NO.

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

DIRECTORATE GENERAL OF SEA COMMUNICATION, MINISTRY OF COMMUNICATIONS (DGSC), THE REPUBLIC OF INDONESIA

THE STUDY FOR THE MARITIME TRAFFIC SAFETY SYSTEM DEVELOPMENT PLAN IN THE REPUBLIC OF INDONESIA

FINAL REPORT

FEASIBILITY STUDY REPORT VOLUME II

PART 2. : DIFFERENTIAL GLOBAL POSITIONING SYSTEM (DGPS)

June 2002

THE JAPAN ASSOCIATION OF MARINE SAFETY (JAMS)

JAPAN AIDS TO NAVIGATION ASSOCIATION (JANA)

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Exchange Rate in the Study:

1 US$ = Rp. 10,000 = 130 Japanese Yen

PREFACE

In response to a request from the Government of the Republic of Indonesia, the Government of Japan decided to conduct a study on Maritime Traffic Safety System Development Plan in the Republic of Indonesia and entrusted the study to Japan International Cooperation Agency.

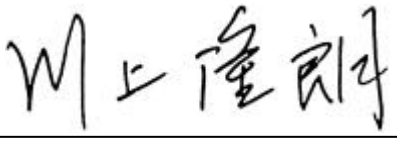
JICA selected and dispatched a study team headed by Mr. Kunio Tashima (until September 4th 2001) of The Japan Association of Marine Safety (JAMS) and Mr. Shingo Tsuda (from September 5th 2001) of JAMS, to Indonesia, three times between April 2001 and March 2002. In addition, JICA set up an advisory committee headed by Mr. Tamotsu Ikeda (Director, Radio Aids Division, Aids to Navigation Department, Japan Coast Guard) between March 2001 and March 2002, which examined the study from specialist and technical points of view.

The team held discussions with the officials concerned of the Government of the Republic of Indonesia and conducted field surveys at study areas. Upon returning to Japan, the team conducted further studies and prepared this Final Report.

I hope that this report will contribute to the promotion of the projects and to the enhancement of friendly relationship between the two countries.

Finally, I wish to express my sincere appreciation to the officials concerned with the Government of the Republic of Indonesia for their close cooperation extended to the study.

June 2002



Takao Kawakami
President,
Japan International Cooperation Agency

LETTER OF TRANSMITTAL

June 2002
Mr. Takao Kawakami
President
Japan International Cooperation Agency

Dear Mr. Kawakami

It is my great pleasure to submit herewith the Final Report of the Study for the Maritime Traffic Safety System Development Plan in the Republic of Indonesia.

The study team of the Japan Association of Maritime Safety (JAMS) and Japan Aids to Navigation Association (JANA) conducted surveys in the Republic of Indonesia over the period between April 2001 and March 2002 as per the contract with Japan International Cooperation Agency.

The findings of this study, which are compiled in this report, were fully discussed with the officials of the Ministry of Communications of the Indonesian Government and other authorities concerned to formulate the Maritime Traffic Safety System Development Plan in the Republic of Indonesia for the period up to the year 2020.

On behalf of the study team, I would like to express my heartfelt appreciation to the Government of the Republic of Indonesia, the Ministry of Communications and other authorities concerned for their diligent cooperation and assistance and for the heartfelt hospitality which they extended to the study team during our stay in the Republic of Indonesia.

I am also deeply indebted to "Japan International Cooperation Agency", "The Ministry of Foreign Affairs of Japan", "The Ministry of Land, Infrastructure and Transport of Japan" and "Embassy of Japan in Indonesia" for giving us valuable suggestions and assistance during the preparation of this report.

Yours faithfully,

津田眞吾

Shingo Tsuda
Team Leader,
The Study for the Maritime Traffic Safety System
Development Plan in the Republic of Indonesia

PROJECT SITE MAP FOR PROPOSED P RIORITY PROJECT
Differential GPS Stations

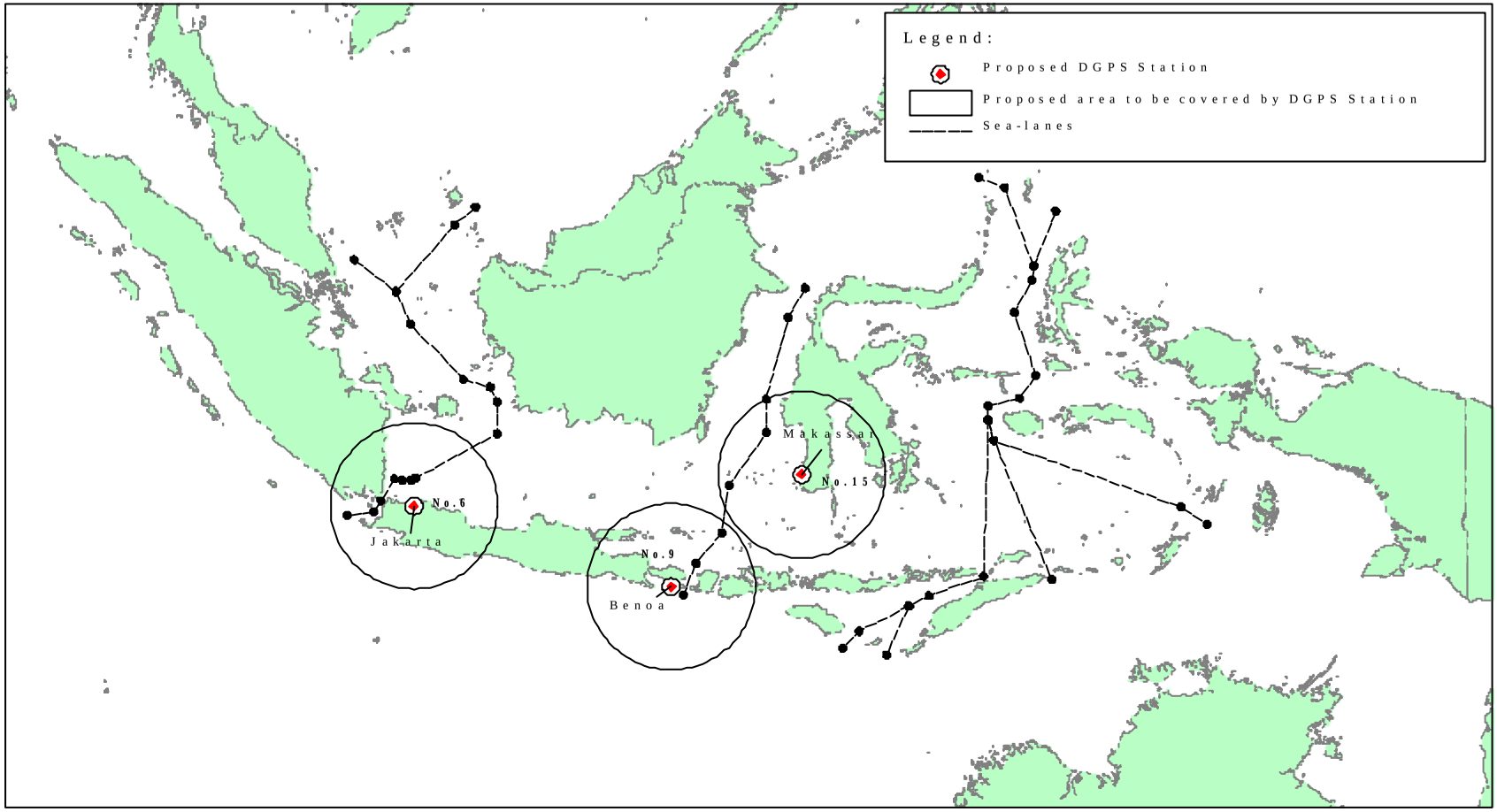
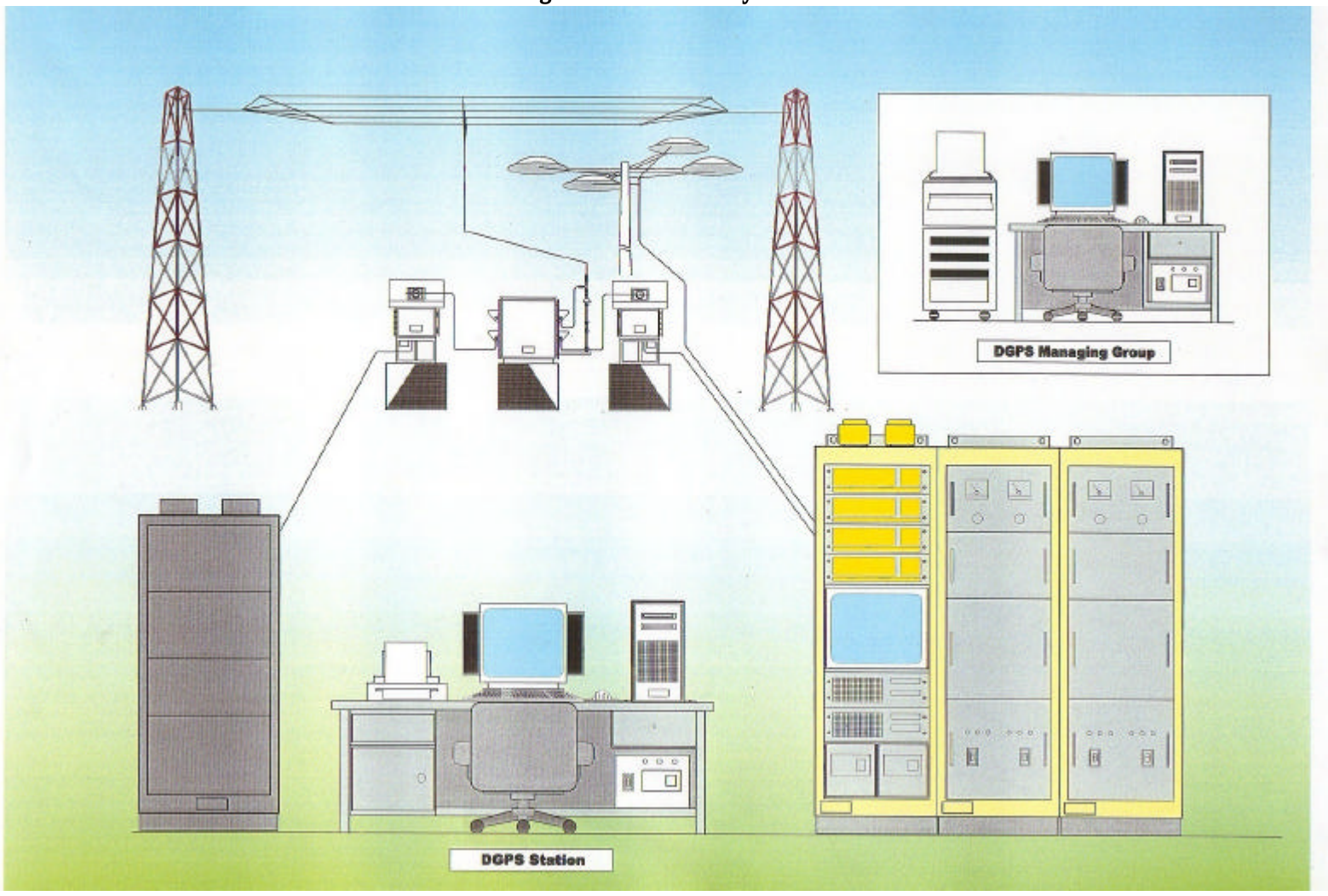


Image of DGPS System



PROJECT SITE MAP PROPOSED PRIORITY PROJECT (DGPS)
Image of DGPS Stations

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ABBREVIATION LIST

A	ADPEL	Administrator Pelabuhan (Port Administrator)
	ADSL	Asymmetric Digital Subscriber Line
	AIS	Automatic Identification System
	ALE	Automatic Link Establishment
	AMDAL	Environmental Impact Analysis
	AMVER	Automated Mutual-assistance Vessel Rescue System
	ARMADA PLP	Guard and Rescue Fleet
	ASDP	Angkutan Sungai Danau dan Penyeberangan (Ferry Transport Services)
	ATN	Aids to Navigation
B	BAKOSURTANAL	National Mapping and Survey Coordination Agency
	BAPEDAL	Environmental Impact Management Agency
	BAPPENAS	Badan Perencanaan Pembangunan Nasional (National Development Planning Agency)
	BASARNAS	Badan SAR Nasional (National SAR Agency)
	BOD	Biological Oxygen Demand
	BPS	Central Bureau of Statistics
	BTKP	Maritime Safety Technological Center
C	CD-ROM	Compact Disk Read-only Memory
	COD	Chemical Oxygen Demand
D	DBS	Direct Broadcasting Service
	DC	Direct Current
	DC/DC	DC/DC Converter
	DGLC	Directorate General of Land Communication, Ministry of Communications
	DGNSS	Differential Global Navigation Satellite System
	DGPS	Differential Global Positioning System
	DGSC	Directorate General of Sea Communication, Ministry of Communications
	DISNAV	District Navigation Office
	DKI	Daerah Khusus Ibukota
	DSC	Digital Selective Call
	DSI	Number of List of Lights

	DWT	Dead Weight Tonnage
E	E/G	Engine Generator
	ECDIS	Electronic Chart Display Information System
	ECS	Electronic Chart System
G	GAMAT	Directorate of Guard and Rescue
	GBHN	Garis-garis Besar Haluan Negara (State Policy Guide Lines)
	GDP	Gross Domestic Product
	GEO	Geo-stationary Orbit
	GNP	Gross National Product
	GMDSS	Global Maritime Distress and Safety System
	GOI	Government of the Republic of Indonesia
	GOJ	Government of Japan
	GPS	Global Positioning System
	GRDP	Gross Regional Domestic Product
	GT	Gross Tonnage
H	HBM	Harbor Master Office
	HF	High Frequency
I	IALA	International Association of Marine Aids to Navigation and Lighthouse Authorities
	IMO	International Maritime Organization
	IMF	International Monetary Fund
	IP	Internet Protocol
	IPC	Indonesia Port Corporation
	IPP	Independent Power Producer
	IT	Information Technology
	ITU	International Telecommunication Union
J	JAMS	The Japan Association of Marine Safety
	JANA	Japan Aids to Navigation Association
	JBIC	Japan Bank for International Cooperation
	JICA	Japan International Cooperation Agency
	JCG	Japan Coast Guard
K	KANPEL	Kantor Pelabuhan (Port Office)
	KANWIL	District Office of Ministry of Communication

L	lat. or Lat.	Latitude
	LH	Light House
	LOI	Letter of Intent
	long. or Long.	Longitude
	LOX	Local Exchanger
M	MEFP	Memorandum of Economic and Financial Policy
	MF	Medium Frequency
	MFB	Medium Wave Radio Beacon
	MOC	Ministry of Communications
	MSC	Maritime Safety Committee
	MOF	Ministry of Finance
	MP	Master Plan
N	NAVAREA	World-wide Navigation Warning Service Area
	NAVIGASI	Directorate of Navigation
	NAVTEX	Navigation Telex
	NBDP	Narrow Band Direct Printing
O	OJT	On the Job Training
	ODA	Official Development Assistance
P	P.	Pulau (Island)
	PC	Personal Computer
	PCA	The People's Consultative Assembly
	PELNI	Pelayaran Nasional Indonesia (Indonesian National Shipping Lines)
	PELINDO	Indonesian Sea Port Corporation
	PLN	Perusahaan Listrik Negara
	PNBP	Non-Taxation State Revenue-Light Dues
	PROPENAS	National Development Program
	PT.	Perseroan Terbatas (Corporation)
R	RACON	Radar Beacon
	REPELITA	National Five-year Development Plan
	RLB	Resilient Light Beacon
	Ro-Ro	Roll on Roll off type vessel
	Rp.	Rupiah
	RR	Radio Regulation
	RS	Reference Station

	RTCM	Radio Technical Commission for Maritime Services
S	SA	Selective Availability
	SAPS	Special Assistance for Project Sustainability
	SAR	Search and Rescue
	SISTRANS	The National Transport Development Plan
	SOLAS	IMO International Convention for the Safety of Life at Sea
	SROP	Coastal Radio Station
	SS	Solid Suspense
	SSB	Single Side Band
	STCW	International Convention on Standards of Training, Certificates and Watch keeping for seafarers
T	TEU	Twenty Foot Equivalent of Unit
	TG	Telegraph
	Tg.	Tanjung : Cape
	TLK	Teluk : Bay, Cove, Gulf
	TP	Telephone
	TSS	Traffic Separation Scheme
	TSSS	Transport Sector Strategy Study in Indonesia in 2000
	TX	Transmitting Station or Transmitter
U	Uj.	Ujung : top, Point
	UKL	Environmental Management Effort
	UNCLOS	United Nations Convention of the Law of the Sea
	UPL	Environmental Monitoring Effort
V	VHF	Very High Frequency
	VSAT	Very Small Aperture Terminal
	VTIS	Vessel Traffic Information Services
	VTMS	Vessel Traffic Management Services
	VTS	Vessel Traffic Service
W	WARC	World Administration Radio Conference
	2drms	2 distance-root-mean-squares

1. Introduction

The Republic of Indonesia is an archipelago country, consists of about 17,000 islands, which are spread about 2,000km from North to South and 5,000km from West to East.

The transportation on the waters between these islands is very important for the life of inhabitants. And also, as Indonesian seawaters connect two big oceans, a number of foreign ships are passing through the waters.

Domestic ships that are tankers, passenger ships, container ships and other cargo ships including sailing ships ranging from large ships engaging international trade such as VLCCs to small fishing boats are operating in this vast seawaters, and enjoying benefits from their shipping activities.

The domestic shipping industry has been playing vital role not only to sustain the life of people living in the islands, but also to develop isolated rural area, by transporting commodities, materials, fuels, and people.

For the development of Indonesian economy and human life, marine transportation hold the key to the solution of the problem.

To improve the efficiency and productivity of maritime activities, establishment of maritime safety system is indispensable, and development, improvement, rehabilitation and proper maintenance and operation of aids to navigation including radio aids to navigation (hereinafter referred to “ATN”) are required.

There are many countermeasures to prevent marine casualties and to secure maritime safety. The most effective countermeasures are to establish ATN system.

The International Maritime Organization (hereinafter referred to “IMO”) recommends that a radio navigation system used to assist in the navigation of ships in those harbor entrances and approaches and other waters where freedom to maneuver is limited shall provide positional information with an error not greater than 10m with a probability of 95%.

2. Background of the Project

As mentioned in Chapter 1 above, Indonesia, archipelago and maritime country, is greatly dependent for the inter-islands transportation upon a marine transportation. Therefore, Indonesia has positively promoted many maritime modernization projects on maritime sector such as shipbuilding, harbor, ATN and so forth for promotion of maritime industry.

As a part of this development, Japan's Yen Loan of 1982 fiscal year, in order to secure navigation safety and promote efficiency of sea traffic at the seawaters with large traffic volume in Indonesian waters, established eighteen (18) of the Medium Wave Radio Beacon (hereinafter referred to "MFB") Stations.

However, the MFB stations almost stop their operation by 1996. It is a major reason that the failures of power supply system and so forth were not recovered because of weakness of management and maintenance system including a lack of budget for operation and maintenance, difficulty of access to the sites, complex factors such as lightning attack, salty wind and rain and so forth exceeding pre-estimate at the time of planning of construction.

At the present time, only one (1) station of No.1 Sabang MFB, which had been operated to the end up to December 1999, has stopped in order to save the maintenance cost.

In connection with the MFB station, IMO and the International Association of Marine Aids to Navigation and Lighthouse Authorities (hereinafter referred to "IALA") have a concept to introduce Differential GPS (hereinafter referred to "DGPS") for an improvement of ship positioning accuracy as a global system. Many of the MFB station in the world were changed to DGPS station, and the exclusive MFB stations out of subject for the DGPS has been closing. Some DGPS stations have been operated by the neighboring country of Indonesia at Malacca Singapore Strait and waters around its strait.

As for the accuracy of DGPS, it is announced by Japan Coast Guard (hereinafter referred to "JCG") that "DGPS, using maritime radio beacon signal, is a system enhancing accuracy of GPS into less than 1m, and also broadcasting warning information such as unscheduled outage." after removal of Selective Availability (hereinafter referred to "SA") added to GPS signal in order to reduce GPS accuracy by the Government of USA.

As the present trend around Indonesian water, Indonesia has established three (3) strategic sea lanes that are Sea Lane Ⅰ, Sea Lane Ⅱ and Sea Lane Ⅲ around Sunda strait, Lombok Strait and other waters respectively.

Indonesia has approved that foreign warships and other vessels can free navigate at the sea lanes as a parts of Indonesian waters since 1998. The extension of Traffic Separation Scheme (TSS) and the introduction of Ship Reporting System at Malacca Singapore Strait were decided. Ministry of Sea Exploration and Fishers was newly established along with start of new administrative power. Based on those points, further, Indonesia has been stressing on the policy as a maritime country.

As those circumstances above, the development of aids to navigation facilities, which is the basis of securing navigation safety in maritime traffic, has become important matter. It is expected that the function of MFB stations, which is available for twenty four (24) hours under all-weather conditions, be voluntarily recovered by Indonesia.

On the other hand, the development of ATN system in Indonesia has been implemented based on the master plan up to the year 2000, which was established in October 1985 by JICA.

However, there are still great demands for expansion and improvement of ATN. It comes from the new establishment of three sea lanes based on UNCLOS, and increasing of vessel traffic as a result of recent marine activities in Indonesia. Especially the Straits of Malacca and Singapore where TSS has been established are crucial sea lanes for carrying dangerous substances such as crude oil carrier.

In this regards, Government of Indonesia (hereinafter referred to "GOI") has decided to prepare the master plan of ATN system as a part of the Maritime Traffic Safety System Plan, which covers up to the year 2020.

In response to the request of GOI, Government of Japan (hereinafter referred to "GOJ") decided to conduct the study on the Development Plan in accordance with the relevant international/internal laws and regulations in force in Indonesia.

JICA sent Preliminary Survey Team in November 2000 to conclude the Scope of Work, and its Minutes of Meeting were mutually agreed on November 13th

2000 between Directorate General of Sea Communication, Ministry of Communications (hereinafter referred to "DGSC") and JICA.

The Japan Association of Marine Safety (hereinafter referred to "JAMS") and Japan Aids to Navigation Association (hereinafter referred to "JANA") organized the JICA Study Team in March 2001.

After the first site survey, the Master Plan up to the year 2020 was formulated on the aids to navigation system, which covers whole seawaters in Indonesia and related locations.

The feasibility study is carried out for the proposed priority project of visual ATN including supporting facilities. Selected locations are shown as an urgent project in the Short Term Plan up to the year 2007. Implementation plan is made for them.

3. Objective of the Project

The proposed Priority Project on Rehabilitation for MFB stations in Indonesia (hereinafter referred to "the Project") has the objective to improve the functionality of the existing MFB stations installed under the Japanese Yen Loan project by providing those stations with DGPS for navigation purpose that is capable of providing highly accurate ATN services, in order that Indonesia will be able to fulfill its international responsibility as one of the signatories of SOLAS Convention in keeping improved safety of navigation and promoting efficient maritime traffic activities.

4. Maritime Activities in Indonesia and its related Study

4.1. Maritime Activities in Indonesia and related study National and Domestic Socio-economic Plan

For recovering from economic crisis, GOI consulted and agreed with IMF on Letter of Intent (LOI). Memorandum of Economic and Financial Policy (MEFP) which was attached to LOI was agreed between IMF and GOI regarding macro- economic policy, financial regional autonomy, banking system reform, enterprise restructuring, legal reform, governance, restructure in public sector, governance and so forth.

A latest macro-economic policy has been managed by economic reform program stipulated in LOI dated Jan. 20th 2000 as middle term macro

economic frame. It has been reviewed and adjusted slightly on May 17th 2000, July 31st 2000 and September 7th 2000. The State Policy Guide Line (GBHN) had been decided based on LOI in October 1999 and National Development Program (PROPENAS), which was established by GBHN, is a new development plan.

The macro-economic framework is meant to provide a description on the short and middle term economic prospect. According to GBHN 1999-2004, the directions of macro-economic policy are:

- to accelerate economic rescue and recovery so as to enable the real sector to recover
- to attain a reasonable level of interest rates, inflation under control, and attain a suitable and realistic exchange rate;
- to restructure the State Budget, by reducing budget deficits, gradually reducing subsides and foreign loans and make the tax structure progressive and equitable, and economize expenditures;
- to accelerate banking re-capitalization and restructure corporate debt;
- to reduce poverty and unemployment;
- to support the development of the people oriented/grass root economy.

Therefore, in the short term, macro-economic policy is directed at economic recovery. In line with the implementation of other policies, medium macro-economic policies are aimed at strengthening the base for sustainable and equitable development.

Regarding regional development, the policy directions as stipulated in the GBHN 1999-2004, the aim of regional development in the period are :

- to ascertain the realization of regional autonomy by increasing the capacity of regional governments;
- to increase development of regional potentials by developing the regional economy;
- to increase the people empowerment by strengthening the local community institutions and organizations, alleviating poverty and providing social protection to the local communities and increasing self-reliance of the public at large for assisting the communities to obtain and utilize their rights for improving the economic, social and political life;
- to accelerate special handling of the Aceh special region, Irian Jaya, and Maluku in conformity with the aspirations, capabilities and cultural roots of the local communities and in line with the principle of national unity and cohesion through the restoration and development of the socio-economic life of the communities, through the settlement of the political problems and violations of human rights and by strengthening the capacity of regional governments.

4.2. Ocean Environment

4.2.1. Current

The currents in the Indonesian waters are also subject to variations linked to the reversal of the monsoons.

Change is continuous with the advance, retreat and intensity of each monsoon varying from year to year.

4.2.2. Tidal streams

Followings are characteristics of the tidal stream at each area related to DGPS stations to be developed in the proposed priority project.

① Sumatera, Jawa and southwest Kalimantan

Tidal streams in these areas have a marked diurnal inequality which generally increase east.

One stream of the day in each direction is markedly stronger than the other, and, in many cases, there is only one stream of any strength in each direction per day.

Also the strength of the tidal streams, in general, decreases from west to east of the area, whereas rates exceeding 3 knots occur in many channels in Pulau Pulau Lingga and Pulau Pulau Riau, rates

rarely attain 1 knot off Pulau Belitung and west coast of Kalimantan.

② Jawa, Nusatenggara, Kalimantan and Sulawesi

Tidal streams in these areas have a strong diurnal inequality.

This is especially marked on the coast of Kalimantan and Jawa, bordering the Java Sea, where the tides are predominantly diurnal. The range of the tide is mostly between 1 and 2m, though at some places on the east coast of Kalimantan and on Froles it reches 2.5m.

4.3. Maritime Industry

4.3.1. Marine Fishery

Indonesian marine fisheries are very complex and diverse, reflecting the country geographic characteristics and great variations in species and population densities.

The western part of archipelago includes the relatively shallow Sunda Shelf area, which is bounded on the east roughly by Makassar and Bali Straits, and includes the large islands of Sumatra, Java and Kalimantan. These waters, which are relatively rich, produce about two-thirds of the total fish catch and attract large amounts of fishing efforts, particularly in the areas relatively close to shore.

Except for the shelf area between Irian Jaya and Australia, i.e., Arafura Sea of the Sahul Shelf, deep waters mark the eastern part of the archipelago. In the Arafra Sea, there is commercial fishing for shrimps, while outside this area, there are large-scale operations focused on tuna and skipjack fisheries.

Total production of marine fisheries was 1,081.6 thousand tons in 1976 and 3,950.0 thousand tons in 1999.

Total fishing boats of marine fisheries numbered 424,158 in 1998 and more than one-half of the fleet are non-powered boats (55.7percent). Among the powered boats, 53.57 percent used outboard engines, typically small-sized boats of less than 5 GRT. Most of the non-powered boats were dugout canoes, ranging from 3 to 10 meters in length and generally operated by three to five fishers, using a wide variety of gear, including fillnets, cast nets, traps, seines and hook-and-line. Their fishing grounds are in the waters close to their home base in a daily trip.

Fishers involved in the marine capture fisheries numbered 1,417,424 in 1988 and 2,087,802 in 1997, classified into two major groups, namely full-time fishers (50.91 percent) and part-time fishers (49.09 percent). The fishers are not evenly distributed throughout the country. A big part of the fishers (22.78 percent) are living along the north coast of Java, followed by those living on the east coast of Sumatra (12.30 percent), south and southeast Sulawesi (9.47 percent), and north Sulawesi (8.91 percent).

4.3.2 Maritime Shipping and Traffic

(1) Condition of Maritime Traffic

Since Indonesia is a country of many islands, sea transportation is very important and strategic to support national development in uniting the whole Indonesian area. Therefore, the development of national sea transportation as well as repair and maintenance of management and port facilities need to be improved and expanded.

Volume of international sea cargo loaded reached 133.7 million tons in 1998, a decrease of 1.8 percent from 1997. Of the total loaded volume D.I. Aceh accounted for 19.94 percent, East Kalimantan contributed 19.37 percent, South Kalimantan 14.75 percent Riau 18.34 percent, and rest was found decline from 67.2 million tons in 1999 to 47.14 million tons in 1998. Of the total volume DKI Jakarta unloaded was 25.11 percent, 17.73 percent in East Kalimantan, 18.77 percent in East Java, and 10.52 percent in West Java.

The volume of cargo loaded was greater than cargo unloaded both for inter-island and international sea-borne cargo. In 1998, the volume of inter-island cargo loaded was 113.49 million tons, a decrease of 23.30 percent. The Provinces with the most cargo loaded were Riau (25.80 percent), East Kalimantan (20.33 percent), South Kalimantan (9.9 percent), South Sumatra (6.97 percent), and Lampung (6.81 percent). In 1998, the volume of inter-island cargo unloaded was 119.80 million tons, a decrease of 19.09 percent compared to 1997. The seven area with the most cargo loaded were Riau, DKI Jakarta, West Java, Central Java, East Java, East Kalimantan, and South Kalimantan.

(2) Shipping

Shipping in Indonesia is divided to the following four forms.

① Ocean Going Shipping

This Shipping may think that it is about the same as the general idea of Ocean Going Shipping, but it turns around plural domestic port, and finally arrives in the foreign country in the neighborhood like Singapore needs attention for Ocean Going Shipping handling not giving in statistics of Indonesia. Such Shipping is included Inter-island Shipping.

② Inter-island Shipping

Inter-island Shipping may think that it is about the same as the general idea of Coastal Shipping, but it turns around plural domestic port, and finally arrives in the foreign country in the neighborhood like Singapore needs attention for Ocean Going Shipping handling not giving in statistics. Such Shipping is included to Inter-island Shipping in Indonesia. And the shipping in the same island like from Jakarta to Surabaya is also included to Inter-island Shipping.

Inter-island Shipping including the following two shipping forms.

a. Traditional Shipping

Inter-island Shipping by small Vessel less than 35GT

b. Local Shipping

Inter-island Shipping by medium Vessel over 35GT,less than 175GT

③ Pioneer Shipping

The purpose of Pioneer Shipping is to make sure of transportation of passengers and living cargo for to support developing islands where they were isolated in the remote place. This shipping has given financial assistance by Indonesian government. This shipping is done by only PELNI; which is the national company by permission.

④ Special Shipping

Special Shipping is marine transportation to do chiefly for oneself by using the vessel that as for itself, an enterprise and so on navigates it. It is typical example that PERTAMINA, which is a national oil enterprise transport its petroleum by our oil tanker.

(3) Maritime Traffic Network

Coastal shipping in Indonesia is composed by Inter-island Shipping and Pioneer Shipping. Coastal shipping in Indonesia is combined these shipping, and transports domestic freight to each region in Indonesia.

Local ports in Indonesia are united in the going directly line from Jakarta or Surabaya, and it is no present condition that there is almost by the thing way between the local ports.

In Indonesia, Tg.Priok, Tg.Perak, Belawan and Makassar are most important ports still now, and these four ports playing central role for coastal shipping network in Indonesia.

4.4. Sea lanes

GOI was recognized as an archipelagic state by the UNCLOS in 1994. This status has given the nation responsibilities for efficiently monitoring maritime traffic in its territorial waters. Most of the traffic between the Indian Ocean and the Pacific Ocean flows through the Malacca and Singapore Straits. Other parts of the traffic use three Indonesian routes that are:

(1) Sunda Strait / Java Sea / Karimata Strait;
(2) Lombok / Makassar Straits;
(3) Indian Ocean / Banda Sea / Maluku Sea.

GOI decided to regulate the maritime traffic by defining three sea lanes in the straits and applied them to the IMO in August 1997. After the investigation in the IMO, they were adopted on May 19th 1998, in the resolution MSC.72(69) titled "Adoption, Designation and Substitution of Archipelagic Sea Lanes" annexed with "Partial System of Archipelagic sea lanes in Indonesian Archipelagic Waters" as shown in **Figure 4.4.1.** The daily marine through-traffic density in each sea lane and the Straits of Malacca and Singapore is also shown in **Table 4.4.1.**

Figure 4.4.1. Three Sea Lanes in Indonesia

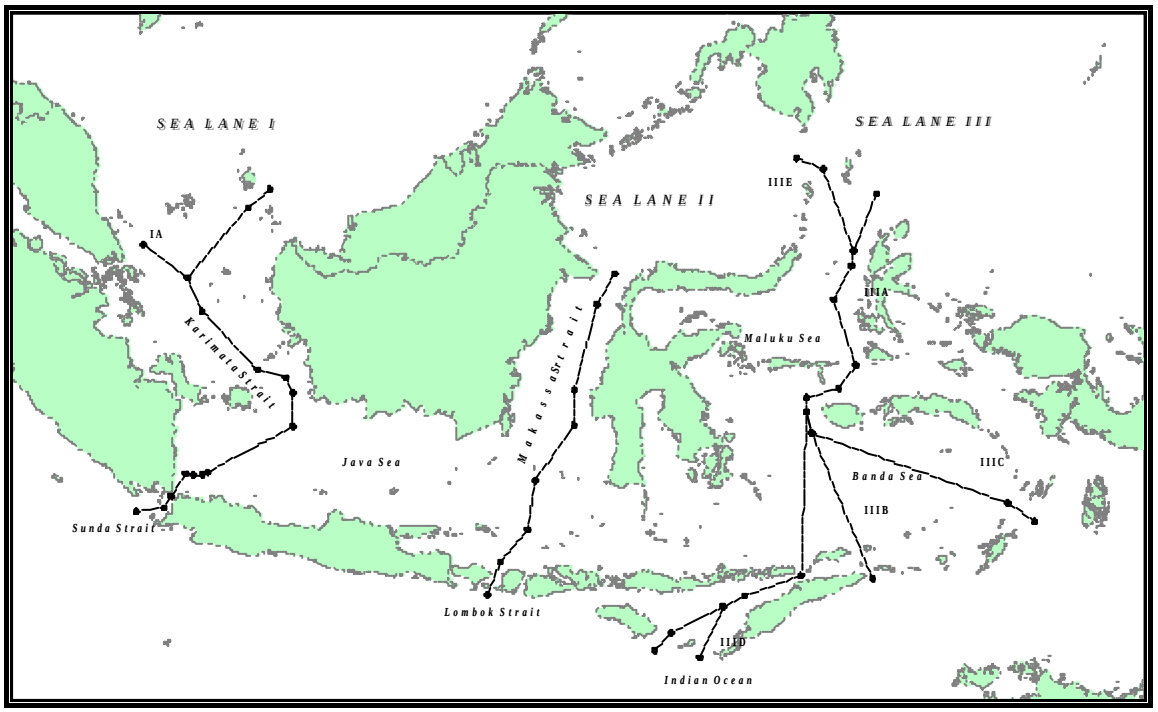


Table 4.4.1. Daily Through-Traffic Density in Each Sea-Lane

Name of Sea Lane	Strait	Estimated Daily Through-Traffic	
The Straits of Malacca and Singapore	At One Fathom Bank	200	
Sea Lane I	Sunda Strait	60	
	Karimata Strait	30	**90**
Sea Lane II	Lombok Strait	13	
	Makassar Strait	20	**33**
Sea Lane III	IIIA(between Maya Island and Halmahera)	8	
	IIIB	3	
	IIIC	4	
	IIID	4	**19**

4.5. Maritime Traffic Routes and Ports and Harbors

4.5.1. Traffic Routes

The traffic routes of ships are designated according to the type of ship. The designated traffic routes for the tanker, passenger ship, container ship and pioneer ship are shown in **Figure 4.5.1** to **Figure 4.5.4.** The traffic routes of general cargo ships are shown in **Figure 4.5.5.**

Figure 4.5.1. Traffic Routes of Tankers in Indonesia

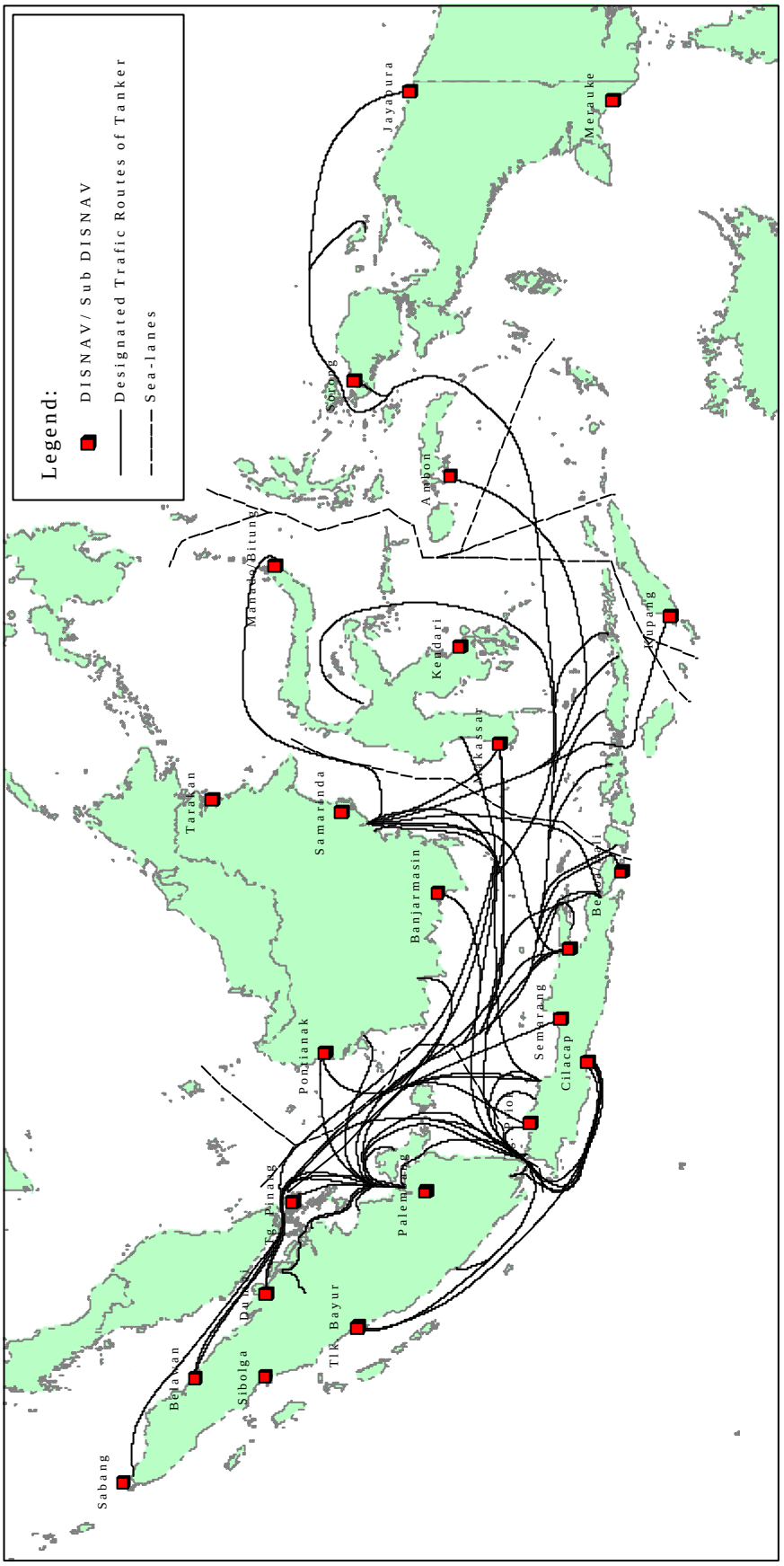


Figure 4.5.2. Traffic Routes of Passenger Ships in Indonesia

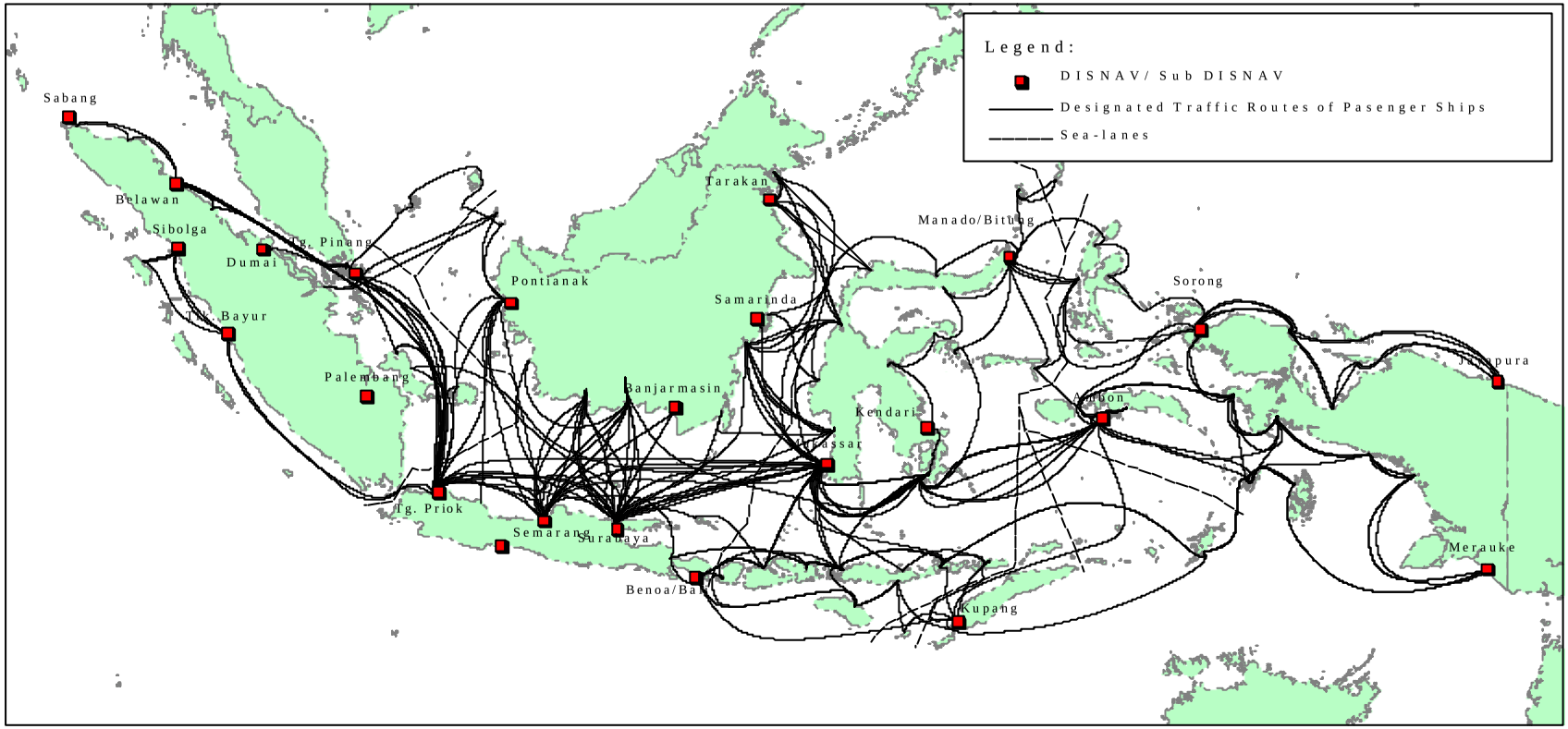


Figure 4.5.3. Traffic Routes of Container Ships in Indonesia

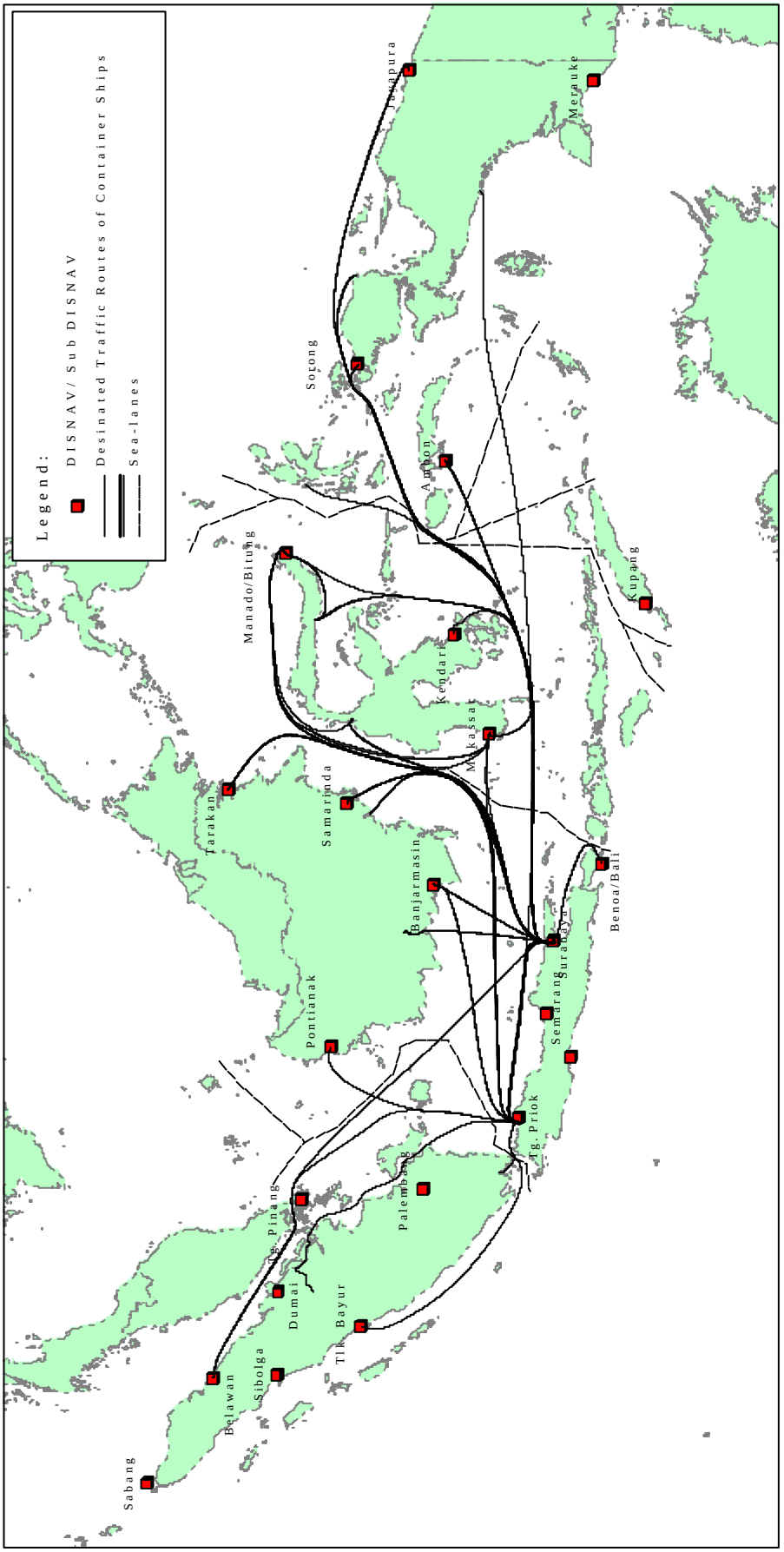


Figure 4.5.4. Traffic Routes of Pioneer Ships in Indonesia

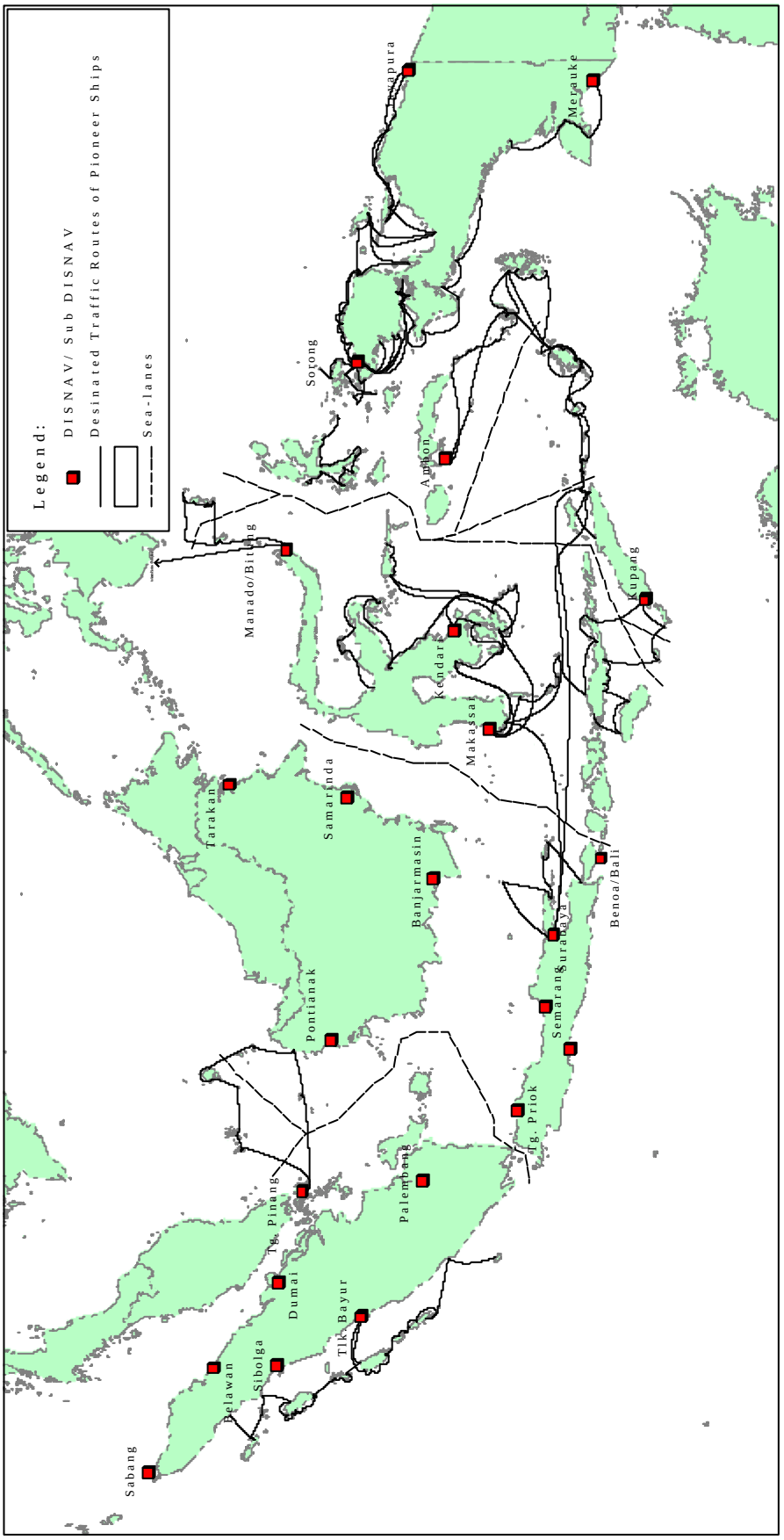
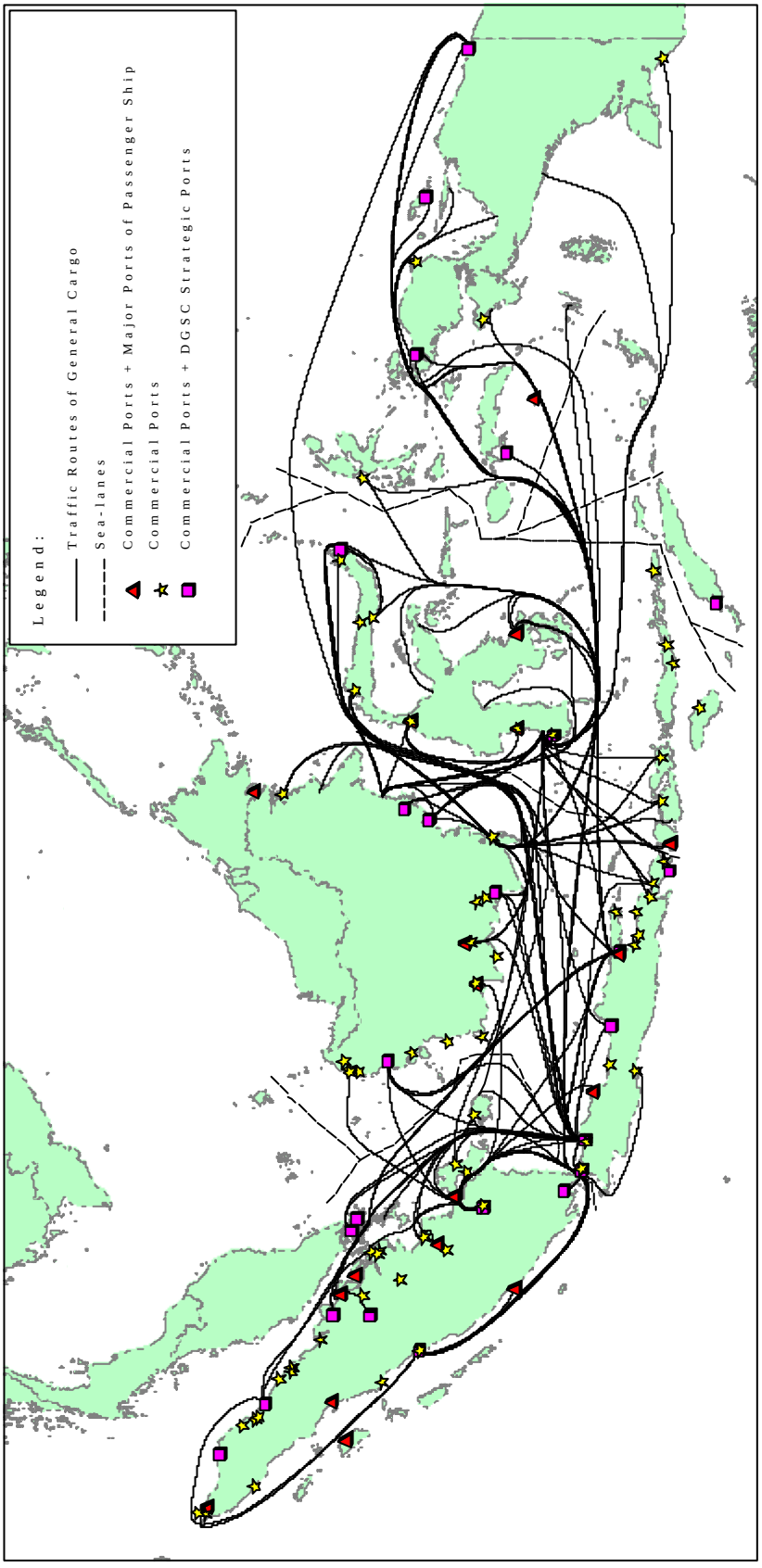


Figure 4.5.5. Traffic Routes of General Cargo Ships in Indonesia



4.5.2. Ports and Harbors

Indonesian ports are classified in accordance with Shipping Law No.21/1992 to two main types of "Public Ports" and "Special Ports". The public ports are available for general cargo ship and divided into "Commercial Ports" and "Non-commercial Ports".

There are 111 commercial ports and 544 non-commercial ports shown in **Figure 4.5.6.** and **Figure 4.5.7**, respectively.

There are some special ports and special berths that are operated for private cargo such as lumber, fish, ore and tourist. Specific state corporations have their own port to handle bulk cargo such as oil and fertilizer.

The proposed seaport hierarchy based on the functional policy given in the National Transport Development Plan (SYSTRANAS) in 1996 classifies the commercial ports as follows:

- Primary port (1 port) that is International Trunk/ Deep Seaports projected to serve the direct trade to foreign countries.
- Secondary ports (8 ports) that are Major Trunk ports projected to serve the trade to foreign countries and also transshipment.
- Tertiary ports (23 ports) that are Major Trunk ports which are projected to serve national as well as international trade.
- National Feeder ports (21 ports) that provide facilities appropriate for national and intra-regional trade.
- Local Feeder ports (58 ports) that provide appropriate facilities for serving intra-regional trade.

These ports classified by SYSTRANA are shown in **Figure 4.5.8.**

DGSC uses a simpler definition of 25 strategic ports, which are not ranked and are based on three criteria of "volume of cargo handled", "location of port" and "regional function of port". DGSC strategic ports are shown in **Figure 4.5.9.**

Figure 4.5.6. Locations of 111 Commercial Ports in Indonesia

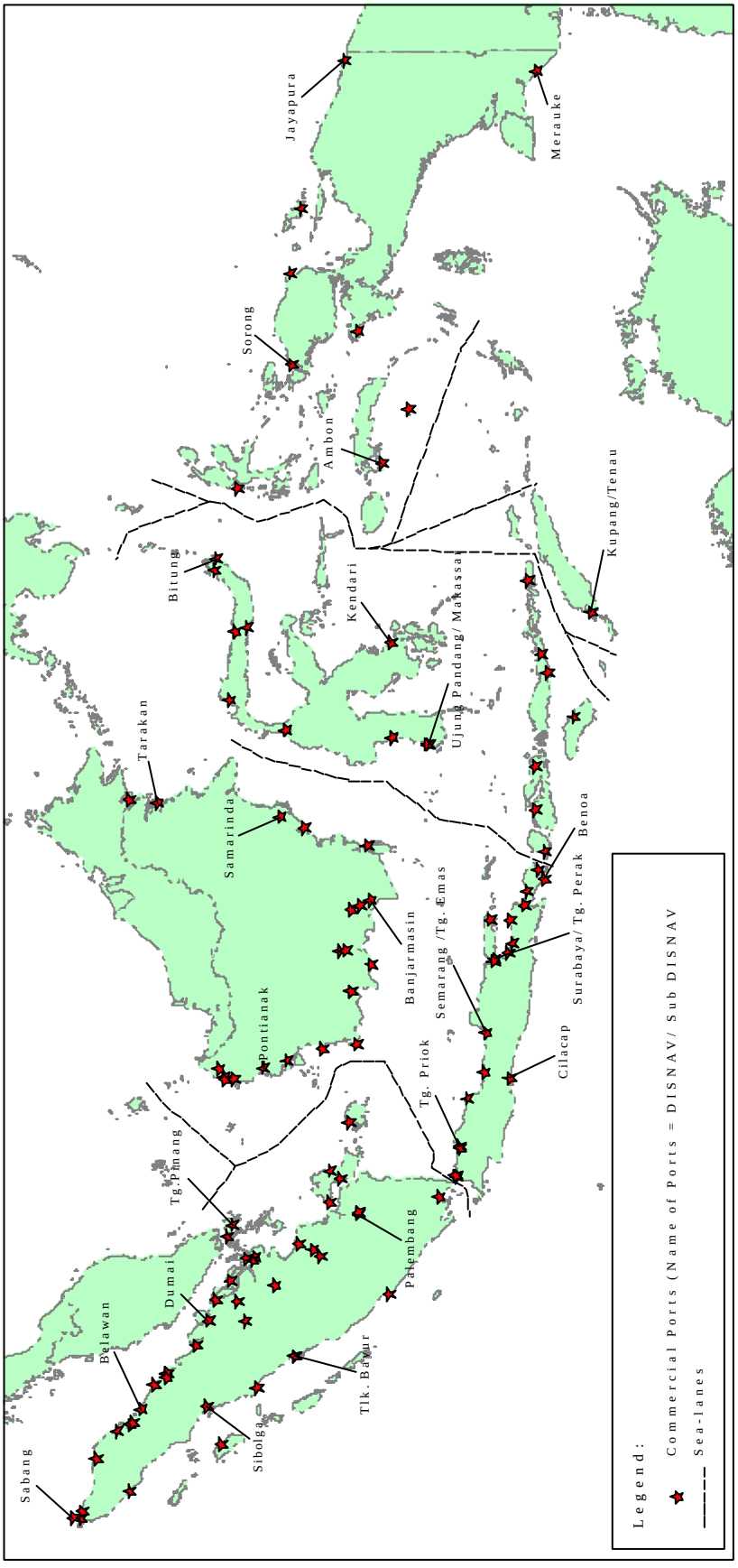


Figure 4.5.7. Locations of 544 Non-Commercial Ports in Indonesia

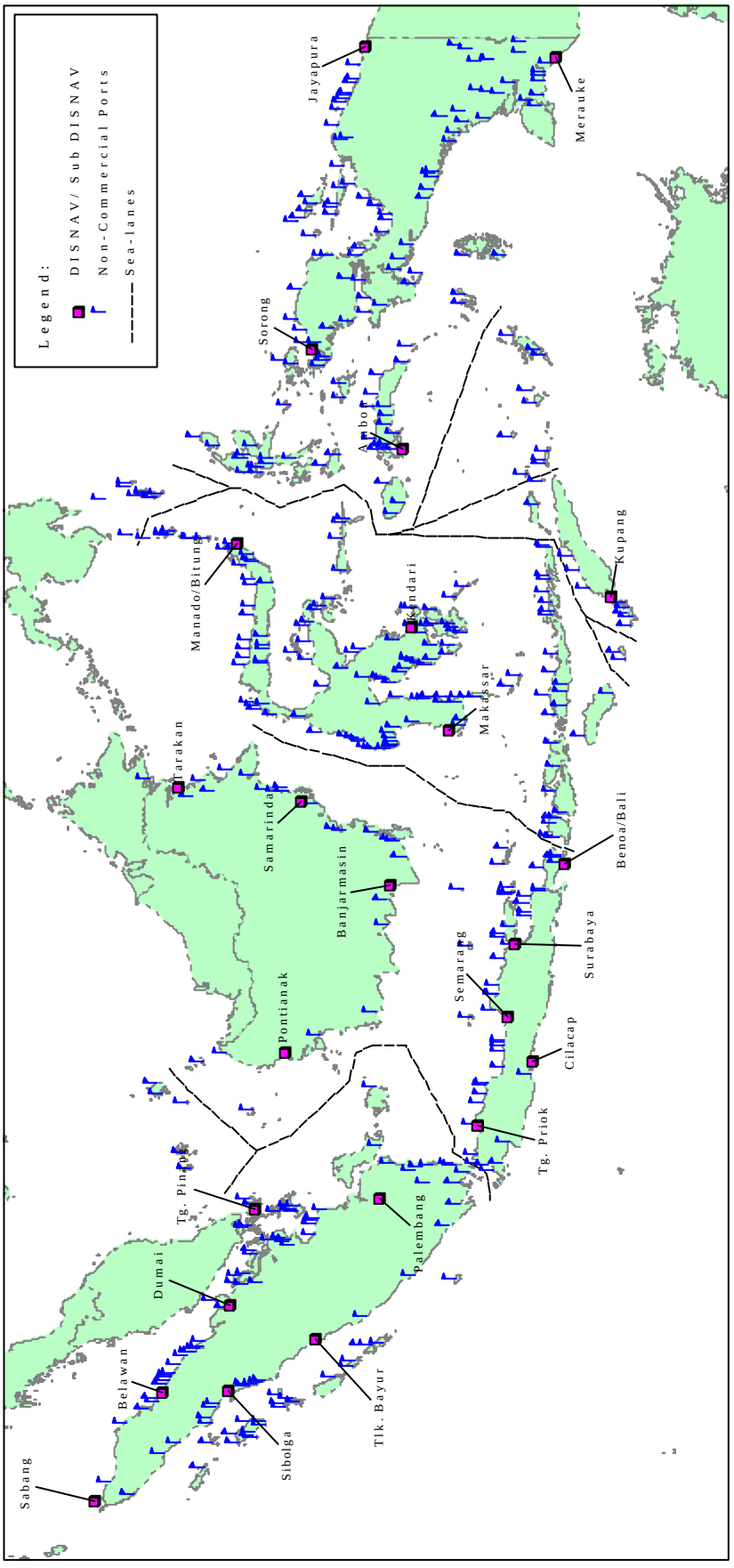


Figure 4.5.8. Locations of Ports classified by SYSTRANAS in Indonesia

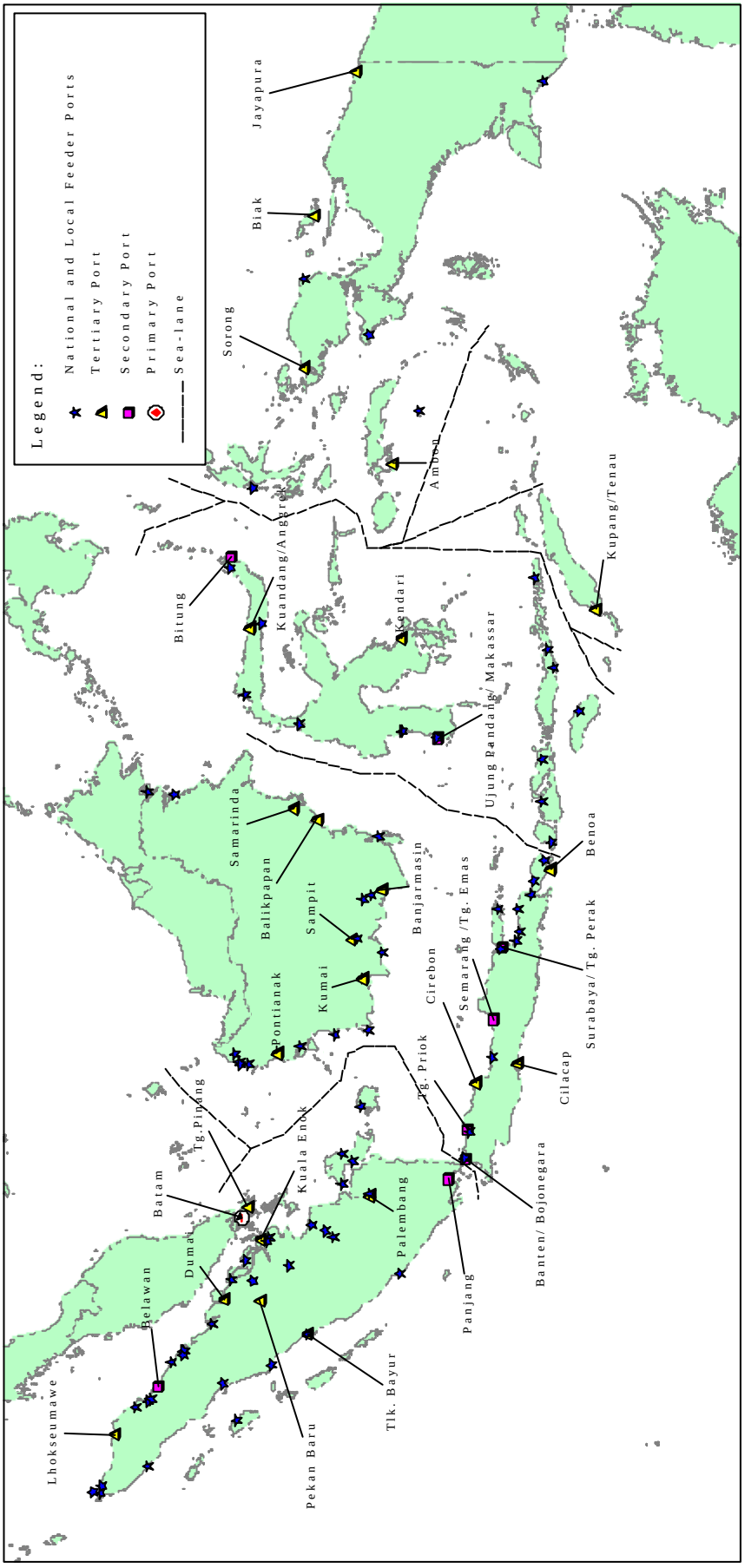
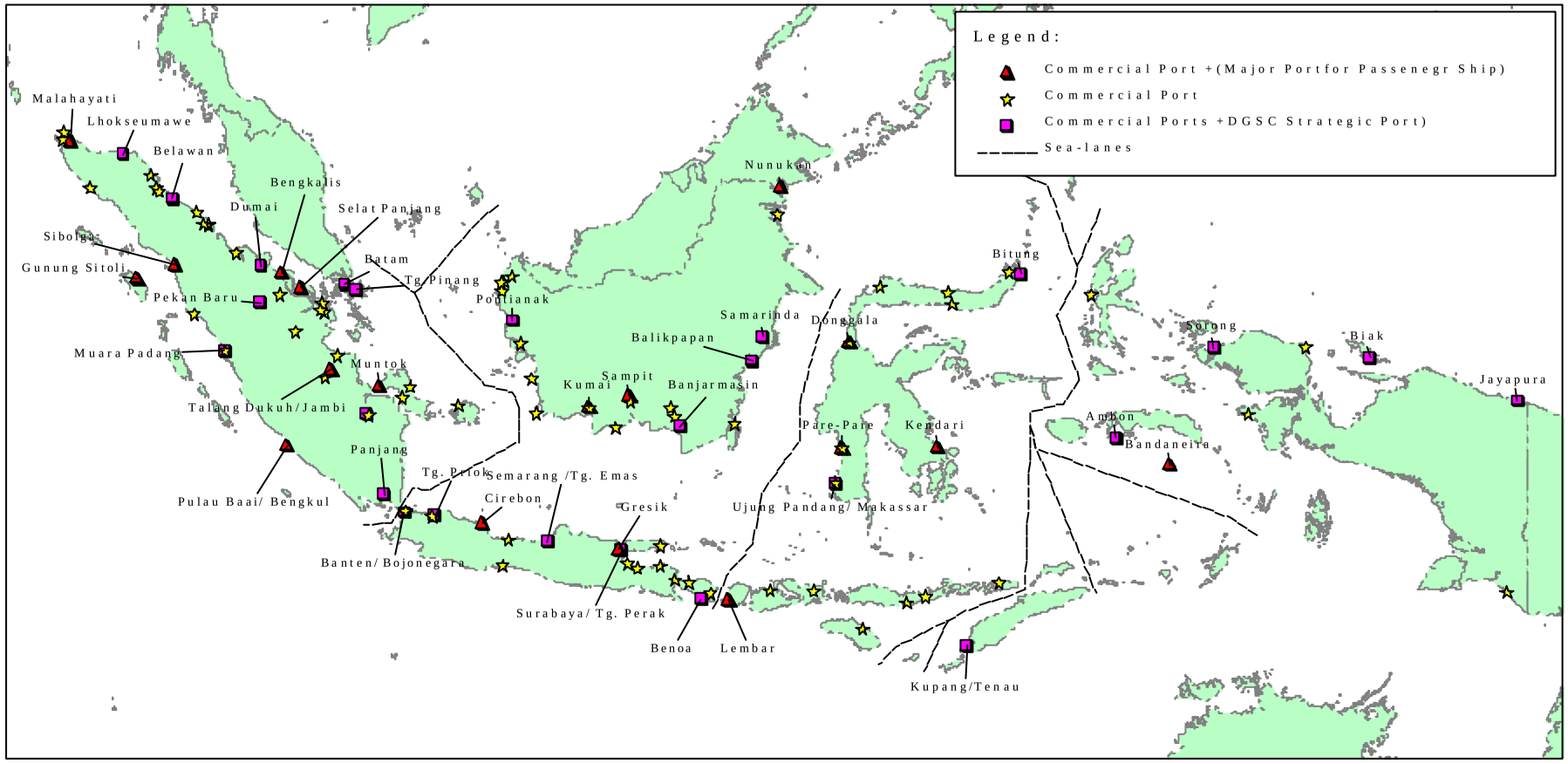


Figure 4.5.9. Locations of DGSC Strategic Ports and Major Ports for Passenger Ships in Indonesia



4.6. Marine Casualties

The marine casualty statistic from April to December 2000 is shown in **Table 4.6.1.**

According to the statistic, it is occurred 3,826 cases of marine casualty during 18 years and 8 months. The average number of casualty per year is 204.1.
The most frequent casualty is “Sunken” and it occurred 87.1 times per year in average. It reaches 42.7% of total casualties.
The second frequent casualty is “Aground” and it occurred 24.7 times per year in average. It is 12.1% of total casualties.
The third casualty is “Collision” and it occurred 20.0 times per year in average. It is 9.8% of total casualties.

The locations of marine casualties from April 1992 to June 2001 that have recorded the coordinates are shown in **Figure 4.6.1.**

Table 4.6.1. Marine Casualty Statistic from April 1982 to December 2000

No.	Casualties	1982/83	1983/84	1984/85	1985/86	1986/87	1987/88	1988/89	1989/90	1990/91	1991/92	1992/93	1993/94	1994/95	1995/96	1996/97	1997	1998	1999	2000	Total	Per Year
1.	**Type of Casualty**																(Apr-Dec)					
	Sunken	171	121	138	158	107	107	120	101	79	82	75	65	62	54	40	43	42	41	27	1,633	87.1
	Fire	15	5	12	4	9	7	7	2	15	6	12	3	13	21	16	5	11	17	8	188	10.0
	Collision	37	26	30	14	19	24	12	24	23	17	23	14	30	21	18	15	16	9	3	375	20.0
	Engine Trouble	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	5	1	1	8	2.1
	Aground	47	37	34	30	23	26	30	24	29	30	25	24	26	13	12	12	13	19	9	463	24.7
	To Float	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	2	0.5
	Leakage	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	5	3	3	12	3.2
	Other	98	117	109	141	115	68	94	86	76	63	47	27	24	22	22	5	10	9	12	1,145	61.1
	Total	**368**	**306**	**323**	**347**	**273**	**232**	**263**	**237**	**222**	**198**	**182**	**133**	**155**	**131**	**108**	**82**	**103**	**99**	**64**	**3,826**	**204.1**
2.	**Looses**																(Apr-Dec)					
	Human Looses	-	-	-	-	-	-	-	-	-	-	147	139	206	611	120	166	151	841	657	3,038	347
	Cargo Looses	-	-	-	-	-	-	-	-	-	-	17300	17100	14800	43000	9800	18809	2688	4027	17024	144,548	16520
	Car Looses	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15	3	-	18	5
	Animal Looses	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	36	204	560	800	200
3.	**Flag**																(Jan-Dec)					
	Indonesia	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	83	99	98	55	335	84
	Foreign	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	19	5	10	17	51	13
	Total	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**102**	**104**	**108**	**72**	**386**	**97**
4.	**Gross Tonnage**																(Apr-Dec)					
	< 100M3 (<35 GT.)	99	77	94	137	93	85	112	92	90	85	80	60	55	44	30	18	27	13	10	1,301	69.4
	100M3 - 500M3	180	155	158	129	112	99	86	88	82	60	64	40	43	60	37	10	6	15	4	1,428	76.2
	(35GT ¯75GT)																					
	> 500m3 (> 75 GT.)	95	99	83	91	77	72	90	82	89	86	78	52	85	58	74	74	71	80	58	1,494	79.7
	Total	**374**	**331**	**335**	**357**	**282**	**256**	**288**	**262**	**261**	**231**	**222**	**152**	**183**	**162**	**141**	**102**	**104**	**108**	**72**	**4,223**	**225.2**
5.	**Type of Vessel**																(Apr-Dec)					
	Motor Ship	230	208	191	211	195	193	201	177	187	160	171	120	125	126	109	70	81	78	62	2,895	154.4
	Motorized Sail Boat	106	108	111	106	59	50	53	51	34	40	34	22	40	27	11	12	13	23	4	904	48.2
	Sail Boat	30	11	28	30	17	6	17	15	18	16	4	3	8	0	6	11	5	2	1	228	12.2
	Barge	8	4	5	10	11	7	17	19	22	15	13	7	10	9	14	11	5	5	5	197	10.5
6.	**Causes**																(Apr-Dec)					
	Human Error	163	100	123	114	55	75	84	81	91	86	92	63	71	51	53	33	44	40	25	1,444	77.0
	Force Major	116	106	110	146	111	112	117	125	91	68	44	38	49	46	39	44	25	38	25	1,450	77.3
	Hull Structure	89	100	90	87	107	45	62	31	40	44	46	32	35	34	16	5	34	21	14	932	49.7
	Total	**368**	**306**	**323**	**347**	**273**	**232**	**263**	**237**	**222**	**198**	**182**	**133**	**155**	**131**	**108**	**82**	**103**	**99**	**64**	**3,826**	

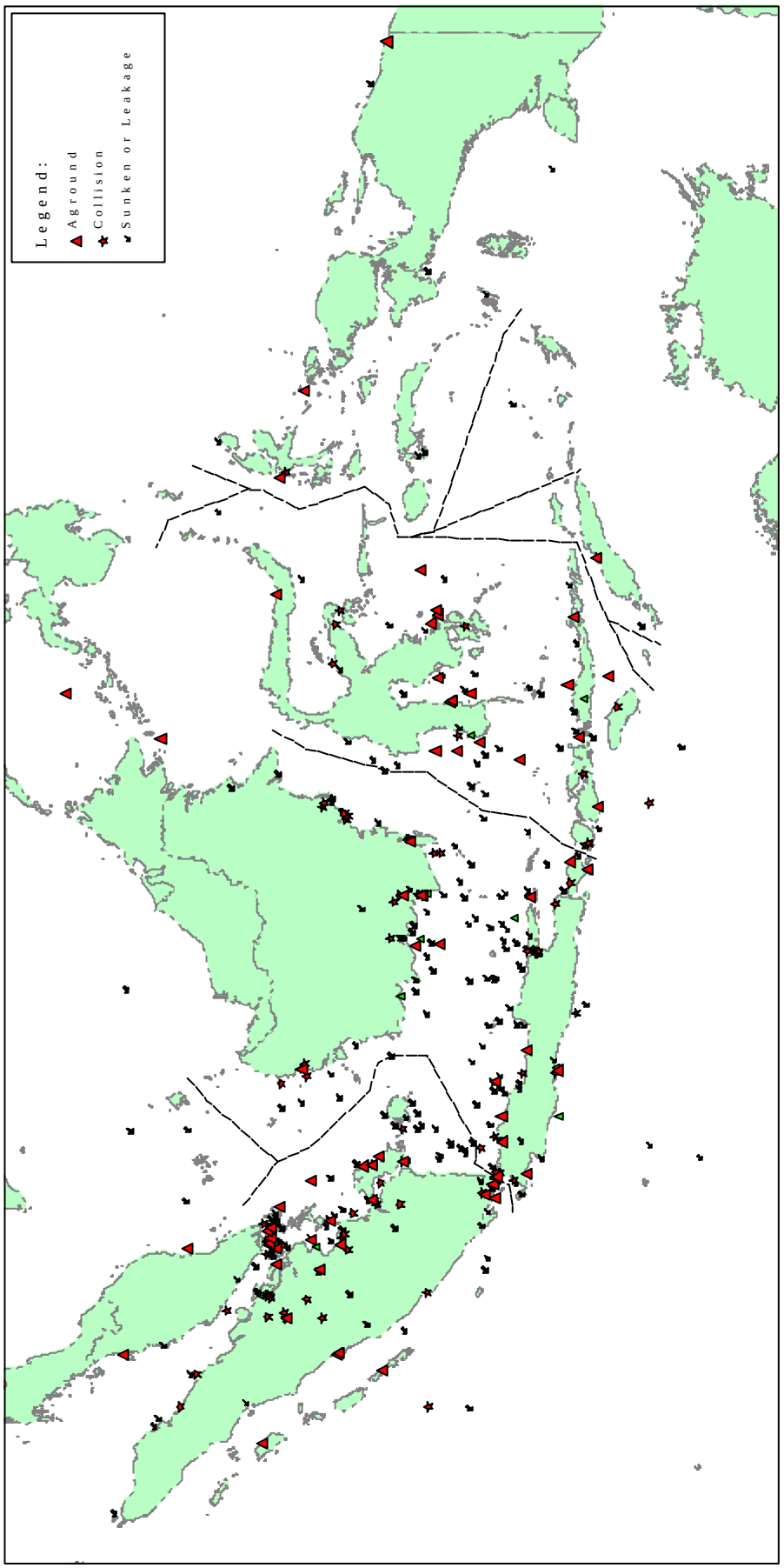


Figure 4.6.1. Marine Casualties with Coordinates from 1992 to 2001

5. Current Situation on DGPS

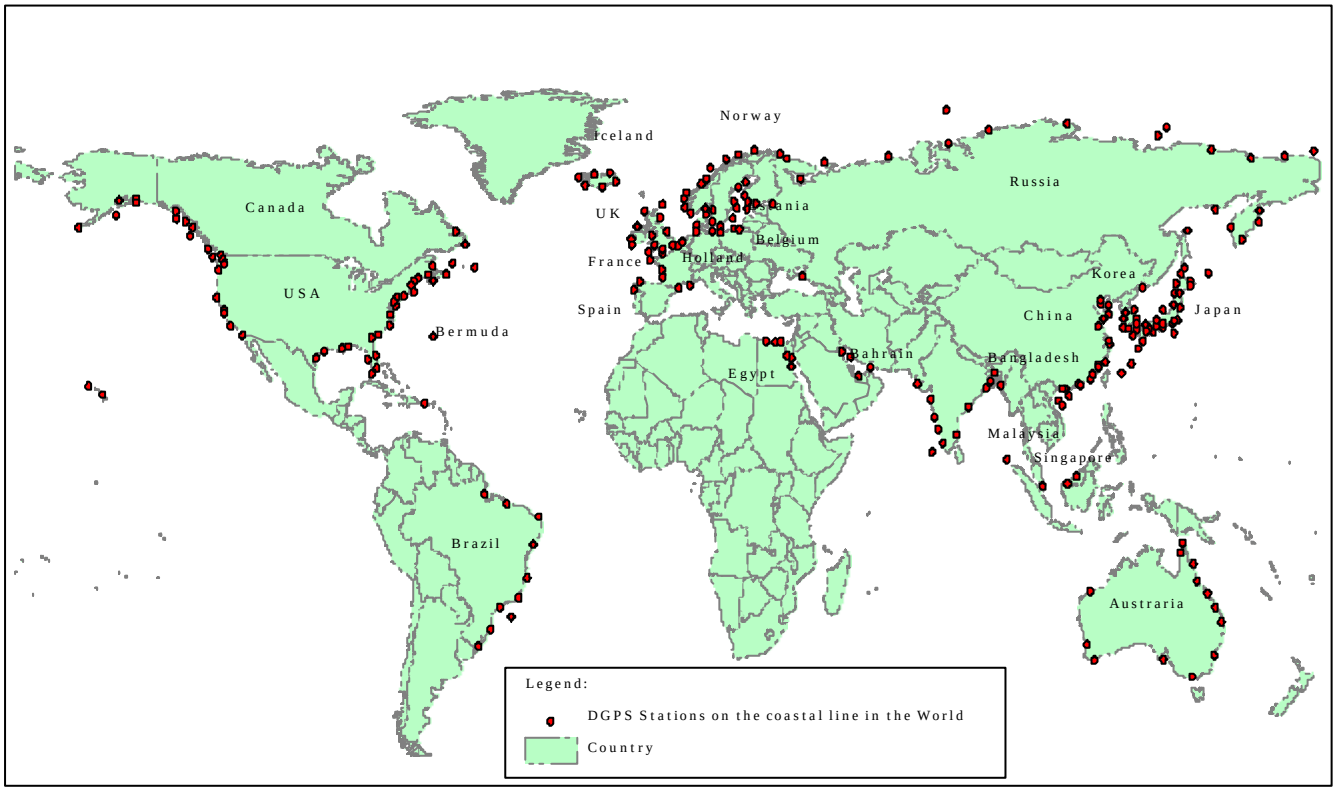
5.1. DGPS in the World

(1) DGPS in the world

Many of the Medium Wave Radio Beacon (MFB) stations in the world were changed to DGPS stations, and the exclusive MFB stations out of subject for the DGPS have been closing and terminated their roles as the navigation positioning system.

The DGPS stations on the coastal line in the world are shown in **Figure 5.1.1.**

Figure 5.1.1. DGPS Stations in the World

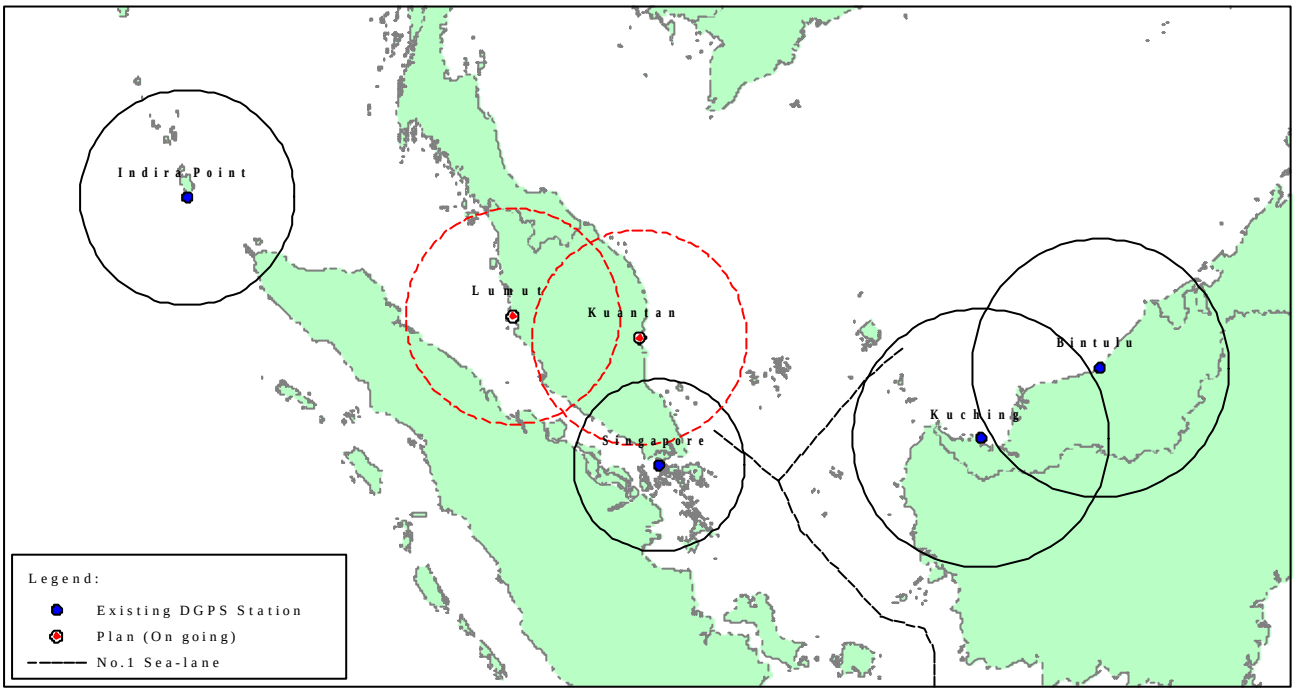


Four (4) DGPS stations are operated, which are Bintulu and Kuching DGPS stations operated by Malaysia on the northern coastal line of Kalimantan, Indra Point DGPS station operated by India at the northern entrance of Malacca Strait and Singapore DGPS station at the southern entrance of Malacca Strait.

Furthermore, Malaysia have a plan to additionally open two (2) DGPS stations that are Lumut located at the middle of Malacca Strait and Kuantan located at the eastern coast line of the Peninsula of Malaysia in this year.

As a result, main part of Malacca and Singapore Strait except around Dumai port is covered by DGPS stations, which are Singapore DGPS station and two (2) DGPS stations planned by Malaysia. A part of northern waters of Sea Lane I is covered by Kuching DGPS station. Coverage area of DGPS stations operated and planned by neighboring countries is shown in **Figure 5.1.2.**

Figure 5.1.2. Locations of DGPS Stations of Neighboring Countries



5.2. Trend of DGPS

In connection with the international trend on the DGPS, at the IALA conference on June 2001, Draft Policy on "The Further of the Marine LF/MF Differential Global Navigation Satellite System (DGNSS)" prepared by Radionavigation Committee 15th Session as RNAV 15/5/3r2 on March 8, 2001 was approved.

In this paper, it is stated that GPS accuracy was improved from 100m with SA to approximately 15-25m without SA. However, IALA has already reaffirmed as a matter of policy the need to continue to maintain and develop DGPS services because of the current IMO requirements for 10m position accuracy (95%) and 1 second integrity warning of satellite malfunction for navigation in harbor entrances / approaches and coastal waters for SOLAS vessels. The continuing need for DGPS is further reinforced as it provides vital input for

proper operation of Electronic Chart Display Information System (ECDIS), Electronic Chart System (ECS) and AIS (Automatic Identification System (AIS).

At present, many countries are developing DGPS stations, because they are the only means which satisfies the "10m positioning accuracy (95%) and 1 second integrity".

AIS system, which is required more accurate positioning system, and also required to have system integrity, and by which the reliability of positioning system is guaranteed.
DGPS, that is the positioning system guaranteed the reliability, is the only satisfied system for ship's positioning.

5.3. Current situation of DGPS based on the Study in Indonesia

In the survey of GPS needs including DGPS (the Survey), the result of the survey indicated that seventy-three (73)% of the ship which participates in the questionnaire desired to implement DGPS.

The result of the Survey indicates that 26.5% of respondents have experience of using DGPS receivers in foreign countries or around Malacca and Singapore Strait.
718 ships (about 59% of total respondents) have GPS receivers and 152 ships (about 20% of the ships fitted with GPS receiver) have GPS receivers being able to receive DGPS signal.

Opinions about the desirable accuracy of positioning from a total of 234 respondents in the survey of GPS need including DGPS were also given as follows:

① 0 to 5m : 5.98% of a total respondents,
② 5 to 10m : 54.70% of a total respondents,
③ 10 to 20m : 8.11% of a total respondents,
④ 20 to 50m : 14.95% of a total respondents,and
⑤ more than 50m: 14.95% of a total respondents

On the other hand, the 10.5m with 95% probability of GPS static accuracy is derived from analysis and calculation result of data that were taken by four (4) time measurement for all GPS receivers.

5.4. Waters requiring DGPS in Indonesia

The waters, where DGPS stations should be established in Indonesia, are the followings:

① Waters in and around ports and harbors, where entry and departure of ships are difficult

- Where high-level operation skill is required because there are dangers such as shoals, atoll and so forth around navigation route, or navigation route bended.
- Where many large and small vessels enter at the same waters, or many foreign vessels, which are unfamiliar with the waters in the vicinity.

② Narrow channels, and the waters where there are danger ours reefs or a group of islands

- Where navigable width is narrow, and many large and small vessels navigate simultaneously.
- Where foreign flag vessels and so forth, which are unfamiliar with the waters, navigate international traffic route.
- Where tide is fast and steady maneuver is difficult.

5.5. Accuracy of DGPS in Japan

After removal of SA (Selective Availability) on May 2200, the Japan Coast Guard has announced "Differential GPS (DGPS), using maritime radio beacon signal, is a system enhancing accuracy of GPS into less than 1m, and also broadcasting warning information such as unscheduled outage. DGPS is based on international standards." The warning information means integrity information informed directly from DGPS station to mariners using DGPS receiver, which is malfunction and so forth of GPS satellite vehicle and operation status of DGPS.

As for example using its accuracy with less than 1m of DGPS, it is confirmed that the DGPS is utilized by some regional governments for positioning work of installation of a man-made gathering-place for fish in Japan.

The positioning accuracy of this installation work generally requires high accuracy. Before DGPS station was established, microwave high precision positioning system and so forth with less than a few meters of positioning accuracy was utilized for such positioning works. However, these types of system take a high cost to maintain the system that must be operated by own cost individually.

6. Effectiveness of DGPS

It is expected that the introduction of DGPS system will make effectiveness as follows:

- Improvement of vessel traffic safety
- Improvement of efficiency of vessel operation (decrease of navigation cost)
- Meeting international standards as a maritime country
- Meeting new international standards and development of infrastructure

(1) Improvement of vessel traffic safety

Twenty-two (22) % of marine casualties occurred around Indonesian waters are collision and stranding. Major causes of them are:

- Mistake of positioning of vessel, and
- Unfamiliarity with the waters.

It is expected that the improvement of positioning accuracy by DGPS will greatly decrease those marine causalities caused by a mistake and unfamiliarity.

It is assumed that about forty-two (42) % of sinking casualties might be caused by collision and stranding, it is expected to decrease sinking accidents by using DGPS.

(2) Improvement of efficiency of vessel operation (decrease of navigation cost)

With the improvement of positioning accuracy, the positioning of vessels can secured and efficiency of vessel operation will be improved and navigation cost will be decreased.

(3) Meeting international standards as a maritime country (For Authorities)

In the Resolution A.815 (19) of IMO, it is recommended that a radio navigation system used to assist the navigation of ships in those harbor entrances and approaches and other waters where freedom to maneuver is limited shall provide positional information with an error not greater than ten (10) m with a probability of ninety-five (95)%.

In major advanced nations, the coastal waters are mostly covered by DGPS as shown in **Figure 5.1.1.**

On the other hand, it is a policy of Indonesia to promote national activation by reinforcement of maritime sector.

For Indonesia as a maritime country, it is indispensable to make major harbor entrance and approaches safe and efficient for navigating vessels according to the recommendation of IMO.

(4) Meeting new international standards and development of infrastructure

The IMO has completely revised the Chapter V of SOLAS Convention that specifies the appropriate measures and so forth on the installation standards of navigation facilities and the navigation safety.

Revision of the convention include the followings:

- Settlement of functional requirements in the installation standards of navigation facilities,
- Review of the installation standards for onboard facilities, and
- Addition of new navigation facilities, and so on.

The revision includes GPS receiver, Automatic Identification System (AIS), Electric Chart Display and Information System (ECDIS) and Vessel Traffic Services (VTS), in relation to the aids to navigation system. It will become effective on July 1st, 2002.

① GPS receiver with DGPS function (For user equipment)

In this revision, all vessels have an obligation to install GPS receiver and so forth. It is specified on GPS receiver in IMO resolution A.819 (19) as follows:

- GPS receiver must have a capability to process DGPS data in compliance with the standards concerning Radio Technical Commission for Maritime Services (RTCM) and the recommendation standards based on International Telecommunication Union ITU-R M823.
- Performance standards on static and dynamic accuracy of GPS receiver must be an error not greater than ten (10) m with a probability of ninety-five (95)%, if DGPS receiver is housed in GPS receiver.

It is requested that an accuracy within 10m must be guaranteed, to both side of operation (Authority) and user, according to the IMO resolution A.815 (15) and A.819 (19), respectively.

② AIS

It is the most remarkable point that all vessels must have responsibility to install AIS equipment.

AIS transmits automatically a Identification Code, Course, Speed and so forth that are data of vessel's own, for the following purposes:

- To accurately grasp the mutual movement among vessels, each other.
- To make a safe navigation such as the avoidance of collision.
- To profit for vessel operation in efficiency.

The most important key factor of AIS is "Position", "Course" and "Speed". This information is regularly figured out by processing based on the positioning data by GPS receiver.

It is required that positioning data on both static and dynamic is far superior, in order to operate AIS effectively.

For this reason, it is the responsibility for authorities to operate aids to navigation system to provide high accuracy positioning system by DGPS.

③ VTS and AIS

It is also specified in the revised SOLAS Convention that AIS must have a function of data communication between vessel and aids to navigation facilities like VTS.

The positioning information by AIS must be accurate in order to:

- Grasp accurately a movement of vessel at VTS, and
- Coordinate traffic effectively in the congested waters.

For these purposes, it is indispensable to obtain high accuracy positioning information by DGPS in the waters of VTS.

④ ECDIS and AIS

ECDIS has become available for navigation instead of former nautical charts by the revised SOLAS Convention.

In Malacca and Singapore Straits, No.1 and No.2 Sea-lanes in Indonesia, it is in progress to digitize nautical charts, and it is expected that ECDIS will spread in the near future.

There is a close relation between AIS and ECDIS. These become an epoch making navigational tool by combining both systems.

For this reason, it is indispensable to develop DGPS system as infrastructure for providing high accuracy positioning data.

(5) Utilization of DGPS other than navigation

The DGPS stations operated are utilized for the following purposes other than navigation in the world:

① Positioning for a dredging works at channel, waterway and so forth,
② Positioning for a installation or replacing of buoy
③ Positioning for a installation of a man-made gathering-place for fish,
④ Positioning for the fishing purposes, and so forth.

7. Development Plan of DGPS Stations in proposed Priority Project

Fifteen (15) proposed DGPS station are formulated in Master Plan up to year 2020 as shown in **Figure 7.1.** and their station names, coordinates and Class of coastal radio stations that DGPS stations are co-sited are given in **Table 7.1.**

When the project sites were selected for the priority project, designated three (3) sea lanes in arch pelagic waters for passage of foreign ships on international voyage had been considered as policy of GOI. And also, Selection work for project sites was made upon consideration of present status of navigation.

As a result of above selection works, No.6 Jakarta DGPS station, No.9 Benoa DGPS station and No.15 Makassar DGPS station were finally selected as for proposed priority project.

Figure 7.1. Proposed DGPS Station in Master Plan

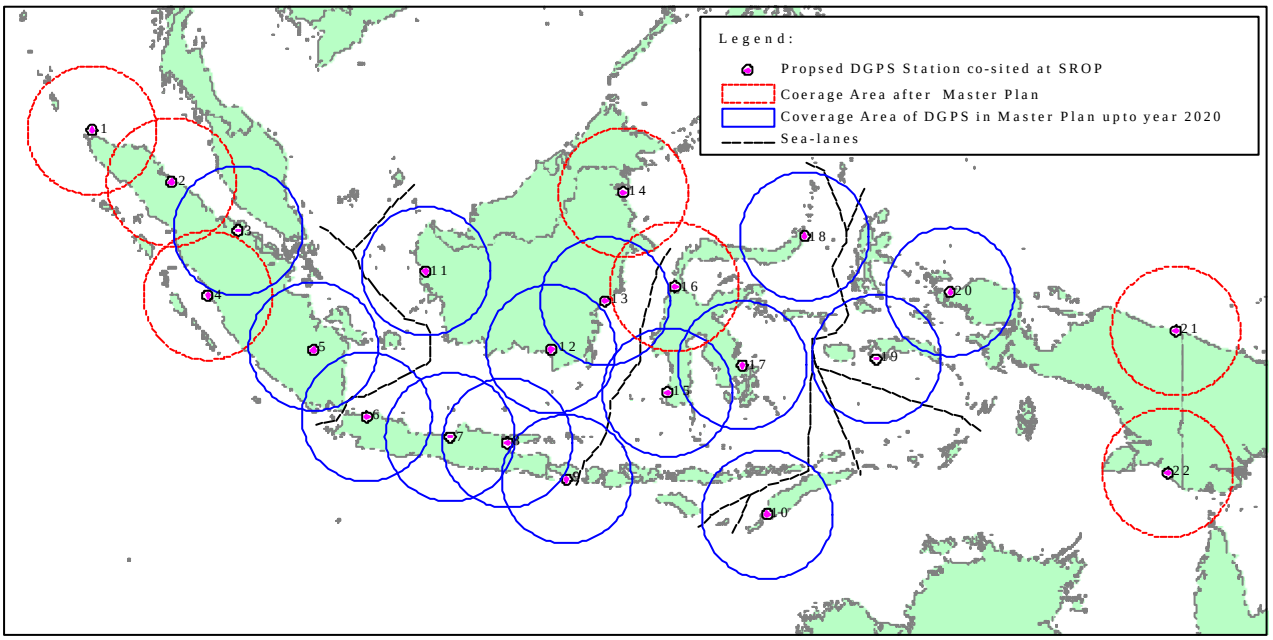


Table 7.1. Location of Proposed DGPS Stations in Indonesia up to Year 2020

NO	NAME	CLASS	LATITUDE	LONGUITUDE	PROVINCE
3	Dumai	I	01-41-10N	101-27-20E	Riau
5	Palembang	I	02-58-08S	104-46-44E	Sumatera Selatan
6	Jakarta	I	06-07-08S	106-51-47E	DKI Jakarta
7	Semarang	II	06-58-34S	110-20-35E	Jawa Tengah
8	Surabaya	I	07-13-05S	112-44-08E	Jawa Timur
9	Benoa	III	08-44-35S	115-12-32E	Bali
10	Kupang	II	10-12-49S	123-37-05E	Nusa Tengagra Timur
11	Pontianak	III	00-01-16S	109-19-02E	Kalimantan Barat
12	Banjarmasin	II	03-18-09S	114-34-38E	Kalimantan Selatan
13	Balikpapan	II	01-16-02S	116-49-32E	Kalimantan Timur
15	Makassar	I	05-06-22S	119-26-31E	Sulawesi Selatan
17	Kendari	III	03-58-00S	122-34-20E	Sulawesi Tenggara
18	Bitung	I	01-27-03N	125-11-03E	Sulawesi Utara
19	Ambon	I	03-41-57S	128-10-40E	Maluku
20	Sorong	II	00-53-03S	131-16-29E	Irian Jaya

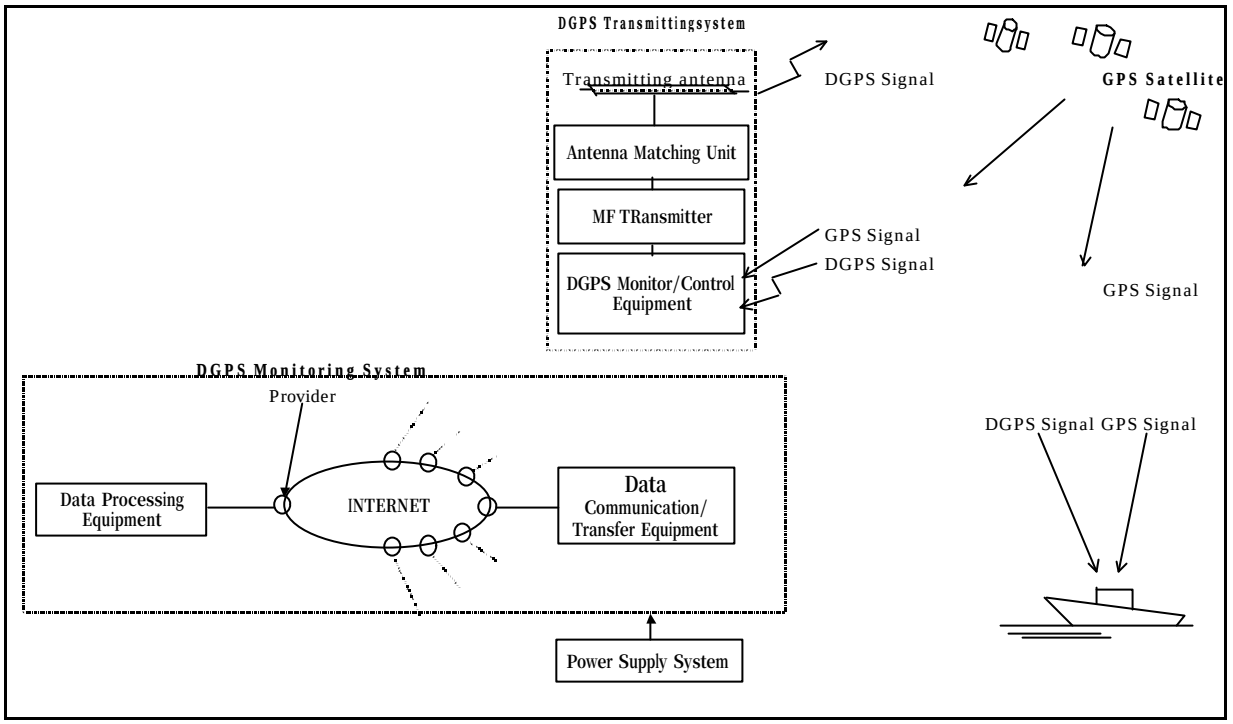
8. DGPS System in Master Plan up to year 2020 and related issues to proposed Priority Project

8.1. Outline of DGPS System

The DGPS system is composed mainly of "DGPS transmitting system" and "DGPS monitoring system" as shown in **Figure 8.1.** The DGPS transmitting system is composed of a transmitting antenna, antenna-matching unit, MF Transmitter and DGPS monitor/control equipment. The DGPS monitoring system is composed of Data communication/transfer equipment and Data processing Equipment that are able to communicate each other by INTERNET. The DGPS Managing Group will be finally able to have the DGPS monitoring data of fifteen (15) stations.

Power supply system and air-conditioners are improved or reinforced in consideration of actual situation of each station. The navigating vessels within the service coverage of DGPS stations are not only able to use DGPS signal for correction of vessel position, but also confirm the integrity of system that guarantees positioning accuracy.

Figure 8.1. DGPS System Outline



8.2. Operation, Maintenance and Management System Plan

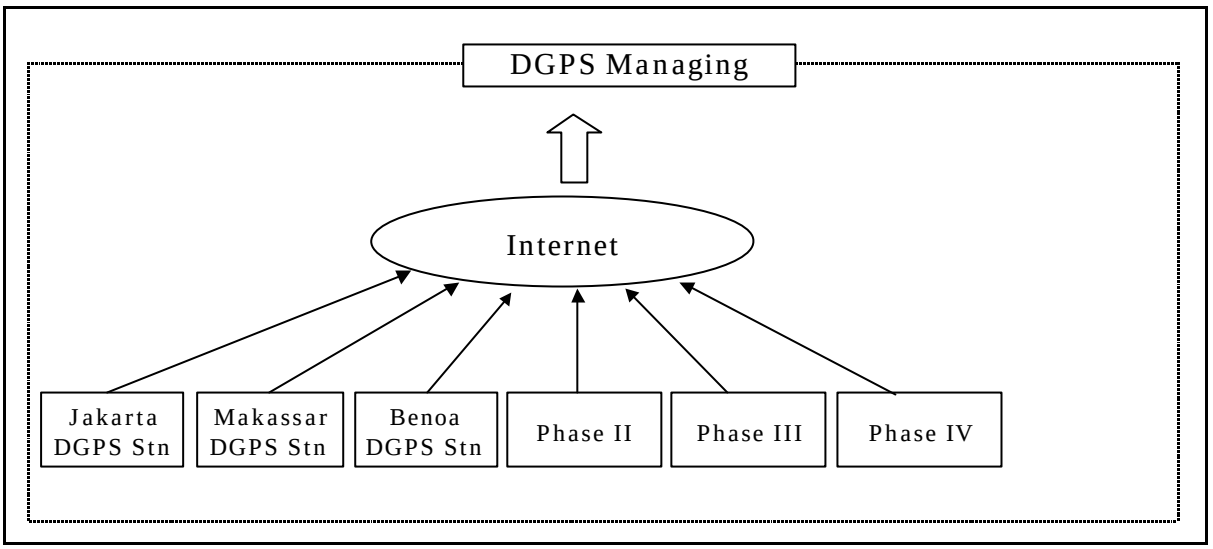
Most of the existing MFB stations constructed under the Japanese Yen Loan had been suspended their operation several years after their starts because of lack of operation and maintenance costs and weakness of operation and maintenance management system.

It is expected that the supplementary budget from light dues can be utilized for the operation, maintenance and management of DGPS system.

For the operation and maintenance system, DGPS Operation and Maintenance System was planned as shown in **Figure 8.2.**

In this plan, the DGPS Managing Group having overall responsibility for the operation and maintenance of the system will be established in the Directorate General of Sea Communication (DGSC), Ministry of Communications (MOC) and at least two dedicated maintenance technicians should be assigned to each DGPS station. Therefore, it is deemed that continuous and stable operation and maintenance of the system will be secured.

Figure 8.2. DGPS Operation and Maintenance System Plan



8.3. Allocation Plan of Main Equipment

Allocation plan of main equipment for fifteen (15) stations is shown in **Table 8.1.**

Table 8.1. Allocation Plan of Main Equipment

Main Equipment	JKT	SMG	BNA	MKS	BPN	BJM	PTK	DMI	PLG	SBY	KPG	KDR	ABN	SRG	BTG	DMG
1. DGPS Transmitting System																
(1) Transmitting Antenna	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	
(2) Antenna Matching Unit	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	
(3) Antenna tower	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	
(4) MF Transmitter	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	
(5) DGPS Monitor/Control	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	
(6) Software for (5) above	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	
2. DGPS Monitoring System																
(1) Data Process. Equipment																○
(2)Data transfer Equipment	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	
(3) Software for (2) above	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	
3. Power supply system																
(1) Engine Generator			○	○			○									
(2) Isolation transformer			○		○	○	○				○	○				
(3) Auto. Voltage Regulator			○		○	○	○				○	○				
(4) Step-up/down	○			○	○	○										

Main Equipment	JKT	SMG	BNA	MKS	BPN	BJM	PTK	DMI	PLG	SBY	KPG	KDR	ABN	SRG	BTG	DMG
4. Interference Protection Equipment			○				○				○	○				
5. Associated facility																
(1) Anti-lightning facility			○	○			○									
(2) Air conditioner				○	○	○										
6. Operation & Maintenance Equipment	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	
7. Spares	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○

Note: JKT:Jakarta, SMG:Semarang, BNA:Benoa, MKR:Makassar, BPN:Balikpapan, BJM:Banjarmasin, PTK:Pontianak, DMI:Dumai,PLG:Palembang, SBY:Surabaya, KPN:Kupang,KDR:Kendari,ABN:Ambon,SRG:Semarang,BTN:Bitung, JKT:Jakarta

▭ shows site in the proposed priority project.

8.4. Education and Training

In order to familiarize the respective personnel assigned for this project implementation with the operation and maintenance of the equipment to be supplied and installed, a comprehensive training shall be held in the manufacturer's facilities site.

The total estimated period of training would be around two (2) months to be held in the manufacturer's country according to proper operation and maintenance manuals including troubleshooting and textbooks.

The number of personnel to be participating in the training is estimated to comprise of 1 from the Management / inspectors, and at least two persons (2) from each site of the technicians. The details of training, such as time and costs are provided under maintenance training cost.

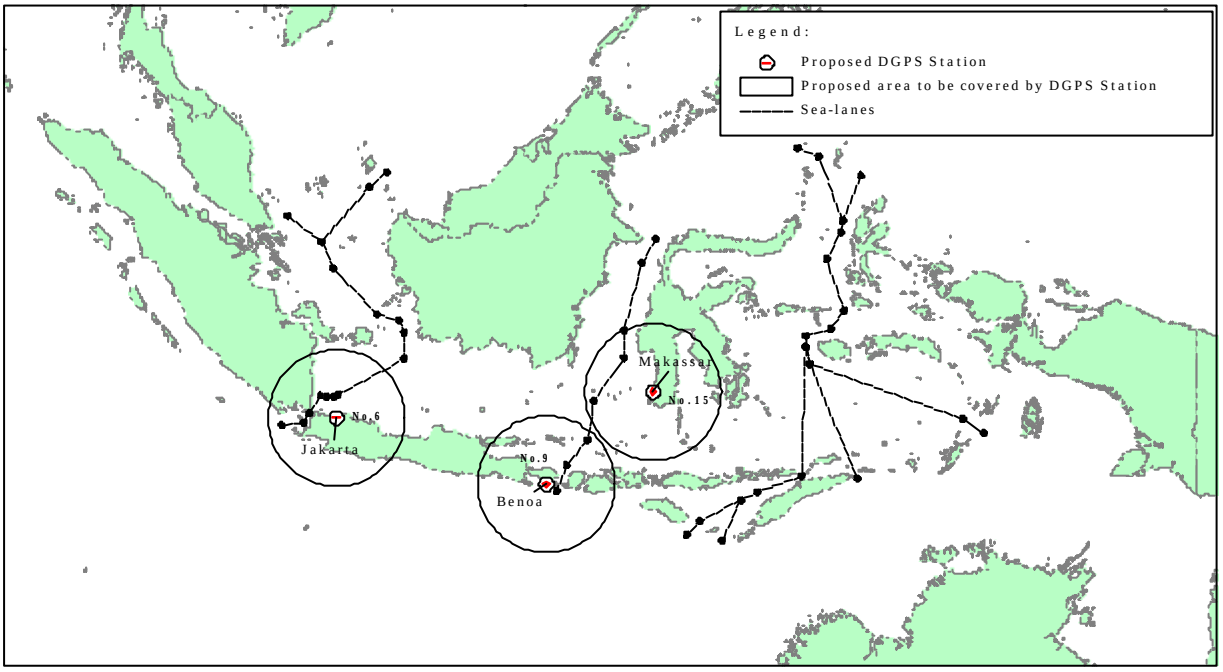
The On-the-Job training (OJT) must be made at each site using actual equipment and facilities for DGPS station. It is desirable that OJT is executed at the time of measuring and testing works. Trainees consist of two (2) technician and six (6) operators at least. Period of OJT are 10 day at site except holiday.

9. Basic Concept of the proposed Priority Project

The basic concept of this plan is that three (3) DGPS stations are established at existing coastal radio stations where commercial power source is available. The DGPS technique is applied to the DGPS stations to serve a stable and high accuracy positioning information with Integrity of the system to vessel that can navigate in more safety and have high efficiency in aspect of navigation.

The service coverage of three (3) proposed DGPS stations is shown in **Figure 9.1.**

Figure 9.1. Service Coverage of DGPS Stations proposed in Priority Project



The proposed DGPS system above is planned on the basis of the following basic concept:

① Compliance with international standards and Indonesian Law,
② Establishment of long-term operation,
③ Securing stable operation of system and easy maintenance,
④ Minimization of maintenance cost,
⑤ Consideration of environmental condition,
⑥ Rehabilitation of the existing equipment on the DGPS system,
⑦ Maximal utilization of existing equipment and facilities, and
⑧ Securing the stable operation and maintenance system.
⑨ Providing sufficient spare parts
⑩ Proposed equipment for DGPS stations and associated facilities and goods basically follows equipment plan specified in “Basic Design Study Report on

the Project for Rehabilitation for Medium Wave Radio Beacon Stations in the Republic of Indonesia"(hereinafter referred to "Basic Design Study").

Based on the concept above, equipment to be supplied for proposed DGPS station is specified in Table 8.1., subject to a result of necessary re-confirmation mentioned in **Chapter 10** for installation work, civil and housing works and operation and maintenance of the system:

10. Necessary Re-confirmation for the proposed Priority Project

The followings must be re-confirmed as a technical aspect in the feasibility study.

① Ability of Local Procurement including raw construction materials.
② Capacity of Commercial Power Source and its condition
③ Securing Space for Equipment to be installed
④ Circumstances of Internet and E-mail
⑤ Environmental Conditions
⑥ Protection of lightning attack
⑦ Accessibility to the Sites
⑧ Condition of GPS antenna position for reference station
⑨ Operation hours
⑩ Personnel for Operation and Maintenance

11.Result of the Feasibility Study in Technical Aspect

11.1. Schedule of the Feasibility Study

The feasibility study was made for "Differential GPS " in Indonesia from 3rd October to 3rd December 2001.

The schedule of site survey is as follows:

(1) October 3rd 2001: Steering Committee Meeting for IC/R
(2) October 9th 2001: Counterpart Meeting for F/S
(3) December 3rd 2001: Counterpart Meeting for report of F/S

(4) From October 12th 2001 to November 2nd
Site Survey period

One (1) site survey team on DGPS of JICA Study Team visited Districts of Navigation offices and their relevant sites on the feasibility study.
The site survey team consisted of Mr. Yasunobu Yamane as the Member of JICA Study Team and DGSC Counterpart.

The site survey team have surveyed on area of proposed sites and relevant locations, that is DISNAV Jakarta and Jakarta Coastal Radio Station (Transmitting Station), DISNAV Benoa and Benoa Coastal Radio Station for the feasibility study.

Makassar DGPS station proposed in the priority project was judged on the basis of result of survey in the first work in Indonesia and through hearing because of security issues. In addition to the said sites, DISNAV Semarang and DISNAV Pontianak were surveyed for their priority given in Master Plan.

11.2. Result of the Feasibility Study in Technical Aspect

Current situation on access to sites, location of project site, installation space, condition of existing equipment and facilities are shown in **Figure 11.1.** to **Figure 11.15.** and **Appendix 11.1.** to **Appendix 11.9.**

Details of site condition are confirmed as follows:

(1) Ability of local procurement

① Personal computers (PCs)

Two (2) types of personal computers are utilized for the following purposes:

a. DGPS monitor/Control equipment that includes PCs, for DGPS transmitting system
b. Data processing equipment that includes PC, for DGPS monitoring system
c. Data communication/transfer equipment that includes PC, for DGPS monitoring system

PCs for a. above is required to be a machine of server class with a guarantee for 24 hours operation continuously in order to secure a reliability of the system.

Another type of PCs is required for data communication between DGPS station and GPS Managing Group. It must be desktop type with wide color monitor.
These PCs and their spares can be obtained in Indonesia.

② Peripheral apparatus for personal computers

Un-interrupted Power Supply (UPS), color and monochrome laser printer, color monitor and their consumables for both types of PC can be procured in Indonesia.

③ Engine generators

15KVA and 50 KVA of diesel engine generator that are relatively required for regular and emergency maintenance, and their consumable and spare parts can be procured in Indonesia.

④ Self-supporting antenna tower

30m high-galvanized steel self-supporting tower with sufficient quality is available in Indonesia.

⑤ Air-conditioning facilities

The air-conditioning facilities that have an important role in order to operate steadily DGPS transmitting system are available in Indonesia. They are suitable for tropical environment.

⑥ General construction materials

- Raw materials for civil and housing works are available at each proposed site.
- Materials for installation work such as cable are available in Jakarta except for coaxial cable for 1kw or more transmitters.

(2) Capacity of commercial power source and its conditions

① Jakarta DGPS station

- Contracted capacity of commercial power source is sufficient to establish DGPS station newly.
- Capacity of step up/down transformer is insufficient to operate DGPS station newly. It must be improved.

② Benoa DGPS station

- Contracted capacity of commercial power source is insufficient to establish DGPS station newly. It must be 15KVA or more. The contract will be changed prior to commencement of the project.
- Capacity of engine generator is insufficient to operate DGPS station newly. And also, isolated transformer and automatic voltage regulator must be improved to 15KVA, respectively.

③ Makassar DGPS station

- Contracted capacity of commercial power source is sufficient to establish DGPS station newly.
- There are two (2) old emergency generators with 50KVA. One (1) cannot repair any longer. Another one is 33 years old and is apt to fault. One (1) of 50KVA engine generators must be replaced.

(3) Securing space for equipment to be installed

① Jakarta DGPS station and Makassar DGPS station

Space and area for installation of equipment and facilities planned in the proposed priority project is sufficient.

② Benoa DGPS station

It is necessary for some existing receiving equipment to be improved for countermeasures against interference because receiving function is not separated from transmitting function.

(4) Circumstances of Internet and E-mail

Management of DGPS system is made by DGPS Managing Group to be established at DGSC. Operation status and relevant matter are reported automatically from each DGPS station to DGPS Managing Group via Internet circuit in order to reduce communication cost. E-mail is utilized in this system.

For this purpose, current situation of each site is as follows:

① Jakarta DGPS station and Benoa DGPS station

- Quality of Communication is good.
- One (1) telephone line is required in order to make an E-mail communication.

② Makassar DGPS station

- There is no telephone line available for E-mail.
- One (1) telephone line is required in order to make an E-mail communication.
- It is assumed that quality of communication is good because telephone line near the transmitting station is good.

(5) Environmental condition

All coastal radio stations that DGPS station are co-sited are good conditions except humidity and temperature. Humidity and temperature can be solved by air-conditioning facilities.

(6) Protection of lightning attack

All equipment to be installed at each coastal radio station exists within the protection angle of lighting rod installed at the top of antenna towers.

(7) Accessibility to the sites

Each site is accessible for the civil and housing works and installation work. There is no serious issue for the construction works.

(8) Condition of GPS antenna position

Each condition of GPS antenna position measured as reference position under the Basic Design Study is very well maintained.

Baseline analysis was made for these GPS antenna positions for RS with high accurate in the Basic Design Study in year of 2000.

Figure 11.1. Jakarta Coastal Radio Station (Class I/Transmitting Station)

Figure 11.2. Map of proposed Jakarta DGPS Station

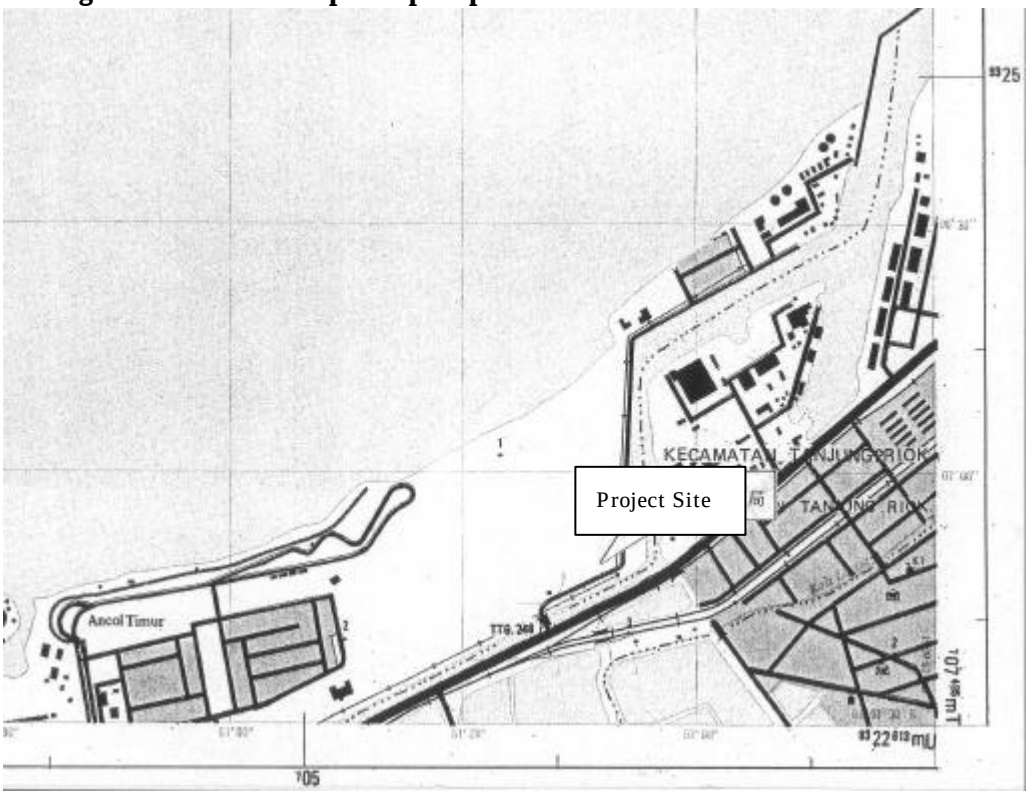


Figure 11.3. Makassar Coastal Radio Station (Class I/Transmitting Station)

Figure 11.4. Map of proposed Makassar DGPS Station

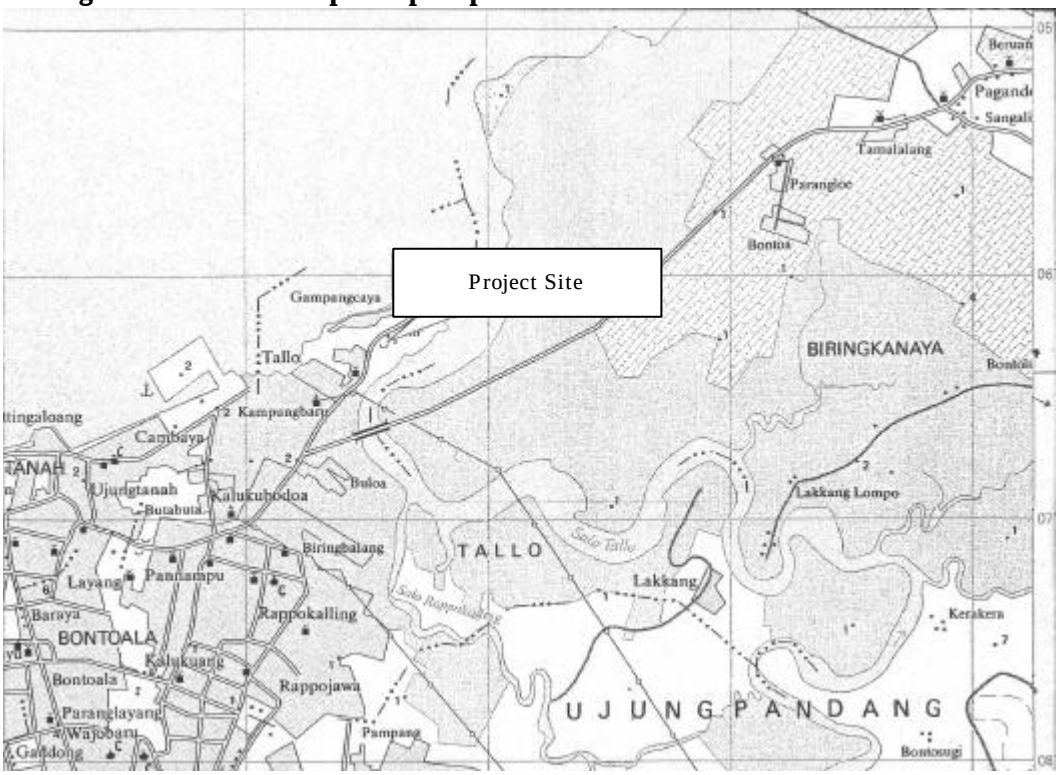


Figure 11.5. Benoa Coastal Radio Station

Figure 11.6. Map of proposed Benoa DGPS Station

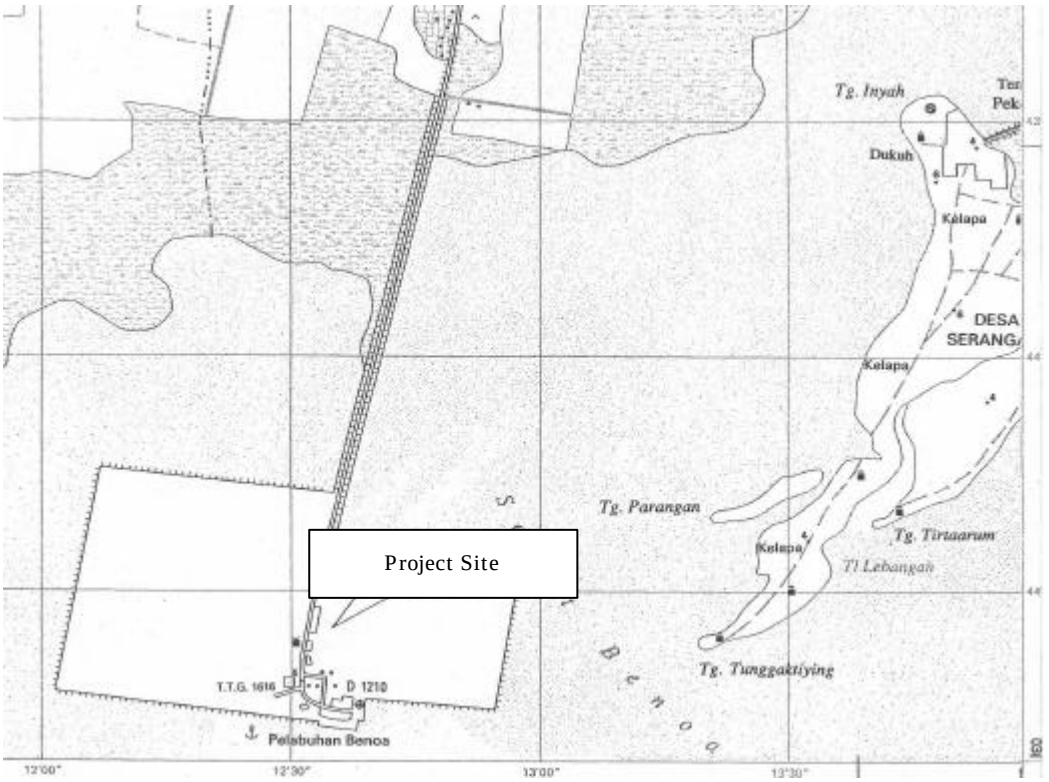


Figure 11.7 Proposed Position of DGPS Transmitter & Monitor/Control (Jakarta)

Figure 11.8. Proposed Position of GPS Receiving Antenna (Jakarta)

Figure 11.9. Engine Generator to be improved (Replace to 50KVA) (Makassar)

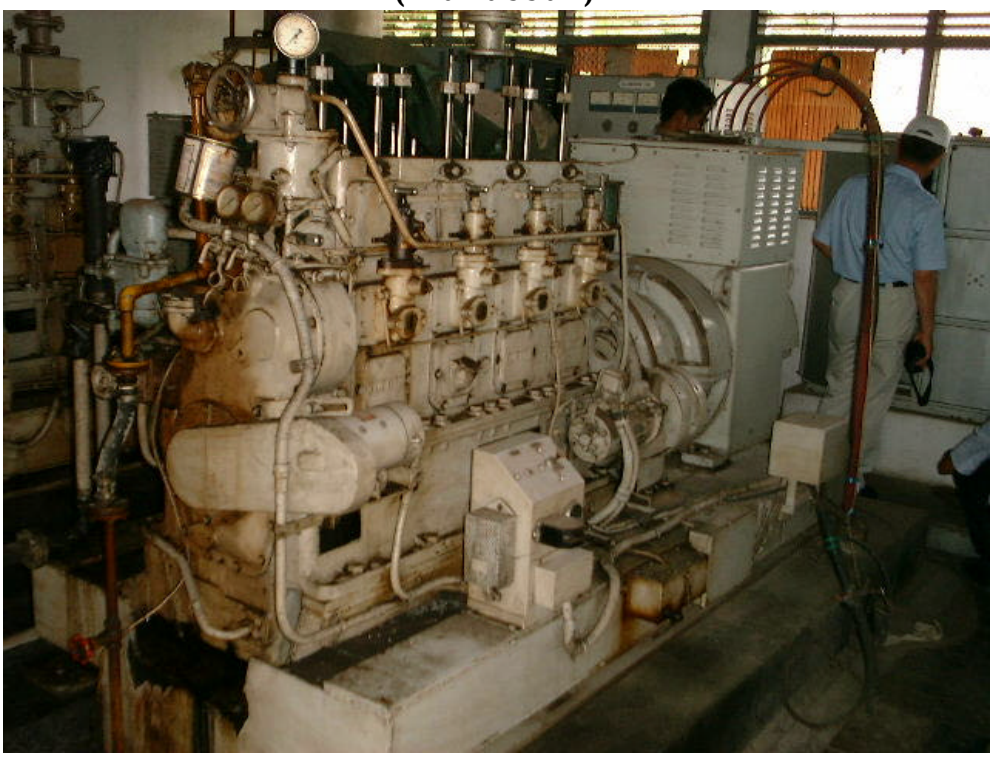


Figure 11.10. Proposed Position of DGPS Transmitter & Monitor/Control (Makassar)

Figure 11.11. Proposed Position of GPS Receiving Antenna (Makassar)

Figure 11.12. Engine Generator to be improved (Improve to15KVA) (Benoa)

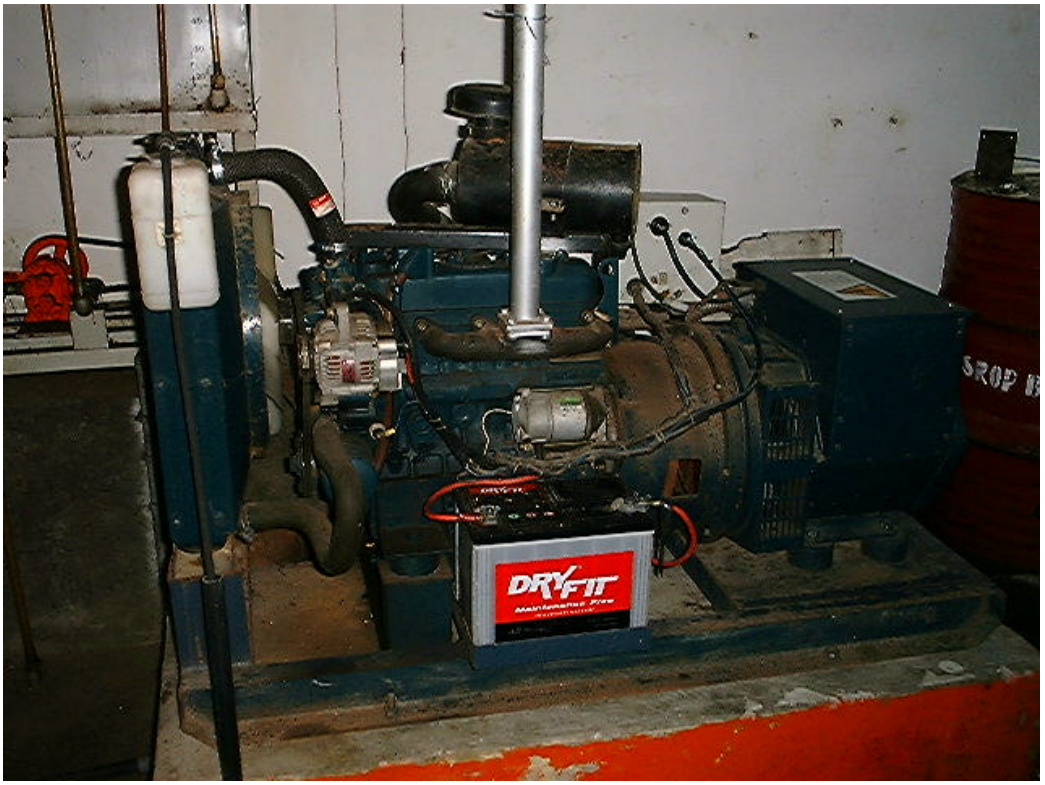


Figure 11.13. Proposed Position of DGPS Transmitter & Monitor/Control (Benoa)

Figure 11.14. Proposed Position of GPS Receiving Antenna (Benoa)

Figure 11.15. Console to be improved for Interference Protection (Benoa)

(9) Operation hours of existing coastal radio stations which co-site DGPS station.

The coastal radio station where DGPS station will be installed is categorized as Class I, Class II and Class III. Criteria to categorize coastal radio station are given in **Table 11.1.**

Table 11.1. Criteria of Coastal Radio Stations in Indonesia

Category	Transmitting Power	Operation Time Schedule	TX and RX Station	Seven (7) stations for the Project
Class Ⅰ	1kW～5kW	24 hours	Separate	Jakarta, Uj. Pandang
Class Ⅱ	500W	16～18 hours	Separate	---------
Class Ⅲ	250W	8 hours	Co-site	Benoa
Class Ⅳ	100W	Intermittent operation	Co-site	---------

There are some discrepancies between the actual operation schedule and the schedule above, in aspect of Transmitting Power and Operation Time Schedule because those criterions have been applied before establishment of GMDSS. For example, even though some coastal radio stations are Class II and III, the 24 hours operation has been adopted.

Therefore, those stations are not necessary to change operation and maintenance system largely for DGPS station.

(10) Personnel for operation and maintenance

The DGPS Managing Group is newly established in DGSC to manage and control the DGPS system. The DGPS Managing Group composes of adequate staffs and leader. Two maintenance personnel at least are assigned for each DGPS Station.

Head of the DGPS Managing Group is recommended to join the over-seas training to have knowledge regarding the securing of a budget, establishment of management group, arrangement of staffs, training plan and operation and maintenance schedule for management of the DGPS Station.

Chief of Technical Engineer is recommended to join the overseas training and On-the-job Training (OJT) for having of knowledge regarding latest technology, and technique of maintenance and operation.

Even though DGSC is able at present to secure two personnel as technician for operation and maintenance of DGPS Station system as shown in **Table 11.2.**, the technical training is important to have the more skilled engineer for maintenance and operation in future.

Training course for maintenance engineer has been postponed in latest five (5) years because of lacking of budget. The resumption of training course is advised in DGSC to skill up and maintains technical level of engineers.

Maintenance engineers for DGPS Station are advised to skill up by carrying out the OJT.

Table 11.2. List of staffs of Coastl Radio Stations

Name of station (Class)	Station Master	Chief Tech-Nician	Mar-conis	Tech-nician	Total
Jakarta (I)	1	1	96	21	119
Uj. Pandang (I)	1	1	46	11	59
Benoa (III)	1	0*	23	1	25

(11) Conclusion of Result of Feasibility Study in Technical Aspect

As a result of study above, it is judged that proposed Priority Project of DGPS for establishment of three (3) DGPS stations and DGPS Managing Group have a feasibility in technical aspect subject to improvement and rehabilitation of some existing equipment and system.

The cost of this equipment to be rehabilitated and improved is estimated in Total Investment Cost for proposed Priority Project for DGPS.

12. Executing Agency of the Project

12.1 . Administration of ATN including DGPS stations

Directorate of Navigation of DGSC, Ministry of Communications (MOC) has a sole responsibility for the administration of aids to navigation including DGPS stations as radio aids to navigation (hereinafter referred to “ATN”).

Directorates of Navigation and District of Navigation Offices (DISNAV/ Sub DISNAV) have a responsibility for operation and maintenance of ATN.

12.2. Organization for the operation and maintenance

District of Navigation (DISNAV) is provided **in Appendix 12.1.**

Maintenance and operation of DGPS station are executed by each Districts of Navigation under the direct operational and administrative control of DGSC with the technical guidance of the Directorate of Navigation.

13. Implementation Schedule

It is desirable that DGPS Stations are established by the fund of DGSC. However, in case that DGSC has insufficient fund, Loan may be considered for earlier establishment of DGPS stations to contribute to safety navigation at waters in and around ports and harbors, where entry and departure of ships are difficult, and narrow channels, and the waters where there are dangerous reefs or a group of islands.

14. Project Cost Estimation

14.1. General

JICA Study Team completed site survey for three (3) proposed sites at Jakarta, Beanoa and Makassar and two (2) relevant areas at Semarang and Pontianak.

System design was finalized and cost of the proposed project for DGPS was estimated on the basis of survey result for procurement of equipment and relevant works and services.

14.2. Equipment including Spares

(1) Jakarta DGPS Station

Jakarta DGPS station is established at Transmitting (TX) station of Jakarta Coastal Radio Station (SROP).

Major equipment to be installed or stored at site consists of:

① DGPS Transmitting System
② DGPS Monitoring System
③ Power Supply System
④ Operation and Maintenance Equipment
⑤ Associated facilities
⑥ Spares

(2) Benoa DGPS Station

Benoa DGPS Station is established at Benoa of SROP.

Major equipment to be installed or stored at site consists of:

① DGPS Transmitting System including 30m high Antenna Tower
② DGPS Monitoring System
③ Interference Protection Equipment
④ Power Supply System including engine generator
⑤ Operation and Maintenance Equipment
⑥ Associated facilities
⑦ Spares

(3) Makassar DGPS Station

Makassar DGPS Station is established at Makassar TX Station of SROP.

Major equipment to be installed or stored at site consists of:

① DGPS Transmitting System
② DGPS Monitoring System
③ Power Supply System including engine generator
④ Operation and Maintenance Equipment
⑤ Associated facilities
⑥ Spares

(4) DGPS Managing Group

DGPS Managing Group will be established at DGSC. Major equipment to be installed or stored at DGPS Managing Group consists of:

① DGPS Monitoring System

② Spares

(5) Other relevant issues

Internet is applied for communication between DGPS Monitoring Group and DGPS stations located at regional offices. Data is sent/ received by E-mail through Internet in order to reduce the communication cost.

Cost on contract for provider and cost borne by communication are excluded from cost estimation of initial cost.

Spares for DGPS Managing Group will be stored at proper site such as Jakarta Transmitting Station of SROP.

14.3. Installation and Civil & Housing Work

(1) Jakarta DGPS Station

① Installation work is applied for equipment to be delivered to sits except for spares.

② Civil and housing works are applied for the followings:

- Foundation of Antenna matching unit, that is combiner and matching unit.
- Foundation of Antenna feeder supporting pole, and so forth.
- Cabling under ground

(2) Benoa DGPS Station

① Installation work is applied for equipment to be delivered to sits except for spares.

② Civil and housing works are applied for the followings:

- Foundation and erection work of 30m high galvanized self-supporting tower.
- Foundation of Antenna matching unit, that is combiner and matching unit.
- Foundation of Antenna feeder supporting pole, and so forth.
- Cabling under ground

(3) Makassar DGPS Station

① Installation work is applied for equipment to be delivered to sits except for spares.

② Civil and housing works are applied for the followings:

- Foundation of Antenna matching unit, that is combiner and

matching unit.

- Foundation of Antenna feeder supporting pole, and so forth.
- Cabling under ground

Foundation work for above is breakdown as follows:

- Site cleaning and leveling works
- Excavation work
- Framing work
- Bar arrangement work
- Concrete work
- Back filling work

14.4. Total Investment Cost

The total investment cost of proposed priority project of DGPS consists of "Procurement of equipment", "Installation work", "Procurement of spare", "Civil and housing work", "Training", "Ocean transportation and inland transportation", "Consulting fee" and "Contingency (5%) of Procurement of equipment to Consulting fee".

Total estimated cost categorized by foreign currency and local currency for the proposed priority project is shown in **Table 14.1.** and its breakdown is shown in **Table 14.2.**

Table 14.1. Estimated Total Investment Cost

Unit: Thousand US$

Item		Foreign Currency	Local Currency	Amount
A	Procurement of Equipment	3,670	209	3,879
B	Installation Work	374	30	404
C	Spares	447	18	465
D	Civil and housing works	0	59	59
E	Training	92	0	92
F	Ocean Transportation	74	4	78
G	Consulting Fee	326	76	402
H	Contingency	249	20	269
Total		5,232	416	5,648

Estimated cost by site, that is Jakarta DGPS station, Benoa DGPS station, Makassar DGPS station and DGPS Monitoring Group is shown in **Table 14.3.**

Table 14.2. Breakdown of Total Investment Cost of proposed Priority Project (D G P S)

Unit: US$

No. Item	Q'ty	Unit	Unit Price	Foreign Currency	Unit Price	Local Currency	Total
A Procurement of Equipment				3,669,728		209,125	3,878,853
1. DGPS Transmitting System				3,153,078		37,959	3,191,037
(1) Transmitting Anttena	3	units			8,857	26,571	26,571
(2) Antenna Maching Unit				571,745		0	571,745
1) Antenna Combiner 1kw/1kw	2	units	86,628	173,256			173,256
2) Antenna Combiner 1kw/5kw	1	unit	112,616	112,616			112,616
3) Antenna Matching U 1kw/1kw	3	units	95,291	285,873			285,873
(3) Antenna Tower	1	unit	0	0	11,388	11,388	11,388
(4) MF Transmitter	3	units	441,802	1,325,406			1,325,406
(5) DGPS Monitor/Control	3	units	277,209	831,627			831,627
(6) Software (5) above	1	lot	424,300	424,300			424,300
2. DGPS Monitoring System				71,036		80,381	151,417
(1) Data Proccess. Equipment	1	unit		0	13,950	13,950	13,950
(2) Data Transfer Equipment	3	units		0	12,021	36,063	36,063
(3) Software (2) above	1	lot	60,640	60,640			60,640
(4) Telephone lineprotection box	4	lot	2,599	10,396			10,396
(5) Consumable goods (5 years)	4	lot			7,592	30,368	30,368
3. Power Supply System				55,442		35,429	90,871
(1) Engine Generator				0		35,429	35,429
1) Engine Generator 15KVA	1	unit		0	13,286	13,286	13,286
2) Engine Generator 50KVA	1	unit		0	22,143	22,143	22,143
(2) Isolation Transformer 15KVA	1	unit	12,994	12,994		0	12,994
(3) Auto. Voltage Regulator 15KVA	1	unit	25,988	25,988		0	25,988
(4) Step-up/down	2	units	3,898	7,796		0	7,796
(5) Power Distribution Board	4	units	2,166	8,664		0	8,664
4. Interference Protection Equipment				90,960		0	90,960
(1) MW/SW radioconsole to be improve	1	unit	17,326	17,326		0	17,326
(2) SSB to be improved	1	unit	56,308	56,308		0	56,308
(3) VHF radio console to be improved	1	unit	17,326	17,326		0	17,326
5. Associated Facility				0		55,356	55,356
(1) Anti-lightning facility	2			0	22,143	44,286	44,286
(2) Air conditioner	5	units		0	2,214	11,070	11,070
6. Operation & Maintenance Equipment				299,212		0	299,212
(1) Measurement & Test Equipment				298,692		0	298,692
1) Spectrum Analizer	4	units	30,320	121,280			121,280
2) Osciloscope	4	units	7,363	29,452			29,452
3) Frequency counter	4	units	3,898	15,592			15,592
4) Multi meter	4	units	953	3,812			3,812
5) Direction coupling unit	4	units	1,819	7,276			7,276
6) DGPS evaluation equipment	4	units	30,320	121,280			121,280
(2) Standard electronic tool sets	4	units	130	520			520
B Installation and setup	1	lot		373,550		30,500	404,050
C Spares	1	lot		447,285		17,715	465,000
(1) DGPS Transmitting System				281,540		0	281,540
1) DGPS Managing Group	1		73,634	73,634			73,634
2) DGPS Transmitting Station	3		69,302	207,906			207,906
(2) DGPS Monitor/Control				165,745		0	165,745
1) DGPS Managing Group	1		100,774	100,774			100,774
2) DGPS Transmitting Station	3		21,657	64,971			64,971
(3) Engine Generator				0		17,715	17,715
1) 15 KVA Engine Generator	1	lot		0	6,327	6,327	6,327
2) 50 KVA Engine Generator	1	lot		0	11,388	11,388	11,388
D Civil and Housing Works	1	lot				59,010	59,010
E Training	1	lot		92,000			92,000
F Ocean Transportation	1	lot		74,109		3,941	78,050
Sub-total				4,656,672		320,291	4,976,963
G Consultant Fee	1	lot		325,967		76,083	402,050
Sub-total				4,982,639		396,374	5,379,013
H Contingency				249,132		19,819	268,951
Total				5,231,771		416,193	5,647,964
Gran Total						5,647,964	5,647,964

Table 14.3. Estimated Cost by Site for proposed Priority Project (DGPS)

Unit: US$

No. Item	Jakarta DGPS	Beona DGPS	Makassar DGPS	DGPS Managing Group	Total
A Procurement of Equipment	1,195,447	1,344,534	1,222,602	116,270	3,878,853
1. DGPS Transmitting System	1,077,208	1,062,608	1,051,221	0	3,191,037
(1) Transmitting Anttena	8,857	8,857	8,857	0	26,571
(2) Antenna Maching Unit	207,907	181,919	181,919	0	571,745
1) Antenna Combiner 1kw/1kw	0	86,628	86,629	0	173,256
2) Antenna Combiner 1kw/5kw	112,616	0	0	0	112,616
3) Antenna Matching U 1kw/1kw	95,291	95,291	95,291	0	285,873
(3) Antenna Tower	0	11,388	0	0	11,388
(4) MF Transmitter	441,802	441,802	441,802	0	1,325,406
(5) DGPS Monitor/Control	277,209	277,209	277,209	0	831,627
(6) Software (5) above	141,433	141,433	141,433	0	424,300
2. DGPS Monitoring System	37,372	37,372	37,372	39,301	151,417
(1) Data Proccess. Equipment	0	0	0	13,950	13,950
(2) Data Transfer Equipment	12,021	12,021	12,021	0	36,063
(3) Software (2) above	15,160	15,160	15,160	15160	60,640
(4) Telephone lineprotection box	2,599	2,599	2,599	2,599	10,396
(5) Consumable goods (5 years)	7,592	7,592	7,592	7,592	30,368
3. Power Supply System	6,064	54,434	28,207	2,166	90,871
(1) Engine Generator	0	13,286	22,143	0	35,429
1) Engine Generator 15KVA	0	13,286	0	0	13,286
2) Engine Generator 50KVA	0	0	22,143	0	22,143
(2) Isolation Transformer 15KVA	0	12,994	0	0	12,994
(3) Auto. Voltage Regulator 15KVA	0	25,988	0	0	25,988
(4) Step-up/down	3,898	0	3,898	0	7,796
(5) Power Distribution Board	2,166	2,166	2,166	2,166	8,664
4. Interference Protection Equipment	0	90,960	0	0	90,960
(1) MW/SW radioconsole to be improve	0	17,326	0	0	17,326
(2) SSB to be improved	0	56,308	0	0	56,308
(3) VHF radio console to be improved	0	17,326	0	0	17,326
5. Associated Facility	0	24,357	30,999	0	55,356
(1) Anti-lightning facility	0	22,143	22,143	0	44,286
(2) Air conditioner	0	2,214	8856	0	11,070
6. Operation & Maintenance Equipment	74,803	74,803	74,803	74,803	299,212
(1) Measurement & Test Equipment	74,673	74,673	74,673	74,673	298,692
1) Spectrum Analizer	30,320	30,320	30,320	30,320	121,280
2) Osciloscope	7,363	7,363	7,363	7,363	29,452
3) Frequency counter	3,898	3,898	3,898	3,898	15,592
4) Multi meter	953	953	953	953	3,812
5) Direction coupling unit	1,819	1,819	1,819	1,819	7,276
6) DGPS evaluation equipment	30,320	30,320	30,320	30,320	121,280
(2) Standard electronic tool sets	130	130	130	130	520
B Installation and setup	133,850	133850	133850	2,500	404,050
C Spares	90,959	97,286	102,347	174,408	465,000
(1) DGPS Transmitting System	69,302	69,302	69,302	73,634	281,540
1) DGPS Managing Group	0	0	0	73,634	73,634
2) DGPS Transmitting Station	69,302	69,302	69,302	0	207,906
(2) DGPS Monitor/Control	21,657	21,657	21,657	100,774	165,745
1) DGPS Managing Group	0	0	0	100,774	100,774
2) DGPS Transmitting Station	21,657	21,657	21,657	0	64,971
(3) Engine Generator	0	6,327	11,388	0	17,715
1) 15 KVA Engine Generator	0	6,327	0	0	6,327
2) 50 KVA Engine Generator	0	0	11,388	0	11,388
D Civil and Housing Works	2,200	53,810	3000	0	59,010
E Training	0	0	0	92,000	92,000
F Ocean Transportation	26,000	26,000	26,000	50	78,050
Sub-total	1,448,456	1,655,480	1,487,799	385,228	4,976,963

15. Operation and Maintenance Cost

The operation and maintenance cost for three (3) DGPS stations and DGPS Managing Group is estimated on the basis of the basic rate as shown in **Table 15.1.** Total operation and maintenance cost per year is US$26,606 as shown in **Table 15.2.**

(1) 5 persons of DGPS Managing Group at DGSC consist of head and 4 staff.

(2) 2 technicians of Each DGPS stations have a responsibility for maintenance, system is operated automatically.

Table 15.1 Basic Rate of Each Cost for Operation and Maintenance

Basic Data for Operation and Maintenance				
1	Personnel Expense		x 1000Rp	
	Headquarter		800	/ month
	title		400	/ month
	Technician of DGPS Station		500	/ month
	(Technician II/A)		410	/ month
	(Technician III/A)		660	/ month
	Allowance		200	/ month
	lumpsum		170	/ day
2	Communication Fee (Telephone)			Times/ period
	>500km, 6 second	(w D)		Holiday
		0	365	365
		6	730	730
		7	1,455	730
		8	1,820	730
		18	1,455	730
		20	730	730
		23	365	365
	Application fee		450,000	
	Basic Rate		39,000	/ month
3	Commercial Power		173	Rupiah/kwH
	Power Comsumption		7	kw
4	Spare's Cost		2,571	Repair Cost x 1/5
	Repair Cost/ecach Station		\12,857	\500,000*3/7(times)
5	Operation (Office supply) for Headquarter		30,177	
6	Operation (Office supply) for DGPS Station		4,311	
7	Flight Fare		Economy Class	
		1	2,049,600	Makassar
		2	1,626,400	Benoa
8	Percel			
	100 gram or less			Actual Rate
	Jawa Island		15,000	8,000
	Other destination		15,000	20,000
	100～500 (DHL)			
	Jawa Island		200,000	
	Other destination		200,000	
	500～1kg (DHL)			
	Jawa Island		200,000	
	Other destination		200,000	
9	Documentation			
	10 page or less		7,000	
	50 page or less		15,000	
	100 page or less		25,000	
10	Reports			
	10 page or less		4	times/ month
	50 page or less		1	time/ month
	100 page or less		0.25	times/ month
11	Replacement Cost		\84,610	
	Battery for PC		\60,000	/ station
	Lifetime		\6	Year
	Personal Computer		\800,000	/ station
	Lifetime		\8	Year

Table 15.2 Estimated Cost for Operation and Maintenance per Year for three (3) DGPS Stations & DGPS Managing Group

1. Operation and Maintenance Cost for DGPS Stations
(3 DGPS Station and DGPS Managing Group) Unit: Rp 1000

Item	Contents	Details	Total Cost	Cost/ Station	
Travelling Cost	2 times from HQ to DGPS Station		10,752		
	•Flight Fare	2 times of R/T	7,352	7,352	(Economy Class x R/T)
	•Accomodation	5 days / time	3,400	170	(170 x 5days x 3 stations x 2 times)
Operation and Maintenance Cost			166,503		
	•Commercial Power	4kw, 3 stations	31,740	10,580	
	•Repair Cost	2 times	38,571	12,857	(2 times Repair for 3 Stations :JPY1,5000,000)
	•Spare's Cost	Repair Cost x 1/5	7,714	1,102	
	•Communication Cost	5 minutes x 3 stations	19,984	6,661	Communication at night)
	•Replacement Cost	PC + Battery	25,384	8,461	(Replacement ofPC(8 years)&BATT for PC(6 years)
	•Operation Cost at Office		43,110		
	(Station)	Weekly, Monthly, Quarterly	12,933	4,311	Reporting and documentation)
	(Headquarter)	Weekly, Monthly, Quarterly	30,177	30,177	Data collecting, Reporting, etc.)
Total			177,255		

2. Personnel Expense Unit: Rp 1000

Item	Contents	Details	Total Cost	Cost/ Station
Personnel Expense			88,800	
	Headquarter		52,800	
		Staff x 4	38,400	9,600
		Head x 1	14,400	14,400
	DGPS Station	Technician x 2	36,000	12,000

3. Total US$26,606

Note:
Total (US$26,606) is converted from Rp213,255,000 (=Total of 1. + Total of 2.).

Exchange Rate:
US$1=\130
US$1=Rp10000

16.Economic Analysis

16.1. Purpose

To utilize effective use of limited resource (human resources, commodities, currency), cost benefit analysis should be implemented quantitatively and qualitatively. The cost benefit analysis should be implemented quantitatively as far as possible on the viewpoint of effective utilization of resources. The items, which cannot be converted into currency, should be expressed by qualitatively.

16.2. Specification of DGPS

DGPS stations (3 stations) and related facilities should be established.

16.3. Evaluation Periods of Projects

The evaluation periods of projects should be normally the same as the loan reimbursement periods. In case of ODA loans, loan period is 30 years, grace period of the principal is 10 years.

(1) The periods for analysis

The periods of analysis is basically settled on termination of year for use.

(2) Termination year for use

Termination year for use of the project is 15 years.

16.4. Approach and Methodology of the Economic Analysis

The approach and methodology of the economic analysis should be implemented quantitatively as far as possible, however, the items, which cannot be converted into currency, should be expressed by qualitatively.

With case means the estimation of decrease effects of vessel's collisions by the projects, without case means zero effects without the projects.

① Qualitative analysis

The benefits of DGPS are the decrease of Vessel's collisions and that of going aground. They are depending on the accuracy of vessel's position. Generally they say the accuracy of DGPS is 1 meter and that of GPS is 10meters. According to the measurement of GPS by the study team, the accuracy of GPS was 10.5 meters (95% Cumulative Probability). However, in the range of normal navigation, it is very difficult to evaluate the difference of the accuracy, which has a range among 1 meter and 10.5 meters in normal navigation. Because even if small vessels, master of the vessel expect the error of ships position more than 10.5 meters. Therefore estimation of quantitative benefits for GPS is almost impossible in the range of this study.

But attention have to be paid following.

Some tanker berth in Japan, it was utilized as measuring of tanker approaching speed to her berth, because tanker-approaching speed to her berth

is extremely limited. Therefore in Indonesia, with increase of import of crude oil, it may be utilized same way.

17.Financial Analysis

17.1. Purpose

The projects under review have expected light dues. On the point of GOI, capability of these projects shall be analyzed. Purpose of this Study is as follows;

(1) Profitability of this project

(2) By implementing this project, is a sound financing of GOI maintained?

(3) To implement the project, suggest suitable measures from the financial angle.

17.2. Current financial situation of GOI

According to The Budgeted Government revenues and Expenditures, Primary balance shows -28,969 Billion Rupiahs in 1999/2000, 10,490 Billion Rupiahs in 2000, 24,020 Billion Rupiahs in 2001. Overall balance shows -83,495 Billion Rupiahs in 1999/2000, -44,134 Billion Rupiahs in 2000, and -52,529 Billion Rupiahs in 2001. It was shown in **Table 17.1**. Primary balance improves gradually but overall balance is always deficit and domestic financing and foreign financing have covered deficit.

Table 17.1. The Budgeted Government Revenue and Expenditures

Unit: Billion Rupiah

	1999/ 2000[1)]	2000 [2)]	2001 [3)]
Revenue and Grants	129,204	152,896	263,227
Domestic Revenue	129,204	152,896	263,227
Tax Revenue	99,481	101,437	179,892
Domestic Tax	93,936	95,538	169,520
International Trade Tax	5,545	5,899	10,372
Non Tax Revenue	29,723	51,459	83,335
Natural Resource Revenue	18,120	40,082	64,458
Profit Transfer from SOE's	4,000	5,281	10,500
Other Non Tax Revenue	7,603	6,096	8,377
Grants	0	0	0
Expenditure	212,699	197,030	315,756
Central Government Expenditure	177,072	163,508	234,079
Current Expenditure	131,454	137,311	190,092
Development Expenditure	45,618	26,197	43,987
Program Aid in Rupiah	15,618	10,167	21,722
Project Aid	30,000	16,030	22,265
Balance Funds	35,627	33,522	81,677
Revenue Sharing	2,902	2,593	20,259
Central Allocation Funds	32,725	30,929	60,517
Special Allocation Funds	0	0	901
Primary Balance	-28,969	10,490	24,020
Overall Balance	-83,495	-44,134	-52,529
Financing Net	83,495	44,134	52,529
Domestic Financing	30,000	25,400	33,500
Domestic Bank Financing	0	0	33,500
Domestic Non Bank Financing	30,000	25,400	0
Foreign Financing	53,495	18,734	19,029
Gross Drawing	77,400	27,330	35,992
Amortizations	-23,905	-8,596	-16,963

Note: 1) April 1999 - March 2000
2) April – December 2000
3) January - December 2001

Source: Ministry of Finance

17.3. Total amount of investment

Total amount of investment is estimated in **Table 17.2.**

Table 17.2. Total Amount of Investment for DGPS

Unit: Thousand US$

Items	Foreign Cost	Local Cost	Total
DGPS	5,232	416	5,648

17.4. Raising funds for investment

Soft loans from foreign banks should be considered for raising funds for investment. Examples of terms and conditions for repayment of soft loans from foreign banks are shown in **Table 17.3.**

Table 17.3. Soft Loans from Foreign Banks

	Interest	Loan Period	Grace Period	Notes
A Bank	0.75 %	40 Years	10 Years	56 % of total amount of loan
	6.47 %	10 Years	During construction	44 % of total amount of loan
B Bank	3.47 %	18 Years	7 Years	
C Bank	3.5 %	17 Years	3 Years	
D Bank	5.88 %	10 years	—	0.6 % should be added to interest.
ODA Loan	1.8 %	30 Years	10 Years	Loan is limited 85 % of total amount of investment.

In the meantime, terms and conditions of repayment for market rate are that interest rate is 6 % and loan period is 10 years.

The hypothetical terms and conditions the study team has implemented are to use official development plan (ODA) and market rate. ODA can be broadly divided into bilateral ODA and multilateral ODA. Bilateral ODA consist of bilateral grants and ODA loan. In this case, ODA loan that is the best terms and conditions among soft loans should be used.

The principal terms and conditions for ODA loan are as follows;

(1) 15% of total amount of investments (foreign cost + local cost) should be paid from funds of GOI as a down payment.
(2) 85% of total amount of investments (foreign cost + local cost) should be

loaned to GOI.

(3) Loan period is 30 years, grace period of the principal is 10 years and interest rate is 1.8%.

17.5. Calculation for revenue

Light dues shall be applied to civil works, facilities, machineries, consulting services and other project needs including operating costs, maintenance costs. According to Communication Bureau of BAPPENAS, 50 % of light dues would be used for aids to navigation, supporting facilities and maritime telecommunication.

Total amount of light dues are shown in **Table 17.4**.

Table 17.4. Forecast of Light Dues

Units: US$

	Likeliest Case	Optimistic case	Pessimistic case
2001	13,094,871	13,094,871	13,094,871
2002	13,994,919	14,299,280	13,693,165
2003	15,175,099	15,840,522	14,529,724
2004	16,457,496	17,552,026	15,418,950
2005	17,851,062	19,452,916	16,364,140
2006	19,365,604	21,564,506	17,368,926
2007	21,011,787	23,910,529	18,437,133
2008	22,801,228	26,517,322	19,572,836
2009	24,746,609	29,414,371	20,780,317
2010	26,861,736	32,634,381	22,064,230
2011	28,511,141	35,219,045	23,028,102
2012	30,262,043	38,008,812	24,034,193
2013	32,120,739	41,019,967	25,084,356
2014	34,093,864	44,270,169	26,180,527
2015	36,188,427	47,778,381	27,324,760
2016	38,411,972	51,565,123	28,519,104
2017	40,772,431	55,652,583	29,765,799
2018	43,278,280	60,064,632	31,067,147
2019	45,938,441	64,827,119	32,425,552
2020	48,762,475	69,967,924	33,843,512

17.6. Consideration for Initial cost and operating cost

To examine the feasibility of the project, consideration for FIRR should be implemented. The initial costs, operating costs and maintenance costs and necessary light dues are shown in **Table 17.5.**

Necessary light dues to achieve 1.8% of FIRR (GDP: Likeliest Case) are 1.64 % of light dues. Necessary funds and light dues (GDP: Likeliest Case) are summarized in **Table 17.6**.

Table 17.5. Financial Analysis for DGPS

Units: Million US$

period	No	Year	TTL Cost (DGPS)							Revenue					
			Civil	Consultant	Initial Cost Total	Operating & Maintenance	Grand Total	Funds (Initial Cost) 15%	Grand Total-Funds	GDP: Likeliest Case		GDP: Optimistic Case		GDP: Pessimistic Case	
										Light Dues		Light Dues		Light Dues	
			1	2	3=1+2	4	5=3+4	6=3 x 0.15	7=5-6	8	9=8-7	10	11=10-7	12	13=12-7
	1	2000													
	2	2001													
	3	2002													
	4	2003								0.249	0.249	0.260	0.260	0.239	0.239
	5	2004								0.271	0.271	0.289	0.289	0.253	0.253
	6	2005								0.293	0.293	0.320	0.320	0.269	0.269
	7	2006		0.161	0.161		0.161	0.024	0.137	0.318	0.182	0.355	0.218	0.286	0.149
1	8	2007	4.681	0.121	4.801		4.801	0.720	4.081	0.345	-3.736	0.393	-3.688	0.303	-3.778
2	9	2008	0.565	0.121	0.686		0.686	0.10288	0.583	0.375	-0.208	0.436	-0.147	0.322	-0.261
3	10	2009				0.027	0.027		0.027	0.407	0.380	0.484	0.457	0.342	0.315
4	11	2010				0.027	0.027		0.027	0.442	0.415	0.536	0.510	0.363	0.336
5	12	2011				0.027	0.027		0.027	0.469	0.442	0.579	0.552	0.379	0.352
6	13	2012				0.027	0.027		0.027	0.497	0.471	0.625	0.598	0.395	0.369
7	14	2013				0.027	0.027		0.027	0.528	0.502	0.674	0.648	0.412	0.386
8	15	2014				0.027	0.027		0.027	0.560	0.534	0.728	0.701	0.430	0.404
9	16	2015				0.027	0.027		0.027	0.595	0.568	0.785	0.759	0.449	0.423
10	17	2016				0.027	0.027		0.027	0.631	0.605	0.848	0.821	0.469	0.442
11	18	2017				0.027	0.027		0.027	0.670	0.644	0.915	0.888	0.489	0.463
12	19	2018				0.027	0.027		0.027	0.711	0.685	0.987	0.961	0.511	0.484
13	20	2019				0.027	0.027		0.027	0.755	0.729	1.066	1.039	0.533	0.507
14	21	2020				0.027	0.027		0.027	0.802	0.775	1.150	1.124	0.556	0.530
15	22	2021				0.187	0.187		0.187	0.851	0.664	1.241	1.054	0.581	0.394
16	23	2022				4.828	4.828		4.828	0.903	-3.925	1.340	-3.488	0.606	-4.222
17	24	2023				0.712	0.712		0.712	0.959	0.246	1.446	0.734	0.633	-0.080
18	25	2024				0.027	0.027		0.027	1.018	0.991	1.561	1.534	0.660	0.634
19	26	2025				0.027	0.027		0.027	1.080	1.054	1.685	1.658	0.689	0.663
20	27	2026				0.027	0.027		0.027	1.147	1.120	1.819	1.792	0.719	0.693
21	28	2027				0.027	0.027		0.027	1.217	1.191	1.963	1.936	0.751	0.724
22	29	2028				0.027	0.027		0.027	1.292	1.266	2.119	2.092	0.784	0.757
23	30	2029				0.027	0.027		0.027	1.372	1.345	2.287	2.260	0.818	0.791
24	31	2030				0.027	0.027		0.027	1.456	1.430	2.469	2.442	0.854	0.827
25	32	2031				0.027	0.027		0.027	1.546	1.519	2.665	2.638	0.891	0.865
26	33	2032				0.027	0.027		0.027	1.641	1.615	2.876	2.850	0.930	0.904
27	34	2033				0.027	0.027		0.027	1.742	1.716	3.105	3.078	0.971	0.944
28	35	2034				0.027	0.027		0.027	1.849	1.823	3.351	3.325	1.013	0.987
29	36	2035				0.027	0.027		0.027	1.963	1.937	3.618	3.591	1.058	1.031
30	37	2036				0.027	0.027		0.027	2.084	2.058	3.905	3.879	1.104	1.078
			5.246	0.402	5.648	6.390	12.038	0.847	11.191	31.042	19.851	48.879	37.688	20.062	8.871
						FIRR					1.80%		4.01%		-0.66%

Table 17.6. Summary of Necessary Funds and Light Dues (Likeliest Case)

Units: Million US$

	Loan	Necessary Funds of GOI	Total Initial Costs	Necessary Light Dues
	1	2	3=1+ 2	
DGPS	4,801	0.847	5.648	1.64%

17.7. Sensitive Analysis

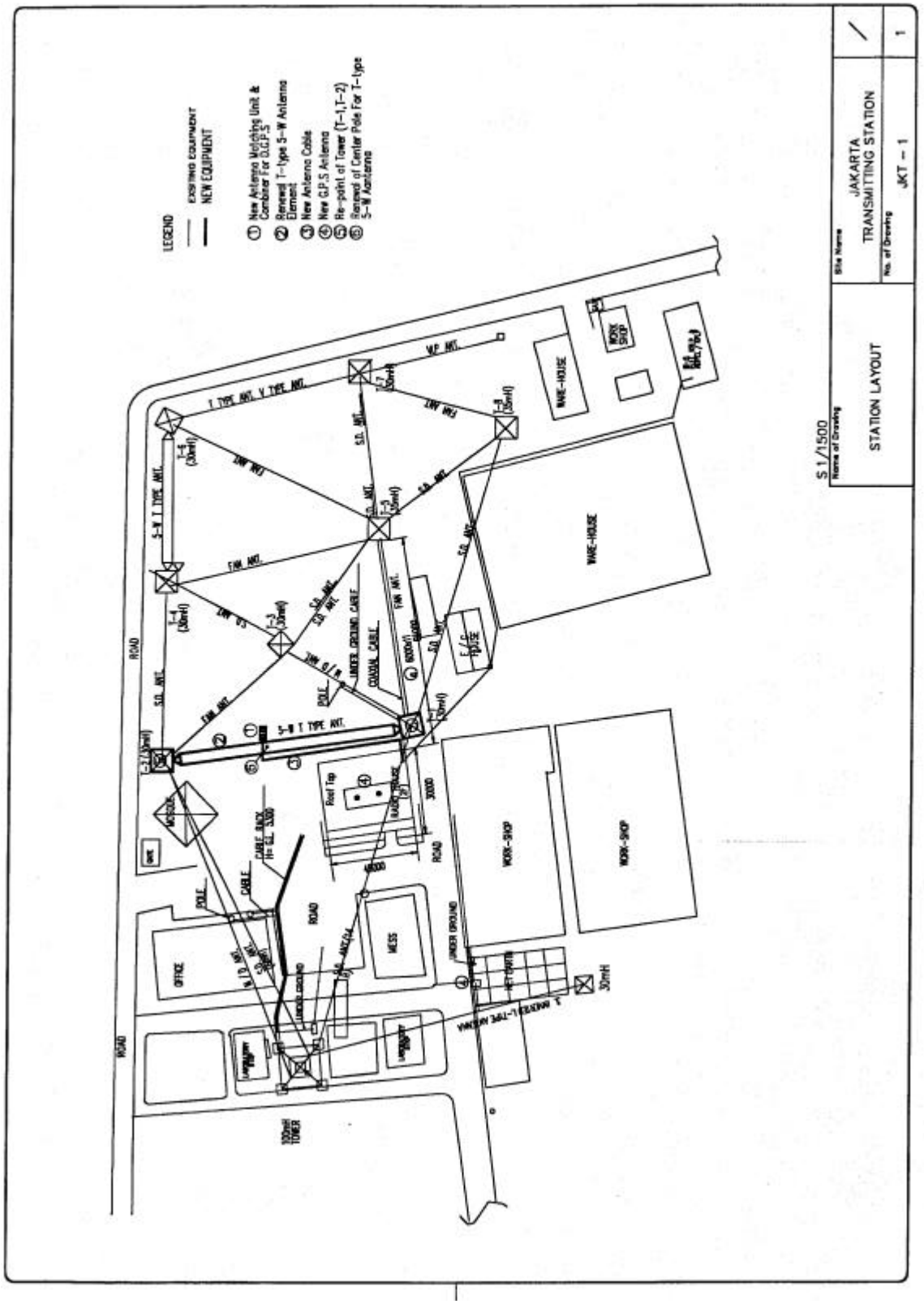
Sensitive analysis should be implemented among three GDP cases. To implement DGPS, necessary light dues are 1.64% in likeliest case, 1.10% in optimistic case, and 2.41% in pessimistic case. It is shown in **Table 17.7.**

Table 17.7. Sensitive Analysis

	Necessary Light Dues		
	GDP: Likeliest Case	GDP:Optimistic Case	GDP: Pessimistic Case
DGPS	1.64%	1.10%	2.41%

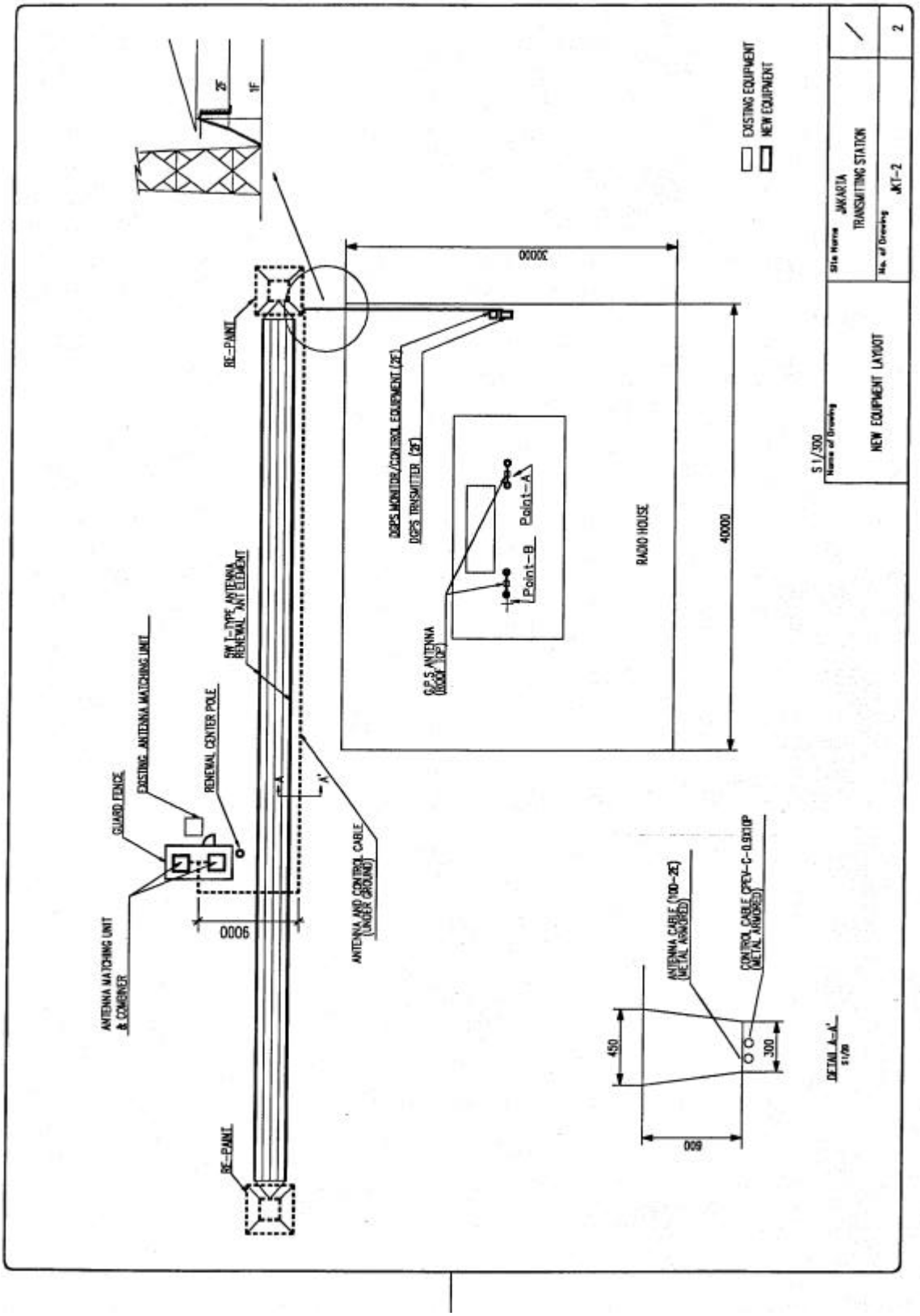
Appendix 11.1

Site Layout of Jakarta DGPS Station



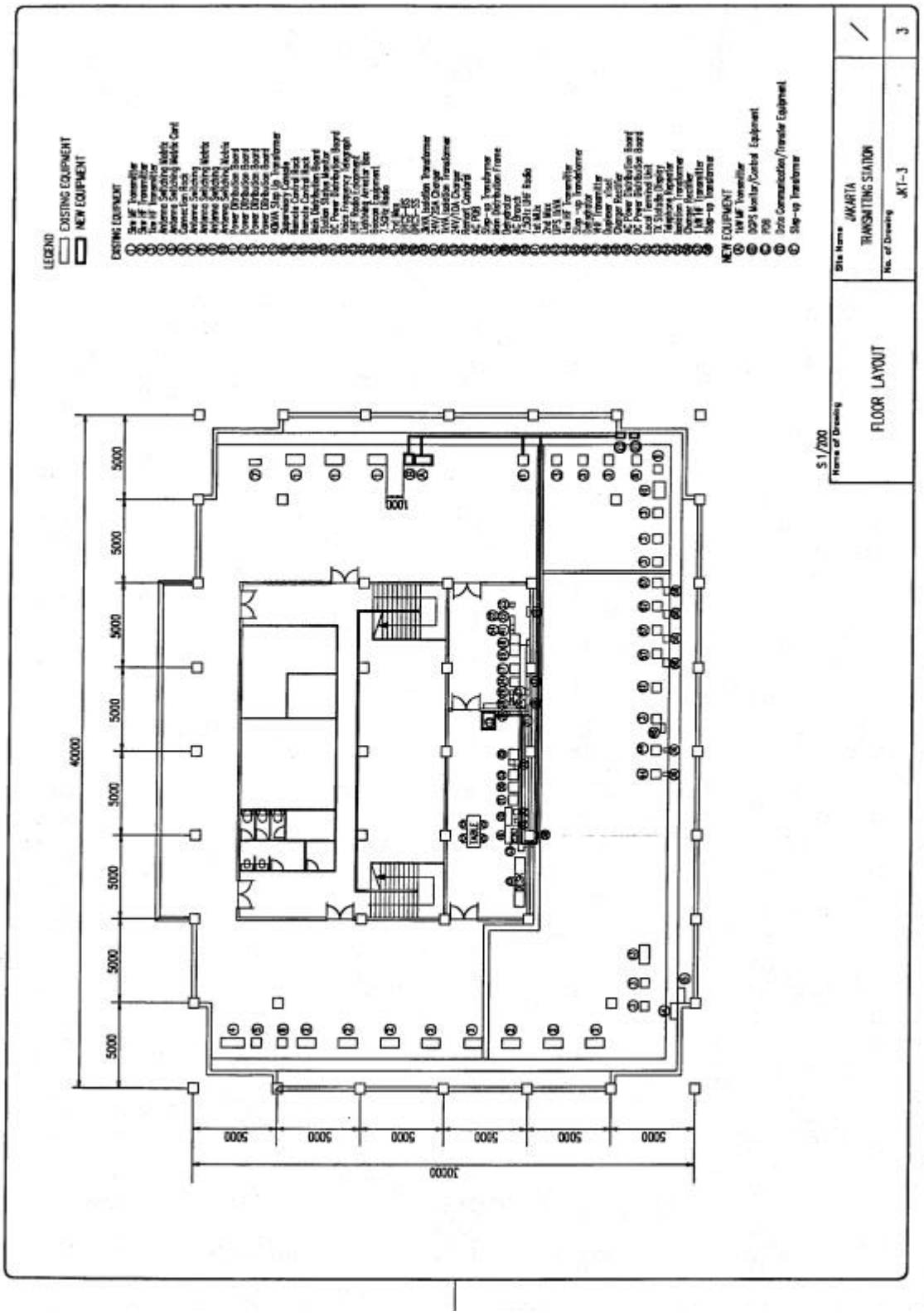
Appendix 11.2

New Equipment Layout of Jakarta DGPS Station



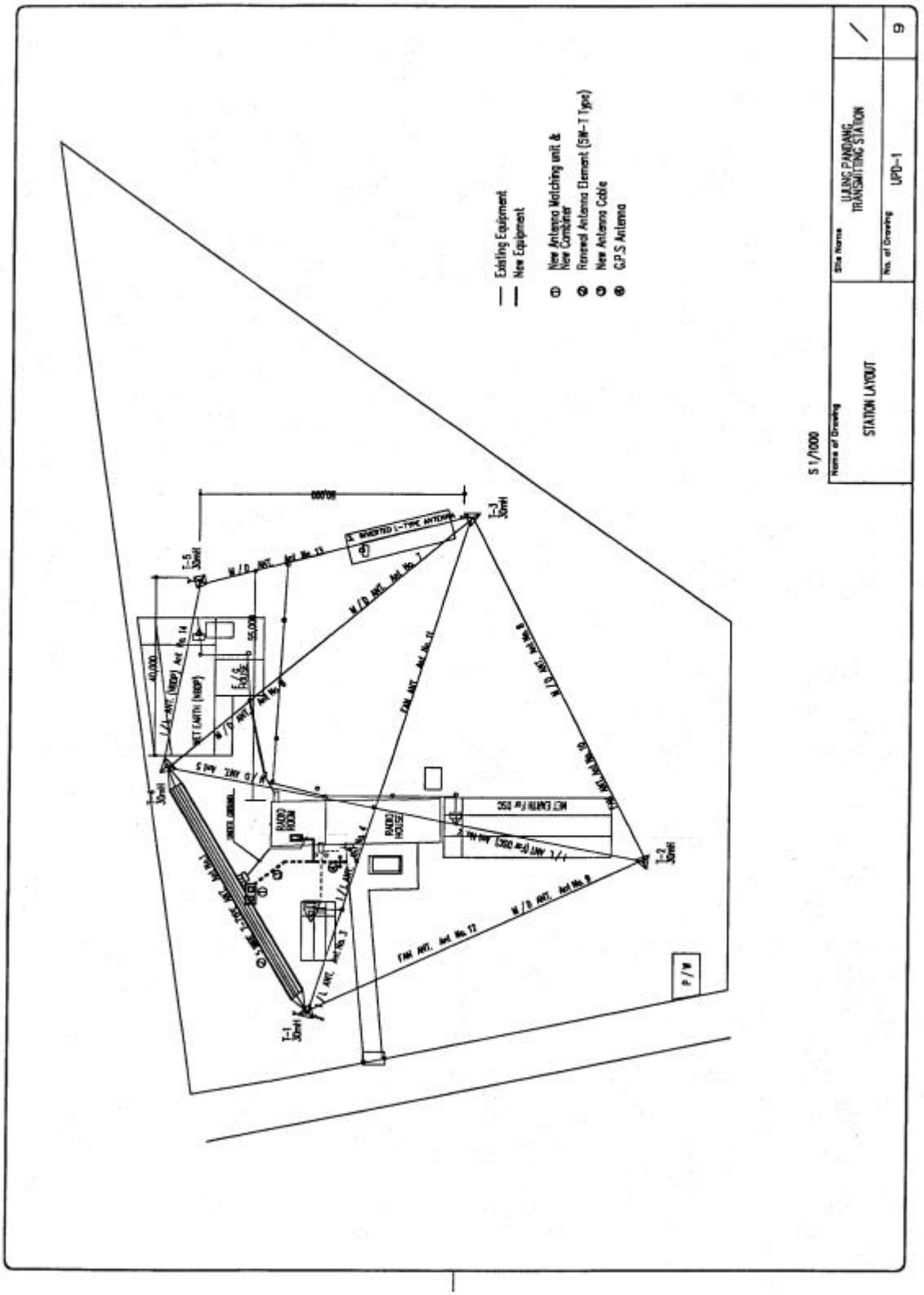
Appendix 11.3

Floor Layout of Jakarta DGPS Station



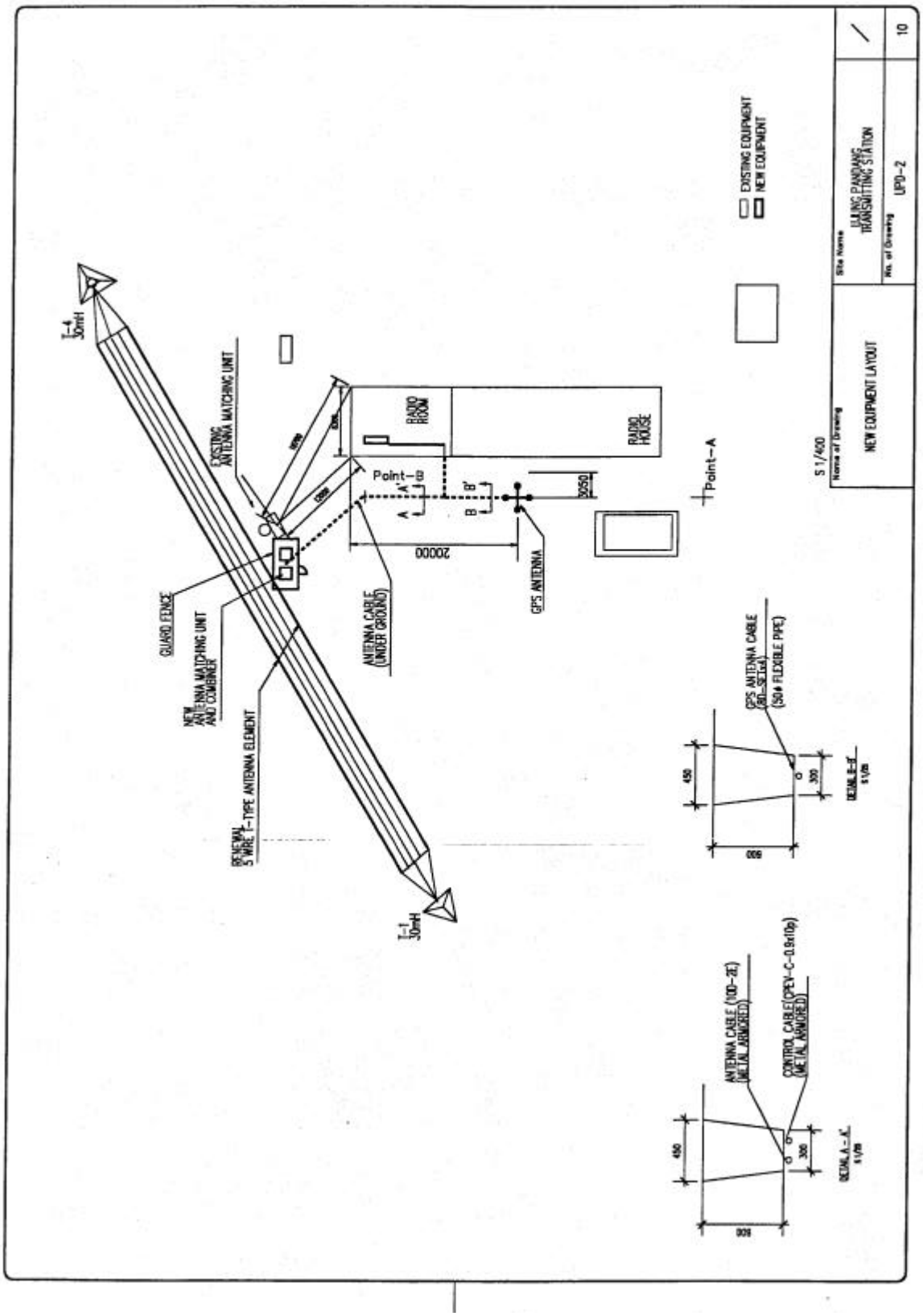
Appendix 11.4

Site Layout of Makassar DGPS Station



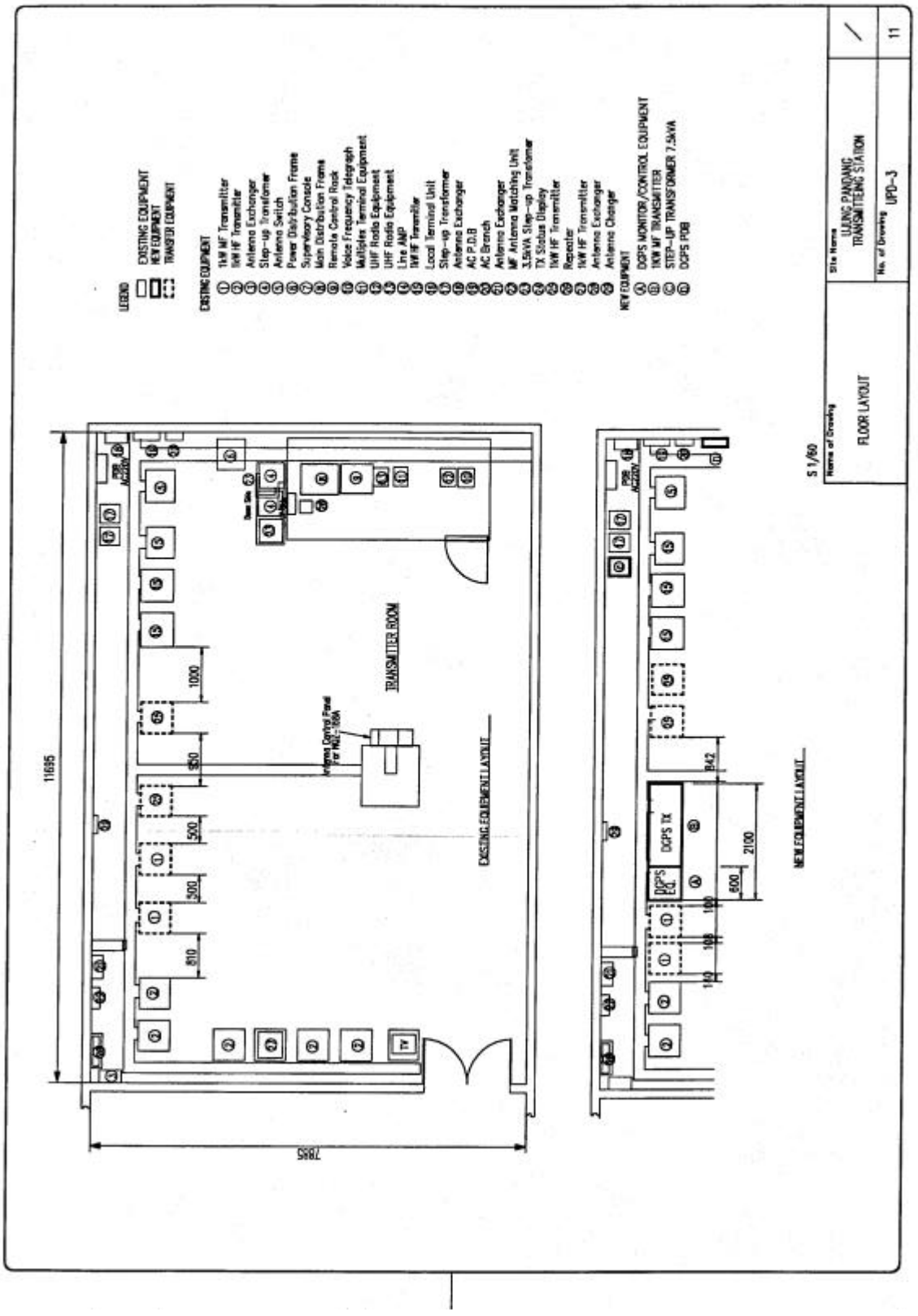
Appendix 11.5

New Equipment Layout of Makassar DGPS Station



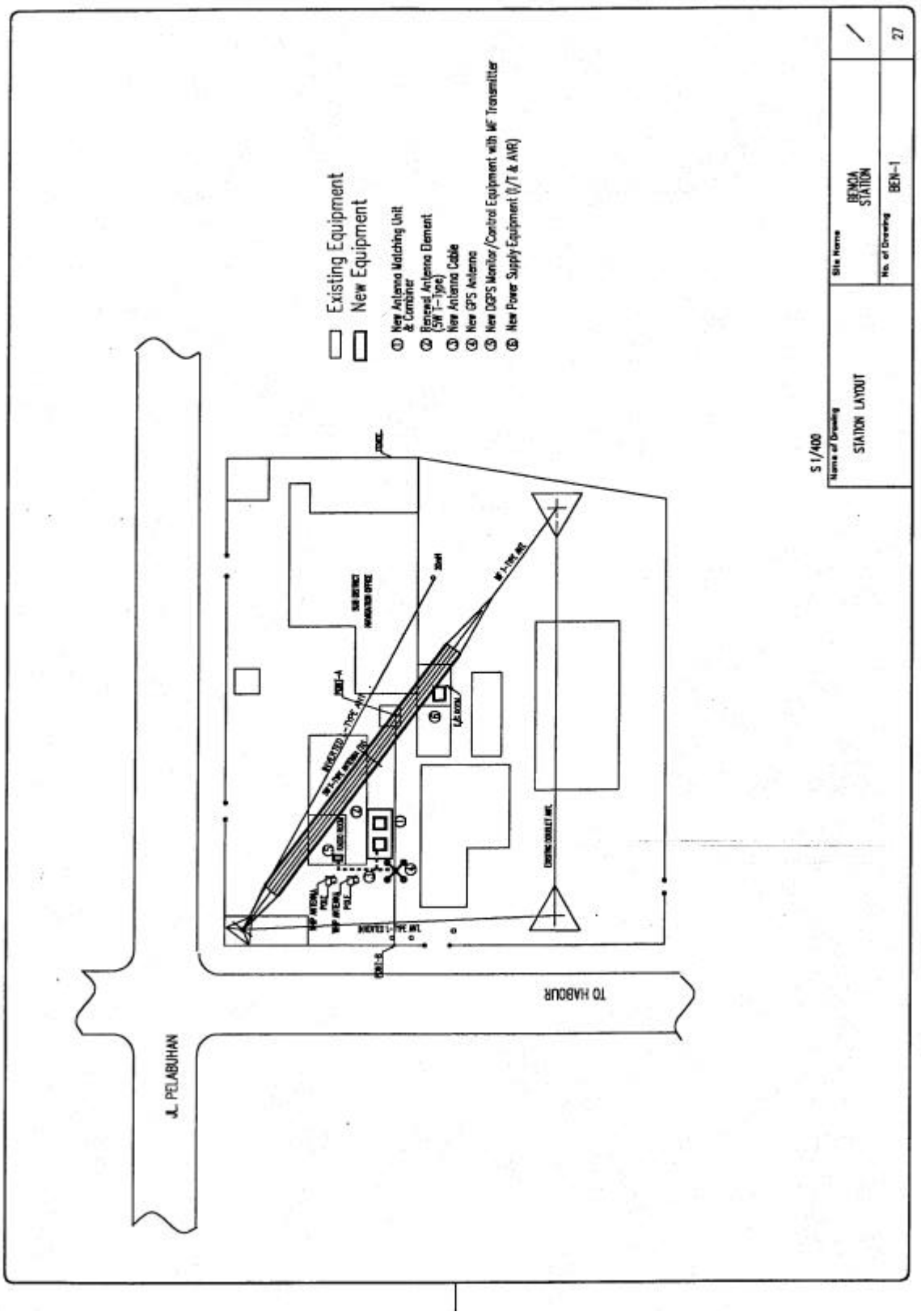
Appendix 11.6

Floor Layout of Makassar DGPS Station



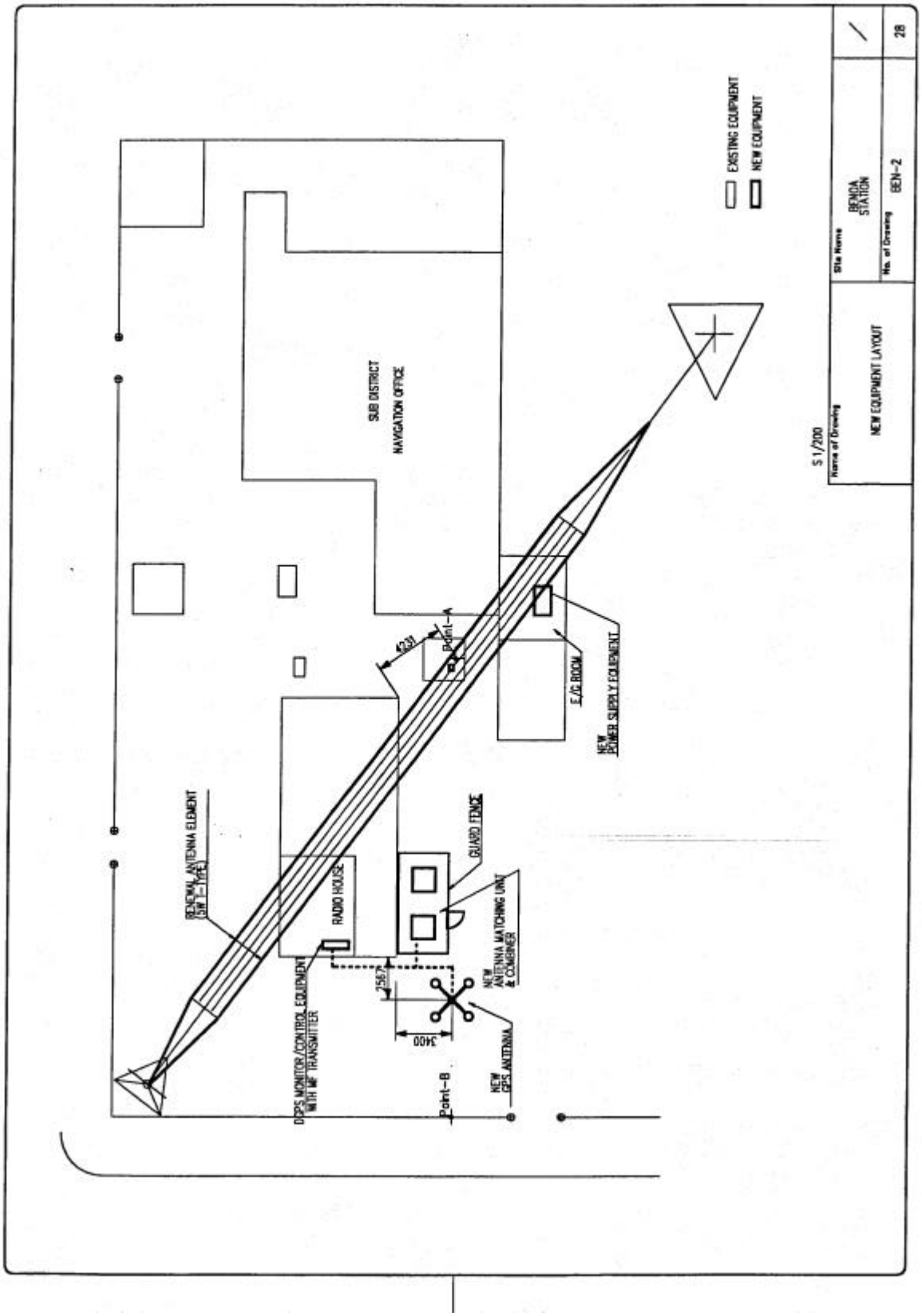
Appendix 11.7

Site Layout of Benoa DGPS Station



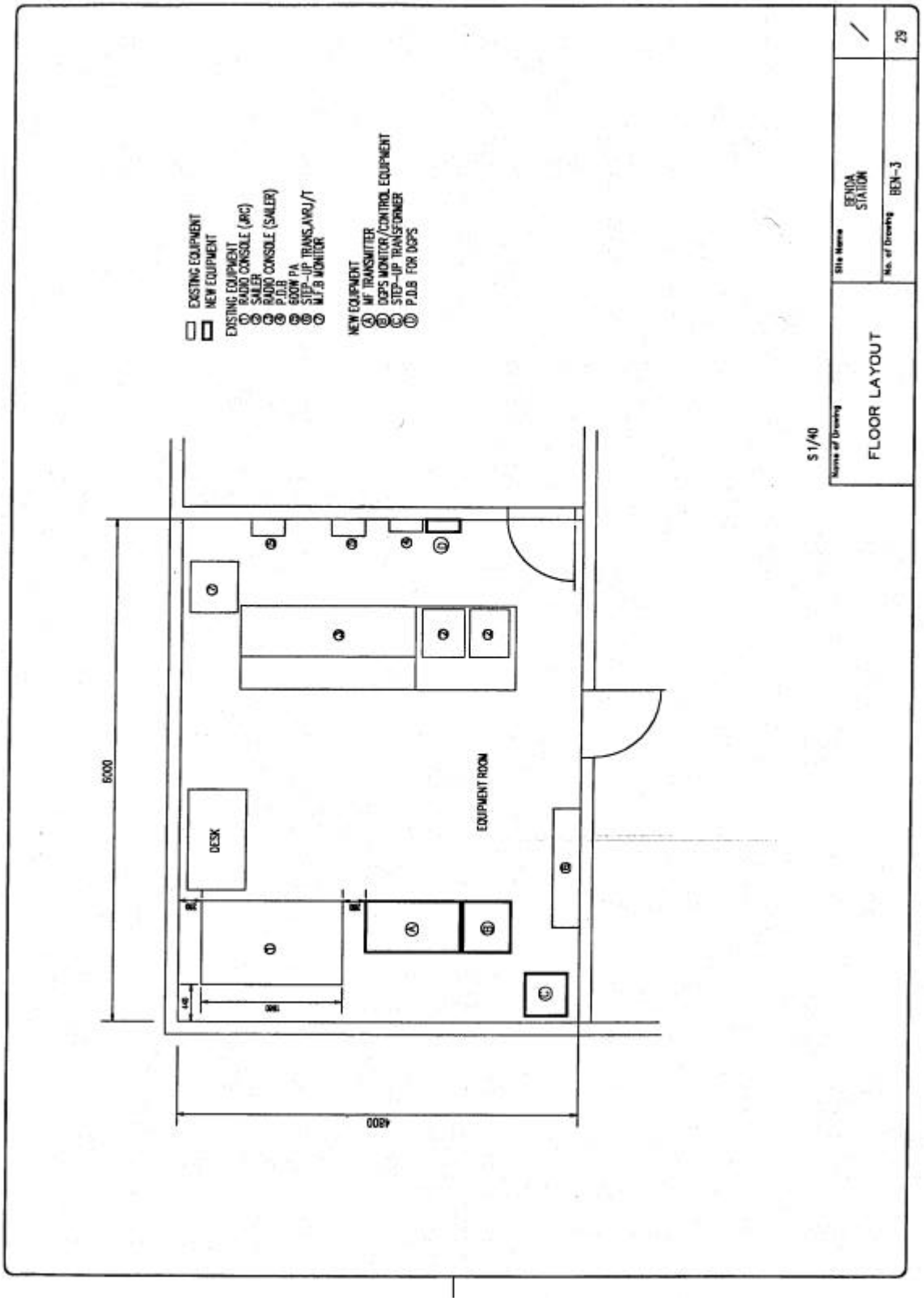
Appendix 11.8

New Equipment Layout of Benoa DGPS Station

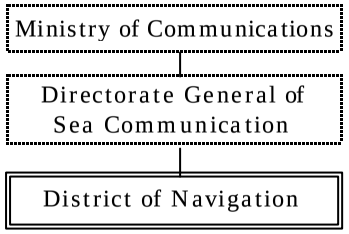


Appendix 11.9

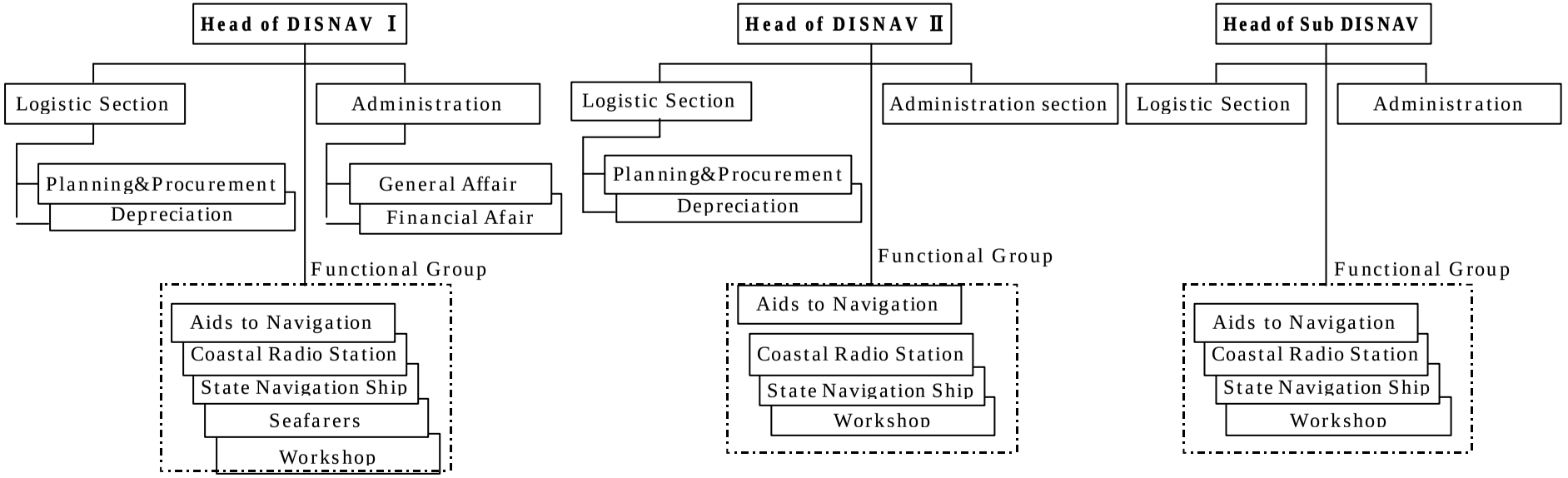
Floor Layout of Benoa DGPS Station



Appendix 12.1.
Organization Chart of District of Navigations (DISNAV/ Sub DISNAV)



- First Class District of Navigation Offices(DISNAV Ⅰ)
- Second Class District of Navigation Offices(DISNAV Ⅱ)
- Sub-District of Navigation Offices(Sub DISNAV)



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