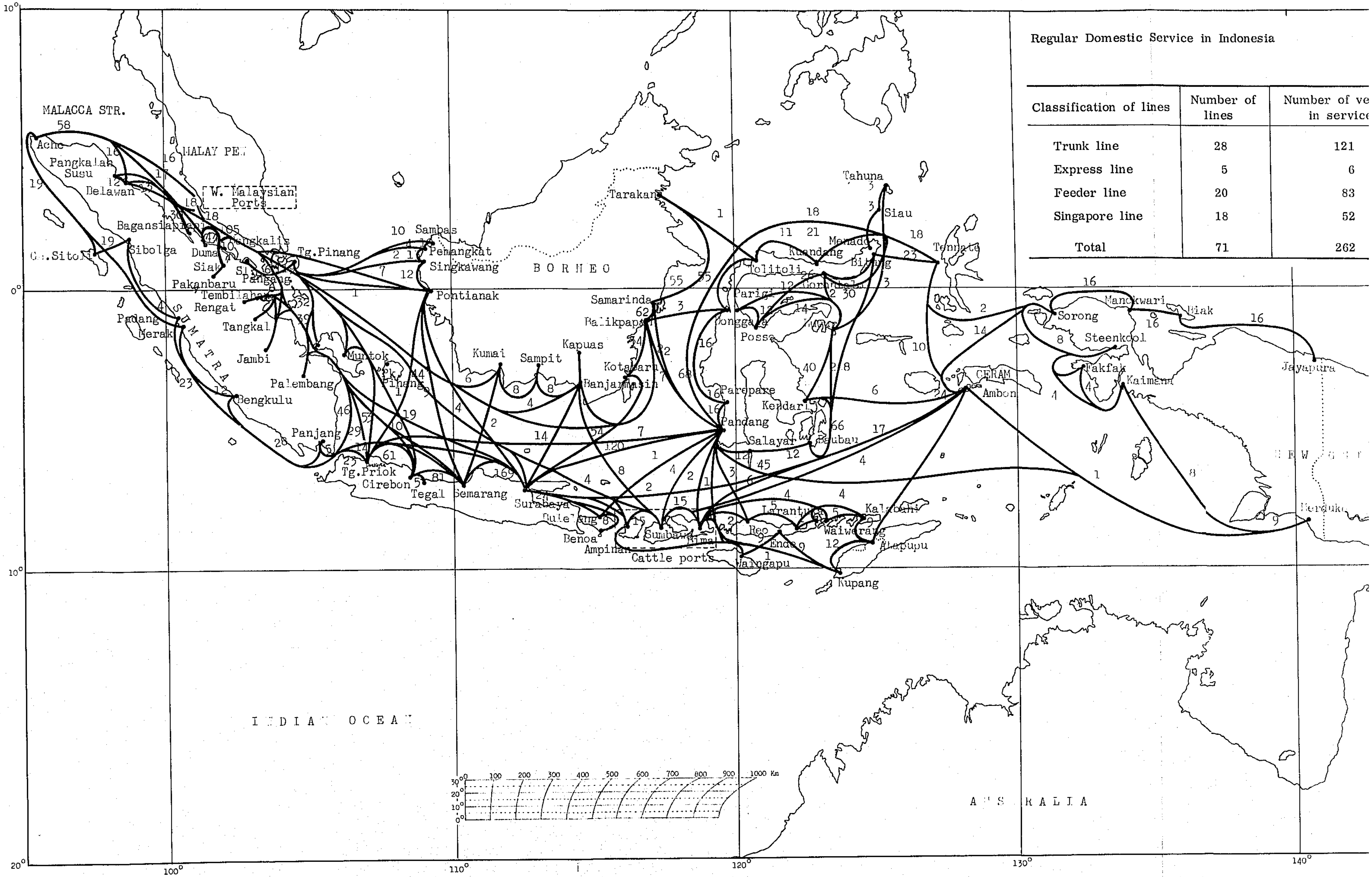
Schedule of construction of Decca Chain (One chain)

Classification	1st Year	2nd Year	3rd Year	Remarks
Survey				
Field survey of sites				
Propagation survey				
Road & site design				Including geological survey
Building survey & design				
Transmitting antenna & tower design				
Land acquisition				
Site for station building & billet		Station building Billet		
Construction works				
Road access, station site				
Radio house, coil house				
Various appliances				Air-cooling & ventilation
Office building, billet				
Warehouse, garage				
Oil, tank, accessory structures				Gate, fence, floor, etc.
Purchase of equipments				
Transmitting apparatus				Including control & switching apparatuses
Transmitting/receiving equipment				For use between stations
Power generating apparatus				
Tower material				For transmitting, receiving & communications
Measuring apparatus				For *maintenance*
Wireless construction				
Antenna, earth construction				For transmitting, receiving & communications
Cable works				For transmitting, receiving & communications
Installation works				
Setting-in of power lines				
Others				
Test signal, evaluation test				
Operation started				
Training of personnel				
Preparation of Decca charts				

Table No. 12

Schedule of construction of medium-wave beacon stations

Classification	1st month	2nd month	3rd month	4th month	5th month	6th month	7th month	8th month	9th month	10th month	11th month	12th month	Remarks
Survey													
Field survey of sites													
Road & site design													
Building survey & design													
Transmitting antenna & tower design													
Land acquisition													
Site for station building & billet													
Construction works													
Road access, station site													
Radio house													
Office building, billet, warehouse													
Oil tank, accessory structures													Gate, fence, floor, etc.
Purchase of equipments													
Transmitting apparatus													
Power generating apparatus													
Tower material													
Measuring apparatus													For maintenance
Wireless construction													
Antenna, earth construction													For transmitting
Cable works													
Installation works													
Setting-in of power lines													
Others													
Test signal, evaluation test													
Operation started													
Training of personnel													

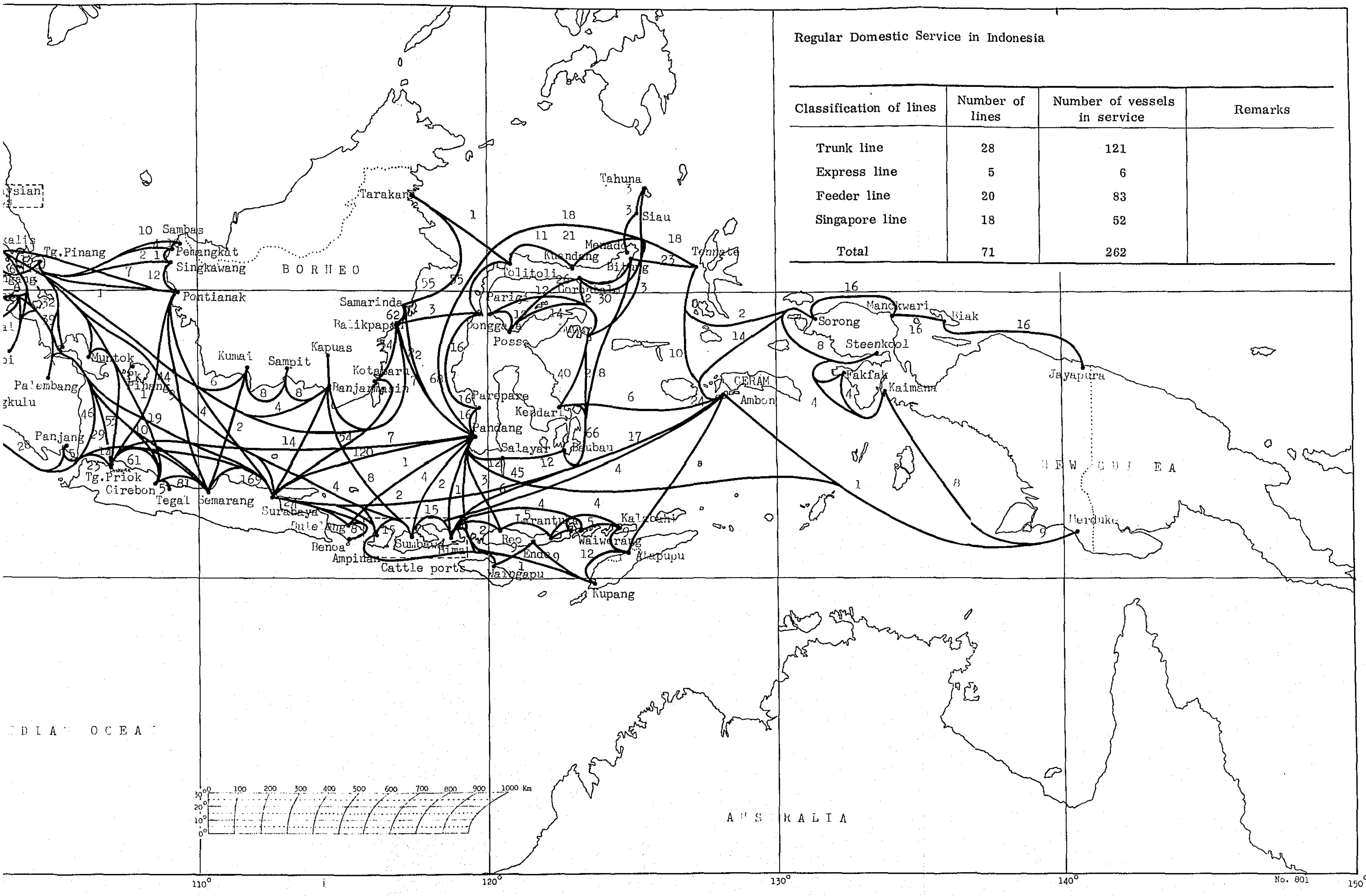


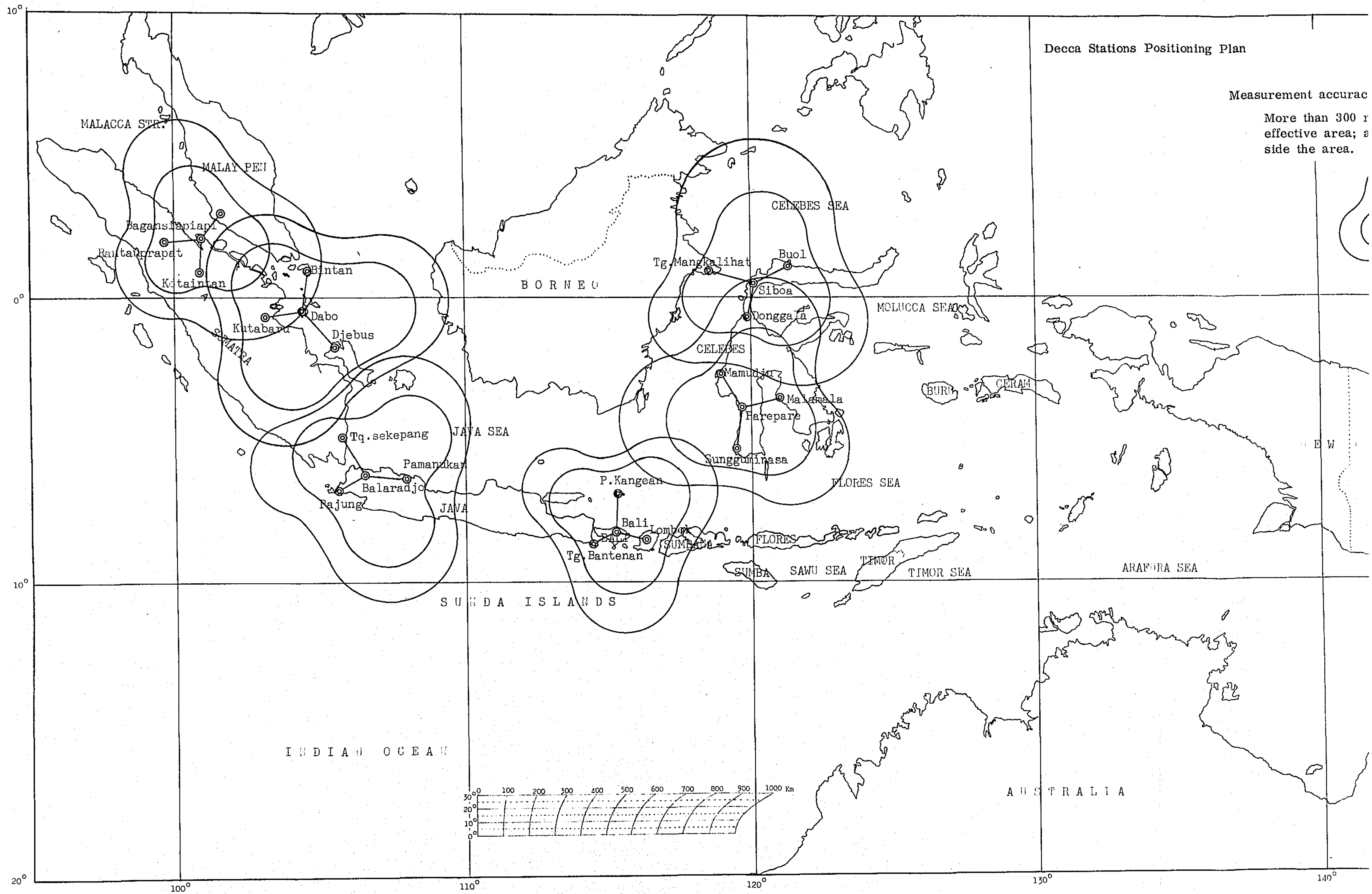
Regular Domestic Service in Indonesia

Classification of lines	Number of lines	Number of ve in service
Trunk line	28	121
Express line	5	6
Feeder line	20	83
Singapore line	18	52
Total	71	262

Regular Domestic Service in Indonesia

Classification of lines	Number of lines	Number of vessels in service	Remarks
Trunk line	28	121	
Express line	5	6	
Feeder line	20	83	
Singapore line	18	52	
Total	71	262	




Decca Stations Positioning Plan
Measurement accurac
More than 300 r
effective area; a
side the area.
MALACCA STR.
MALAY PEN
Bagansiapiapi
Rantauprapat
Kotaintan
Bintan
Dabo
Kutabaru
Djebus
SUMATRA
BORNEO
CELEBES SEA
Tg.Mangkalihat
Buol
Siboa
Donggala
MOLUCCA SEA
CELEBES
Mamudjo
Malamala
Parepare
Sungguminasa
BURU
CERAM
Tq.sekepang
JAVA SEA
Pamanukan
Balaradjo
Pajung
JAVA
P.Kangean
Bali
Lombok
Tg.Bantenan
SUMBAWA
FLORES
FLORES SEA
SUMBA
SAWU SEA
TIMOR
TIMOR SEA
ARAFURA SEA
SUNDA ISLANDS
INDIAN OCEAN
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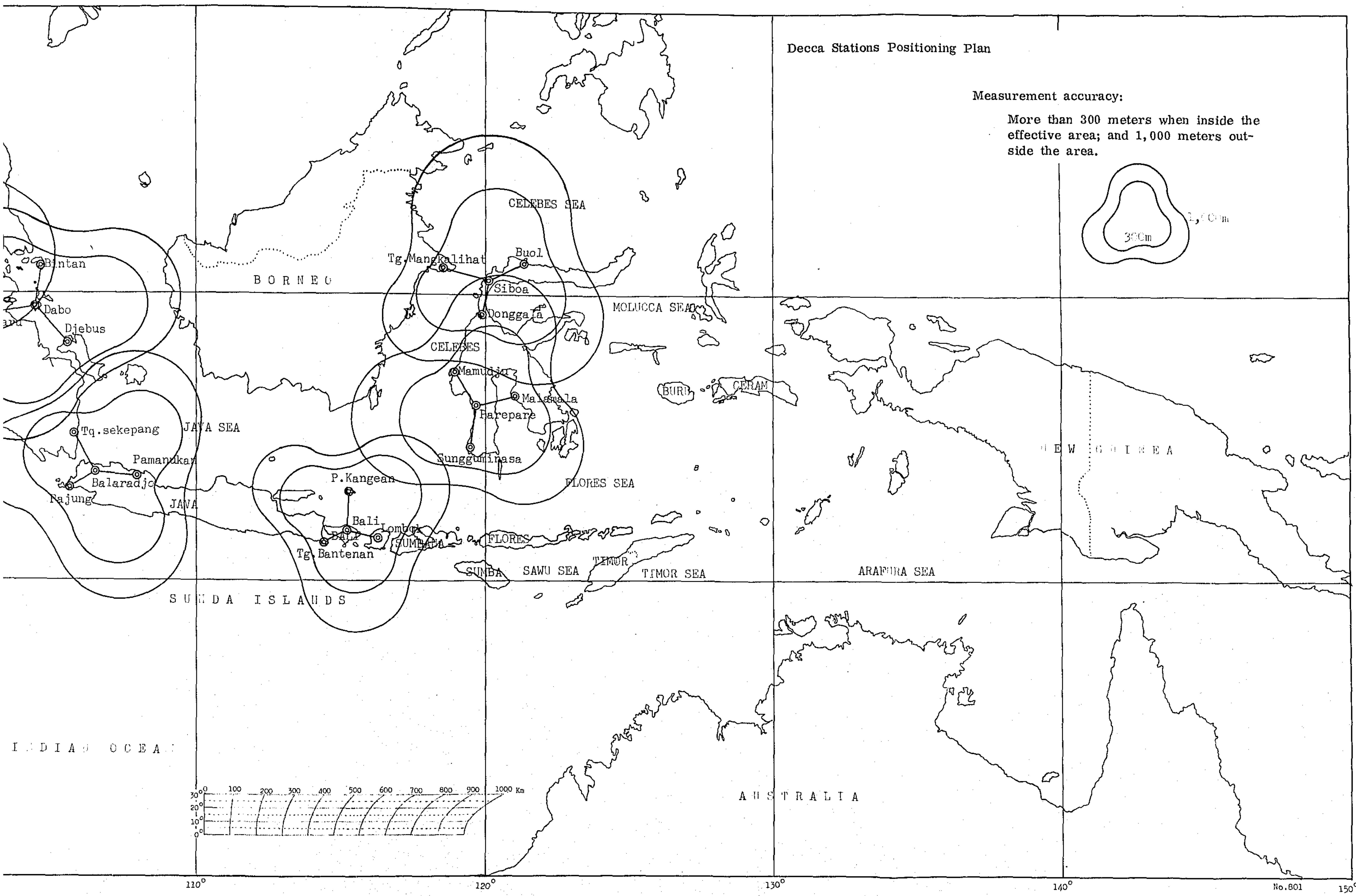
Decca Stations Positioning Plan
Measurement accuracy:
More than 300 meters when inside the effective area; and 1,000 meters outside the area.
CELEBES SEA
BORNEO
Bintan
Dabo
Djebus
Tg.Mangkalihat
Buol
Siboa
Donggala
MOLUCCA SEA
CELEBES
Mamudju
Malamala
Parepare
Sunggurninasa
Tq.sekepang
JAVA SEA
Pamanukan
Balaradjo
Pajung
JAVA
P.Kangean
Bali
Lombok
Tg.Bantenan
SUMBAWA
FLORES
FLORES SEA
SUMBA
SAWU SEA
TIMOR
TIMOR SEA
ARAFURA SEA
BURU
CERAM
SUNDA ISLANDS
AUSTRALIA
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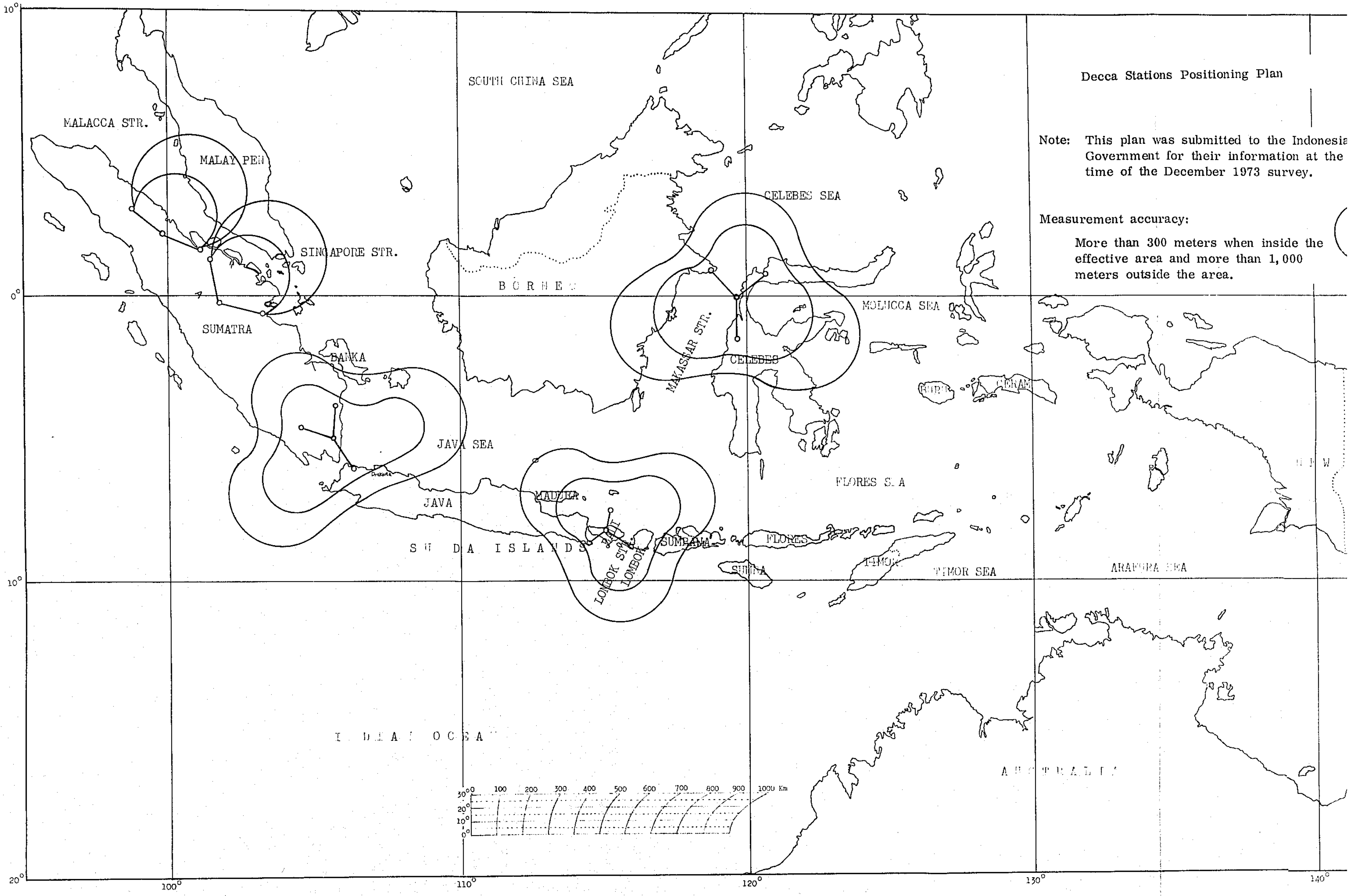
Decca Stations Positioning Plan
Note: This plan was submitted to the Indonesia Government for their information at the time of the December 1973 survey.
Measurement accuracy:
More than 300 meters when inside the effective area and more than 1,000 meters outside the area.
MALACCA STR.
MALAY PEN
SINGAPORE STR.
SUMATRA
BANKA
SOUTH CHINA SEA
CELEBES SEA
MAKASAR STR.
CELEBES
MOLUCCA SEA
JAVA SEA
JAVA
MADURA
BALI
LOMBOK STR.
LOMBOK
SUMBAWA
FLORES
FLORES S. A
SUMBA
TIMOR SEA
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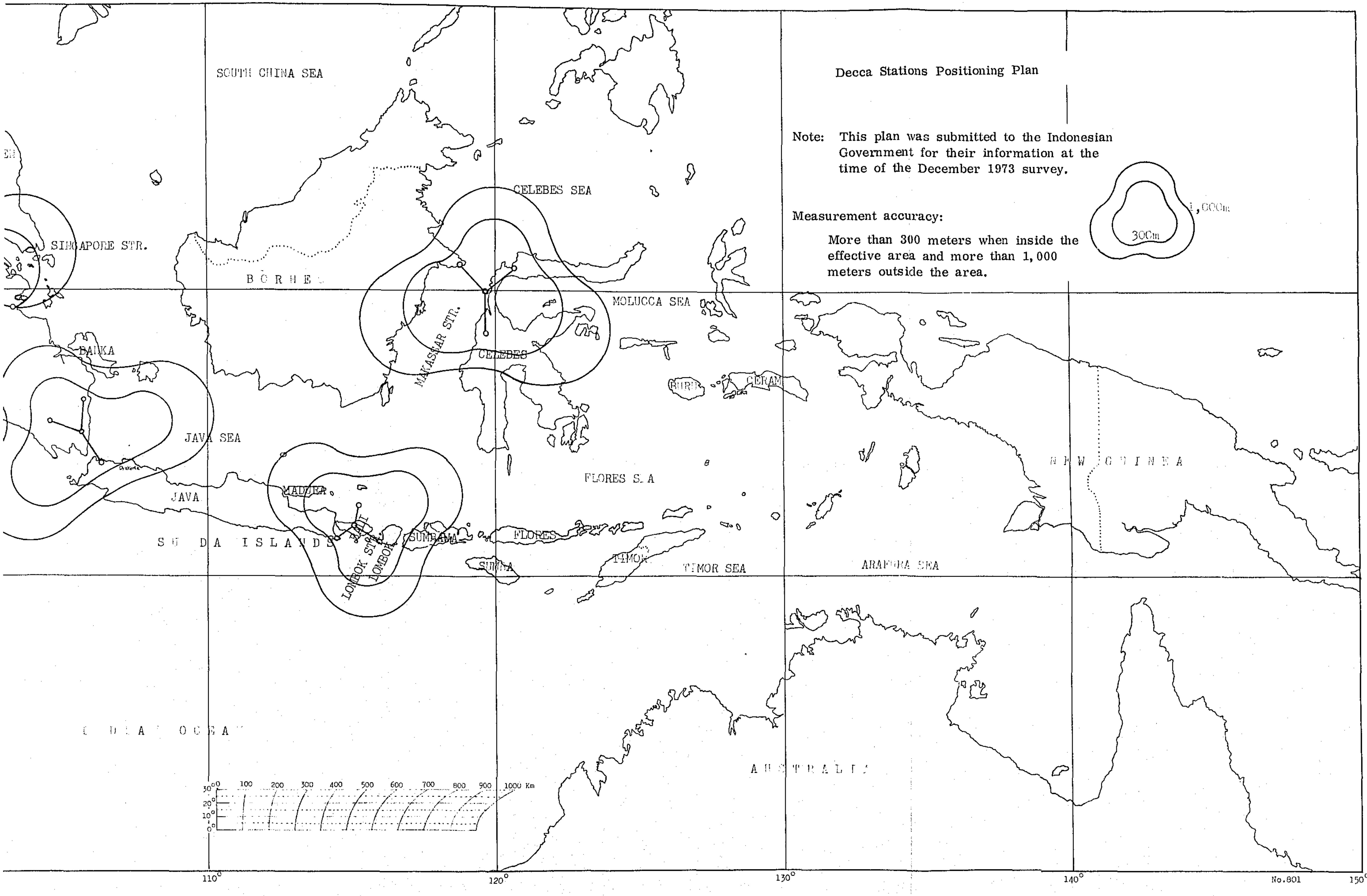
140°


Decca Stations Positioning Plan
Note: This plan was submitted to the Indonesian Government for their information at the time of the December 1973 survey.
Measurement accuracy:
More than 300 meters when inside the effective area and more than 1,000 meters outside the area.
300m
SOUTH CHINA SEA
CELEBES SEA
MOLUCCA SEA
MAKASSAR STR.
CELEBES
JAVA SEA
JAVA
BALI
LOMBOK STR.
LOMBOK
SUMBAWA
FLORES
TIMOR
TIMOR SEA
CERAM
100 200 300 400 500 600 700 800 900 1000 Km
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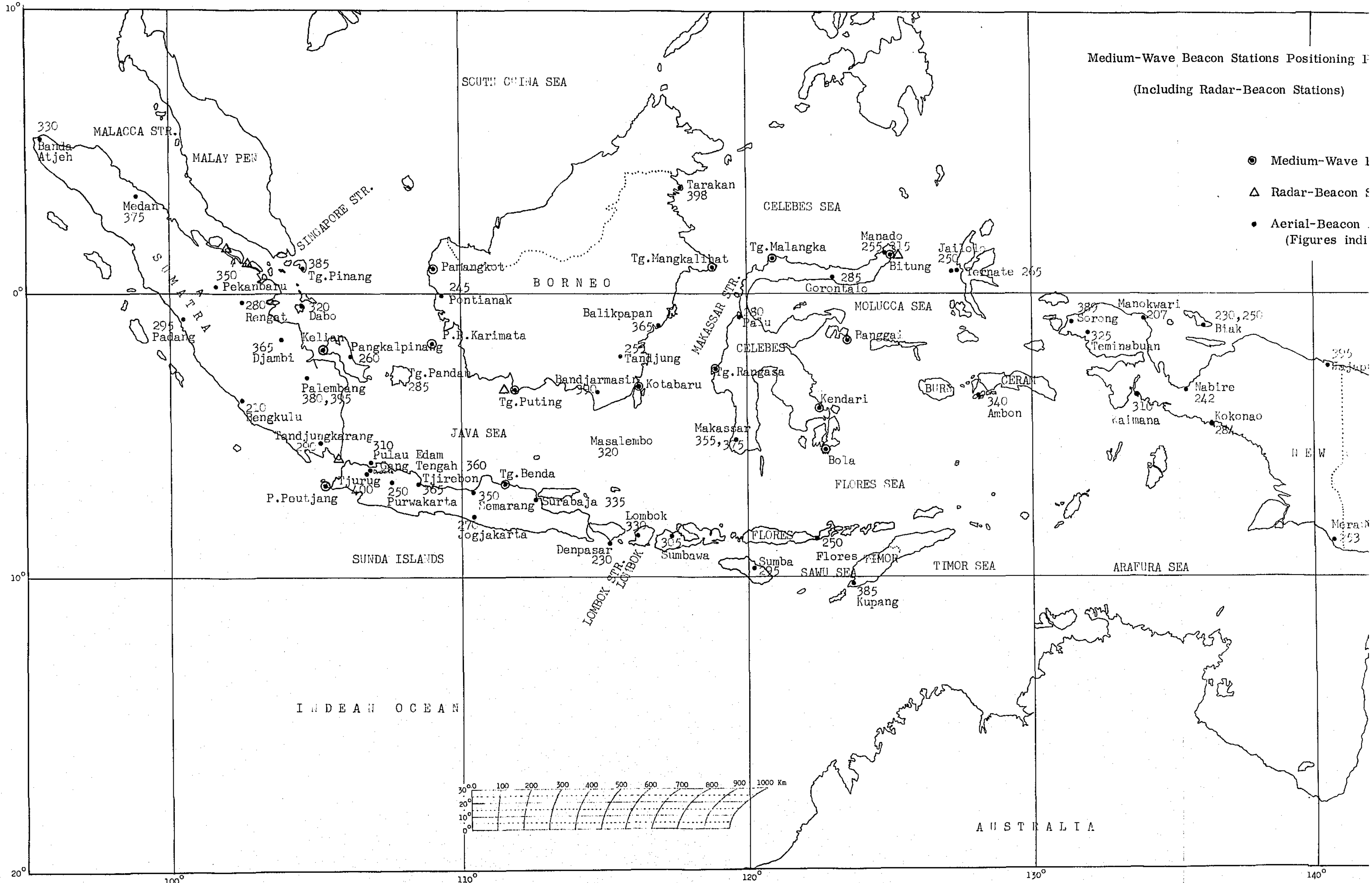
Medium-Wave Beacon Stations Positioning
(Including Radar-Beacon Stations)
Medium-Wave
Radar-Beacon
Aerial-Beacon
(Figures indi
SOUTH CHINA SEA
MALACCA STR.
MALAY PEN
SINGAPORE STR.
SUMATRA
BORNEO
CELEBES SEA
MOLUCCA SEA
MAKASSAR STR.
CELEBES
JAVA SEA
FLORES SEA
SUNDA ISLANDS
INDEAN OCEAN
TIMOR SEA
ARAFURA SEA
SAWU SEA
LOMBOK STR.
LOMBOK
FLORES
TIMOR
BURU
CERAM
NEW
AUSTRALIA
330 Banda Atjeh
Medan 375
350 Pekanbaru
385 Tg.Pinang
280 Rengat
320 Dabo
295 Padang
365 Djambi
Kelian
Pangkalpinang 260
Palembang 380, 395
210 Bengkulu
Tandjungkarang
310 Pulau Edam
Gang Tengah 360
Tjirebon 365
Tjurug 400
P.Peutjang
250 Purwakarta
350 Semarang
270 Jogjakarta
Tg.Benda
Surabaja 335
Pamangkot
245 Pontianak
P.B.Karimata
Tg.Pandan 285
Tg.Puting
Bandjarmasin 390
Kotabaru
Balikpapan 365
255 Tandjung
Tg.Mangkalihat
Tarakan 398
Masalembo 320
Lombok 330
Denpasar 230
305 Sumbawa
Tg.Malangka
Manado 255, 315
Bitung
285 Gorontalo
180 Palu
Banggai
Tg.Rangasa
Kendari
Makassar 355, 375
Bola
250 Flores
Sumba 295
385 Kupang
Jailolo 250
Ternate 265
380 Sorong
Manokwari 207
230, 250 Biak
325 Teminabuan
340 Ambon
Nabire 242
310 Kaimana
Kokonao 284
Merauke
100°
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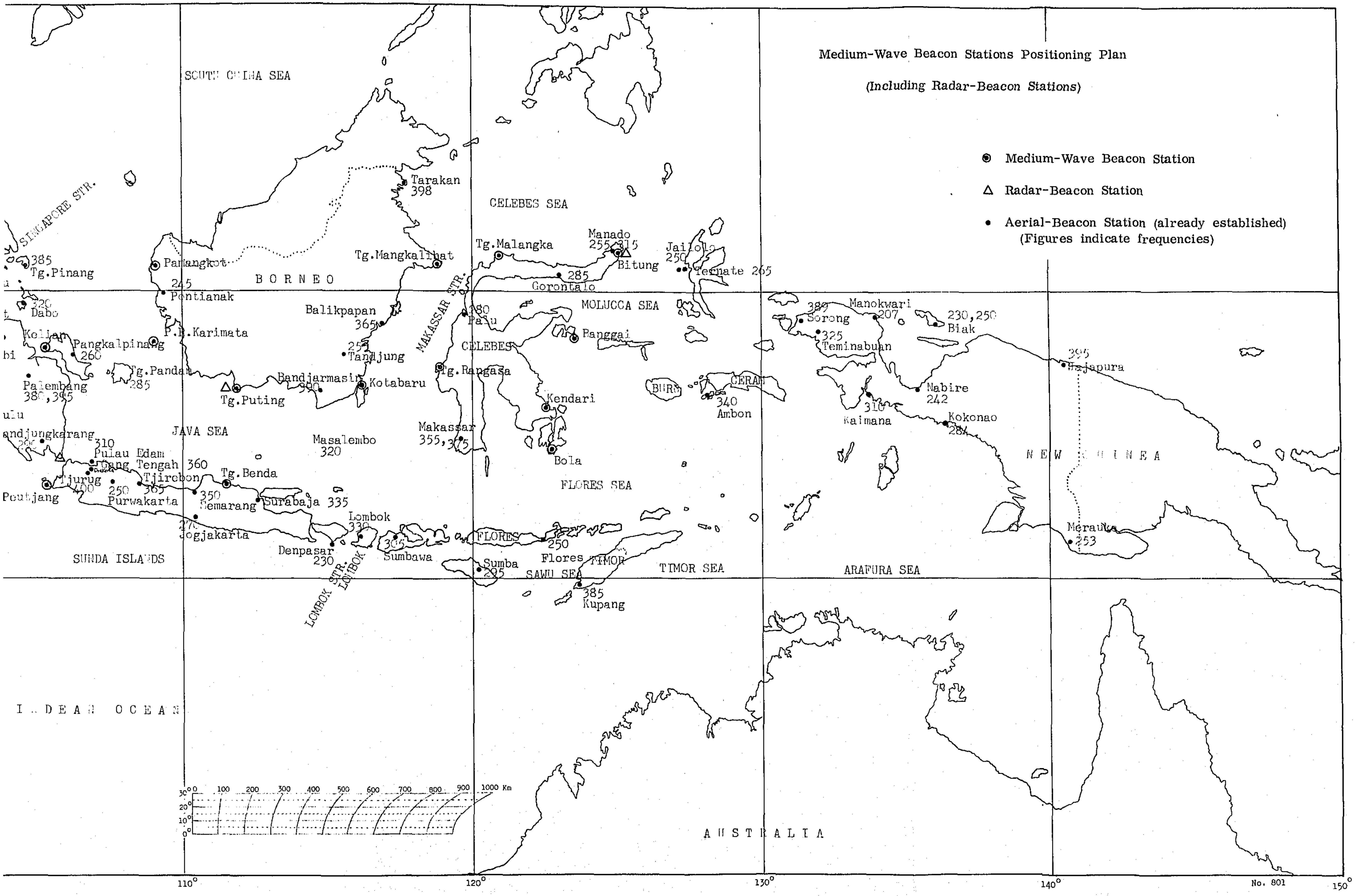
20°
1000 Km



Medium-Wave Beacon Stations Positioning Plan

(Including Radar-Beacon Stations)