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 I

PART 1. : VISUAL AIDS TO NAVIGATION INCLUDING SUPPORTING FACILITIES

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

(based on the approximate mean rates during February 2002)

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.

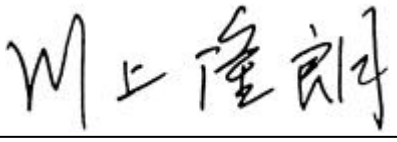
JICA selected and dispatched a study team headed by Mr. Kunio Tashima (until September 4th 2001) of The Japan Association of Marine Safety (JAMS) and Mr. Shingo Tsuda (from September 5th 2001) of JAMS, to Indonesia, three times between April 2001 and March 2002. In addition, JICA set up an advisory committee 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

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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	Candela
	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
	E/N	Exchange of Note
F	FC	Cast Iron
	FCD	Ductile Cast Iron
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
	GL	Ground Level
	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
	GRP	Glass Reinforced Plastic
	Gs.	Gosong (Sandbar)
	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
	Iso.	Isolated danger
	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
	JCG	Japan Coast Guard
	JICA	Japan International Cooperation Agency
K	KANPEL	Kantor Pelabuhan (Port Office)
	KANWIL	District Office of Ministry of Communication
	KfW	Deutsche (German) Bank of Reconstruction
	Kr.	Karang (Coral, Coral reef or Atoll)
L	L/A	Loan Agreement
	lat. or Lat.	Latitude
	LB	Light Beacon
	LED	Light Emitting Diode
	LH	Lighthouse
	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
	MIL	Military Specifications and Standards
	MOC	Ministry of Communications
	MSC	Maritime Safety Committee
	MOF	Ministry of Finance
	MP	Master Plan
N	NA	Not Applicable
	NAVAREA	World-wide Navigation Warning Service Area
	NAVIGASI	Directorate of Navigation
	NAVTEX	Navigation Telex
	NBDP	Narrow Band Direct Printing
	NM or n.m.	Nautical Mile
O	OJT	On the Job Training
	ODA	Official Development Assistamce

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
	P/Q	Pre-qualification
	PROPENAS	National Development Program
	PT.	Perseroan Terbatas (Corporation)
R	RACON	Radar Beacon
	RC	Reinforced Concrete
	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
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	T	Transmission factor
	T/D	Tender Document(s)
	TEU	Twenty Foot Equivalent of Unit
	TG	Telegraph
	Tg. or 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	V.ATN	Visual Aids to Navigation
	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
	2drm	2 distance-root-mean-squares

1. Introduction

The Republic of Indonesia is an archipelagic country, consists of about 17,000 islands, which 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 waters 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 waters, 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 areas, by transporting commodities, materials, fuels, and people.

For the development of Indonesian economy and human life, marine transportation holds 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 (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, and one of the most important and fundamental countermeasures is visual ATN. It will reduce the possibility of marine casualties.

And also, the proper supporting facilities are required to operate those visual ATN with high reliability and availability.

2. Background of the Project

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. The come 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.

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

In response to the request of GOI, Government of Japan (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 (DGSC) and JICA.

The Japan Association of Marine Safety (JAMS) and Japan Aids to Navigation Association (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 waters 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. Maritime Activities in Indonesia and related study

3.1. 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.

The 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 subsidies 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.

3.2. Ocean Environment

3.2.1. Geographical and Topographical Conditions

(1) Seabed

① Southeast part of Malacca Strait

The southeast half of Malacca Strait is generally less than 50m in depth. Strong currents occur on the bottom of the narrowest part, causing large uniform sand waves to form at right angles to the current flow.

② Northwest part of Malacca Strait

In the northwest approach to Malacca Strait, the depths increase generally to the depth of 100m contours, and sand predominates before the continental slope to the Andaman Sea.

Beyond the shelf edge, the bottom is mainly mud with isolated patch of sand.

At the west of Dreadnought Bank, the bottom falls away steeply, reaching depths over 3800m in the channel between Sumatra and Great Nicobar Island.

③ Southwest coast of Sumatra

The southwest coast of Sumatra and outlying islands have shallow coral fringes, beyond which depths increase rapidly. Between these islands and Sumatra, there are 3 elongated basins with depth from 500 to 1000m.

④ Sunda Shelf

Sunda Shelf is one of the largest shallow sea areas in the world.

At the west end of Selat Sunda, the edge of the shelf falls steeply towards the floor of the Indian Ocean.

⑤ North coast of Java

North coast of Java is most severely affected by deposits of alluvial sediments causing coastline extensions seawards.

⑥ South of Java and Nusatenggara

The zone of the fold mountains is bounded on the Indian Ocean side by a narrow zone comprising a double line of trenches running close and parallel with Java and Nusatenggara. The inner depression is known as the Lombok Basin, and the outer and deeper is known as the Sunda Trench (Java Trench), which contains the greatest known depth in the Indian Ocean, 7244m.

⑦ Java Sea

The typical depths in the Java Sea range from about 40m or less in the west part, and 30 to 75m in the east part, gradually taking a very gentle downward sloping seabed to the south limit of Selat Makasar where it drops nearly 550m and to even greater depths toward Selat Lombok in the south.

Bottom conditions of the Java Sea, and in the shallow water of Selat Makassar fronting the east coast of Kalimantan, are dominated by the processes of the shallow water disposition of river borne sediments, and of coral growth in those parts relatively remote from sources of sediment.

⑧ Southwest of Kalimantan

There are elongated sandbanks aligned with the direction of the tidal streams, with muddy channels between them.

⑨ Banda Sea

The Banda Sea is enclosed on its south side by a chain of active and extinct volcanoes forming the Inner Banda Arc. A series of deeps, culminating in the Weber Basin, 7439m deep, lies external and parallel to the volcanic chain.

A non-volcanic arc, known as the Outer Banda Arc, extends from Buru to Timor, as an enormous U-shaped chain.

(2) Sand waves

① Malacca Strait

On the bottom of the narrow part of the southeast half of Malacca Strait, strong current causes large sand waves to form at right angles to the current flow.

Their height is between 4 and 7m, and the lengths of their waves are between 250 and 450m. In addition, there are large long ridge running parallel with the direction of the tidal currents.

② Other areas

In the other areas, sand waves are particularly in evidence off the coastal bank of the south coast of Kalimantan, in Selat Kalimata, in the area leading from Java Sea into Selat Makassar, and in the shallower waters north of Pulau-pulau Kankean.

3.2.2. Current, Sea Level, Tide, Tidal Streams, Sea and Swell

(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.

(2) Sea level, tide and tidal streams

Followings are characteristics of the tides at each area. Further details are given in Admiralty Tide Tables.

① Sea level

Marked seasonal changes in weather, such as those which occur during monsoons, result in changes of sea level due to the effect of wind and/or barometric pressure.

② Tide

a. Malacca Strait

In Malacca strait, the tide is generally semi-diurnal with the diurnal component increasing towards the southeast end.

In Singapore Strait, the diurnal component starts to increase rapidly becoming a diurnal tide at about Tanjung Ayam on the north coast and Pulau Kapalajernih on the south coast.

The high water wave travels through Malacca Straight from northwest to southeast into Phillip Channel where it meets the diurnal wave from the South China Sea that has passed west through Singapore Strait.

The tidal range increases to a maximum of 3.7m at One Fathom Bank, then decreases to 1.9m at Gesong Rob Roy Bank, increases again to 2.6m at the level of Pulau Pisang and finally decreases again in Singapore Strait to 1.6m at Horsburgh Lighthouse.

b. Southweat coast of Sumatra

At Pulau Raya, the range is only 0.2m, to the southeast, the range increases, the range is 0.8m on the equator.

c. Selat Sunda

The tides in Selat Sunda and round the islands on the south side of Singapore Strait are semi-diurnal, the mean spring range in the former being not more than 1.0m, and in the latter about 1.5m at the east end, increasing to 3.0m at the west end.

d. North coast of Java

On the north coast of Java and in Selat Surabaya are predominantly diurnal, the main straits separating Java with Bali and Bali with the islands of Nusatenggara are all predominantly semi-diurnal, farther east there is a mixture in places but generally the tides are semi-diurnal.

The tidal range seldom exceeds 0.5m, and through Selat Surabaya 1.5m.

e. East coast of Sumatra

On the east coast of Sumatra and the coast of Pulau Banka and Pulau

Bilitung, the range is mostly between 1.0 and 1.5m, but it increase to over 2m at the outer bar of Sungai Palembang and off the coast north of Kuala Niur.

f. South and west coast of Kalimantan

On the south coast of Kalimantan, the range of the tide seldom exceeds 1.0m, whilst on its east coast the range may reach 2.5m, and 1.5m in the vicinity of Teluk Sukadana.

g. Nusatenggara

Around the islands of Nusatenggara the range seldom exceeds 1.5m.

h. Sulawesi

Throughout Sulawesi the range seldom exceeds 1m.

i. Irian Jaya

The greatest tidal ranges are to be found in Selat Marianne, where it is 5.4m, and at the head of Teluk Bintuni where it is 4.4m.

In the islands fringing Celebes Sea, the range is between 1.5 and 2m, almost elsewhere it is between 1 and 1.5m.

③ Tidal streams

a. Malacca Strait

The flow in Malacca Strait is considerably influenced by the prevailing northwest-going current which, in the main channel, has a rate of about 3/4 knot, but may vary considerably.

In the north part of Malacca Strait, the general directions of the tidal streams are : －0100 local HW Southeast-going at maximum rate.
－0100 local LW Northwest-going at maximum rate.

In the main fair way, the spring rates are about 1.5 knots, but in the more restricted channels and inshore waters, they may reach 2.5 to 3 knots.

At the south end of Malacca Strait, the streams set southeast and northwest to and from Selat Durian. They are not necessarily associated with any particular streams in Singapore Strait, and many meet or separate from the latter south of Tanjung Piai, the south extremity of Malaysia.

b. Sumatra, Java 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.

c. Java, Nusatenggara, Kalimantan and Sulawesi

Tidal streams in these areas have a strong diurnal inequality.

This is especially marked on the coast of Kalimantan and Java, 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 reaches 2.5m.

d. Halmahera and Irian Jaya

Within these areas, there is considerable diurnal inequality.

This is the least in the northwest, on the coasts of Halmahera and Sulawesi and the islands in Celebes Sea to the north, where despite the inequality, the tides are classified as semi-diurnal, and the greatest in the southeast where on the east coast of Pulau Pulau Aru and a stretch of the southwest coast of Irian Jaya, the tide is usually diurnal.

(3) Sea and swell

① Sea

a. Malacca Strait

Sea state is almost invariably smooth or slight in Malacca Strait. Squalls may raise moderate or rough seas for short periods.

In the N approaches to Malacca Strait and off the west coast of the south part of Sumatra, rough seas may be encountered from May to September on about 5 % of occasions.

b. Sumatra, Java and southwest Kalimantan

Sea waves are generated locally by the wind and can be very variable in direction, especially in the transitional months (April and late October to November) between the northwest and southwest monsoons.

Throughout the year, the height of the sea waves is frequently less than 1m. During the transitional months moderate or higher seas are reported on less than 3% of occasions. In January, moderate or higher seas are reported on around 10% to 14% of occasions in the extreme north and southeast of the area, and about 4% to 8% in central areas. During August, the figures are around 5% to 7% of occasions in the south and 3% to 5% in the north.

c. Java, Nusatenggara, Kalimantan and Sulawesi

Sea waves are generated locally by the wind and can be variable in direction during transitional months between late March and April and again between October and mid November. Off the east coast of

Kalimantan, seas of around 2m or over are relatively rare with a frequency of around 2% to 3% of occasions. Over the south part of Selebes Sea and the whole of the Molucca Sea , the frequency is around 5% to 10% during the northwest monsoon and 8% to 14% during the southeast monsoon.

During the height of the northwest monsoon, the frequency of 2m waves and over, in the central part of the Java, Flores and Banda Seas, decreases from around 14% of occasions in the west to 11% in the east, and during the southeast monsoon, it is usually less than 10% of occasions.

To the south of Java and Nusantenggara, in January, the frequency is 18% in the far southeast, and increasing to around 23% in central south areas, then decreasing to around 15% in the extreme southwest of the area.

The percentage figures during the height of the southeast monsoon are 15% in the extreme southeast of the area and then steadily increasing to around 45% to 50% in the extreme southwest of the area.

In the transitional months of March/April and October/November, the frequency is generally less but around 25% to 30% in the extreme southwest.

d. Halmahera and Irian Jaya

Seas from between east and south prevail over the area from about the end of May until late August or early September when the area is dominated by the southeast monsoon.

In the area north of about 5° S, the seas are from southeast to south, mostly slight to moderate but occasionally becoming rough. In the area south of 5° S, the east to southeast seas are often only slight to moderate but may be rough or very rough on up to 10% of occasions.

As the southeast monsoon weakens and recedes south to be followed by the northwest monsoon, seas from between northwest and northeast in response to this change of regime gradually extend south to most parts, reaching the south of the area by December. Wave heights are mainly moderate or slight but rough or very rough seas are not uncommon.

These seas from northwest to northeast continue through March and then the southeast monsoon spreads north again, sometimes preceded by a few weeks of less well-defined seas.

② Swell

a. Malacca Strait

Swell in Malacca Strait is normally negligible or slight, and only on

rare occasions a moderate swell develops, and there is no predominant direction.

Off the west coast of Sumatra, swell from between southeast and southwest is a regular feature. Swell height is normally less than 2m, but during the southwest monsoon, moderate swells from 2 to 4m develop.

b. Sumatra, Java and southwest Kalimantan

In the north of these areas in January, swells from between north and northeast are not common, although swells of 2m and over are only reported on about 5% to 8% of occasions.

In central areas, swells are most frequent from between north and northwest, and in the southeast of these areas from west-northwest. Swell heights of 2m and over are reported on around 5% to 10% of occasions in the south and southeast.

In August, swells of 2m high and over are reported on less than 2% of occasions in central and north areas, and on about 2% to 4% in the south and southeast.

The predominant direction of the swell is from east-southeast in the south of the area becoming south-southeast in the north.

c. Sumatra, Java and southwest Kalimantan

In the north of these areas, the swell is often low in January, and low in July, and in the Java, Flores and Banda Seas, low in January and July. To the south of Java and Nusatenggara in January, the swell is often low in the southwest of the area and low to moderate in the east of this area.

In July, the swell in the southwest of the area is frequently moderate from between south and east, and low from east-southeast in the extreme southeast of the area.

d. Halmahera and Irian Jaya

In the rare occasions when a tropical storm affects the area, the confused and steady swell from these storms affects the area.

The north shores exposed to the Pacific also experience considerable swell from December to February, during the northwest monsoon. Heavy swell accompanied by high seas is a hazard during these months, but conditions vary markedly according to the strength of the monsoon.

The extreme conditions can occur in straits and constricted channels, when favorable winds are funneled and thereby increased in strength.

3.3. Maritime Industry

3.3.1. 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).

3.3.2. 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 into the following four forms.

① Ocean Going Shipping

This Shipping may be thought to be about the same as the general idea of Ocean Going Shipping, but in case where a vessel turns around plural domestic ports, and finally arrives in a foreign country in the neighborhood like Singapore, it is not treated as Ocean Going Shipping. In statistics of Indonesia, such shipping is included in Inter-island Shipping.

② Inter-island Shipping

Inter-island Shipping may be thought to be about the same as the general idea of Coastal Shipping, but in case where a vessel turns around plural domestic ports, and finally arrives in a foreign country in the neighborhood like Singapore, it is not treated as Ocean Going Shipping. Such Shipping is included in Inter-island Shipping in statistics in Indonesia. And the shipping in the same island like from Jakarta to Surabaya is also included in Inter-island Shipping.

Inter-island Shipping including the following two shipping forms.

Traditional Shipping

Inter-island Shipping by small vessels less than 35GT

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 the transportation of passengers and living daily necessities to support developing islands where they were isolated in the remote places. 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 own vessels. An enterprise and so on operate the vessels. The typical example is PERTAMINA, which is a national oil enterprise and transports its petroleum by its oil tankers.

(3) Maritime Traffic Network

Coastal shipping in Indonesia is composed by Inter-island Shipping and Pioneer Shipping. Coastal shipping in Indonesia is a combination of these types of shipping, and transports domestic cargoes to each region in Indonesia.

Local ports in Indonesia are united in going directly from Jakarta ơ Surabaya..

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

3.4. Sea Lanes

Indonesia 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 3.4.1.** The daily marine through-traffic density in each sea lane and the Straits of Malacca and Singapore is also shown in **Table 3.4.1.**

Figure 3.4.1. Three Sea Lanes in Indonesia

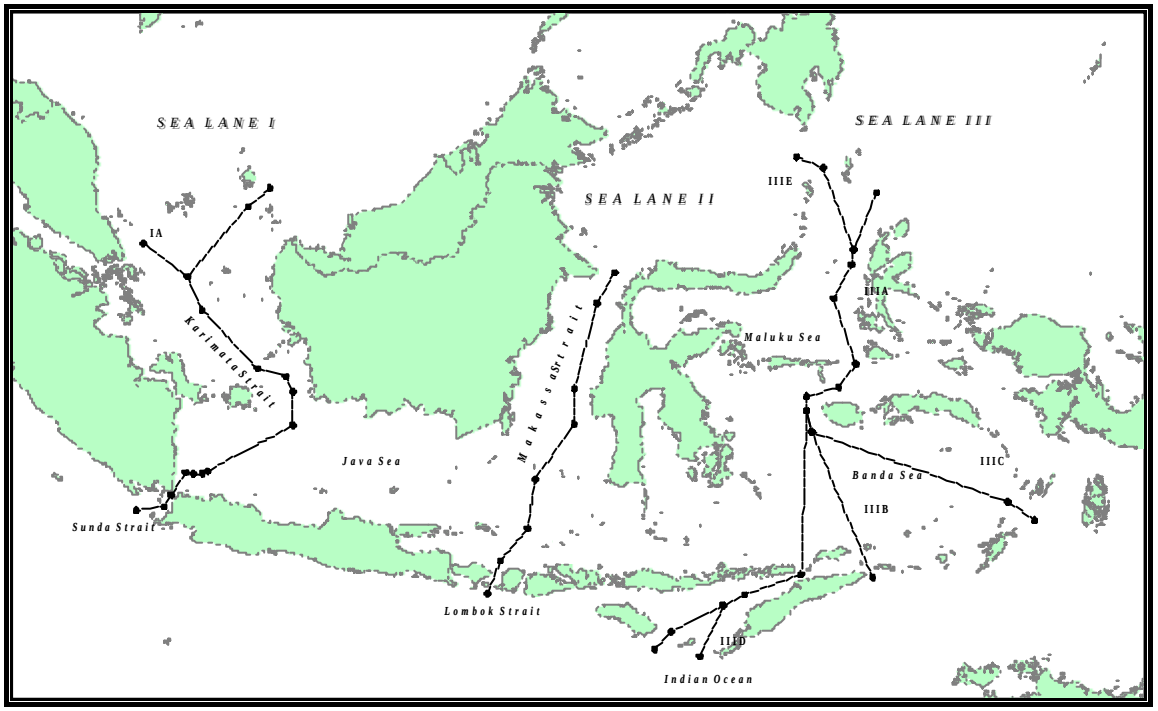


Table 3.4.1. Daily Through-Traffic Density in each Sea Lane

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**

3.5. Maritime Traffic Routes and Ports and Harbors

3.5.1. Traffic Routes

The traffic routes of ships are designated according to the types of ship. The designated traffic routes for tankers, passenger ships, container ships and pioneer ships are shown in **Figure 3.5.1.** to **Figure 3.5.4**. The traffic routes of general cargo ships are shown in **Figure 3.5.5**.

Figure 3.5.1. Traffic Routes of Tankers in Indonesia

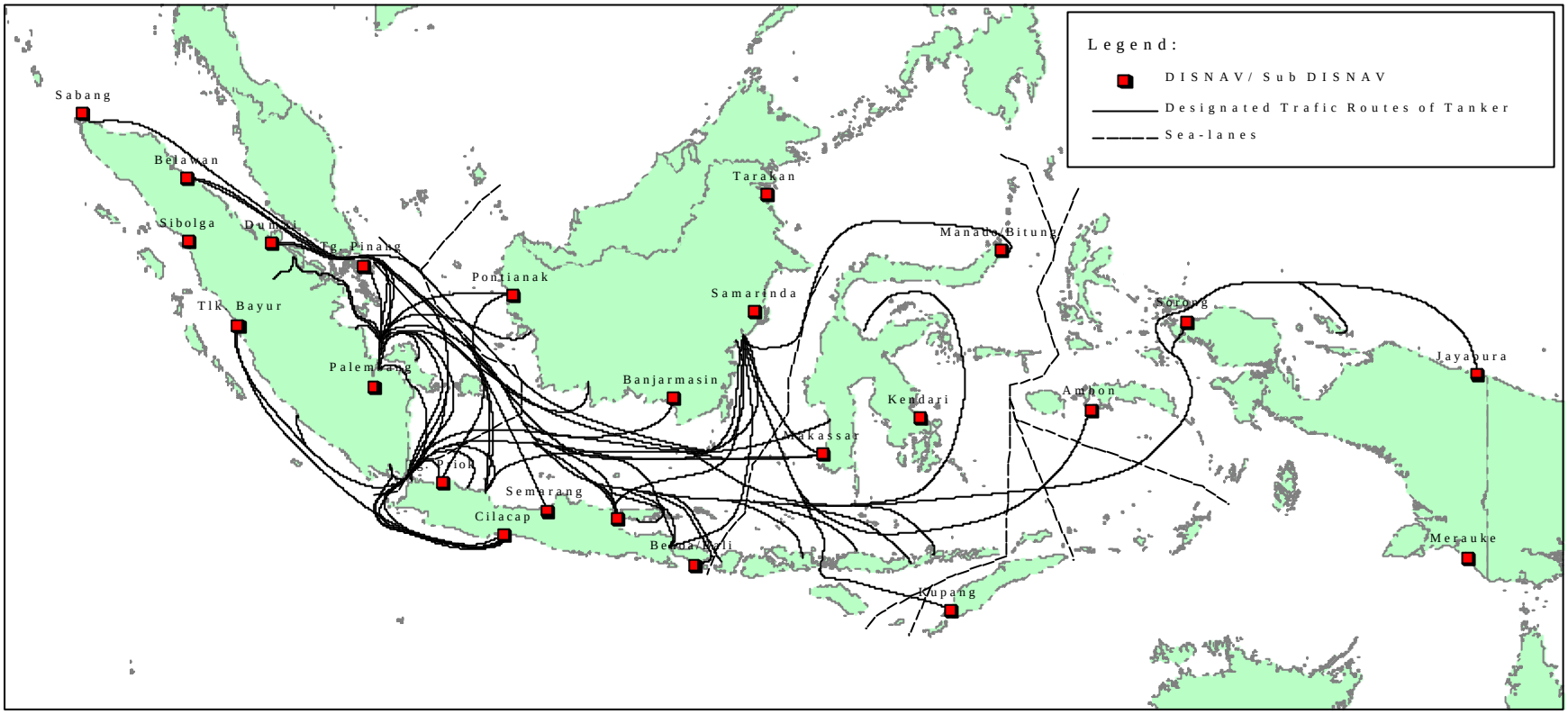


Figure 3.5.2. Traffic Routes of Passenger Ships in Indonesia

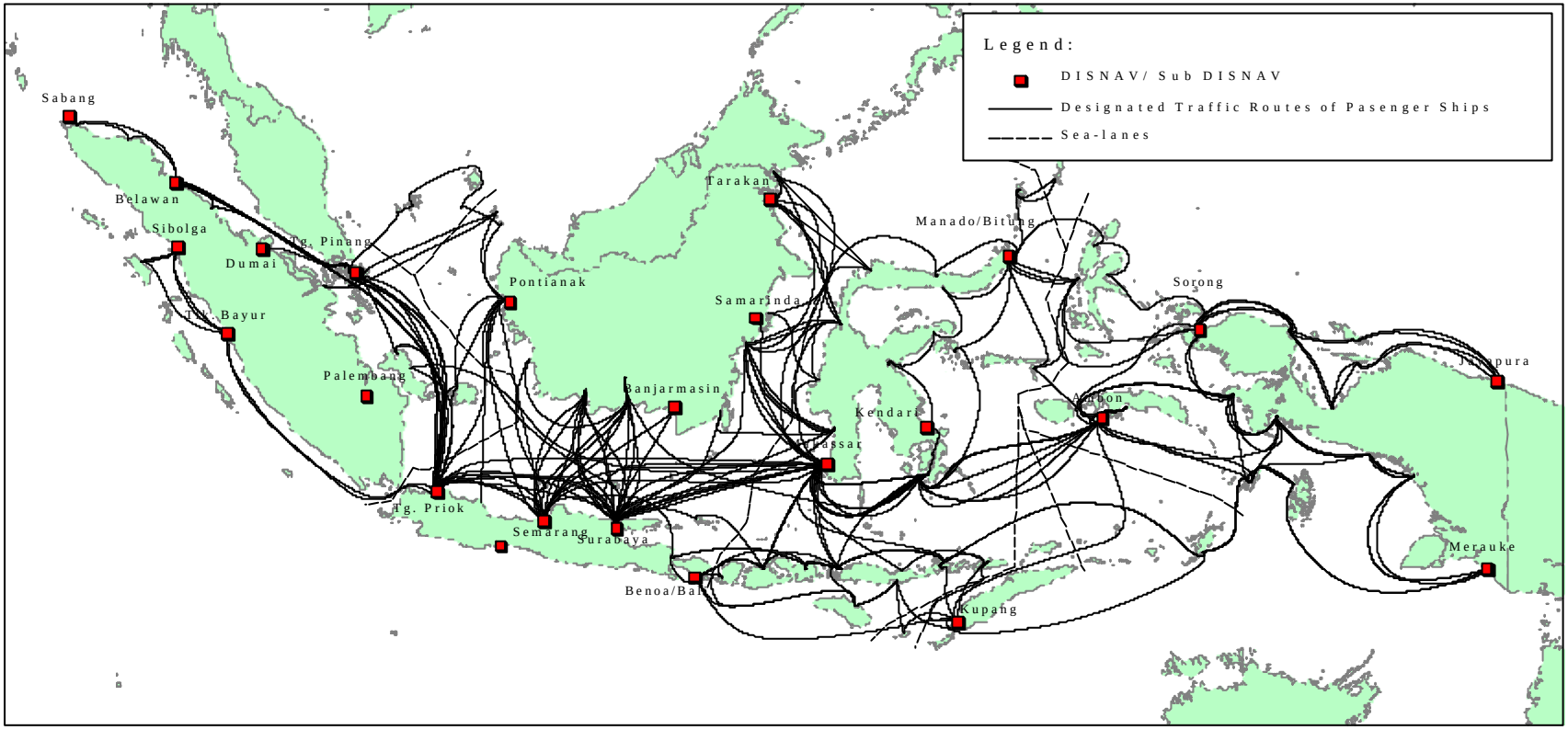


Figure 3.5.3. Traffic Routes of Container Ships in Indonesia

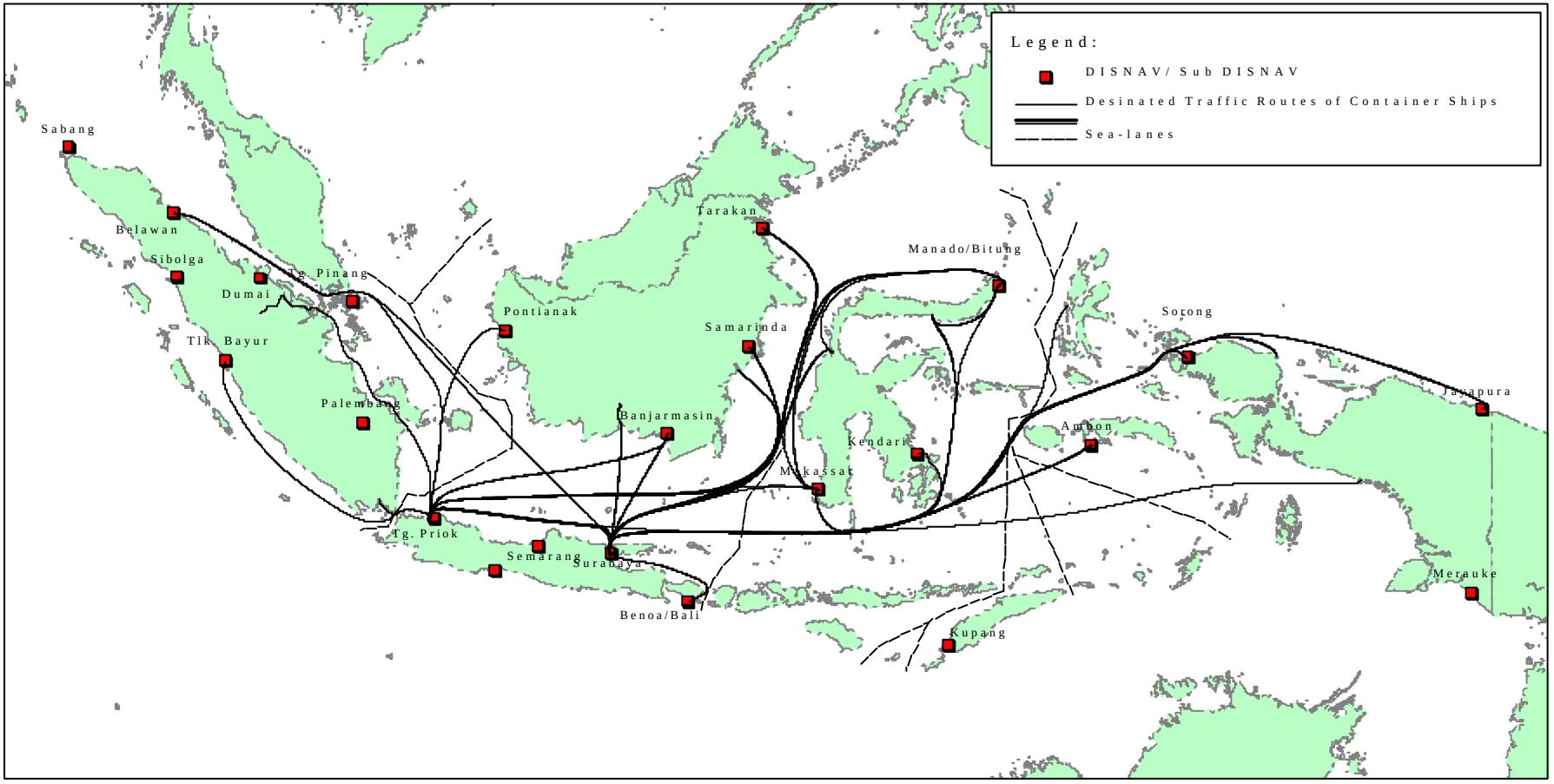


Figure 3.5.4. Traffic Routes of Pioneer Ships in Indonesia

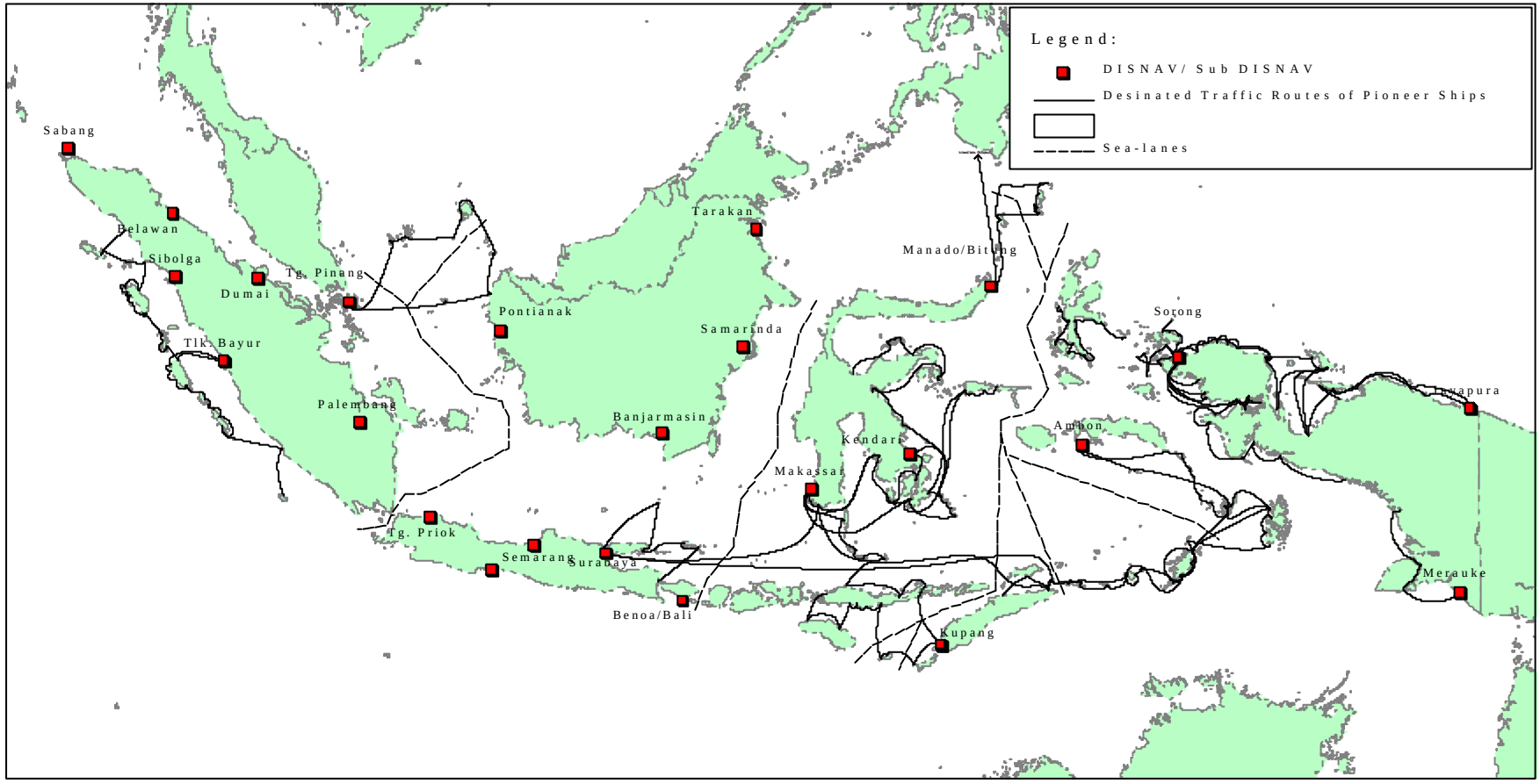
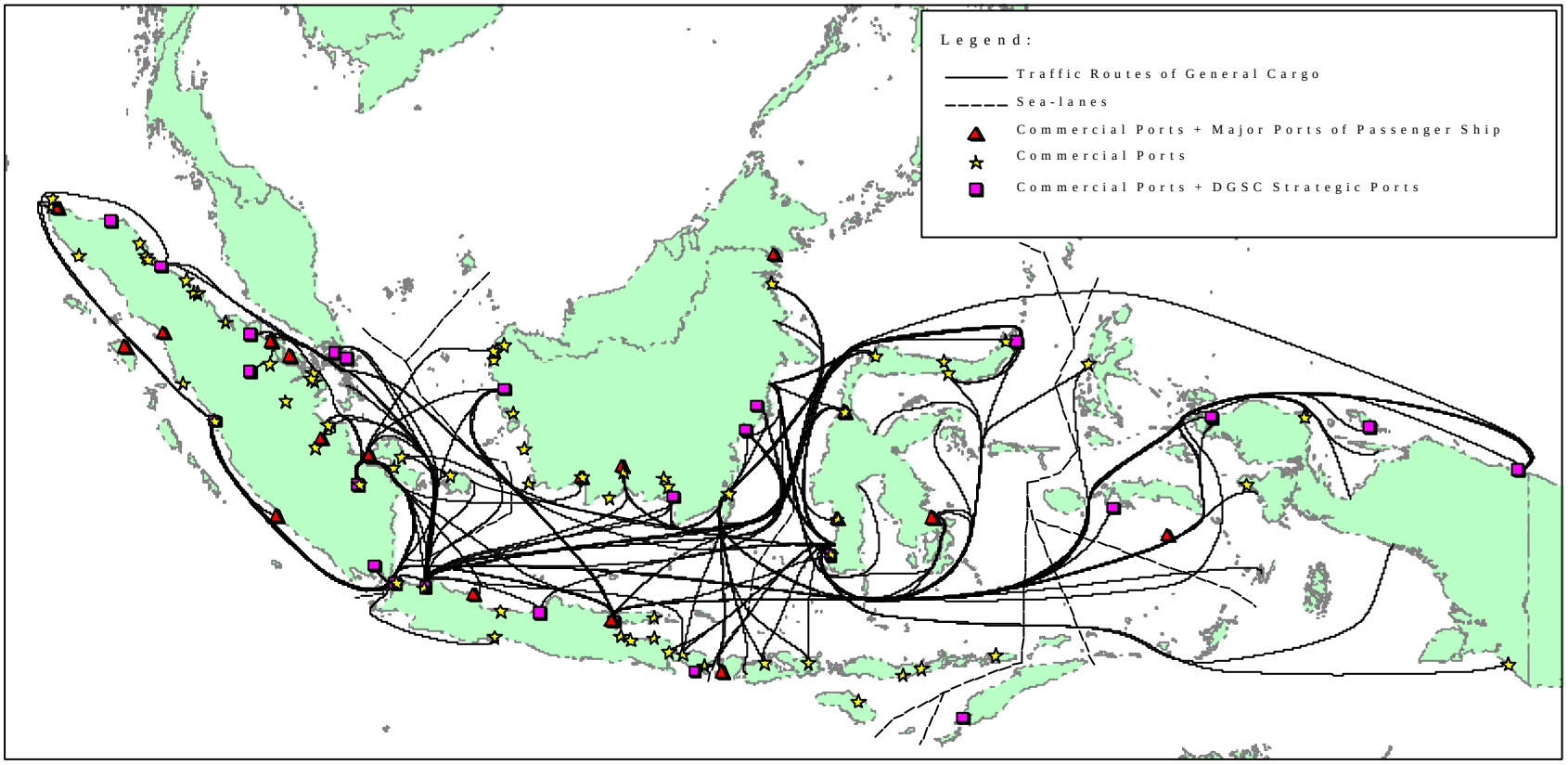


Figure 3.5.5. Traffic Routes of General Cargo Ships in Indonesia



3.5.2. Ports and Harbors

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

There are 111 commercial ports and 544 non-commercial ports shown in **Figure 3.5.6**. and **Figure 3.5.7.**, 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 ports 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 3.5.8.**

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 3.5.9**.

Figure 3.5.6. Locations of 111 Commercial Ports in Indonesia

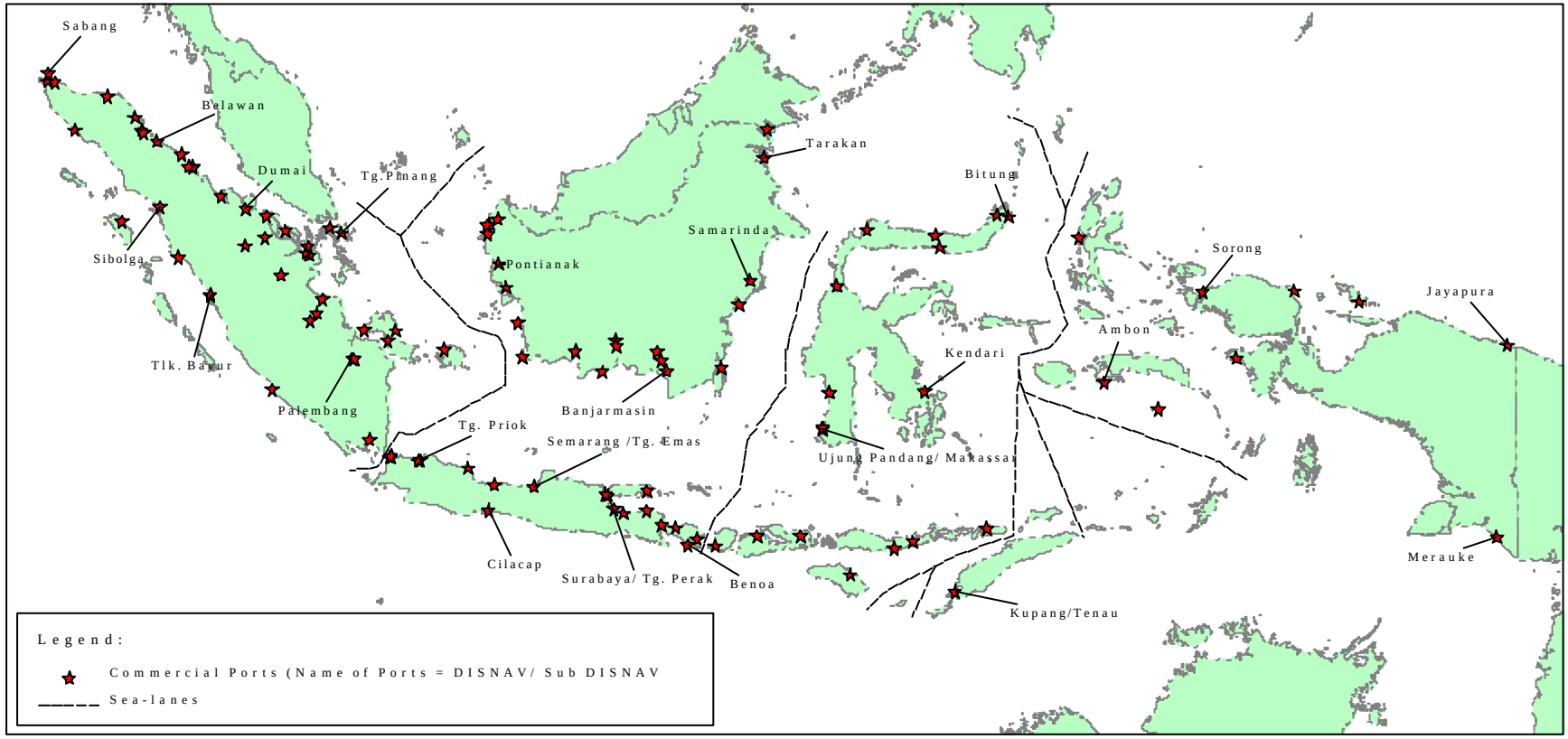


Figure 3.5.7. Locations of 544 Non-Commercial Ports in Indonesia

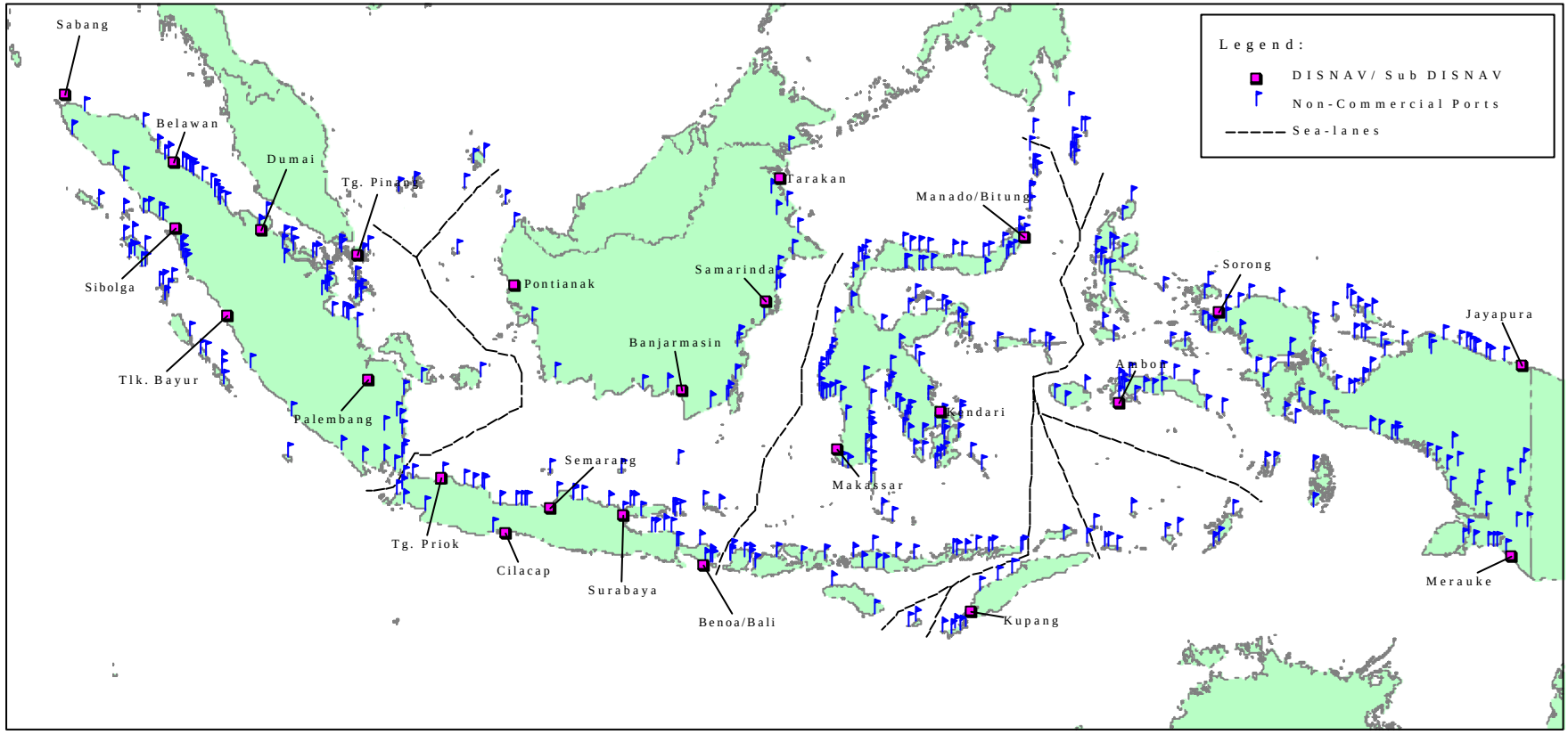


Figure 3.5.8. Locations of Ports classified by SYSTRANAS in Indonesia

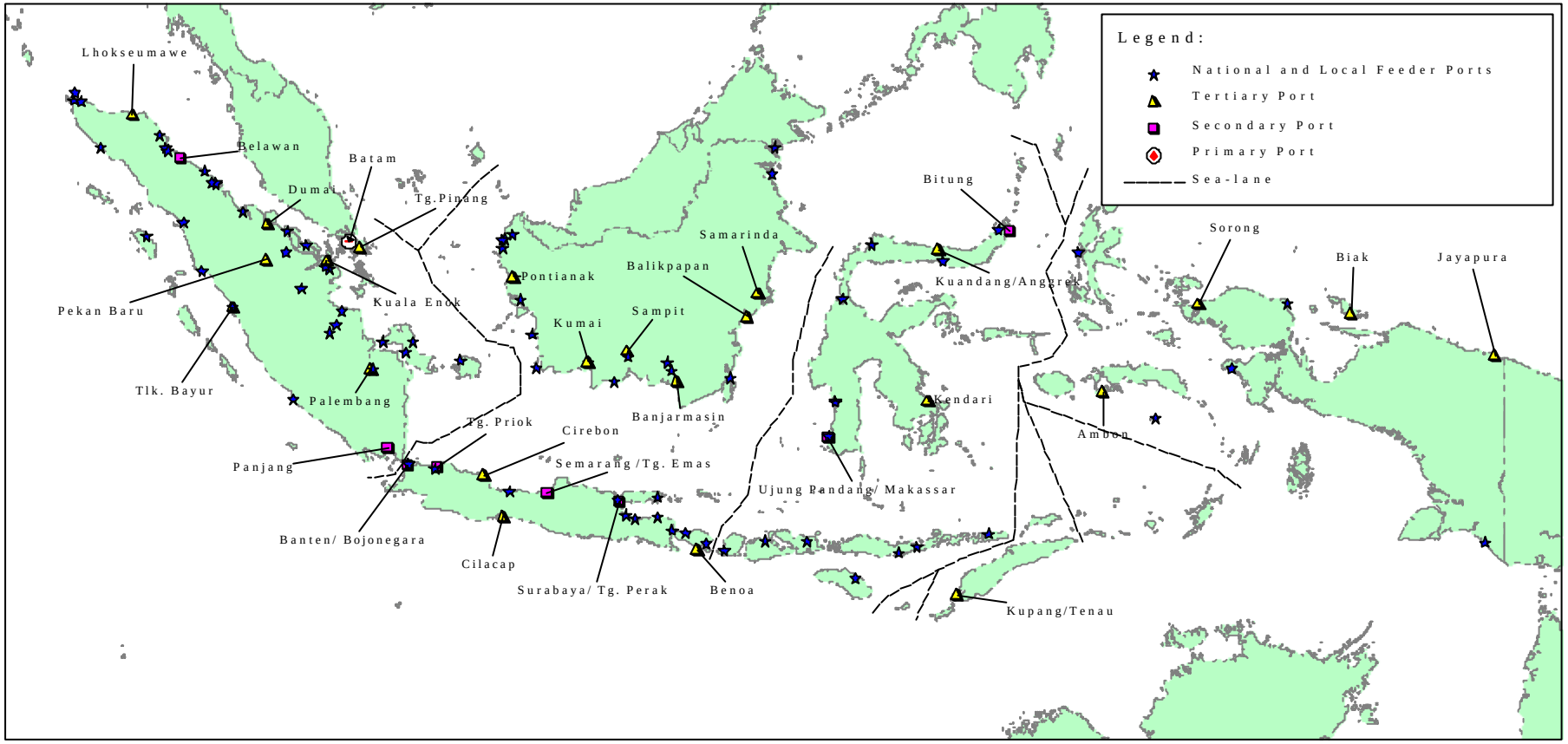
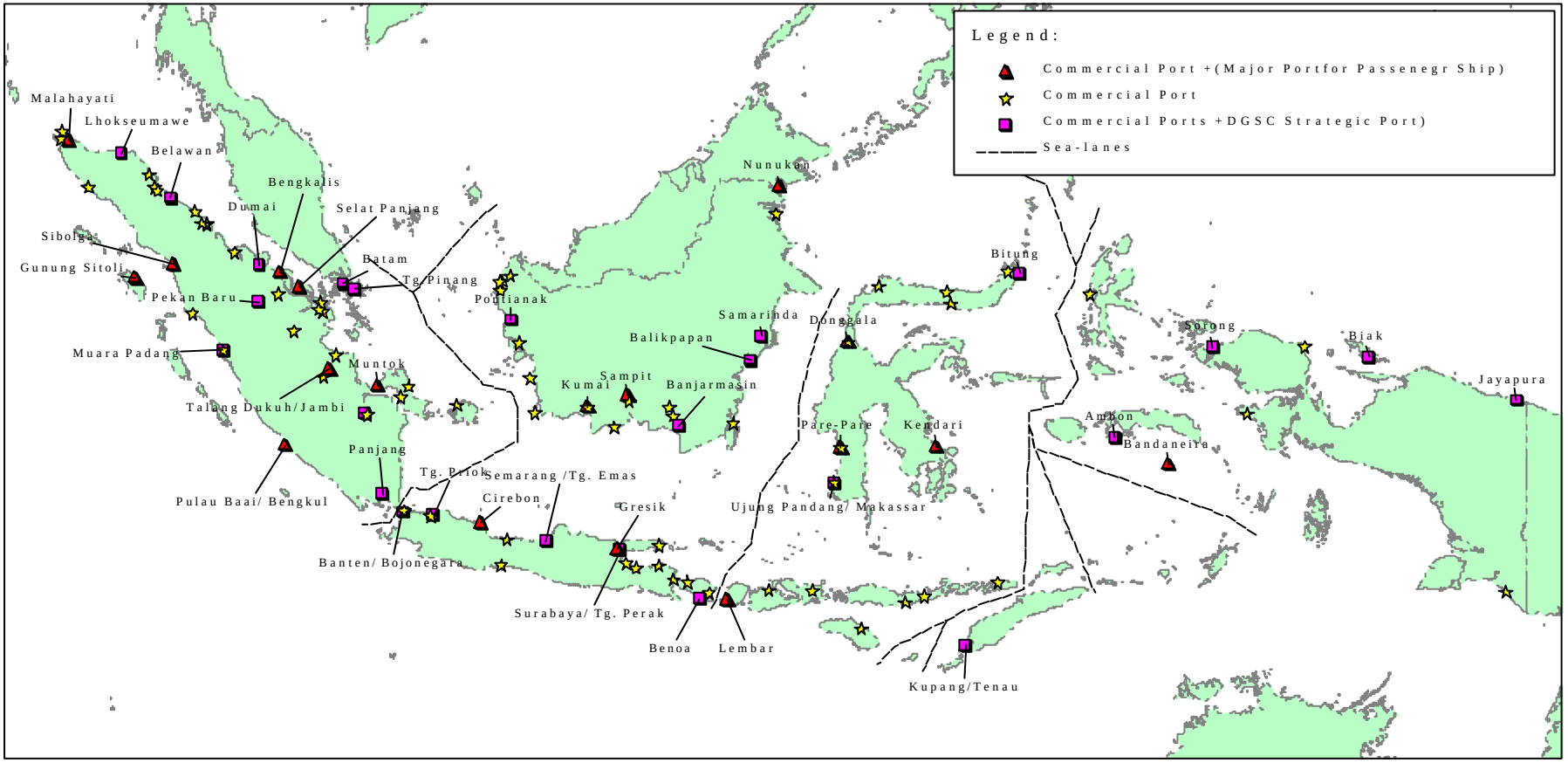


Figure 3.5.9. Locations of DGSC Strategic Ports and Major Ports for Passenger Ships in Indonesia



3.6. Marine Casualties

The marine casualty statistics from April 1982 to December 2000 is shown in **Table 3.6.1.**

According to the statistics, there 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 “Grounding” and it occurred 24.7 times per year in average. It is 12.1% of total casualties.

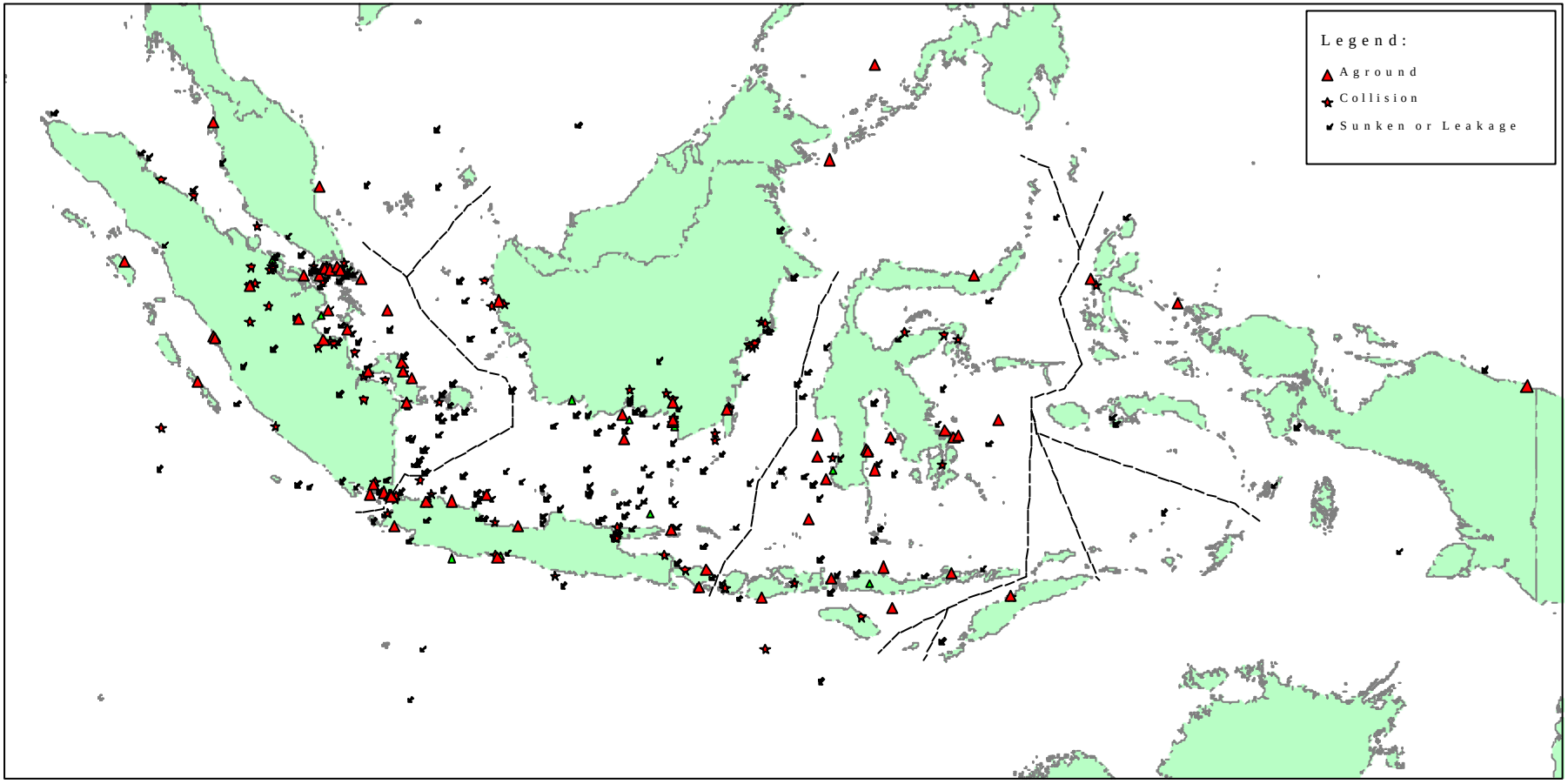
The third casualty is “Collision” and it occurred 20.0 times per year in average. It is 9.8% of total casualties.

The locations of marine casualties from April 1992 to June 2001 that have recorded the coordinates are shown in **Figure 3.6.1**.

Table 3.6.1. 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 3.6.1. Marine Casualties with Coordinates from 1992 to 2001



4. Current Situation of ATN and Supporting Facilities

4.1. Administration of ATN and Supporting Facilities

Directorate of Navigation of DGSC, Ministry of Communications (MOC) has a sole responsibility for the administration of ATN in Indonesia including management of the number to be registered in List of Lights for Non-property Lights.

Directorates of Navigation and District of Navigation Offices (DISNAV/ Sub DISNAV) have a responsibility for operation and maintenance of ATN except Non-property lights. Non-property lights are operated and maintained by the owner.

4.2. Current Situation of ATN

4.2.1. Number of ATN

As of July 31 2001, the DGSC has owned 1,735 units of visual ATN consisting of:

① Lighthouse	235 units
② Light beacon including Resilient Light Beacon (RLB)	1,168 units
③ Light Buoy	332 units
④ Unlighted beacon	260 units
⑤ Unlighted buoy	103 units

Number of non-property light operated by other organization and state owned company other than DGSC is 983 units consisting of 833 units of lighted visual ATN and 150 units of unlighted visual ATN.

Number of visual ATN served to mariners in the responsible area of each DISNAV/ Sub DISNAV is shown in **Table 4.2.1.**

Table 4.2.1. Number of Visual ATN in Service

NO.	Name of DisNav	Light house	Light Beacon		Light Buoy		Unlighted beacon		Unlighted buoy		Total
		DGSC	DGSC	NON-DGSC	DGSC	NON-DGSC	DGSC	NON-DGSC	DGSC	NON-DGSC	
1	Sabang	9	31	3	4	4	4	0	2	0	57
2	Belawan	5	45	15	27	27	1	1	1	0	122
3	Sibolga	7	46	5	0	0	3	3	0	4	68
4	Dumai	5	34	5	54	16	3	9	2	0	128
5	Tg.Pinang	22	71	37	26	57	60	0	11	0	284
6	Tlk.Bayaur	8	40	5	0	1	2	0	0	0	56
7	Palembang	4	63	0	16	6	8	0	4	0	101
8	Tg.Priok	27	96	81	45	38	22	0	48	0	357
9	Semarang	7	31	4	12	4	19	8	0	4	89
10	Cilacap	6	17	11	5	36	0	10	0	20	105
11	Surabaya	19	58	12	36	21	0	4	21	4	175
12	Benoa	15	57	13	8	8	12	0	1	3	117
13	Pontianak	3	42	1	14	0	6	0	2	0	68
14	Banjarmasin	7	38	49	18	14	14	2	0	0	142
15	Samarinda	5	48	137	17	134	4	16	9	10	380
16	Tarakan	2	24	0	6	10	1	0	0	0	43
17	Manado/Bitur	21	84	1	7	6	6	9	0	0	134
18	Kendari	6	62	13	0	1	6	22	0	0	110
19	Makassar	18	50	0	8	0	64	14	0	0	154
20	Kupang	13	48	10	3	0	10	2	0	0	86
21	Ambon	12	71	22	5	4	8	0	0	0	122
22	Jayapura	7	34	0	0	0	4	1	0	0	46
23	Sorong	6	52	13	17	9	3	4	0	0	104
24	Merauke	1	26	0	4	0	0	0	2	0	33
Total		235	1168	437	332	396	260	105	103	45	3081
		235	1605		728		365		148		3081
		2568					513				3081

4.2.2. Availability of lighted visual ATN

The International Association of Lighthouse Authorities (IALA) recommends on the availability of lighted visual ATN as follows:

① Category 1:

Major lighthouse, leading lights and manned light vessels should have an availability exceeding 0.998.

② Category 2:

Other lights on fixed structure (means "light beacon") should have an availability exceeding 0.99.

③ Category 3:

Light buoys should have an availability exceeding 0.97.

The absolute minimum level of availability should be set at 95% for each light.

The availability of lighted visual ATN operated by each DISNAV/ Sub DISNAV was simply calculated based on the data April to December 2000. The result of simple calculation of availability is shown in **Table 4.2.2.**

As a result of simple calculation, the availability of visual lighted ATN operated by DISNAV Sibolga, DISNAV Belawan, DISNAV Tanjung Priok, Sub DISNAV Cilacap, DISNAV Banjarmasin and Sub DISNAV Merauke do not meet a minimum recommendation (95%) of IALA.

The causes reducing availability of lights are mainly theft, collision with ship, collapsed, sinking/ drifting, shortage of spare parts due to the limited budget and so forth.

Table 4.2.2. Availability of Lighted Visual ATN of Each DISNAV/ Sub DISNAV (Reference only)

As of December 2000

NO.	District of Navigation	NO. of lighted ATN	Total Days unlighted										Availavility
			Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total	
1	Sabang	42	0	0	0	0	37	33	33	95	95	293	97.46%
2	Belawan	78	184	190	185	188	232	219	233	202	196	1829	91.47%
3	Sibolga	50	*	*	*	*	*	*	*	*	*	1677	87.80%
4	Dumai	91	90	91	90	62	62	60	62	60	62	639	97.45%
5	Tg.Pinang	114	0	0	0	279	279	0	0	0	0	558	98.22%
6	Tlk.Bayaur	55	76	0	0	0	124	0	0	0	0	200	98.68%
7	Palembang	84	0	0	0	0	403	0	0	0	0	403	98.26%
8	Tg.Priok	155	0	816	756	1462	1023	0	403	0	0	4460	89.54%
9	Semarang	49	30	0	159	0	162	0	0	0	0	351	97.40%
10	Cilacap	29	0	151	228	278	329	240	0	0	0	1226	84.63%
11	Surabaya	97	*	*	*	*	*	*	*	*	*	66	99.75%
12	Benoa	74	91	119	0	0	0	0	0	0	0	210	98.97%
13	Pontianak	58	-	-	-	-	-	-	-	-	-	-	**
14	Banjarmasin	64	0	0	0	463	0	0	527	0	0	990	94.38%
15	Samarinda	68	-	-	-	-	-	-	-	-	-	-	**
16	Tarakan	37	0	138	0	186	0	0	0	0	0	324	96.82%
17	Manado /Bitung	105	0	125	0	111	95	0	0	120	0	451	98.44%
18	Kendari	69	210	93	0	93	217	0	0	0	0	613	96.77%
19	Makassar	76	-	-	-	-	-	-	-	-	-	-	**
20	Kupang	71	0	0	0	0	0	90	0	0	0	90	99.54%
21	Ambon	86	-	-	-	-	-	-	-	-	-	-	**
22	Jayapura	43	0	0	0	85	56	60	0	57	0	258	97.82%
23	Sorong	73	72	62	0	0	0	0	31	90	92	347	98.27%
24	Merauke	31	0	0	180	186	186	0	0	240	0	792	90.71%

Note: * shows that data of total days unlighted was given in annual reports.

** shows no data.

Fiscal year 2000: April 1, 2000 to December 31, 2000

Availability =

(1- Total days unlighted / Number of lighted ATN x 275 days) x 100%

4.2.3. Current operation status of lighted visual ATN

(1) Lighthouse

35 units of existing lighthouse are required to rehabilitate or improve the system. Conditions of equipment are as shown in **Table 4.2.3.**

Table 4.2.3. Conditions of Equipment for Lighthouse

No.	Operation Status	Lighting Equipment	Power Supply	Light Tower	Number of Lighthouses
1	Light off	Damaged	Damaged	Collapsed	3 units
2	Light off	Good	Good	Collapsed	2 units
3	Light on	Degrading	Degrading	Degrading	13 units
4	Light on	Good	Good	Degrading	10 units
5	Light on	Degrading	Degrading	Good	7 units
Total					35 units

(2) Light beacon

194 units of existing light beacon are required to rehabilitate or improve the system. Conditions of equipment are as shown in **Table 4.2.4.**

Table 4.2.4. Conditions of Equipment for Light Beacons

No.	Operation Status	Lighting Equipment	Power Supply	Light Tower	Number of Light Beacons
1	Light off	Damaged	Damaged	Collapsed	65 units
2	Light off	Damaged	Damaged	Degrading	47 units
3	Light off	Good	Good	Degrading	1 unit
4	Light off	Damaged	Damaged	Good	8 unit
5	Light on	Degrading	Degrading	Degrading	16 units
6	Light on	Good	Good	Degrading	50 units
7	Light on	Degrading	Degrading	Good	7 units
Total					194 units

(3) Light Buoy

61 units of existing light buoy are required to rehabilitate or improve the system. Conditions of equipment are summarized in **Table 4.2.5.** Details of current situation are shown in **Appendix 4.2.1.**

Table 4.2.5. Conditions of Equipment for Light buoys

No.	Operation Status	Lighting Equipment	Power Supply	Buoy Body & Super Structure	Number of Light Beacons
1	Light off	Missing	Missing	Missing	18 units
2	Light off	Missing	Damaged	Damaged	3 units
3	Light off	Damaged	Damaged	Damaged	2 unit
4	Light off	Degrading	Degrading	Degrading	25 unit
5	Light off	Good	Good	Damaged	1 units
6	Light on	Good	Good	Degrading	12 units
Total					61 units

4.3. Current Situation of Supporting Facilities

(1) Buoy base including open storage

There are nine (9) buoy bases to maintain all buoys in the whole area of Indonesia. On this site survey, the site areas of 2 buoy bases are not sufficient for their work.

There is one DISNAV that does not store buoy body, although mooring chains, shackles and sinkers are stored in the buoy base.

The occupied areas of buoy base and open storage are shown in **Table 4.3.1.**

(2) Workshop including storage and jetty

Workshop is estimated to all DISNAVs except District.

The area of workshop is not sufficient for maintenance work of ATN equipments in several Districts. Tool and machine of workshop is old and deficiency.

Development of Jetty as supporting facility for aids to navigation is required to deploy vessels quickly on a number of District Navigation.

There are three (3) DISNAVs with small exclusive jetty and ten (10) DISNAVs without jetty. The occupied area of workshop, storage and jetty are shown in **Table 4.3.1.**

Table 4.3.1. Areas of Workshop and Buoy Base of Each District of Navigation

As of March 31, 2001

No	ATN Office	ID	Work Shop	Jetty	Storage	Open Storage	Buoy Base	Office	Workshop Equipment	Remarks
		No	(m^2)	(m)	(m^2)	(m^2)	(m^2)	(m^2)		
1	SABANG	1	80	40	80	0	0	360	*	
2	BELAWAN	2	142	38	242	0	415	282	*	
3	SIBOLGA	3	80	0	80	0	0	200	*	
4	DUMAI	4	550	70	352	0	1,000	810	*	◎
5	TG.PINANG	5	230(600)	40	170	0	0	1,000	KfW	**, ****
6	TLK BAYUR	6	200	40	135	0	0	250	*	***
7	PALEMBANG	7	550	33	350	0	300	550	*	
8	TG.PRIOK	8	2,050	175	3,315	150	5,900	2,000	KfW	
9	SEMARANG	9	280	40	80	0	0	784	*	
10	CILACAP	10	160	25	0	0	300	550	*	
11	SURABAYA	11	770	115	285	165	732	2,625	*	
12	BENOA	12	80(600)	0	0	0	0	215	KfW	****
13	PONTIANAK	13	600	0	0	0	0	550	KfW	
14	BANJARMASIN	14	80	0	0	0	0	318	*	◎
15	SAMARINDA	15	1,600	50	416	200	2,956	550	*	
16	TARAKAN	16	0	0	0	0	0	750	*	
17	MANADO/BITUNG	17	600	0	80	0	750	735	IP-380	
18	KENDARI	18	600	0	0	0	0	300	IP-394	
19	UJ.PANDANG	19	400	40	177	0	0	400	IP-380	
20	KUPANG	20	200	0	0	0	0	418	IP-394	
21	AMBON	21	80(600)	40	80	0	0	844	KfW	****
22	JAYAPURA	22	426	0	55	0	0	375	*	
23	SORONG	23	600	40	120	120	750	420	IP-394	
24	MERAUKE	24	335	0	464	0	0	150	*	
25	B T K P	25	600	75	1,255	--	--	1,200	*	

** Workshop and Buoy Base of Tg.Pinang to be established to Kijang in fiscal year 2001(December).

*** Office of Tlk Bayur burnt down at Sept. 2001, will be change to Tlk Bungus.

**** Shows that workshop with 600m^2 area will be established in fiscal year 2002.

KfW Ongoing(Navigational Safety Project in Indonesia).

5. Development, Improvement and Rehabilitation Plan for ATN and Supporting Facilities in the proposed Priority Project

As mentioned in Chapter 4,there are some DISNAVs that do not reach the minimum requirement (95%) of availability recommended by IALA.

This problems is caused from existence of lights with malfunction, damage or unsteady operation conditions, which are about 19% of existing lighted visual ATNs (1735 lights). It is required to recover the function by rehabilitation or improvement.

On-site maintenance every two (2) month recommended by the JICA Study Team in order to secure reliability of lights is very difficult for unmanned light beacon and light buoy, because both the quantity and quality of supporting facilities are insufficient and decreasing year by year. Therefore, rehabilitation and improvement plan are a matter of highest priority. Those lights with a difficulty of operation must be recovered in proposed Priority Project. However, development plan is also required for the reason of some changes of maritime traffic environment such as sea lanes.

5.1. Rehabilitation and Improvement Plan of Visual ATN

The number of lighthouse, light beacon and light buoy to be rehabilitated and improved is shown in **Table 5.1.1.**

Current situation of lighthouses and light beacons to be rehabilitated and improved in Priority Project is shown in **Appendix 5.1.1.** and **Appendix 5.1.2.**, respectively.

The locations of lighthouse and light beacon for rehabilitation and improvement are shown in **Figure 5.1.1.** and **Figure 5.1.2**., respectively.

Current situation of light buoys to be rehabilitated and improved is shown in **Appendix 5.1.3.** Light buoys in Priority Project are allocated to main ports in SISTRANAS.

Table 5.1.1. Total Number of ATN to be rehabilitated and improved in proposed Priority Project

Type	Lighthouse	Light beacon	Light buoy
Number of units	21(35) unit	131(231) units	61(61) units
Ratio	60%	56.7%	100%

Note: ( ) is shown number of Master plan

Table 5.1.2. Visual ATN to be rehabilitated and improved in proposed Priority Project

No.	ATN Office	Class	Light House				Light Beacon				Light Buoy			
			Existing 2001	Ongoing 2002	2002 Total	Rehabilitation and Improvement Priority Project	Existing 2001	Ongoing 2002	2002 Total	Rehabilitation and Improvement Priority Project	Existing 2001	Ongoing 2002	2002 Total	Rehabilitation and Improvement Priority Project
1	SABANG	Sub	9	0	9	5	31	0	31	1	4	0	4	1
2	BELAWAN	II	5	0	5	0	45	0	45	12	27	10	37	1
3	SIBOLGA	Sub	7	0	7	0	46	0	46	7	0	0	0	0
4	DUMAI	I	5	0	5	0	34	0	34	6	54	18	72	10
5	TG. PINANG	I	22	1	23	4	71	3	74	5	26	12	38	6
6	TLK. BAYUR	II	8	0	8	0	40	0	40	2	0	0	0	0
7	PALEMBANG	II	4	0	4	0	63	0	63	8	16	6	22	7
8	TG.PRIOK	I	27	0	27	0	96	2	98	22	45	27	72	0
9	SEMARANG	II	7	0	7	5	31	0	31	5	12	4	16	12
10	CILACAP	Sub	6	0	6	0	17	0	17	1	5	0	5	0
11	SURABAYA	I	19	0	19	0	58	0	58	0	36	12	48	0
12	BENOA	II	15	0	15	2	57	1	58	5	8	2	10	1
13	PONTIANAK	Sub	3	1	4	1	42	1	43	14	14	4	18	3
14	BANJARMASIN	II	7	0	7	0	38	0	38	5	18	7	25	8
15	SAMARINDA	I	5	0	5	1	48	0	48	8	17	6	23	3
16	TARAKAN	II	2	0	2	0	24	0	24	3	6	0	6	1
17	MANADO/BITUNG	I	21	0	21	0	84	2	86	8	7	0	7	1
18	KENDARI	Sub	6	0	6	0	62	0	62	4	0	0	0	0
19	UJ.PANDANG	I	18	0	18	1	50	2	52	2	8	5	13	0
20	KUPANG	II	13	4	17	1	48	8	56	0	3	0	3	0
21	AMBON	I	12	5	17	0	71	4	75	5	5	0	5	0
22	JAYAPURA	II	7	0	7	0	34	0	34	0	0	0	0	0
23	SORONG	I	6	0	6	1	52	0	52	5	17	6	23	3
24	MERAUKE	Sub	1	0	1	0	26	0	26	3	4	0	4	4
	TOTAL		235	11	246	21	1,168	23	1,191	131	332	119	451	61

Figure 5.1.1. Location Map of Rehabilitation and Improvement of Lighthouse in proposed Priority Project

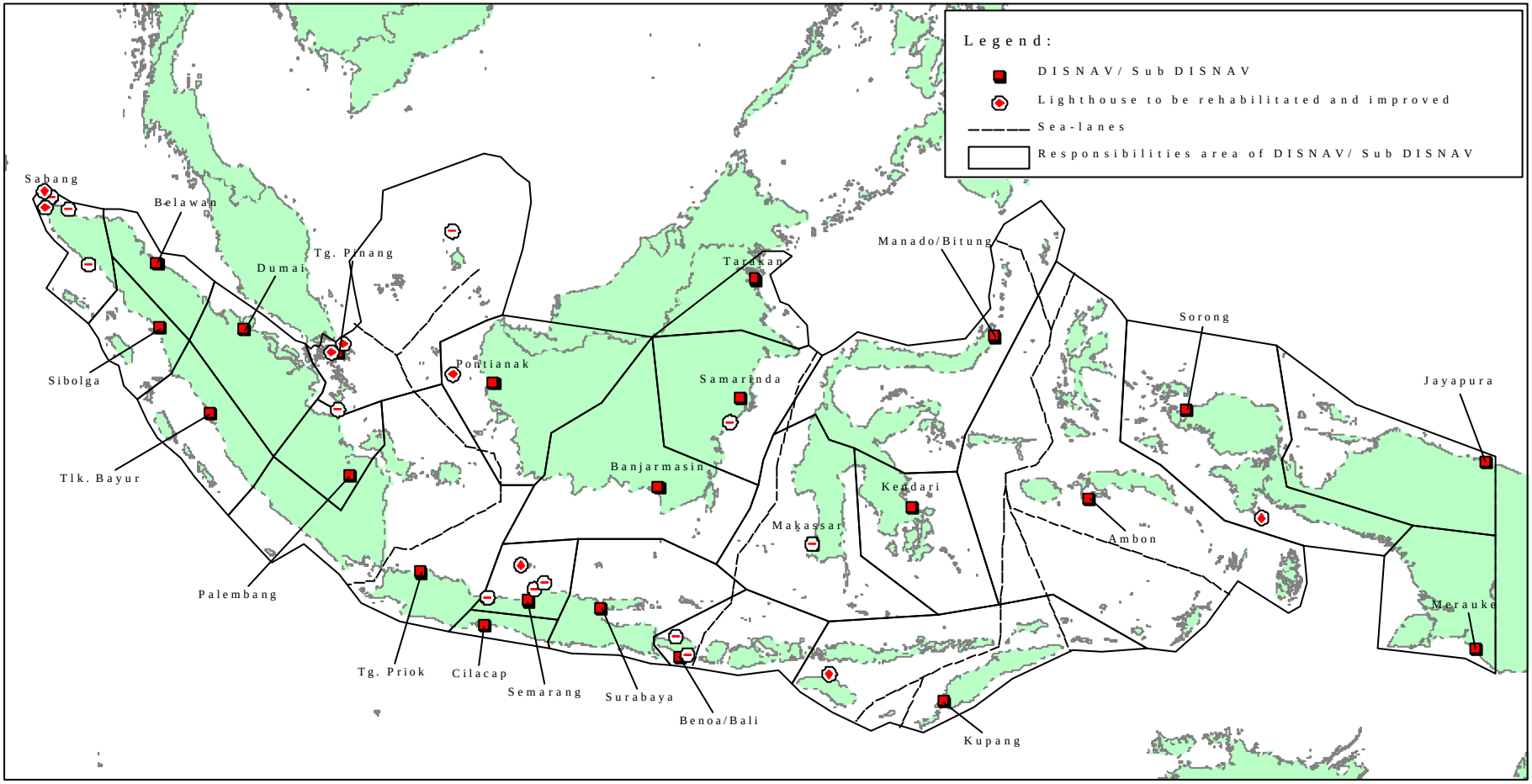
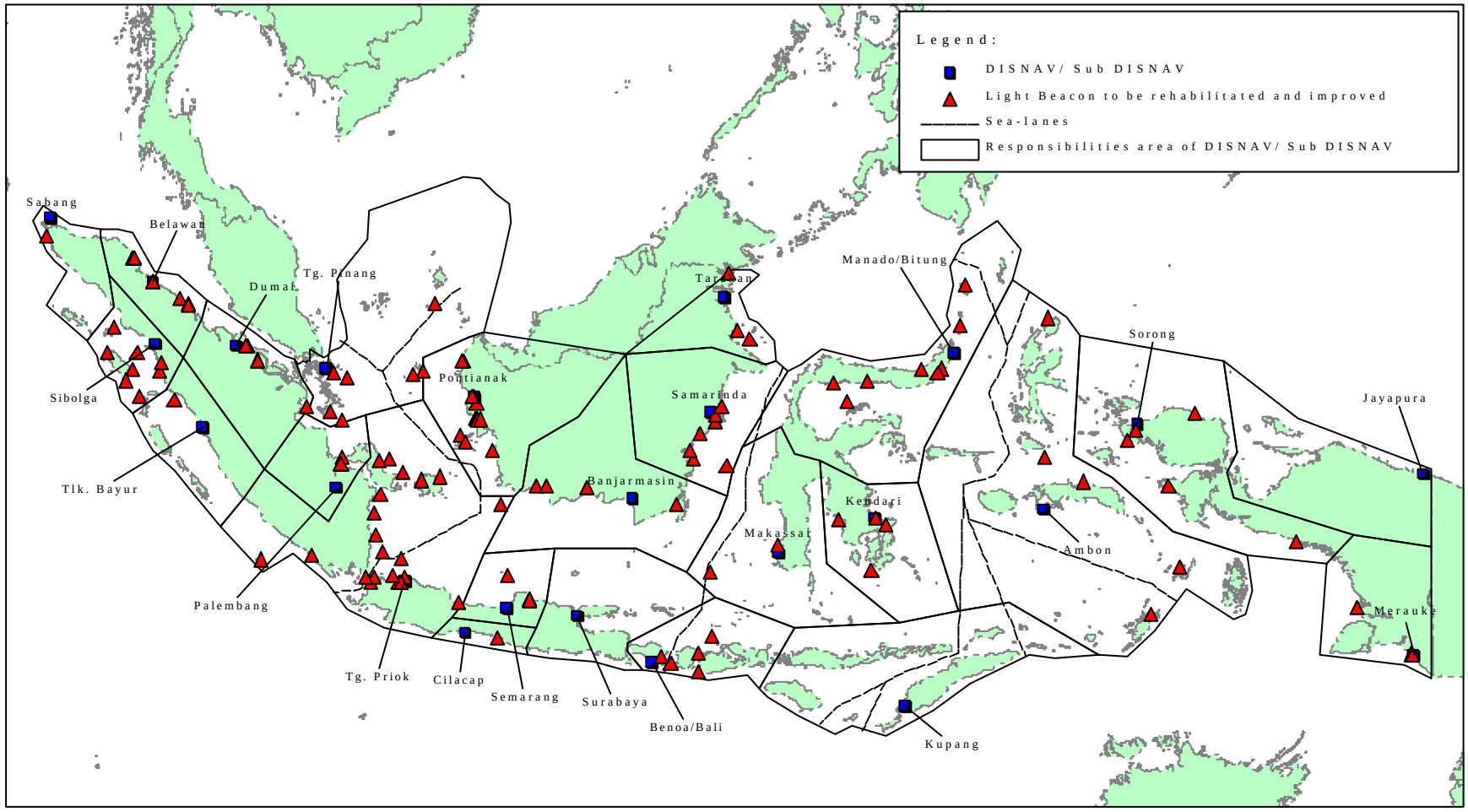


Figure 5.1.2. Location Map of Rehabilitation and Improvement Plan of Light Beacons in proposed Priority Project



5.2. Development Plan of Visual ATN

The number of lighthouse, light beacon and light buoy to be developed is shown in **Table 5.2.1.**

Locations of lighthouses and light beacons to be developed in Priority Project are shown in **Appendix 5.2.1.** and **Appendix 5.2.2.**, respectively.

The location map of lighthouses and light beacons to be developed in Priority Project are shown in **Figure 5.2.1.** and **Figure 5.2.1.** respectively.

Light buoys to be developed are shown in **Appendix 5.2.3.**

Table 5.2.1. Total Number of ATN to be developed in proposed Priority Project

Type	Lighthouse	Light beacon	Light buoy
Number of units	8 unit (111 units)	33units (350units)	34units (350 units)
Ratio	7.2%	9.4%	9.7%

Note:( ) shows number of Master plan

Table 5.2.2. ATN to be developed in proposed Priority Project

No.	ATN Office	Class	Light House			Light Beacon			Light Buoy		
			Exist ing 2001	Ongo ing 2002	Priority Project	Exist ing 2001	Ongo ing 2002	Priority Project	Exist ing 2001	Ongo ing 2002	Priority Project
1	SABANG	Sub	9	0		31	0		4	0	0
2	BELAWAN	II	5	0		45	0		27	10	3 (1)
3	SIBOLGA	Sub	7	0		46	0		0	0	0
4	DUMAI	I	5	0		34	0	7	54	18	6 (2)
5	TG. PINANG	I	22	1	3	71	3	9	26	12	3 (1)
6	TLK. BAYUR	II	8	0		40	0		0	0	0
7	PALEMBANG	II	4	0	3	63	0	5	16	6	2
8	TG.PRIOK	I	27	0		96	2	3	45	27	6 (2)
9	SEMARANG	II	7	0		31	0	3	12	4	1
10	CILACAP	Sub	6	0		17	0		5	0	0
11	SURABAYA	I	19	0	1	58	0	2	36	12	4 (1)
12	BENOA	II	15	0	1	57	1		8	2	1
13	PONTIANAK	Sub	3	1		42	1		14	4	1
14	BANJARMASIN	II	7	0		38	0		18	7	2 (1)
15	SAMARINDA	I	5	0		48	0		17	6	2
16	TARAKAN	II	2	0		24	0		6	0	0
17	MANADO/BITUNG	I	21	0		84	2	4	7	0	0
18	KENDARI	Sub	6	0		62	0		0	0	0
19	UJ.PANDANG	I	18	0		50	2		8	5	1
20	KUPANG	II	13	4		48	8		3	0	0
21	AMBON	I	12	5		71	4		5	0	0
22	JAYAPURA	II	7	0		34	0		0	0	2
23	SORONG	I	6	0		52	0		17	6	0
24	MERAUKE	Sub	1	0		26	0		4	0	0
	TOTAL		235	11	8	1,168	23	33	332	119	34 (8)

Note : ( ) shows spares.

Figure. 5.2.1. Location Map of Development of Lighthouse in proposed Priority Project

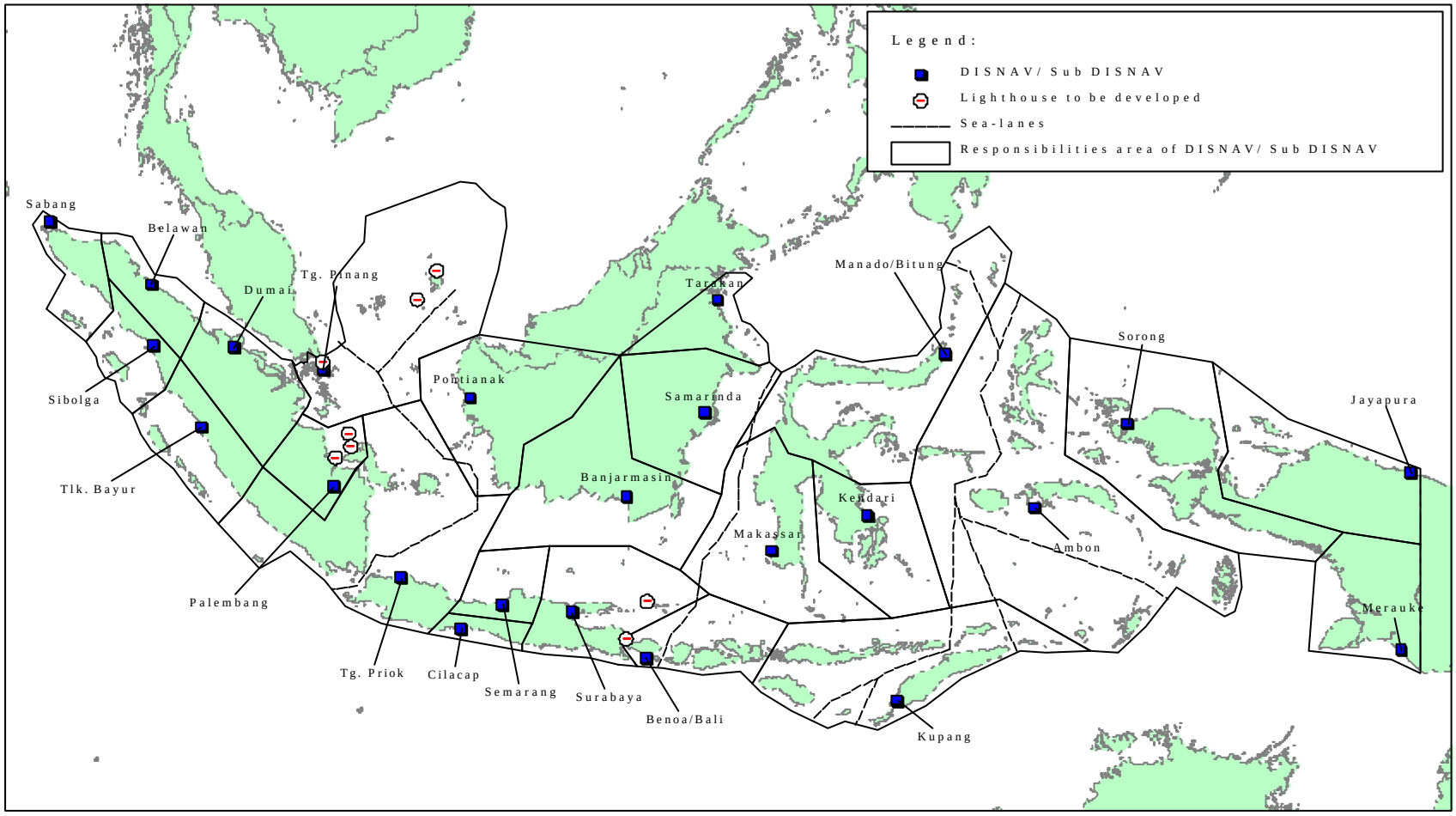
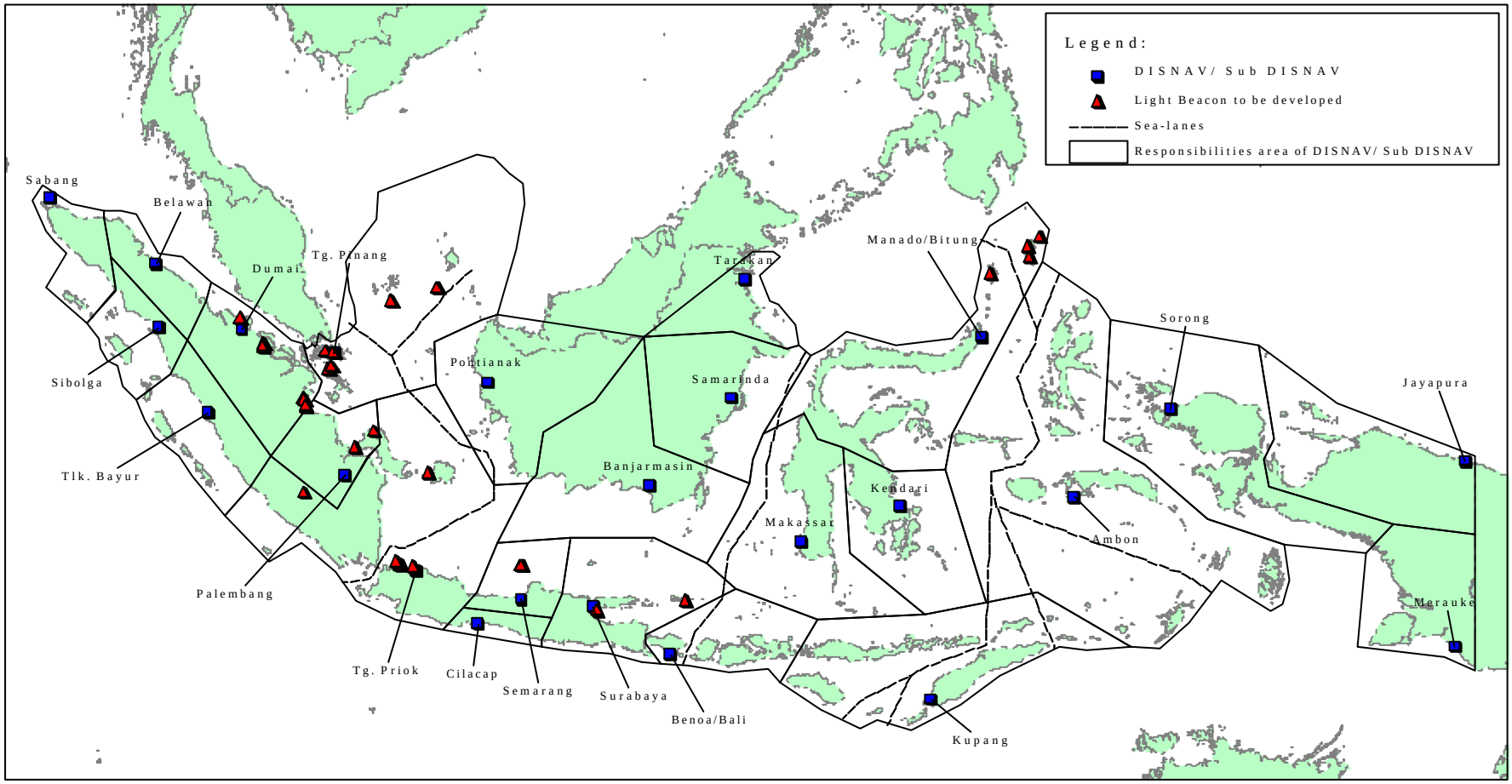


Figure. 5.2.2. Location Map of Development of Light Beacon in proposed Priority Project



5.3. Supporting Facilities

The locations and quantities except vessels of supporting facilities to be developed, rehabilitated and improved in proposed Priority Project are shown in **Table 5.3.1.** and **Table 5.3.2.**, respectively.

Table 5.3.1. Locations of Supporting Facilities to be improved and developed in proposed Priority Project

(1) Development

Item	DISNAV	
Buoy base	Tanjung Pinang	Benoa
	Semarang	
Open storage	Belawan	Palembang
	Tanjung Pinang	Semarang
	Tlk Bayur	

(2) Improvement

Item	DISNAV	
Buoy base	Tanjung Priok	Samarinda
Workshop	Surabaya	Palembang
		Samarinda
Storage	Tanjung Pinang	Benoa

Table 5.3.2. Supporting Facilities to be developed, rehabilitated and improved in proposed Priority Project

Item	Development	Rehabilitation	Improvement
Buoy Base	3 offices		2 offices
Open Storage	5 offices		
Workshop			3 offices
Storage			2 offices

6. Necessity and Justification of the Project

6.1. Current Situation of Operation and Maintenance for Aids to Navigati

6.1.1. Organization for the operation and maintenance

District of Navigation (DISNAV) is provided in **Appendix 4.1.1.**
Maintenance and operation of visual ATN are executed by nine (9) First Class and nine (9) Second Class and six (6) Sub Class District of Navigation Offices under the direct operational and administrative control of DGSC with the technical guidance of the Directorate of Navigation.

As for the maintenance of buoys, the whole sea area is presently divided into six (6) areas for the First Class DISNAV in order to execute the most effective operation of buoy in remote areas and high seas according to numbers of buoy tenders in operation. Second Class DISNAV s and Sub Class DISNAVs execute the regular maintenance work other than the large scale maintenance work, such as reparing work in buoy base.

6.1.2. Operation and maintenance working procedure

Lighthouses, light beacons and light buoys located in remote areas and high seas are serviced generally twice a year by buoy tenders and aids tenders for supply of necessities, checking of equipment and their maintenance. The ATN located near coasts and in ports are locally maintained using Inspection boats and so forth.

The maintenance works for buoy by buoy tenders are under the responsibility of First Class DISNAV. On the other hand, the regular checking and major repair works are under the all DISNAVs including Second Class and Sub DISNAVs.

The managements and coordination for the works executed by buoy tenders are provided as follows:

- Request of services by Second class and Sub Class DISNAV for the buoys within their responsible regions will be made to the First Class DISNAV, with information to be sent to DGSC.
- When the First Class DISNAV received the request of services, he will instruct their buoy tender to carry out necessary works.
- The ship carries out the works instructed.
- After completion of the works, the ship reports to the second or sub class DISNAV on the completion with the information to be sent to the first class DISNAV.
- Second and Sub Class of DISNAV reports to DGSC about the completion

of works with the information to be sent.

- If the First Class DISNAV should be unable to meet the request for service to be made by the Second or Sub Class of DISNAV, then the request is sent to the Maritime Safety Technology Center via DGSC with information sent to the Maritime Safety Technological Center.
- Maritime Safety Technology Center provides their ship with the instruction to carry out the works.
- The ship instructed to carry out the works, and reports the completion to the Second or Sub Class DISNAV with information sent to the Maritime Technology Center.
- The Second Class DISNAV of Navigation reports to DGSC regarding the completion of works with information sent to the first class DISNAV.

6.1.3. Personnel for maintenance

The boarding personnel engaged in the operation and maintenance of aids to navigation are provided from DISNAV.

6.2. Necessity of Visual Aids to Navigation and Supporting Facilities

6.2.1. Aids to Navigation

In this connection, as an indicator for the total number of coastal fixed light and floating light in Indonesia, the followings could be applied:

(1) Coastal fixed light to obtain the cross bearing

Approximate number of visual aids to navigation needed to obtain the cross bearing within 10miles off coast is assumed as follows:

Covering ranges of lighted aids are estimated as follows:

① Average range of major lights is assumed to be 20NM

② Average range of medium lights is assumed to be 12NM

③ Separation between lights is calculated as approximately 16NM ((20 + 12)/2).

④ When cross bearing is required at 10NM off coast, the separation between lights is approximately 12.49NM.

Therefore, the number of lights to be needed for cross bearing is given as follows:

$$\frac{\text{Total length of coastline}}{\text{Separation between lights}} = \frac{43{,}624\ \text{NM}\ *}{12.49\ \text{NM}} \qquad 3{,}493\ \text{units}$$

(Note: * source is Indonesian navy through DGSC)

(2) Floating lights for navigational channel

Approximate number of visual aids to navigation to be needed for

navigation channel is assumed as follows:

① Range of buoy is generally estimated as approximately 4NM.

② Total length of navigational channel is 2645NM*.

③ Average separation of floating lights is 2NM when overlap range of 50% is required

Therefore, the number of lights to be needed for channel is given as follows:

$$\frac{\text{Total length of channel}}{\text{Separation between lights}} = \frac{\text{2,645NM *}}{\text{2 NM}} \qquad \text{1,322 units}$$

(Note: * source is Indonesian navy through DGSC)

(3) Sufficiency ratio of the lights

The present sufficiency ratio of lights in Indonesia is estimated as follows:

$$\frac{\text{Total number of existing lights}}{\text{Aimed total number}} \times \quad 100\%$$

The calculated sufficiency ratio of lights is about 50% and 55% for fixed lights and floating lights respectively, based on total number of lighted aids in Indonesia.

The insufficient number of ATN have caused quite large loss of materials, ships and its cargo and human life as shown in **Table 3.6.1** of **Chapter 3**. Human loss and cargo loss has been increasing year after year from year 1993.

Therefore, the necessity of counter the above marine accidents and casualties preventing from re-occurring on a large scale, with the objective to minimize the possibilities of accidents, is becoming very urgent and very vital.

One of the major and effective countermeasures to avoid further unnecessary marine accidents is by improving the condition of the existing ATN and at the same time also increasing the quantities so that it would be able to effectively and safely increase the shipping navigation smoothness and safety.

6.2.2. Supporting Facilities

In this plan, periodical maintenance work is assumed to carry out four (4) times a year, to improve the reliability/availability of aids to navigation. And supply of material and relief of personnel is planned to execute 12 times a year.

Development and improvement plan of supporting facilities, such as

workshop, storage, buoy base and open storage area are included.

There are some DISNAVs who have no space to keep buoy bodies, although they are managing relatively a lot of buoys. Some other DISNAVs have space but too small, and one of other DISNAV has enough space to keep buoy body, but it submerges at high tide.

Therefore, to make a development and improvement plan, these conditions and the increase of buoys in future are taken into consideration.
The workshops of small area are planned to enlarge. The workshops without storage and the workshops whose tool and equipment are over-aged are planned to improve in early stage.

6.3. Introducing of the Light Dues

Considering the recent routine budgetary situation in Directorate of Navigation, it is scarcely expected to obtain the budget for new development, improvement and rehabilitation from general account. The actual budget from general account in 1999 was suppressed at about 35% of requested budget since the economic crisis aroused in 1998.

The light dues system was enforced in May 2000 and started to collect in June 2000 as a special account for supplement of budget.

The routine budget for operation, management and maintenance from general account has been extremely insufficient. The supplement budget from light dues will improve the budgetary situation for operation and maintenance and management.

7. Contents of the Project

7.1. Basic Concept of the Project

The proposed Priority Project of Aids to Navigation including Supporting facilities should be implemented based on the following basic concept:

- Compliance with International Standards and Indonesian Law
- Establishment of long-term operation
- Securing stable operation of system and easy maintenance
- Minimization of maintenance cost
- Consideration of environmental condition

- Rehabilitation and improvement for the existing aids to navigation system
- Maximal utilization of existing equipments and facilities
- Securing the stable operation and maintenance system
- Light buoys shall be short-tail type in order to utilize effectively the limited space of buoy tender with vertical holding position of buoys.
- Light beacons shall be required to use appropriate material in accordance with the height and the location of installation in consideration of both fabrication cost and installation cost.
- Mooring equipment for buoy shall be the standard length and diameter in order to meet the whole light buoys used now in Indonesia in consideration of sea condition.
- Lantern shall be tough in strength against the wind and wave pressures.
- Power source shall be easy in its maintenance in order to execute the efficient maintenance and operation and will be used such as solar panel and/or other natural energy in order to execute economically.
- Consideration of utilizing local products

7.2. Criteria for Site Selection

7.2.1. Development of ATN

In Priority Project, selection criteria of each visual ATN for development is decided as follows.

(1) Lighthouse

- To indicate dangerous shoals, sandbanks, rocks and so forth.
- To indicate a Line of Position (LOP).
- To indicate landfalls, headlands, entrance to estuaries or ports and so forth.

(2) Light beacon including leading light

- To mark a landfall position.
- To be a part of leading (range) lights.
- To mark an obstruction or danger in or near the route.
- To indicate the lateral limits of channel or navigable waterway.
- To indicate an area.
- To indicate a turning point or a junction of the waterway.
- To indicate the navigable channel.
- To indicate the deepest part of the waterway for deep draught vessels.
- To indicate the navigable channel where fixed and floating aids to navigation are not available.
- To provide safe approach to an entrance of harbor or river, particularly

where there are crosscurrents.

- To separate two way traffic.

(3) Light buoy

- To indicate lateral limit of channel or waterway.
- To indicate a navigational danger or hazard.
- To indicate an obstruction which can be dangerous to certain categories of navigation.
- To indicate a landfall position.
- To indicate the center of channel position.

7.2.2. Rehabilitation and Improvement of ATN

Selection criteria for rehabilitation and improvement of visual ATN are decided as follows.

- To confirm the actual conditions of visual ATN at several sites of each District of Navigation Offices (DISNAV/ Sub DISNAV).
- To confirm the current situation of visual ATN for sufficient service through discussion with the DISNAVs on survey.
- To study the result of Inventory prepared by the local consultant.
- To consider the improvement of availability and reliability of lighted ATN.

7.2.3. Supporting Facilities

Selection criteria for rehabilitation, improvement and development of supporting facilities are applied for workshop and buoy base as follows:

- To maintain the performance of visual ATN
- To repair the visual ATN
- To inspect normal operation of ATN
- To recover failure and malfunction of ATN
- To serve the works related to ATN services

7.3. Design Concept

7.3.1. Development of ATN

The standard composition of equipment and facilities for each lighted visual ATN are as follows:

(1) Lighthouse

- Area 5000 ㎡ with fencing
  (Reference: **Appendix 7.3.1.** to **Appendix 7.3.3.**)
- Housing Living quarters for five (5) families
  Powerhouse

- Equipment
  - Light tower — 40m above ground level
  - Lantern house
  - Lighting equipment
    - Main light — Rotating type lantern with controller
    - Emergency light — Flashing type lantern with controller
  - Power supply system:
    - for the lighting equipment — Solar system
    - for the living quarters — Engine generator

(2) Light beacon

- Area — 400 ㎡ with fencing (Except for offshore)
- Equipment
  - Light tower — 30m, 20m, or 10m above ground level depending on site
  - Lighting equipment — Flashing type lantern with controller
  - Power supply system: — Solar system

(3) Light buoy

- Floating equipment — 2.5m diameters for lateral mark; 3.5m diameter for safe water mark
- Lighting equipment — Flashing type lantern
- Power supply system — Solar system
- Mooring system — Chain of 32mm diameters for buoy of 2.5m float type; Chain of 38mm diameters for buoy of 3.5m float type
- Associated equipment — Top-mark, day-mark and Radar reflectors for lateral mark

(4) Light source for the lighting equipment

The light source for each type of lighting equipment is proposed in this plan as shown in **Table 7.3.1**.

The Light Emitting Diode (LED) is applied for the light source of light beacon 10m and light buoy because of its free maintenance and long lifetime.

Table. 7.3.1. Light Source of Each Type of Lighting Equipment

Type	Luminous Range	Light source
Lighthouse 40m Main light Emergency light	20 nautical miles at T=0.85 (7,790cd, or over) 18 nautical miles at T=0.85(4,143cd, or over)	Metal haloid, Halogen, or Incandescent lamp Metal haloid, Halogen, or Incandescent lamp
Light beacon 30m	18 nautical miles at T=0.85 (4,143cd, or over)	Metal haloid, Halogen, or Incandescent lamp
Light beacon 20m	15 nautical miles at T=0.85 (2,500cd, or over)	Metal haloid, Halogen, or Incandescent lamp
Light beacon 10m	10 nautical miles at T=0.85 (360cd, or over)	LED
Light buoy (Lateral, etc)	4 nautical miles at T=0.85 (21cd, or over)	LED
Light buoy (Safe Water Mark, etc)	6 nautical miles at T=0.85 (66cd, or over)	LED

7.3.2. Rehabilitation and Improvement of ATN

The contents for rehabilitation and improvement are classified into 3 types from the current status as follow.:

(1) Supply of lantern and power supply
(2) Repairing of structure
(3) Replacement of the system
(4) Considering the lightning attack
(5) Expansion of spare parts
(6) Utilizing natural energy such as solar cell

7.3.3. Supporting Facilities

Standard condition of supporting facilities is shown in **Table 7.3.2**.

Table 7.3.2. Standards for Facilities of Workshops and Buoy Bases

Name of Facility	DISNAV I Class I	DISNAV II / Sub DISNAV Class II
Open storage for Buoy	3000 ㎡	1000 ㎡
Open storage for moorings	200 ㎡	100 ㎡
Workshop	1000 ㎡	600 ㎡
Storage for Workshop	1000 ㎡	500 ㎡
Workshop Equipment	1 set *	1 set *
Jetty	80m	60m

Standard equipment of workshop necessary for ATN service is shown in **Table 7.3.3.**

Table 7.3.3. Outline of Workshop Equipment

No.	Equipment	Main Specification	Workshop Class I Quantity	Workshop Class II Quantity	B T K P Quantity
A	MACHINE TOOLS				
1	Lathe	2000 x 250 mm	2	1	1
2	Precision Lathe	400 x 50 mm	1	1	1
3	Universal Milling Machine	270 x 1350 mm	1	1	--
4	Vertical Milling Machine		1	--	--
5	Radial Drilling Machine	0 40 mm	1	--	--
6	Vertical Drilling Machine	0 25 mm	2	1	1
7	Bench Drilling Machine	13 mm	2	1	1
8	Shaping Machine	Stroke 500 mm	1	1	1
9	Hack Saw Machine	ö 350 mm	2	1	1
10	Bench Grinder	ö 250 mm,3000rpm	2	2	1
11	Bending Machine	1800 x 15 mm	1	1	1
12	Shearing Plat	1800 x 15 mm	1	1	--
13	Press Machine	25ton	1	1	1
14	Pipe Bender	ö 80 mm	1	1	1
15	Combined Punching And Shearing Machine	Thickness 16 mm ö 28 mm	1	1	--
16	Table Circular Saw	Min 100mm ,2800rpm	1	1	1
B	WOOD WORK MACHINE				
1	Wood Milling Machine	500 x 2000 mm	1	1	1
2	Wood Band Saw	500 x 2000 mm	1	1	1
3	Circular Saw	Table 220 mm	1	1	1
4	Wood Lathe	400 x 1000 mm	1	--	--
5	Multipurpose Wood Work Machine		1	--	--
6	Profile Wood Machine		1	1	--
7	Jig saw	220 - 400 V / 50 - 60 Hz	1	1	--
C	WELDINGS MACHINE				
1	Engine Welder	200 kVA, 300 A	3	2	1
2	Acetylene Gas Set	Complete set	2	1	1
3	Welding Transformer	16kVA, 260 A	2	1	1
D	MACHIN COMPRESSOR AND PUMP				
1	Blower	15M3 / min	3	2	1
2	Water Jet Pump	25 m , 10M3 / h	2	1	1
3	Mobil Air Compressor	8 ber / 102 Psi	1	1	--

No.	Equipment	Main Specification	Workshop Class I Quantity	Workshop Class II Quantity	B T K P Quantity
4	High Pressure Water Jet	1000 ber	1	1 *	--
* shows that it is planned only for DISNAV Palembang, Jayapura Sub DISNAV Pontianak, Merauke.					
E	HAND TOOLS				
1	Air Hammer	5 kg/cm2, 1500/min	2	1	--
2	Hand Pneumatic Chisel	5 kg/cm2, 1500/min	2	2	--
3	Hand Surface Chisel	0 150 mm, 3000 rpm	3	2	--
4	Hand Drilling	0-12 mm, 2600 rpm	3	2	1
5	Universal Hand Drill	0-25 mm, 250 rpm	2	1	1
6	Hand Circular Saw	0 270 mm, 3000rpm	2	1	1
7	Soldering	200 Watt	4	2	2
8	Hand Pneumatic Chipper	1/1,500 min 1.2 cbm/min	2	1	--
9	Spray Gun For Painting	0.6 ltr, 130-200 l/min	2	2	1
10	Hand Hack Saw	Length 300 mm	4	3	1
11	Magnetic base for dial gauge		2	1	1
12	Hand Surface Grinder	350 - 500 Watt	2	1	1
13	Accu-Drilling Machine	1 - 10 mm , 9 - 12 V	2	1	1
F	BENCH TOOLS				
1	Parallel Vice	100 x 200 mm	3	2	2
2	Steel Anvil	313 x 416 mm	4	2	1
3	Hammer for Smith Set	2.7 kg, 5.0kg	4	2	1
4	Hammer Set	Claw & Test Hammer	2	1	1
5	Tracker	No.1 - 6	2	1	1
6	Petroleum Oil Torch		2	1	1
7	Slide Hammer Puller Set	No.1 - 6	2	1	1
8	Pipe Cutter Set	ö 10 - 90 mm	2	1	1
9	Pipe Wrench	10 - 40 & 40 - 90 mm	2	2	2
10	Chain Thong	19 - 100 & 38 - 200 mm	2	2	2
11	Die Set	8 - 50 mm	2	2	1
12	File Set For Machinist	L=150 , 200 , 250	3	2	2
13	Adjustable Wrench	20 - 60 mm	4	3	2
14	Reamer Set Taper Shank Type	10- 45 mm	3	2	2
15	Wire Rope Cutter & Clamp Set	S/d 0 1,5 inc	2	1	1
16	Screw Driver Set	Complete set	4	2	2

No.	Equipment	Main Specification	Workshop Class Ⅰ Quantity	Workshop Class Ⅱ Quantity	B T K P Quantity
17	Socket Wrench	8 - 27 mm	3	2	2
18	Caliper Outside & Inside	150,300 mm	4	2	2
19	Tool Box	Complete set	4	2	3
20	Steele Compass	150,300,400 mm	3	3	3
21	Spanner Adjustable	0 - 30 mm,0 - 50 mm	2	2	2
22	Bearing Scrapper	Approx 80 x 16	2	2	2
23	Ideal Pattern Snip	260 R, 260L	2	2	2
24	Mechanical Tool Box	Complete set	2	2	2
25	Torque Wrench Set	20 – 120& 40 - 200 Nm	2	2	2
26	Locker		12	8	8
27	Monkey Wrench		3	2	2
28	Filter Wrench		2	1	2
29	Bearing Puller Set	Complete set	2	2	2
30	Work Bench	basic model	2	2	2
31	Steel Pipe Vices	up to 90 mm	2	1	1
G	TESTING AND MEASURING EQUIPMENT				
1	Vernier Caliper	150,300,mm	4	2	2
2	Outside Micrometer	0 - 100 mm	2	1	2
3	Tubular Inside Micrometer	25 – 300 mm	2	1	2
4	Ruler Set	30 - 60 mm	2	2	2
5	Hand Tachometer Contact and Non Contact	50 - 20.000 rpm	2	2	2
6	Digital Multimeter	0 - 2 k,0 - 25k	3	2	2
7	Vibrometer	10 - 1000 Hz	2	1	1
8	Megger Tester		2	1	1
9	Digital Thickness Gage		2	1	2
10	Fuel Injection Tester	Pressure test	1	1	1
11	Gas Pressure Indicator		1	1	1
12	GPS Receiver		1	1	1
13	Luminous Intensity		1	1	1
14	Hipendance Meter LCR		2	1	1
15	Dummy Load	10kW	1	1	1
16	Multi Meter		2	1	1
17	Solar Module Test	0.5 V - 0.5 A	1	1	1

No.	Equipment	Main Specification	Workshop Class I Quantity	Workshop Class II Quantity	B T K P Quantity
18	Battery Charger	DC 24 V 20A	1	1	1
19	Ultra. Thickness Gauge	0.5 - 500 mm	1	1	1
20	Thermometer Infrared		1	1	1
21	Digital Anemometer		1	1	1
22	Digital Barometer		1	1	1
23	Hair Hygrometer		1	1	1
24	Sound Level Meter		1	1	1
25	Digimatic Concrete Test Hammer		1	1	1
26	Tensile Strength Tester	5-1,000 kg	--	--	1
27	Impact Tester		--	--	1
28	Universal Testing M/C	10-200 ton	--	--	1
29	Earth Tester		1	1	1
30	PH Meter		1	1	1
31	Wet Film Thickness Gage		1	1	1
32	Ultrasonic Hardness Tester		1	1	1
H	ELECTRONIC EQUIPMENT				
1	Oscilloscope	min. 20MHz. 2-ch.	1	1	1
2	Voltmeter	300uV - 100V	1	1	1
3	Frequency Counter	10 Hz - 500 MHz	1	1	1
4	Regulated DC Power Supply	300V / 7A	1	1	1
5	Dipmeter (DIP Meter)	400 kHz - 200MHz	1	1	1
6	Function Power Meter	400 kHz - 200MHz	1	1	1
7	Digital Multimeter	1 M Ohm	3	2	2
8	Current Meter	250 A, DC/AC	1	1	1
9	Signal Generator	30 kHz - 40 MHz	1	1	1
10	TTL / CMOS Book		2	1	2
11	Electrician Tool Set	Complete set	4	2	2
12	EDM		1	1	1
13	Electronic Soldering Unit	150 - 450 deg C	4	3	3
14	Digital Clamp Meter AC/DC	up to 350A rasp. 750V	1	1	1
15	Insulation Tester	ACV and Ohm	1	1	1

No.	Equipment	Main Specification	Workshop Class I Quantity	Workshop Class II Quantity	B T K P Quantity
I	HANDLING EQUIPMENT				
1	Cain Hoist	1.5 Ton, 3 Ton	2	2	2
2	Electric Hoist	5 Ton	1	1	1
3	Overhead Traveling Crane	7.5 Ton	1	1	1
4	Fork Lift	7.5 Ton	2	1	1
5	Mobile Crane	10 Ton	1	1	--
6	Hydraulic Jack	30 Ton	1	1	1
7	Truck	7.5 Ton	1	1	--
8	Maintenance Car		1	1	1
9	Hydraulic Hand Pallet	2400 - 2600 kg	1	1	1
10	Traveling Unit Geared Trolley	min 5000 kg	1	1	--
11	Hydraulic Workshop Crane	900 - 1200 kg	1	1	--
J	GENERATOR SET ENGINE DIESEL				
1	Diesel Generator	55 kVA / 45 kVA	1	1	1
2	Mobile Generator	30 kVA	1	1	1

7.4. 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 1(one) month to be held in the manufacturer's country.

The number of personnel to be participating in the training is estimated to comprise of 1 from the management / inspectors, and at least one person from each site of the technicians. The details of training, such as time and costs are provided under maintenance training cost.

8. Result of the Feasibilities Study in Technical Aspect

8.1. Contents of the Study

The feasibility study for proposed Priority Project on Aids to Navigation including Supporting Facilities was made on the basis of the following:

(1) Rehabilitation and improvement of visual ATN

As a feasibility study for rehabilitation and improvement of ATN, confirmation of inventory was made, and some proposed location were confirmed through the field survey.

The study of inventory included the following items to check and confirm operation status and condition of equipment was made through inventory check.:

① Construction year and rehabilitation year
② Operation status (Light off / Light on)
③ Condition of lantern (Degrading, Malfunction and damaged)
④ Condition of power system (ditto)
⑤ Condition of light tower (Degrading, damaged and collapsed)
⑥ Other study was made through confirmation of DUP (Project proposal list)
⑦ Coordinate (Lat / Long)
⑧ Height of light tower
⑨ Energy source for light (Solar, Battery, Commercial power, etc.)

(2) Development of visual ATN

As a feasibility study for development of visual ATN, the following points were confirmed through the field survey:

① Condition of surrounding site by map survey
② Availability of raw construction materials
③ Availability of premises
④ Access to the site (including land, sea and air transportation)
⑤ Availability of commercial power source or natural energy
⑥ Coordinates by GPS
⑦ Availability of man power for construction works
⑧ Ground level
⑨ Ground water level
⑩ Depth of water by echo sounder
⑪ Light character of neighboring existing lights
⑫ Seabed substances
⑬ Obstruction of light
⑭ Marine casualties
⑮ Topographic condition

⑯ Sea condition
⑰ Tentative measurement of land for cost estimation
⑱ Accommodation facilities near the site
⑲ Transportation route and method
⑳ Features of soil

(3) Supporting Facilities

1) Workshop
① Area and space of existing facilities
② Availability of premises
③ Availability of commercial power source

2) Buoy base
① Area and space of existing facilities
② Availability of premises
③ Availability of commercial power source

8.2. Method of the Study

The feasibility study of a technical aspect was made for the development, rehabilitation and improvement of visual ATN and supporting facilities with the following method:

8.2.1. Rehabilitation and Improvement of ATN

The feasibility study on rehabilitation and improvement of ATN was made through confirmation and check of the inventory and data from DGSC such as project proposal list (DUP), and then confirmed through site survey and hearing for some sites. Items of Check List for these are given as follows:

① Construction year and rehabilitation year ( )
② Operation status ( ) *1
③ Condition of lantern (Degrading, Malfunction and damaged) (0 or1) *2
④ Condition of power system (ditto) (0 or 1) *3
⑤ Condition of light tower (Degrading, damaged and collapsed) (0 or 1) *4
⑥ Dup ( )
⑦ Coordinates (Lat / Long) ( )
⑧ Material of light structure ( )
⑨ Energy source for light (Solar, Battery, Commercial power, etc.) ( )

Note: *1 means that light off is “0” and Light on is “1”.
*2 , *3 and *4 means that equipment status was totally judged on the basis of condition of lighting equipment, condition of power supply, condition of light tower and operation status through referring project proposal list (Dup).

8.2.2. Development of Aids to Navigation

The feasibility study on development of ATN was made to confirm and check existing condition of the sites through Survey Sheet shown in **Appendix 8.2.1.**

① Condition of surroundings of site by map survey (Yes:No light within 10 NM for land fall mark/ No : Yes)
② Availability of raw construction materials (Yes / No)
③ Availability of premises (Yes / No / Under Confirmation)
④ Access to the site (including land, sea and air transportation) Difficult/ Accessible)
⑤ Availability of commercial power source (Yes / No)
⑥ Coordinates by GPS
⑦ Availability of man power for construction works (Yes / No)
⑧ Ground level (m)
⑨ Ground water level (m)
⑩ Depth of water by echo sounder (m)
⑪ Light character of neighboring existing lights (Yes / No)
⑫ Seabed substances ( )
⑬ Obstruction of light (Yes / No)
⑭ Marine casualties ( )
⑮ Topographic condition (± m)
⑯ Sea condition (Influence to construction works)
⑰ Tentative measurement of land for cost estimation (Area specified: Yes / No)
⑱ Accommodation facilities near the site (Yes / No)
⑲ Transportation route and method (Good / No)
⑳ Features of soil ( )

8.2.3. Supporting Facilities

The feasibility study on development, rehabilitation and improvement of supporting facilities was made through confirmation and check of the inventory and data from DGSC such as project proposal list (DUP), and then confirmed through site survey and hearing for some sites. Items of Check List for these are given as follows:

(1) Workshop

① Area and space of existing facilities (Yes / No)
② Availability of premise (Yes / No/ Under confirmation)
③ Availability of commercial power source (Yes / No)

(2) Buoy base

① Area and space of existing facilities (Yes/ No)

② Availability of premise (Yes /No)

③ Availability of commercial power source (Yes /No)

8.3. Schedule of the Feasibility Study

The feasibility study was made for "Aids to Navigation including Supporting Facilities" 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

Three (3) site survey teams of Aids to Navigation including Supporting Facilities of JICA Study Team visited Districts of Navigation offices and thier relevant sites on the feasibility study.
The site survey team consisted of three (3), that is Team I, Team II and Team III. Each team consisted of the Member of JICA Study Team and DGSC Counterpart.
The members of each site survey team are as follows:

- Team I: Mr. Kazuhiro Watanabe, Mr. Shintaro Hashimoto
  DGSC Counterpart
- Team II: Mr. Makoto Nikaido, Mr. Naoki Washiyama
  DGSC Counterpart
- Team III: Mr. Yasunobu Yamane,
  DGSC Counterpart

The site survey teams have surveyed on area of aids to navigation to be developed and several sites to be rehabilitated and improved.
That is;

- Team I: DISNAV Manado/ Bitung area, DISNAV Palembang Area and DISNAV Tg. Priok area
- Team II: DISNAV Tg. Pinang area, DISNAV Dumai area and Palembang area
- Team III: DISNAV Tg. Priok area, DISNAV Semarang area, DISNAV Surabaya area and DISNAV Benoa area

8.4. Result of the Study

8.4.1. ATN

(1) Rehabilitation & Improvement of ATN

On the rehabilitation and improvement of lighthouse, light beacon and light buoy, the current situation of existing lights are shown in **Table 4.2.3**., **Table 4.2.4.** and **Table 4.2.5.** in compliance with **Appendix 5.1.1.**, **Appendix 5.1.2.** and **Appendix 5.1.3**., respectively.

Each visual ATN is categorized into the following types of rehabilitation and improvement:

① Lighthouses

a. Type 1, whose light tower, lighting equipment and power supply systems are replaced in order to rehabilitate the system and improve the range of light. Civil work for foundation of light tower is required.
b. Type 2, which is the same as Type 1 above.
c. Type 3, whose lighting equipment and power supply systems are replaced in order to improve the range of light and light towers are repaired.
d. Type 4, whose light tower is repaired.
e. Type 5, whose lighting equipment and power supply system is replaced in order to improve the range of light.

Repair of light towers are included in installation works.
There are sufficient spaces to construct light towers newly for Type 1 and Type 2 above.

② Light beacons

a. Type 1, whose light towers, lighting equipment and power supply systems are replaced in order to rehabilitate and to improve the range of light. Civil work for foundation of light tower is required.
b. Type 2, whose lighting equipment and power supply systems are replaced in order to rehabilitate and improve the range of light and then light towers are repaired.
c. Type 3, whose light tower is repaired.
d. Type 4, which is the same as Type 2 above.
e. Type 5, which is the same as Type 2 above.
f. Type 6, which is the same as Type 3 above.
g. Type 7, whose lighting equipment and power supply systems are

replaced in order to rehabilitate and improve the range of light.

Repair of light tower is made in installation work.
There are sufficient spaces to construct light tower newly for Type 1 above.

③ Light buoys

a. Type 1, which is missing.
b. Type 2, whose lighting equipment is missing and buoy body is damaged by collision.
c. Type 3, which all components of light buoy are damaged by collision.
d. Type 4, whose degraded buoy body has reached to the end of lifetime (10 years) and lighting equipment and power supply system is replaced in order to improve the range of light.
e. Type 5, whose lighting equipment and power supply systems are good, but buoy body is damaged by collision. The lighting equipment and powder supply has been used as spare.
f. Type 6, whose degrading buoy body has reached the end of lifetime (10 years) and gas lantern is changed to electricity energy in order to improve the range of light.

These buoys are replaced with new buoys. However, reusable lighting equipment, power supply systems which are still in service and gas lantern will be used as spares for other existing light buoys.

(2) Development of ATN

① Lighthouses and light beacons

The feasibilities on construction of lighthouses and light beacons to be developed in the proposed Priority Project were confirmed in compliance with **Table 8.4.1.** and **Table 8.4.2.,** respectively.

Table 8.4.1. Check Sheet on Construction of Lighthouses to be developed

Item	LH1	LH2	LH3	LH4	LH5	LH6	LH7	LH8
①	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
②	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
③	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
④	A	A	A	A	A	A	A	A
⑤	No	No	No	No	No	No	No	No
⑥	GPS	GPS	GPS	GPS	GPS	GPS	GPS	GPS
⑦	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
⑧	51m	65m	15m	4m	50m	50m	2m	30m
⑨	>2m	>1m	NA	>2m	>1m	>2m	-2m	NA
⑩	Land	Land	Land	Land	Land	Land	Land	Land
⑪	No	No	No	No	No	No	No	No
⑫	NA	NA	NA	NA	NA	NA	NA	NA
⑬	No	No	No	Yes *1	No	No	No	No
⑭	Occurred	Occurred	Occurred	Occurred	Occurred	Occurred	Occurred	Occurred
⑮	± 1 m	± 1 m	Flat	Flat	± 1 m	± 1.5 m	Flat	± 1 m
⑯	Good	Good	Good	Good	Good	Good	Good	Good
⑰	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
⑱	No	No	No	Yes	Yes	No	Yes	Yes
⑲	Good	Good	Good	Good	Good	Good	Good	Good
⑳	Sandy Rock	Rock, Mud	Stone	Siol	Stone,Mud	Mud	Sand	Rock
Judge	F	F	F	F	F	F	F	F
Purpose	Land fall	Land fall	Land fall	Land fall	Land fall	Land fall	Land fall	Land fall

Note: "A" means "Accessible". "NA" means "Not applicable".

*1 shows that trees are able to cut down during construction work.

">2m " and ">1m" mean "No ground water below 2m or 1m".

"F" means "Feasible".

Items confirmed in **Table 8.4.1** comply with **Section 8.2.2.**

Well is available for LH4 and LH7, rainwater is available for LH1 to LH3 and LH5, LH6 and LH8. All lighthouses to be developed are usable as landfall mark.

Table 8.4.2. Check Sheet on Construction of Light Beacons to be developed

	LB1	LB2	LB3	LB4	LB5	LB6	LB7	LB8	LB9	LB10
①	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
②	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
③	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
④	A	A	A	A	A	A	A	A	A	A
⑤	No	No	No	No	No	No	No	No	No	No
⑥	GPS	GPS	GPS	GPS	GPS	GPS	GPS	GPS	GPS	GPS
⑦	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
⑧	Offshore	Offshore	Offshore	Offshore	Offshore	Offshore	Offshore	60m	Offshore	15m
⑨	NA	NA	NA	NA	NA	NA	NA	>1m	NA	>1m
⑩	-0.1m	4.6	4.4	1.4	0.5	0.8	0.8	NA	0m	NA
⑪	No	No	No	No	No	No	No	Yes *1	No	No
⑫	Sand	Mud	Mud	Mud	Clay	Clay	Rock	Soil	Rock	Rock
⑬	No	No	No	No	No	Yes *2	No	Yes *2	No	Yes *2
⑭	Occurred	Occurred	Occurred	Occurred	Occurred	Occurred	Offshore	Occurred	Occurred	Occurred
⑮	Offshore	Offshore	Offshore	Offshore	Offshore	Offshore	Offshore	± 2 m	Offshore	± 1 m
⑯	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good
⑰	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
⑱	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No
⑲	Good	Good	Good	Good	Good	Good	Good	Good	Good	A
⑳	NA	NA	NA	NA	NA	NA	Clay	Rock, Mud	NA	Rock, Mud
Judge	F	F	F	F	F	F	F	F	F	F
purpose	Iso. Danger	Lateral	Lateral	Lateral	Iso. Danger	Iso. Danger	Iso. Danger	Land fall	Iso. Danger	Lateral

Table 8.4.2. Check Sheet on Construction of Light Beacons to be developed

	LB11	LB12	LB13	LB14	LB15	LB16	LB17	LB18	LB19	LB20
①	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
②	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
③	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
④	A	A	A	A	A	A	A	A	A	A
⑤	No	No	No	No	No	No	No	No	No	No
⑥	GPS	GPS	GPS	GPS	GPS	GPS	GPS	GPS	GPS	GPS
⑦	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
⑧	30m	Offshore	Offshore	Offshore	Offshore	Offshore	Offshore	Offshore	Offshore	Offshore
⑨	>1m	NA	NA	NA	NA	NA	NA	NA	NA	NA
⑩	NA	4.1m	3.4m	2m	.9m	-0.1m	3.7m	1.1m	1.9m	-0.5m
⑪	No	No	No	No	No	No	No	No	No	No
⑫	Rock, Mud	Stone, Sand	Stone, Sand	Mud	Stone, Sand	Stone, Sand	Rock, Sand	Mud	Mud	Rock, Sand
⑬	Yes *2	No	No	No	No	No	No	No	No	No
⑭	Occurred	No	No	No	Occurred	Occurred	Occurred	Occurred	Occurred	Occurred
⑮	± 1 m	Offshore	Offshore	Offshore	Offshore	Offshore	Offshore	Offshore	Offshore	Offshore
⑯	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good
⑰	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
⑱	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
⑲	A	A	A	Good	Good	Good	Good	Good	Good	A
⑳	Clay	-	-	-	-	-	-	-	-	-
Judge	F	F	F	F	F	F	F	F	F	F
purpose	Lateral	Iso. Danger	Iso. Danger	Harber	Lateral	Lateral	Iso. Danger	Lateral	Lateral	Iso. Danger

Table 8.4.2. Check Sheet on Construction of Light Beacons to be developed

	LB21	LB22	LB23	LB24	LB25	LB26	LB27	LB28	LB29	LB30
①	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
②	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
③	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
④	A	A	A	A	A	A	A	A	A	A
⑤	No	No	No	No	No	No	No	No	No	No
⑥	GPS	GPS	GPS	GPS	GPS	GPS	GPS	GPS	GPS	GPS
⑦	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
⑧	1.5m	Offshore	Offshore	Offshore	Offshore	Offshore	Offshore	Offshore	Offshore	Offshore
⑨	>1m	NA	NA	NA	NA	NA	NA	NA	NA	NA
⑩	NA	2.1m	4.2m	2.2m	2.7m	2.2m	3.3m	4.1m	2.1m	3.2m
⑪	No	No	No	No	No	No	No	No	No	No
⑫	NA	Rock, Sand	Rock, Sand	Mud	Rock, Sand	Rock, Sand	Rock, Sand	Mud	Rock, Sand	Rock, Sand
⑬	No	No	No	No	No	No	No	No	No	No
⑭	Occurred	Occurred	Occurred	Occurred	Occurred	Occurred	Occurred	Occurred	Occurred	No
⑮	± 0.5 m	NA	NA	NA	NA	NA	NA	NA	NA	NA
⑯	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good
⑰	Yes	NA	NA	NA	NA	NA	NA	NA	NA	NA
⑱	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
⑲	Good	Good	Good	Good	Good	Good	Good	Good	Good	A
⑳	Soil	NA	NA	NA	NA	NA	NA	NA	NA	NA
Judge	F	F	F	F	F	F	F	F	F	F

Table 8.4.2. Check Sheet on Construction of Light Beacons to be developed

	LB31	LB32	LB33
①	Yes	Yes	Yes
②	Yes	Yes	Yes
③	Yes	Yes	Yes
④	A	A	A
⑤	No	No	No
⑥	GPS	GPS	GPS
⑦	Yes	Yes	Yes
⑧	1.5m	50m	4m
⑨	>1m	>1m	>2m
⑩	NA	NA	NA
⑪	No	No	No
⑫	NA	NA	NA
⑬	No	Yes *2	Yes *2
⑭	Occurred	Occurred	Occurred
⑮	± 1 m	± 1 m	± 1 m
⑯	Good	Good	Good
⑰	Yes	Yes	Yes
⑱	No	No	No
⑲	Good	Good	Good
⑳	Soil, Stone	Soil, Stone	Siol
Judge	F	F	F
purpose	Land fall	Land fall	Land fall

Note: "A" means "Accessible". "NA" means "Not applicable".
*2 shows that trees are able to cut down during construction work.
">2m " and ">1m" mean "No ground water below 2m or 1m".
"F" means "Feasible".
Items confirmed in **Table 8.4.2.** comply with **Section 8.2.2.**

② Light buoys

a. The following DISNAV/ Sub DISNAV are operating light buoys installed at approach channels to ports. The distance of light buoys is more than 6 nautical miles. It is necessary to decrease the distance of lights.

- DISNAV Belawan
- DISNAV Dumai
- DISNAV Tg. Pinang
- DISNAV Tg. Priok

- DISNAV Surabaya
- DISNAV Banjarmasin
- DISNAV Sorong

b. There is an insufficient spare buoy or no spare. The following DISNAV/ Sub DISNAV have sufficient space to store spare of buoy:

- DISNAV Belawan
- DISNAV Dumai
- DISNAV Tg. Priok
- DISNAV Surabaya
- DISNAV Banjarmasin

8.4.2. Supporting Facilities

(1) Rehabilitation & Improvement of workshop and Buoy base

It is confirmed that buoy bases and open storages to be rehabilitated and improved have feasibilities for proposed priority project.

Result of feasibility study for workshops and buoy bases to be rehabilitated and improved is shown in **Table 8.4.3.**

Table 8.4.3. Check Sheet for Improvement of Workshop and Buoy base

Improvement						
Item	Work shop				Buoy base	
	Dumai	Palembang	Surabaya	Samarinda	Tg. Priok	Samarinda
①	Yes	Yes	Yes	Yes	Yes	Yes
②	Yes	Yes	Yes	Yes	Yes	Yes
③	Yes	Yes	Yes	Yes	Yes	Yes
	F	F	F	F	F	F

Note: "F" means "Feasible".

Items confirmed in **Table 8.4.3.** comply with **Section 8.4.3.**

(2) Development of Storages, Buoy bases and Open Storages

It is confirmed that storages and buoy bases to be developed have feasibilities for Proposed priority project.

Result of feasibility study for buoy bases, workshops and storages to be developed is shown in **Table 8.4.4.**

Table 8.4.4. Results of Feasibility Study for Development of Storages, Buoy Bases and Open Storages

Development					
Item	Storage		Buoy base		
	Tg. Pinang	Benoa *2	Tg. Pinang *1	Benoa *2	Semarang
①	Yes	Yes	Yes	Yes	Yes
②	Yes	Yes	Yes	Yes	Yes
③	Yes	Yes	Yes	Yes	Yes
	F	F	F	F	F
Development					
Item	Open storage				
	Belawan	Palembang	Tg.Pinang *1	Semaran	Tlk Bayul
①	Yes	Yes	Yes	Yes	Yes
②	Yes	Yes	Yes	Yes	Yes
③	Yes	Yes	Yes	Yes	Yes
	F	F	F	F	F

Note: "F" means "Feasible".
*1 shows that buoy base, etc. planned at DISNAV Tg. Pinang in the Priority Project is on going.
*2 shows that land acquisition will be available for land under reclamation by PELINDO III.
Items confirmed in **Table 8.4.3.** comply with **Section 8.2.3.**

8.4.3. Confirmation of Workload for Visual Aids to Navigation in each DISNAV/Sub DISNAV

In this feasibility study, workload of aids to navigation on vessel was examined in order to confirm the feasibility of the proposed priority project.

Result of the study on workload of the vessels for aids to navigation services is described in **Chapter 10, Section10.3.** in this feasibility study report.

As a result of the survey, four (4) times per year of periodical routine maintenance for light buoy and light beacon are applicable for maintenance of unmanned light by using existing vessels, subject to their rehabilitation and change of homeport in order to improve an availability/ reliability of visual aids to navigation.

9. Executing Agency of the Project

For the implementation of the project under the scope of implementation program that will be separately prepared, MOC with all its related subordinate agencies would be directly involved and play very important role and function.

The subordinate agencies under the MOC related to this project are DGSC.

(1) DGSC

The DGSC is the organizational and functional implementing agency under the MOC.

The DGSC further comprises:

① Secretariat Office of the Directorate General
② Directorate of Sea Traffic and Transportation
③ Directorate of Shipping
④ Directorate of Ports and Dredging
⑤ Directorate of Navigation
⑥ Directorate Maritime Services
⑦ Directorate of Sea and Coast Guard

Furthermore, the Districts of Navigation comprising First Class, Second Class and Sub Class being 9 of the First Class and 9 of the Second Class and 6 of the Sub Class, are controlled and coordinated by the DGSC of MOC with technical guidance and supervision by the Directorate of Navigation.

The Districts of Navigation, that is First Class, Second Class and Sub Class, are as shown in **Figure 9.1.**

(2) Directorate of Navigation

The Directorate of Navigation is one of the six Directorates, along with the Secretariat Office of Directorate General, whose main responsibilities are to execute part of the main duties of DGSC in the field of navigational matters in line with the policy of DGSC, and more specifically, among those responsibilities included in their main duties are:

① To manage the navigational aids and coastal light facilities in order to secure navigation safety at sea, off-shore and in the harbors.
② To manage electronics and telecommunications between ships and coast-stations so as to secure maximum safety of human lives and ships including the cargoes and the internal communication of the Directorate General.

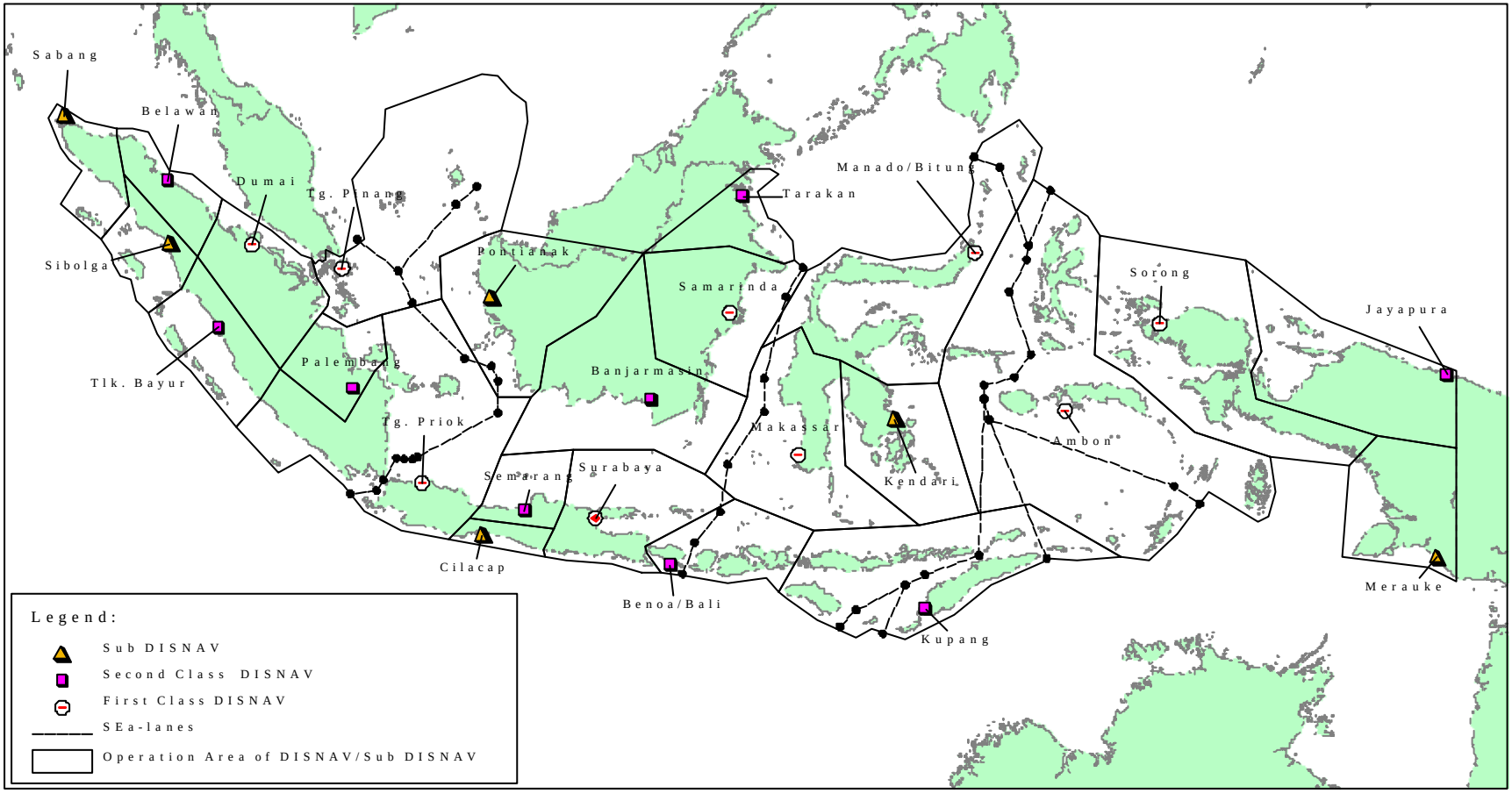
The District of Navigation Offices comprise, each of the 24 District of Navigation Offices as reflected on the Map of the District Office of Navigation shown in **Figure 9.1.** which indicates 9 First Class, 9 Second Class and 6 Sub Class Districts.

(3) Consulting Services

A professional consulting firm should be utilized for the purpose of providing the required procurement/ tendering procedures in line with the Government's Policy and for the preparation of all required consulting services for the project implementation.

Further engineering services are required for marine construction works for jetties.

Figure 9.1. Operation Area of each District of Navigation (DISNAV/Sub DISNAV)



10. Study related to the Project

10.1. Atmospheric Transmission Factor

The maximum distance from the illuminant that the ship's navigator can observe the light is the visual range. This is based on two factors.

One is because light is interrupted by the surface of the earth and it stops being within eyes of the navigator. This is geographical range.

As for one of others, it is because light diffusion due to an extinction and absorption in the atmosphere and stops being impressed in the eyes of the navigator. This is luminous range.

The luminous range is decided by the next factor.

① The intensity of aids to navigation light.
② The degree of the atmosphere muddiness.
③ The condition of the background of aids to navigation light.
④ The condition of the observatory (the navigator).

All isn't fixed except for the intensity of aids to navigation light, and it changes by weather, area and time others.

Therefore, it is difficult to find an optical distance to comply with these all.
Because it is calculated method of it in 3 elements is taken by the luminous intensity of the practical light, the limited atmosphere transmission factor and of the stage value of the absolute luminance threshold.

As for absolute luminance threshold is difficult to limit numerical value changes by at noon, night, each background condition, the optical color of the light, a difference of navigator, measurement condition and of others.

As for this value for convenience' sake is being given to 1×10^{-3}lx in the daytime and 2×10^{-7}lx at night by the IALA.

An atmospheric transmission factor changes greatly by the weather condition, followed by an optical distance change.
Optical distances decrease rapidly when an atmospheric transmission factor lowers.

At this time, there is no much effect even if the intensity of light of the illuminant is enlarged.

Like this, an atmospheric transmission factor makes an optical distance change greatly.

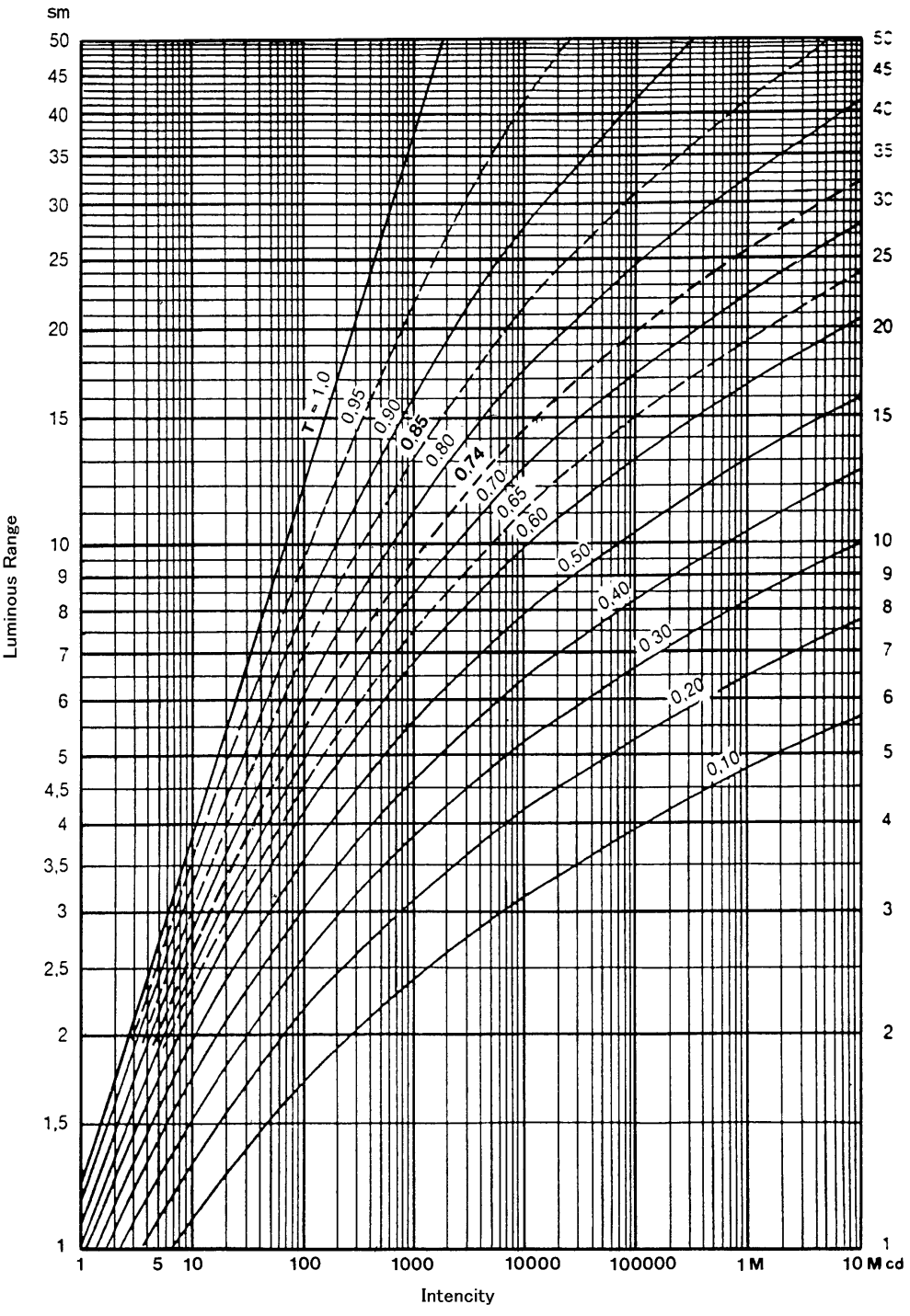
IALA takes 10 nautical miles (in satisfactory the atmospheric transmission factor 0.74) as standard visibility, and each of the world countries uses this value dealing with a luminous range.
JCG (Japan Coast Guard) adopts an atmospheric transmission factor 0.85.

This atmospheric transmission factor was decided as a result of measuring in the past 30 years of the weather station of each place in Japan.

An equation is shown below.
$E=(I \cdot T^{d})/d^{2}$
E : Absolute luminance threshold (n.m. Candela s.m.c)
$(2 \cdot 10^{-7}$ lx=0.686 s.m.c)
I : Luminous intensity of light (cd)
T : Atmospheric transmission factor
d : Luminous range (n.m.) d is shown in **Figure 10.1.1.**

Or
$I=3.43 \cdot 10^{6} \cdot E \cdot d^{2} \cdot T^{-d}$
E : Absolute luminance threshold (lx)
I :Luminous intensity of light (cd)
T : Atmospheric transmission factor
d : Luminous range (n.m.)

Figure 10.1.1. Luminous Range



10.2. Study on Materials for the Light Tower of ATN

10.2.1. Purposes of Study

As a result of site survey, it is found that many light towers have collapsed for the short period in comparison with the expected lifetime.

The light tower, which occupies a considerable ratio of the project cost, is a large factor to be studied for the development and improvement of aids to navigation.

In this study, the study was made for the following five (5) materials:

- Reinforced Concrete Tower
- Steel Lattice Tower
- Cast Iron/Steel
- Glass Reinforced Plastic (GRP)
- Aluminum Alloy

10.2.2.Comparison of Materials

Materials to be used for the light towers for the aids to navigation were compared with each other, and the result is summarized in the**Table 10.2.1.**

Table 10.2.1. Comparison of Materials

		Materials				
		Mild Steel (SS400)	Cast iron (FCD450)	Reinforced Concrete	GRP (MIL 4 Class)	Aluminum Alloy (A5083)
①	Density (t/m^3)	7.85	7.1	2.4	1.6	2.72
②	Allowable Stress (Mpa)	137	137	20	26	84
③	Specific Tensile Strength (Mpa / t/m^3)	17.4	19.2	8.3	16.2	30.8
④	Corrosion	0.1 mm/year	Better than mild steel	Degrading of reinforcing bar	NA	1μm/year
⑤	Degradation	NA	NA	Deterioration of strength	Deterioration of strength	NA
⑥	Conductivity	Conductive	Conductive	Insulative	Insulative	Conductive
⑦	Marketability	Easily available le	Ordinary	Easily available	Ordinary	Ordinary
⑧	Quality Control	Easy Hot-dip galvanizing	Casting Mould	Blending Construction at site Ageing	Forming	Welding
⑨	Anti-rusting (corrosion-resisting weather proofing)	Hot-dip galvanizing	Painting	Admixture	UV ray absorbent	To avoid the contact of different metals
⑩	Maintenance	Rust proofing	Painting	Repairing	Painting	Painting
⑪	Ability of Reutilization	Applicable	Applicable	Applicable	Difficult	Applicable

(1) Density

Density means the mass (t) of materials per m^3. All over the above-mentioned table, GRP is the most advantageous in mass.

(2) Allowable Stress

Allowable Stress means the strength of materials. All over the above-mentioned table, Mild Steel and Cast iron is the most advantageous in strength.

(3) Specific Tensile Strength

Specific Tensile Strength means the ratio of the intensity of material and its mass. The higher the value is, the lighter and the tougher it is, and when horizontal force is received as external force and an inertia moment is arisen, it shows that it is advantageous in strength. (An earthquake etc. can be mentioned as an example of external force.)

(4) Corrosion

Corrosion means the corrosion rate in the air at the seaside.

As for ferroconcrete, the inner reinforcing bars will be corroded in the ambient environment and it leads to cause cracking on the concrete.

In case of aluminum alloy (A5083), the data about depths of corrosion and pitting of aluminum alloy that are exposed to the air for 10 years are stated in ‘ Aluminum Handbook ’issued by Japan Light Metal Association, an incorporated association, and its depth of corrosion is 1.0 μm in average at oceanic atmosphere (on an ocean vessel) and is 0.43 μm in average at the seaside. Therefore, aluminum alloy is considered as what hardly carries out corrosion and the same can be said to GRP.

(5) Degradation

GRP has strength reduction under the influence of an ultraviolet ray. In case of GRP, it has the so-called chalking phenomenon in which a surface color deteriorates by the ultraviolet ray. Usually, the limit of anti-color deterioration is about two years.

From the graph of weather resistance of GRP by outdoor exposure for 4 years〔it is based on ‘Reinforced Plastic Handbook’ of Kyouka Plastic Gijutsu Kyokai (the Reinforced Plastic Technical Association) 〕, it is presumed that the strength deterioration of GRP becomes about 75 - 80% of initial intensity in ten years. Moreover, it is also reported in FRP Manual that the decrease of bending strength would appear by natural exposure in 2 to 3 years. In addition, though the initial intensity can be strengthened by changing glass content, the wall thickness needs to be increased in order to maintain the required strength.

(6) Conductivity

Mild steel and Aluminum are good electric conductors, and Concrete and

FRP are insulators. If Concrete, which is a conductor, is struck by a direct lightning, it suffers external damage which causes the strength reduction. As GRP is a character to be easily charged, it may affect the apparatus or human body by static electricity when it is considered as the material of Light Tower. Moreover, compared with electric conductor, grounding is difficult and it especially requires cautions in an area with many lightning. On the other hand, Mild Steel and Aluminum will, though they may receive damage by direct lightning, receive almost no external damage as Concrete and they are effective to lightning since grounding is easy.

(7) Marketability

The assign ability as the material (the easiness of acquisition) is shown herewith.

(8) Quality Control

① Mild Steel

As the welding may cause strength reduction by stress concentration etc. and may affect the durability, the construction should be carried out in suitable environment by qualified workers who own predetermined technology. Although the hot-dip galvanizing is effective to anti-rusting, it is important to have construction management such as the preparation of base metal surfaces, the film thickness, etc. in galvanizing processing since sufficient effect may not be acquired due to its construction and the durability may be affected.

② Cast iron

The cast iron may have foam by mixed rate of materials, temperature control and so forth. It may be affect to lifetime.

Mold necessary for cast iron requires high accurate and high skill workers.

③ Concrete

As for the construction of concrete, there are many matters, such as mixing of materials, ageing after casting of concrete, etc. which are originated in the site. As there may be changes in the strength or deterioration speed which may cause the durability of concrete in its construction works, and as the period of construction works may be affected by the weather conditions at the site, it is important to appropriately manage the construction works at the site.

④ GRP

Although the forming of GRP is done by hand lay-up, GRP may easily have unevenness in the strength and the durability may be affected by such unevenness. Therefore, it is important to appropriately manage

the construction works in the thickness, evenness of figuration, etc.

⑤ Aluminum Alloy

The matters related to welding are the same as in the case of Mild Steel.

(9) Anti-rusting (Anti-corrosion, Weather Resistance)

① Mild Steel

There is a hot dip galvanizing processing as Anti-rusting processing which can delay the corrosion speed of mother metal.

② Cast iron

Cast iron requires painting periodically to protect a rust on surface.

③ Concrete

As corrosion of concrete, there is corrosion of reinforcing bars, which is generated by its environment, mixing of materials and ingredients. Though this corrosion can be prevented by mixing the admixtures in compliance with the environment they are used and by adjusting the ingredients, the admixtures shall be decided by checking, actual results in the past, etc., in compliance with the environment they are used.

④ GRP

There are processes to apply ultraviolet ray-proof clear resin, etc. in order to mitigate the influence by ultraviolet ray on GRP. The durability against color fading can be extended from approx. 2 years to approx. 5 years by adopting this processing.

⑤ Aluminum

In case of aluminum, when a different metal is contacted, the contact corrosion current produced by the potential difference between metals flows and the corrosion is generated on aluminum. This corrosion can be prevented by insulating aluminum from different metal and can be prevented by using paint and insulating material.

(10) Maintenance

① Mild Steel

As steel can be easily corroded, it is necessary to control it by maintaining the rust proofing processing. As zinc itself can be corroded and the corrosion can be generated on galvanized steel due to the variation of quality at the time of galvanizing or peeling off caused by external force, the early detection of corrosion generating and rust proofing treatment are necessary, and steel is necessary to be replaced in order to maintain the initial strength.

② Cast iron

Cast iron requires painting periodically to protect a rust on surface.

③ Concrete

Concrete needs to be controlled in order to decrease the strength

reduction due to external force or ageing. As corrosion on internal reinforcement bars and strength reduction of concrete will progress when cracks are occurred due to external force or ageing, the early detection of corrosion generating and repairing are necessary. However, it is difficult to maintain the initial strength even though the decreasing of progress can be expected by repairing.

④ GRP

GRP needs to be controlled in order to decrease the affect by ultraviolet ray. Though there are color fading and strength reduction of GRP as the affects by ultraviolet ray, it is necessary to apply ultraviolet ray-proof resin, repaint or replace at regular interval, because either one can be judged only by the change of appearance.

⑤ Aluminum

Aluminum needs to be controlled in order to maintain the processing against the corrosion by different metal contact. It is necessary to repaint or replace insulating material in regard to repainting or using insulating material.

(11) Availability of re-utilizing of materials

Materials other than GRP are easy to re-utilize for the material for second production. GRP is improper to reutilize for the second production.

10.2.3. Comparison of Light Tower

The study on the comparison of the light tower made by five (5) materials is shown in **Table 10.2.2**. They are shown in **Appendix 10.2.1.～10.2.17.**

Table 10.2.2. Comparison of Light Tower by Materials

Item	RC	Cast Iron	GRP	Aluminum Alloy	Steel Lattice
	Concrete Foundation				
Structure	Shell				Open
	One body	Assembling			
Height	◎	◎	△ (～10m)	◎	◎
Degree of Protection	◎	◎	○	◎	△
Security	◎	◎	○	◎	△
Anti-lightning	△	○	△	◎	◎
Effectiveness as daymarks	◎	◎	◎	◎	○
Easiness of rehabilitation	○	△	○	○	○
Construction methods	Full on site	On site assembling after manufacturing			
Easiness to transport	○	△	◎	◎	○
Easiness of treatment	○	△	◎	◎	○
Affect by weather, etc	○	○	◎	◎	◎
Construction Period	△	△	◎	◎	◎
Installation Method	One body	Installed by anchor bolts on concrete base			
Availability of shift	NA	△	◎	◎	◎

◎：excellent ○：Good △：common

Table 10.2.3. Assumed Lifetime and Maintenance Interval by Repair and Rehabilitation

Item	Cast	RC	Lattice	Aluminum	GRP
Rehabilitation frequency Major Item					
Every 3 years	—	—	—	—	Repainting
Every 5 years	Repainting	Repainting	Repainting, Replace of parts	—	Repair, Rehabilitation
Every 10 years	—	Repair, Mortared	—	—	—
Every 15 years	—	—	—	Repainting	—
Lifetime	> about 100	About 50～70	About 30	About 50	About 15

10.2.4. Comparison of Cost

The comparison of costs are made according to the following conditions:

① Evaluation period : 50 years

② Maintenance costs are included

The comparison of costs are evaluated based on the initial cost and running cost.

Table 10.2.4. Comparison of Cost

Unit: US$

	Cast Iron	RC	Aluminum Alloy	G. Steel Lattice	GRP
1. Summary of Comparison on Initial Cost and Maintenance Cost for Light Tower (10m)					
(1) Initial Cost					
a. Light Tower	168,076	29,840	117,307	35,600	20,307
b. Foundation	8,769	17,120	4,846	7,520	4,846
c. Transportation(out)	9,230	0	9,230	14,400	9,230
d. Transportation(in)	2,384	2,560	1,153	2,160	769
Sub Total of (1)	188,459	49,520	132,536	59,680	35,152
(2) Maintenance Cost					
a. 0～10	1,615	4,560	769	3,520	3,230
b. 11～20	2,692	15,760	2,461	8,480	46,692
c. 21～30	2,692	22,800	6,615	12,480	7,461
d. 31～40	2,692	34,400	9,769	121,040	70,692
e. 41～50	2,692	50,960	14,384	27,360	96,538
Sub Total of (2)	12,383	128,480	33,998	172,880	224,613
Total (1) + (2)	200,842	178,000	166,534	232,560	259,765
2. Summary of Comparison on Initial Cost and Maintenance Cost for Light Tower (20m)					
(1) Initial Cost					
a. Light Tower	1,372,769	36,080	231,461	61,040	
b. Foundation	19,692	43,680	12,000	13,200	
c. Transportation(out)	37,692	0	13,846	21,600	
d. Transportation(in)	5,615	4,640	2,846	3,120	
Sub Total	1,435,768	84,400	260,153	98,960	
(2) Maintenance Cost					
a. 0～10	9,000	5,200	769	5,360	
b. 11～20	16,307	17,520	3,384	13,280	
c. 21～30	16,307	25,440	9,076	19,520	
d. 31～40	16,307	38,400	13,384	196,800	
e. 41～50	16,307	56,880	19,769	42,800	
Sub Total of (2)	74,228	143,440	46,382	277,760	
Total (1) + (2)	1,509,996	227,840	306,535	376,720	
3. Summary of Comparison on Initial Cost and Maintenance Cost for Light Tower (30m)					
(1) Initial Cost					
a. Light Tower	2,049,846	56,960	546,692	92,320	
b. Foundation	36,307	52,480	18,538	18,720	
c. Transportation(out)	53,846	0	21,538	33,600	
d. Transportation(in)	10,230	6,400	4,692	4,240	
Sub Total	2,150,229	115,840	591,460	148,880	
(2) Maintenance Cost					
a. 0～10	15,538	7,280	846	7,280	
b. 11～20	28,076	23,280	4,769	18,160	
c. 21～30	28,076	33,920	12,769	26,800	
d. 31～40	28,076	50,960	18,846	292,960	
e. 41～50	28,076	75,360	27,923	58,800	
Sub Total of (2)	127,842	190,800	65,153	404,000	
Total (1) + (2)	2,278,071	306,640	656,613	552,880	
4. Summary of Comparison on Initial Cost and Maintenance Cost for Light Tower (40m)					
(1) Initial Cost					
a. Light Tower	2,775,923	76,000	826,538	137,120	
b. Foundation	71,538	65,600	39,230	27,200	
c. Transportation(out)	76,923	—	36,923	57,600	
d. Transportation(in)	18,692	8,800	10,000	6,080	
Sub Total	2,943,076	150,400	912,691	228,000	
(2) Maintenance Cost					
a. 0～10	22,538	9,360	846	10,960	
b. 11～20	41,000	28,960	6,076	27,920	
c. 21～30	41,000	42,400	16,384	41,200	
d. 31～40	41,000	63,440	24,307	450,720	
e. 41～50	41,000	93,920	35,923	90,320	
Sub Total of (2)	186,538	238,080	83,536	621,120	
Total (1) + (2)	3,129,614	388,480	996,227	849,120	

10.3. Work Load of the Vessels for ATN Services

Basic criteria for workload calculation for visual aids to navigation service are as follows:

Workload = F × {A + SP + (L / 24 × V) + PO } + Work at Site + 10% Margin

Each factor is specified as shown in **Table 10.3.1.**

Table 10.3.1. Definition of Each Factor for Work Load Calculation

	Class I and II	Class III and IV	Average
F : Frequency of Sailing	See Below		
A : Arrangement	3 day	1 day	2 days
SP : Sailing reparation	6 days	2 day	4 days
L : Route Distance			
V : Ship Speed	10 knots	8 knots	9 knots
PO : Post Operation	3 days	1 day	2 days

	Class	Sailing Frequency
Frequency of Sailing		
Buoy Tender Vessel	Class I	Min. 4 Times Annually
Aids Tender Vessel	Class I,II,III&IV	12 Times Annually
Inspection Boat	Class III&IV	Min. 8 Times Annually

Visit to site for Lighthouse is minimum 12 times in a year.
Visit to site for Light Beacon and Light Buoy is minimum 4 times in a year
Annual workdays of vessels are shown in **Table 10.3.2.**

Table 10.3.2. Work Days of Vessels for ATN Service

Item of Work Days	Buoy Tender and Aids Tender	Inspection Boat
Ship sailing days per vessel	215 days annually	245 days annually
Ship staying days in base	90 days annually	90 days annually
Docking days	60 days annually	30 days annually

Number of visit per year and number of sites to visit in a day is shown in **Table 10.3.3.**

Table 10.3.3. Number of Visit per year and Visiting sites in a Day

Criteria of Calculation	Number of visit per year (Time/Year)	Visiting sites in a day (Sites/day)
Light House		
Logistic Support (Stock Supply and Relief)	12	4
Major Maintenance (Overhaul)	1/4	1
Light Beacon		
Standard Maintenance	4	4
Major Maintenance (Overhaul)	1/4	2
Light Buoy		
Standard Maintenance	4	4
Major Maintenance (Overhaul)	1/4	3
Replace of Buoy	1/2	4

The workdays of vessels calculated with these new criteria and the numbers of vessels required at the year of 2007 and 2020 is shown in **Appendix 10.3.1., Appendix 10.3.2.** and **10.3.3.**

On this time, about sixty-three (63) units of vessels for aids to navigation service are required in minimum at the end of this plan, taking into account the load of vessels, which is expected to increase of present status, up to the year of 2020.

In consideration with scrap and rehabilitation plan shown in Appendix **10.3.4.**, number of vessels to be required for aids to navigation services up to 2007 and 2020 is shown in **Table 10.3.4.** and **Table 10.3.5.**, respectively.

Table 10.3.4. Vessels to be required up to Year of 2007

No.	ATN Office	Class	Number of Vessels available for ATN Services up to 2007									Number of Vessels to be required for ATN Services up to 2007				
			S/V	B/T	A/T			I/B			Total	S/V	B/T	A/T	I/B	Total
					A/T	A/T*	Sub-total	I/B	I/B*	Sub-total						
1	SABANG	Sub			2		2			0	2			1	1	2
2	BELAWAN	II			2	1	3			0	3			1	1	2
3	SIBOLGA	Sub			1		1			0	1			1	1	2
4	DUMAI	I		1	2		2	1		1	4		1	1	1	3
5	TG. PINANG	I		1	3		3	1		1	5		1	1	1	3
6	TLK. BAYUR	II			1		1			0	1			1	1	2
7	PALEMBANG	II				2	2	1		1	3			1	1	2
8	TG.PRIOK	I			4	1	5			0	5		1	1	1	3
9	SEMARANG	II			1	2	3			0	3			1	1	2
10	CILACAP	Sub			2		2			0	2			1	1	2
11	SURABAYA	I		1	1		1	1		1	3		1	1	1	3
12	BENOA	II			1	1	2			0	2			1	1	2
13	PONTIANAK	Sub				1	1	1		1	2			1	1	2
14	BANJARMASIN	II			1		1	2		2	3			1	1	2
15	SAMARINDA	I		1	1		1	1		1	3		1	1	1	3
16	TARAKAN	II				1	1			0	1			1	1	2
17	BITUNG	I			2	1	3			0	3			2	1	3
18	KENDARI	Sub					0			0	0			1	1	2
19	MAKASSAR	I			1	2	3			0	3			1	1	2
20	KUPANG	II			1		1			0	1			1	1	2
21	AMBON	I			1		1			0	1		1	1	1	3
22	JAYAPURA	II			2		2	1		1	3			1	1	2
23	SORONG	I		1	1		1			0	2		1	1	1	3
24	MERAUKE	Sub			1		1	1	1	2	3			1	1	2
25	BTKP	---	1	1			0			0	2	1		1		2
Total			1	6	31	12	43	10	1	11	61	1	7	26	24	58

	S/V	B/T	A/T	I/B	Total
Number of Vessles to be developed by 2007	0	3	4	0	7

Note:

S/V: Survey Vessel
B/T: Buoy Tender
A/T: Aids Tender
I/B: Inspection Boat
* shows vessel that scrapping should be postponed until year of 2007 at least.

Table 10.3.5. Vessels to be required up to Year of 2020

No.	ATN Office	Class	Number of Vessels available for ATN Services up to 2020					Number of Vessels to be required for ATN Services up to 2020				
			S/V	B/T	A/T	I/B	Total	S/V	B/T	A/T	I/B	Total
1	SABANG	Sub			1		1			1	1	2
2	BELAWAN	II			1		1			1	1	2
3	SIBOLGA	Sub			1		1			1	1	2
4	DUMAI	I			1		1		1	1	1	3
5	TG. PINANG	I		1	2	1	4		1	1	1	3
6	TLK. BAYUR	II			1		1			1	1	2
7	PALEMBANG	II					0			1	1	2
8	TG.PRIOK	I			2		2		1	2	1	4
9	SEMARANG	II			1		1			1	1	2
10	CILACAP	Sub					0			1	1	2
11	SURABAYA	I		1	1		2		1	1	1	3
12	BENOA	II			1		1			1	1	2
13	PONTIANAK	Sub					0			1	1	2
14	BANJARMASIN	II				1	1			1	1	2
15	SAMARINDA	I		1	1	1	3		1	1	1	3
16	TARAKAN	II					0			1	1	2
17	BITUNG	I			1		1		1	2	1	4
18	KENDARI	Sub					0			1	1	2
19	MAKASSAR	I			1		1		1	1	1	3
20	KUPANG	II			1		1			2	1	3
21	AMBON	I			1		1		1	2	1	4
22	JAYAPURA	II			1		1			1	1	2
23	SORONG	I		1	1		2		1	1	1	3
24	MERAUKE	Sub			1		1			1	1	2
25	BTKP	---	1				1	1		1		2
Sub-total			1	4	20	3	28	1	9	29	24	63
Number of Vessels to be developed by 2007			0	3	4	0	7					
Total			1	7	24	3	35					

	S/V	B/T	A/T	I/B	Total
Number of Vessels to be developed by 2020	0	2	5	21	28

Note:

S/V: Survey Vessel
B/T: Buoy Tender
A/T: Aids Tender
I/B: Inspection Boat

11. Effects of the Project

(1) Decrease in marine casualties

The development and improvement of ATN will have remarkable effects on preventing marine accidents, especially grounding among other accidents.

The most substantial impacts are as follows:

① Decrease in human casualties

② Decrease in casualties of ships and cargos

③ Mitigation in work load of ship's crew

④ Easy traffic control of ships

(2) Increase in transportation capabilities due to improvement in navigation efficiency

The development and improvement of ATN will enable ships, large to small, to have accurate positioning, by means of which correct heading may be maintained, and will facilitate their easy navigation in the waters.

It is expected that this will bring about an increase in ships transportation capabilities and cost saving in fuel and other operation costs.

(3) Improvement of productivity in maritime fishery

The development and improvement of ATN will make it possible to increase in time the cruising opportunities, to facilitate locating fishing grounds and thus making available more time for fishing operation through mileage saving to the grounds, which consequently lead to an improvement in productivity of maritime fishery as a whole.

(4) Socio-economical effect

① Development of national economy and industry through efficient sea transportation and expansion of transportation capabilities, and increase in opportunities for employment deriving there from

② Balancing of local social and economical gaps, improvement of distribution mechanism, and improvement of national life due to cost stabilization deriving from furtherance of the local development through smoothing distribution goods.

(5) Other effects

There are other effects considered to stem from the development and improvement of ATN.

① Modernization of electronic industry

Introduction of electronic technique and engineering into ATN will

eventually necessitate development of domestic electronic industry.

② Furtherance of exploration of maritime resources

Some effects will be bought about on such maritime activities as finding positions of exploration area, offshore transportation for necessary materials and equipment, etc. for oil rigs in the development of oil resources.

12. Investigation of Environmental Management Effort (UKL) and Environmental Monitoring Effort (UPL)

12.1. Selection of Target Sites for Investigation

(1) Because of rehabilitation of existing facilities, rehabilitation projects were excluded from the target.

(2) Because of small scale of their civil work, development of Light Beacons and Light Buoys are also excluded from the target.

(3) Based on general consideration about the location of each site, and consultation with counterpart, 4 target sites for development of lighthouse out of 13 planned sites of Priority Projects were selected as target sites for investigation, because it is considered that potential impacts of lighthouse development to the environment are similar and not significant.

(4) Environmental assessment on the other 9 planned sites for development of lighthouses was to be presumed based on the results of the investigation of selected 4 target sites.

12.2. Re-entrustment to Local Consultant

After consulting with counterpart, we selected a local consultant, and re-entrusted the investigation of UKL and UPL on above 4 sites for development of lighthouses to them.

12.3. Outline of Investigation

(1) Basic concept

The investigation was conducted based on the concept provided in the Decree of the Minister of Communication No.KM4 and KM5 Year 1996.

(2) Survey of present environmental conditions

Data collection, field survey, hearing from community residents and concerned people, laboratory testing and analysis of present environmental conditions consisting of the following components were conducted:

① Land

a. Geography
b. Land usage
c. Susceptible natural disaster (Earthquake, Tsunami, Flood, Slide)
d. Chemical physical quality of land

② Water
a. Chemical physical quality of water
b. Bacteriological, plankton, benthos examination

③ Noise
a. Level of noise

④ Flora and Fauna
a. Type of flora and fauna found in sites and surrounding of sites
b. Natural growth of valuable protected plants

⑤ Social, Economical, Cultural Life
a. Population
b. Occupation
c. Culture and health of the society
d. Existence of historical heritage
e. Existence of national park
f. Existence of preserve

(3) Study on impacts arising from the planned project

Based on the results of above investigation on present environmental conditions, impacts arising from the planned project were studied.

(4) Establishment of UKL and UPL plans

Based on the results of the above study on environmental impacts arising from the planned project, UKL and UPL Plans were established.

12.4. Summarized Results of the Investigation

Results of the investigation are summarized as follows;

Details of the investigation are explained in the Chapter 4 of Main Report Volume 2.

(1) Summary of environmental impacts

Environmental impacts arising from the planned project at the 4 sites are summarized as **Table 12.1.**

Table 12.1. Summary of Environmental Impacts

a. Timau, Sading and Membrit

Type of impact	Level of impact	Necessity of UKL/UPL
Air quality	Not significant	No
Noise	ditto.	No
Seawater	ditto.	No
Flora	ditto.	No
Fauna	ditto.	No
Land compensation	ditto.	Yes
Employment opportunity	dotto	Yes

b. Menjangan

Type of impact	Level of impact	Necessity of UKL/UPL
Air quality	Not significant	No
Noise	ditto.	No
Seawater	ditto.	Yes
Flora	ditto.	No
Fauna	Significant	Yes
Land compensation	Not significant	Yes
Employment opportunity	dotto	Yes

(2) Summary of UKL and UPL

The established UKL and UPL are summarized as **Table 12.2.**

Table 12.2. Summary of UKL and UPL

Site	UKL	UPL
Timau	Land release compensation Employment opportunity	Land release compensation Employment opportunity
Sading	Land release compensation Employment opportunity	Land release compensation Employment opportunity
Membrit	Land release compensation Employment opportunity	Land release compensation Employment opportunity
Menjangan	Seawater quality Fauna Land release compensation Employment opportunities	Seawater quality Fauna Land release compensation Employment opportunities

(3) Conclusion

Based on the results of the investigation, it is concluded as follows;

① Environmental impacts arising from planned sites of light houses at

Timau, Sading and Memburit on the above mentioned environmental components are classified as not significant.

② However, UKL and UPL on the "Land release compensation" and "Employment opportunity for local people" should be conducted.

③ Environmental impacts arising from planned sites of light house at Menjangan on the above mentioned environmental components except fauna are classified as not significant, but impact on fauna is classified as significant, because Menjangan Island is the natural conservation area, both land and water fauna in this island are protected.

④ Therefore, UKL and UPL on the "Seawater quality", "Fauna", "Land release compensation" and "Employment opportunity for local people" should be conducted

12.5. Environmental Assessment on the other planned sites of Lighthouse

Based on the results of the investigation of UKL and UPL on 4 planned sites of Lighthouse, it is considered to be able to assess as follows:

(1) Environmental impacts of the other planned sites

The environmental impacts of the other planned 4 lighthouse development sites of Priority Project might be similar to those of the investigated 4 sites, and also not serious.

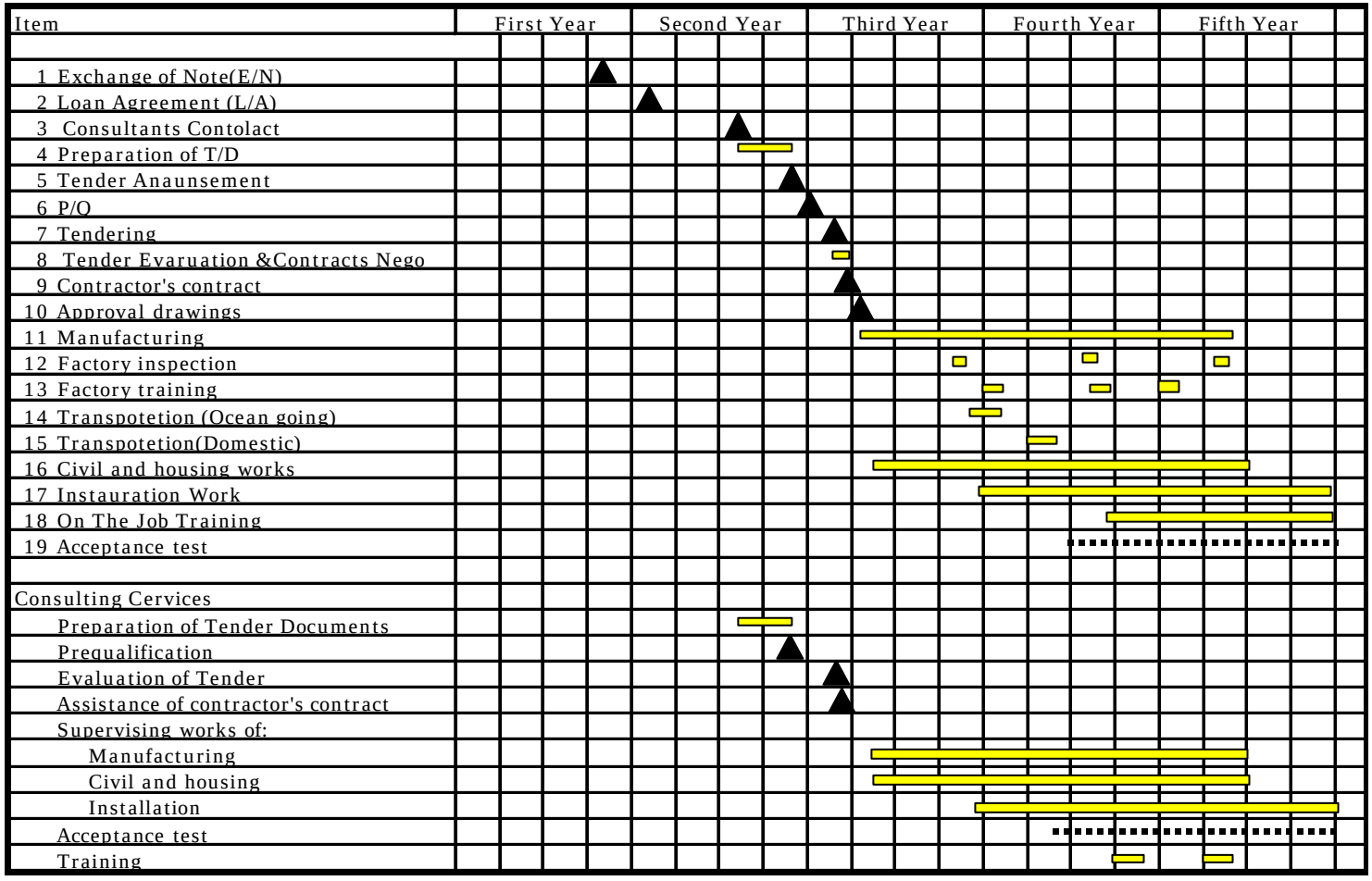
(2) Establishment of UKL and UPL Plans

UKL and UPL Plans on the other planned 4 sites might be similar to the investigated 4 sites and then those plans shall be established based on the above 4 investigated site plans.

13. Implementation Schedule

The Implementation Schedule for proposed Priority Project is shown in **Table 13.1.**

Table 13.1 Implementation Schedule for Aids to Navigation including Supporting Facilities in proposed Priority Project



14. Project Cost Estimation

14.1. Contents of the Project Cost

JICA Study Team completed site survey for locations of proposed Priority Project and system design was finalized. Cost estimation was carried out in accordance with a result of site survey for proposed "Aids to Navigation including Supporting Facilities" (the Project).

The project cost for the Project composes the following items:

(1) Procurement of Equipment
(2) Civil and Housing Works
(3) Installation Works
(4) Transportation
(5) Consulting Services
(6) Contingencies

The project cost was estimated based on the design concept given in **Chapter 7, Section 7.3.**

14.2. Contents of Procurement of Equipment

The procurement of equipment is applied for the following items:

(1) Equipment for visual ATN

① Equipment for Rehabilitation and Improvement of lighted visual ATN

Unit price of equipment consists of:

a. Complete set of lighthouse equipment, that is light tower, lighting equipment and power supply system,
b. Complete set of each light beacon equipment, that is light tower, lighting equipment and power supply system,
c. Complete set of each lantern equipment for lighthouse and light beacon, that is lighting equipment and power supply system, and
d. Complete set of light buoy, that is buoy body with super structure, mooring system and accessories, lighting equipment and power supply system.

② Equipment for Development of lighted visual ATN

a. Two (2) types of complete set of lighthouse equipment, that is light tower, lighting equipment and power supply system,
b. Three (3) types of complete set of each light beacon equipment, that is light tower, lighting equipment and power supply equipment, and
c. Two (2) types of complete set of light buoy, that is buoy body with superstructure, mooring system and accessories, lighting equipment and

power supply equipment.

③ Spares for lighted visual ATN

a. Complete set of lantern for lighthouse, that is lighting equipment and power supply system,

b. Three (3) types of complete set of lantern for light beacons, that is lighting equipment and power supply system, and

c. Complete sets of 2.5m light buoy, that is buoy body with superstructure, mooring system and accessories, lighting equipment and power supply equipment.

④ Training for ATN

a. Overseas training at manufacturer's country for technician of ATN

Tentative schedule of overseas training is as follows:

- Period of training: One (1) month
- Number of trainee: Two (2) persons each from eight (8) DISNAV/ Sub DISNAV and 1 person each from fifteen (15) DISNAV/ Sub DISNAV and one (1) supervisor/ coordinator.
- Training program: Class room training for new technology on aids to navigation services, management work of ATN, and factory training on operation and maintenance

b. On-the-job training (OJT)

OJT is executed at some principal sites using actual equipment and system in order to familiarize with system, when testing and measuring works are carried out during installation work. Tentative schedule of OJT is as follows:

- Period of training: One (1) weeks for one (1) site
- Number of site for OJT: Three (5) locations
- Number of lecturer: One (1) person of manufacturer
- Number of trainee: Ten (10) lighthouse keeper for each locations.

(2) Equipment for Supporting Facilities

The equipment for workshops comprises the following major categories:

① Machine tools,
② Wood work machines,
③ Welding machines,
④ Compressor machine and pump,
⑤ Hand tools,
⑥ Bench tools,
⑦ Testing and measuring equipment,
⑧ Electronic equipment for measuring,

⑨ Handling equipment, and

⑩ Engine generator sets

The unit price of workshop equipment includes operational spare parts and consumable spares for ten (10) years.

14.3. Contents of Civil and Housing Works

Units price of costs for civil and housing work are applied for the followings:

(1) Visual ATN

① Rehabilitation and improvement of visual ATN

Unit price of foundation work for each light tower to be replaced for lighthouse and light beacon consists of excavation, steel bar arrangement, framework, back filling and concrete work.

② Development of visual ATN

a. Lighthouse

Unit price for lighthouse includes the following works:

- Foundation of light tower for 40m high lighthouse,
- Construction of Five (5) units of 50 ㎡ Housing,
- Construction of one (1) power house,
- Cabling work for housing,
- Pavement works,
- Fencing works, and
- Digging work for well

b. Light Beacon

- Foundation of light tower for each height of light beacon,
- Pavement work (except offshore), and
- Fencing works (except offshore)

(2) Supporting facilities

Unit prices of civil and housing works for the supporting facilities consist of:

① Extending of workshop building

② Construction of storage house for workshop

③ Site leveling of open storage for buoy base

④ Filling work for buoy base

14.4. Contents of Installation Works

Unit prices of costs for installation works are applied for the followings:

(1) Visual ATN

① Rehabilitation and improvement of visual ATN

a. Erection of light tower with lantern house,

b. Installation of lighting equipment and power supply system,

c. Repair of light tower,

d. Cabling work for lighthouse and light beacon,

e. Installation of light buoy including assembling, and

f. Measurement and testing work.

② Development of visual ATN

a. Erection of light tower,

b. Installation of lantern house,

c. Installation of lighting equipment and power supply system,

d. Installation of light buoy including assembling,

e. Cabling work for lighting equipment and power supply system, and

f. Measurement and testing work

(2) Supporting facilities

Unit price of workshop equipment are applied for the following machine and tools:

① Machine tools,

② Wood work machines

③ Overhead traveling crane in handling equipment, and

④ Diesel engine generators

14.5. Result of the Cost Estimation

According to the unit price of each item, result of cost estimation for the proposed Priority Project is summarized in **Table 14.5.1.**

Unit price applied for the cost estimation is shown in **Appendix 14.5.1.** to **Appendix 14.5.4.**

Estimated cost of each site or location for visual ATN is shown in **Appendix 14.5.5.** to **Appendix 14.14.5.11.**, respectively.

Estimated cost for spares for ATN is shown in **Appendix 14.5.12.**

Estimated cost for training for ATN is shown in **Appendix 14.5.13.**

Estimated cost for workshops and buoy bases is shown in **Appendix 14.5.14** to **Appendix 14.5.17.**

Table 14.5.1. Estimated Project Cost of proposed Priority Project

Unit : US$

No. Items	Q'ty	Unit	Foreign Currency	Local Currency
1. Procurement of Equipment	1	lot	15,467,560	818,860
(1) Rehabilitation and Imrovement of AT	1	lot	8,027,895	0
a. Lighthouse	21	units	1,999,177	0
b. Light Beacon	131	units	4,183,773	0
c. Light Buoy	61	units	1,844,945	0
(2) Development of ATN	1	lot	4,082,009	0
a. Lighthouse	8	units	1,634,328	0
b. Light Beacon	33	units	1,599,607	0
c. Light Buoy	26	units	848,074	0
(3) Supporting Facilities	1	lot	2,512,236	818,860
1) Workshops & Buoy Bases	3	locations	2,512,236	818,860
a. Improvement	3	locations	2,512,236	818,860
(4) Spares for ATN	1	lot	624,562	0
(5) Training for ATN	1	lot	220,858	0
2. Civil & Housing Works	1	lot	0	3,415,932
(1) Rehabilitation & Improvement of AT	1	lot	0	1,598,979
a. Lighthouse	21	units	0	529,493
b. Light Beacon	131	units	0	1,069,486
(2) Development of ATN	1	lot	0	1,538,924
a. Lighthouse	8	units	0	868,720
b. Light Beacon	33	units	0	670,205
(3) Supporting Facilities	1	lot		278,029
1) Workshop & Buoy Bases	1	lot		278,029
a. Improvement	6	locations	0	225,117
b. Development	7	locations	0	52,912
3. Installation Works	1	lot	0	1,469,088
(1) Rehabilitation & Imprvement of ATN	1	lot	0	1,018,267
a. Lighthouse	21	units	0	326,179
b. Light Beacon	131	units	0	667,932
c. Light Buoy	61	units	0	24,156
(2) Development of ATN	1	lot	0	230,020
a. Lighthouse	8	units	0	101,483
b. Light Beacon	33	units	0	118,241
c. Light Buoy	26	units	0	10,296
(3) Supporting Facilities	1	lot	0	220,801
1) Workshops & Buoy Bases	1	lot	0	220,801
a. Improvement	3	locations	0	220,801
4. Transportation	1	lot	309,351	211,714
				253,437
5. Consultaning Fee	1	lot	1,398,317	591,559
6. Sub Total			17,175,228	6,507,153
7. Contingency			858,761	325,358
Total			18,033,990	6,832,510
Grand Total				24,866,500

15. Operation and Maintenance Cost

15.1. Visual ATN

DISNAV/ Sub DISNAV has a responsibility for executing organization of operation and maintenance. It is firstly required that at least 95% of reliability/ availability of lighted visual ATN must be maintained as minimum requirement according to the recommendation of IALA. Secondly, efforts should be continuously made to attain 99.8% as a goal of reliability/ availability in compliance with IALA recommendation.

For those purposes, the operation and maintenance of equipment and system to be rehabilitated and improved and developed in the proposed priority project are assumed as follows:

(1) Lighthouses

Five (5) lighthouse keepers maintain the lighthouse for 24 hours. They serve not only operation of lights, but also regular and emergency maintenance for lighting equipment, power supply system and associated facilities for lights. As a result of manned operation system for lighthouse, its reliability/ availability is higher than unmanned operation system for light beacon and light buoy. It reaches about 98% or over.

For the cost estimation of operation and maintenance for lighthouse, manned operation system is applied.

It is considered that eight (8) lighthouses to be newly established are required to recruit forty (40) lighthouse keepers.

(2) Light beacons and Light buoys

On-site work is made by periodical regular maintenance of two (2) times per year for light beacons and light buoys under unmanned operation system.

The JICA Study Team has recommended executing the regular maintenance four (4) times at least per year in the Master Plan in order to improve the reliability/ availability of lights.

For the cost estimation of operation and maintenance, four (4) times of regular maintenance is applied for the light beacon and light buoy.

(3) Pattern of maintenance

For the cost estimation of operation and maintenance of visual ATN, tentative pattern of major maintenance are prepared by the JICA Study Team in order to attain a goal of reliability/ availability of lights. Its

tentative major maintenance pattern for thirty (30) years after the completion of the project is shown in **Table 15.1.1.**

(4) Maintenance for visual ATN

The maintenance for visual ATN is required for the followings:

① Lighting Equipment

a. Lamp for light source
b. Fuse
c. Filter
d. Rotating parts
e. Cooling water
f. Battery
g. Fan belt
h. Gear and controller
i. Solar panel and cell
j. Overhaul of engine generator and lighting equipment
k. Replacement of lighting equipment, power supply system

Items from a. to g. are required for daily maintenance. Items from h. to k. are required for major maintenance and emergency maintenance. Item k. is required 20 years after the completion of the project.

② Light tower

a. Tightening bolts and nuts
b. Checking foundation of offshore light beacon
c. Checking verticality of tower
d. Re-painting
e. Partial repair
f. Mortar finish work for foundation of offshore light beacon
g. Replacement of lattice tower 30 years after the completion of the project.

Items from a. to d. are required for daily or regular maintenance per three months. Items f. and g. are required for major maintenance and emergency maintenance.

③ Buoy

a. Mooring chain and sinker
b. Buoy body and superstructure
c. Replacement of buoy body per 2 years for total maintenance.
The lifetime of buoy body is assumed about 10 years.

15.2. Supporting Facilities (Workshop and Buoy Base)

Technician of workshop under DISNAV/Sub DISNAV executes operation and maintenance of workshop equipment.

For this purpose, four (4) DISNAVs have sufficient number of technicians to be operators for equipment, who will be trained by On-the-job training (OJT) in the project.

Consumable spares for machines and tools are provided in the proposed Priority Project.

The following costs are required for operation and maintenance:

① Fuel oil for engine generator and so forth,
② Lubricating oil for engine generator and machine tools,
③ Commercial power source,
④ Water for machine tools,
⑤ Maintenance of workshop housing and storage, and
⑥ Replacement of machine and tools

Items from ① to ④ are required for routine work for operation and maintenance. Item ⑤ is required for yearly maintenance.

Item ⑥ is required as follows:

- Replacement of tools and machines except heavy machine such as lathe, universal milling machine, tensile strength meter and so forth at 15 years after the completion of the project,
- Replacement of all equipment at 30 years after the completion of the project.

The tentative maintenance pattern for workshop equipment is shown in **Table 15.1.1.**

15.3. Operation and maintenance Cost

The operation and maintenance cost for visual ATN including workshops is shown in **Table 15.3.1.** according to the maintenance method above. The personnel expenses for lighthouse keepers are shown in **Table 15.3.2.**

Table 15.1.1. Tentative Pattern of Maintenance for Visual ATN and Supporting Facilities

Lighing Equipment & Power Supply System		Year																														
		2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
Lamp, etc	1	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Cable,	2		○		○		○		○		○		○		○		○		○		○		○		○		○		○	
Battery	5					○					○					○					○					○				
10 Years Overhaul	10										○										○									
20 years Overhaul	20																				○									
Type of maintenance		1	2	1	2	3	2	1	2	1	4	1	2	1	2	3	2	1	2	1	5	1	2	1	2	3	2	1	2	1
Lattice Tower		Year																														
		2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
Initial Maintenance		○	○					○																						
Lamp, etc	1	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Cable, etc.	2		○		○		○		○		○		○		○		○		○		○		○		○		○		○	
Re-painting and Battery	5					○					○					○					○					○				
Foundation of Offshore	7							○							○							○							○	
Housing and Solor cell	10										○										○									
Lighting Equipment	20																				○									
Type of Maintenance		1	2	3	4	5	4	6	4	3	7	3	4	3	8	5	4	3	4	3	9	10	4	3	4	5	4	3	8	3
Aluminum Tower		Year																														
		2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
Initial Maintenance		○	○					○																						
Lamp, etc	1	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Cable, etc.	2		○		○		○		○		○		○		○		○		○		○		○		○		○		○	
Re-painting & Battery (● shows battery only)	5					●					●					○					○					○				
Foundation of offshore	7							○							○							○							○	
Housing & Solar Cell	10										○										○									
Replacement of Lighting Equipment	20																				○									
Type of Maintenance		1	2	3	4	5	4	6	4	3	7	3	4	3	8	9	4	3	4	3	10	11	4	3	4	9	4	3	8	3

Table 15.1.1. Tentative Pattern of Maintenance for Visual ATN and Supporting Facilities

Light Buoy		Year																														
		2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
Re-painting (Minor)	2		○				○						○				○								○				○	
Re-painting (Major) & Replacement of bottom of Mooring	4				○				○						○				○				○				○			
Replacement of Battery	4				○				○				○				○				○				○				○	
Replacement of upper part of mooring	8								○								○				○				○				○	
Replacement of Buoy Body	10										○										○									
Replacement of parts of Lighting Equipment & Battery	10										○										○									
Replacement of Lighting Equipment	20																				○									
Type of Maintenance			1		2		1		3		4		5		2'		6		2'		7		2'		6		2'		6	

Workshop		Year																														
		2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
Fuel oil, etc.	1	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Repair of housing	1	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Replacement except heavy machine	10										○																			
Replacement of all equipment	20																				○									
Type of Maintenance			1	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	3	1	1	1	1	1	1	1	1	1

Table 15.3.1. Operation and Maintenance Cost for Visual ATN and Workshop

Unit : US$

Year	Lantern only	Steel Lattice Light Tower (Complete Set)	Alminum Light Tower (Complete Set)	Light Buoy	Workshop	Total
2008	4,252	4,594	371	0	20,366	29,582
2009	15,409	18,836	1,088	26,085	20,366	81,784
2010	4,252	16,879	371	0	20,366	41,867
2011	15,409	18,836	1,088	234,384	20,366	290,083
2012	140,485	910,783	8,954	0	20,366	1,080,588
2013	15,409	18,836	1,088	26,085	20,366	81,784
2014	4,252	43,790	826	0	20,366	69,234
2015	15,409	18,836	1,088	624,365	20,366	680,064
2016	4,252	16,879	371	0	20,366	41,867
2017	475,808	1,064,068	49,420	1,766,310	793,866	4,149,473
2018	4,252	16,879	371	0	20,366	41,867
2019	15,409	18,836	1,088	232,460	20,366	288,159
2020	4,252	16,879	371	0	20,366	41,867
2021	15,409	53,439	1,088	234,384	20,366	324,686
2022	140,485	910,783	25,216	0	20,366	1,096,849
2023	15,409	18,836	1,088	248,430	20,366	304,129
2024	4,252	16,879	371	0	20,366	41,867
2025	15,409	18,836	1,088	234,384	20,366	290,083
2026	4,252	16,879	371	0	20,366	41,867
2027	1,542,639	2,153,980	127,447	2,520,317	1,647,919	7,992,303
2028	4,252	0	743	0	20,366	25,360
2029	15,409	18,836	1,088	234,384	20,366	290,083
2030	4,252	16,879	371	0	20,366	41,867
2031	15,409	18,836	1,088	248,430	20,366	304,129
2032	140,485	910,783	25,216	0	20,366	1,096,849
2033	15,409	18,836	151	234,384	20,366	289,146
2034	4,252	16,879	371	0	20,366	41,867
2035	15,409	53,439	1,088	248,430	20,366	338,732
2036	4,252	16,879	371	0	20,366	41,867
Total	2,675,829	6,445,927	253,659	7,112,832	2,991,661	19,479,908

Table 15.3.2. Personnel Expenses for Lighthouse Keepers of 8 Lighthouses

No.	Year	Wage/ Man-month	Wage/ person in Year	Wage/ Location (5 persons)	Total Wage/8 locations	Total Wage/8 locations
1	2008	Rp. 500,000	Rp. 0	Rp. 0	Rp. 0	US$ 0
2	2009	520,000	6,240,000	31,200,000	249,600,000	24,960
3	2010	540,800	6,489,600	32,448,000	259,584,000	25,958
4	2011	562,432	6,749,184	33,745,920	269,967,360	26,996
5	2012	584,929	7,019,148	35,095,740	280,765,920	28,076
6	2013	608,326	7,299,912	36,499,560	291,996,480	29,199
7	2014	632,660	7,591,920	37,959,600	303,676,800	30,367
8	2015	657,966	7,895,592	39,477,960	315,823,680	31,582
9	2016	684,285	8,211,420	41,057,100	328,456,800	32,845
10	2017	711,656	8,539,872	42,699,360	341,594,880	34,159
11	2018	740,122	8,881,464	44,407,320	355,258,560	35,525
12	2019	769,727	9,236,724	46,183,620	369,468,960	36,946
13	2020	800,516	9,606,192	48,030,960	384,247,680	38,424
14	2021	832,537	9,990,444	49,952,220	399,617,760	39,961
15	2022	865,838	10,390,056	51,950,280	415,602,240	41,560
16	2023	900,472	10,805,664	54,028,320	432,226,560	43,222
17	2024	936,491	11,237,892	56,189,460	449,515,680	44,951
18	2025	973,950	11,687,400	58,437,000	467,496,000	46,749
19	2026	1,012,908	12,154,896	60,774,480	486,195,840	48,619
20	2027	1,053,425	12,641,100	63,205,500	505,644,000	50,564
21	2028	1,095,562	13,146,744	65,733,720	525,869,760	52,586
22	2029	1,139,384	13,672,608	68,363,040	546,904,320	54,690
23	2030	1,184,959	14,219,508	71,097,540	568,780,320	56,878
24	2031	1,232,358	14,788,296	73,941,480	591,531,840	59,153
25	2032	1,281,652	15,379,824	76,899,120	615,192,960	61,519
26	2033	1,332,918	15,995,016	79,975,080	639,800,640	63,980
27	2034	1,386,235	16,634,820	83,174,100	665,392,800	66,539
28	2035	1,441,684	17,300,208	86,501,040	692,008,320	69,200
29	2036	1,499,352	17,992,224	89,961,120	719,688,960	71,968
30	2037	1,559,326	18,711,912	93,559,560	748,476,480	74,847
31	2038	1,621,699	19,460,388	97,301,940	778,415,520	77,841
Total						1,399,864

16. Economic Analysis

16.1. Purpose

For the 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 from the viewpoint of effective utilization of resources. The items, which cannot be converted into currency, should be expressed qualitatively.

16.2. Specification of Project

(1) Rehabilitation and improvement of visual aids to navigation.

Rehabilitation and improvement of visual aids to navigation are shown in **Table 16.1.**

Table 16.1. Rehabilitation and Improvement of Visual Aids to Navigation

Light Houses	21 Locations
Light Beacons	131 Locations
Light Buoys	61 units selected by operation status

(2) Development of visual aids to navigation and supporting facilities

Development of Visual aids to navigation and supporting facilities are shown in **Table 16.2.**

Table 16.2. Development of Visual Aids to Navigation and Supporting Facilities

Light Houses	8 Locations
Light Beacons	33 Locations
Light Buoys	34 units

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, and therefore evaluation periods of the projects are settled on termination year for use as shown in **Table 16.3.**

Table 16.3. Termination for Use

Type	Main body	Years
Light House	GRP	15
	Iron	30
	Aluminum	50
	Concrete	70
	Casting	100
Light Buoy		10
DGPS		15
VTS System		15
GMDSS		15
Ship Reporting System		15

Source: The Study Team

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) Approach and methodology

In Indonesian waters, the benefit is the decrease effects of vessel's collisions as a result of the organization of traffic flows.

By the organization of traffic flows, the collisions at sea should be decreased. Forecasting the collision at Indonesian waters, following formula should be applied.

$$Ng = \sum_i \sum_j DiDj\, W_{ij} \,|\, \vec{Vi} - \vec{Vj} \,|\, T \qquad \textbf{(formula 16.1)}$$

$$N / Ng = P \qquad \textbf{(formula 16.2)}$$

Where

Ng : Number of theoretical collisions

Di : Traffic density for direction i

Dj : Traffic density for direction j

W_{ij} : Average ship's length

$|\vec{Vi} - \vec{Vj}|$: Relative speed of two group of vessels

T : Hours

N :Number of actual collisions

The decreased number of collisions are shown **in Appendix 16.1.** Damage and loss per vessel, which mean benefit per one vessel, is shown in **Appendix 16.2.**

Total Benefit is shown in **Table 16.4**. In this table, social discount rate is used 10%, which is used at international bank such as World Bank. Economic internal rate of return (EIRR) show 12.0 %. In this case, EIRR is bigger than social discount rate, therefore this project has enough benefit. .

Table 16.4. Economic Analysis for Visual Aids to Navigation and Supporting Facilities

Year		Social Discount Rate	Benefit		Remaining Price	Present Value	Civil		Operating & Maintenance Cost		Present Value of Costs
			Benefit	Present Value			Cost	Present Value	Coat	Present Value	
		10%									
2003	4	1.000									
2004	5	0.900					0.597	0.537			0.537
2005	6	0.810					9.230	7.476			7.476
2006	7	0.729					7.584	5.529			5.529
2007	8	0.656	3.887	2.550		2.550	7.456	4.892			4.892
2008	9	0.590	6.908	4.079		4.079			0.030	0.017	0.017
2009	10	0.531	7.922	4.210		4.210			0.082	0.043	0.043
2010	11	0.478	8.936	4.274		4.274			0.042	0.020	0.020
2011	12	0.430	10.013	4.310		4.310			0.290	0.125	0.125
2012	13	0.387	11.027	4.272		4.272			1.081	0.419	0.419
2013	14	0.349	12.041	4.198		4.198			0.082	0.029	0.029
2014	15	0.314	13.118	4.117		4.117			0.069	0.022	0.022
2015	16	0.282	14.132	3.991		3.991			0.680	0.192	0.192
2016	17	0.254	15.210	3.866		3.866			0.042	0.011	0.011
2017	18	0.229	16.224	3.711		3.711			4.149	0.949	0.949
2018	19	0.206	17.238	3.549		3.549			0.042	0.009	0.009
2019	20	0.185	18.315	3.394		3.394			0.288	0.053	0.053
2020	21	0.167	19.329	3.224		3.224			0.042	0.007	0.007
2021	22	0.150	20.343	3.053		3.053			0.325	0.049	0.049
2022	23	0.135	21.420	2.894		2.894			1.097	0.148	0.148
2023	24	0.122	22.434	2.727		2.727			0.304	0.037	0.037
2024	25	0.109	23.468	2.568		2.568			0.042	0.005	0.005
2025	26	0.098	24.504	2.413		2.413			0.290	0.029	0.029
2026	27	0.089	25.539	2.264		2.264			0.042	0.004	0.004
2027	28	0.080	26.575	2.120		2.120			7.992	0.638	0.638
2028	29	0.072	27.611	1.982		1.982			0.025	0.002	0.002
2029	30	0.065	28.647	1.851		1.851			0.290	0.019	0.019
2030	31	0.058	29.683	1.726		1.726			0.042	0.002	0.002
2031	32	0.052	30.719	1.608		1.608			0.304	0.016	0.016
2032	33	0.047	31.755	1.496		1.496			1.097	0.052	0.052
2033	34	0.042	32.791	1.390		1.390			0.289	0.012	0.012
2034	35	0.038	33.827	1.291		1.291			0.042	0.002	0.002
2035	36	0.034	34.863	1.197		1.197			0.339	0.012	0.012
2036	37	0.031	35.899	1.109	0.064	1.109			0.042	0.001	0.001
TTL			624.377	85.434	0.064	85.498	24.867	18.434	19.480	2.921	21.356
										EIRR	**12.0%**

17. Financial Analysis

17.1. Purpose

The projects under review have expected light dues. From the view 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. Contents of the Work

(1) Current financial situation of GOI

According to The Budgeted Government revenues and Expenditures, Primary balance shows -28,969 Billion Rupiah in 1999/2000, 10,490 Billion Rupiah in 2000, 24,020 Billion Rupiah in 2001. Overall balance shows -83,495 Billion Rupiah in 1999/2000, -44,134 Billion Rupiah in 2000, and -52,529 Billion Rupiah 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 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 2000 - December 2000

3) January 2001 – December 2001

Source: Ministry of Finance

(2) Total amount of investment

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

Table 17.2. Total Amount of Investment

Unit: Thousand US$

Items	Foreign Cost	Local Cost	Total
Visual Aids to Navigation and supporting facilities	18,034	6,833	24,867

17.3. 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	0.75 % interest to be applied to 56 % of total amount of loan
	6.47 %	10 Years	During construction	6.47% interest to be applied to 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%.

17.4. 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

Unit: 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

17.5. Consideration for Financial Internal Rate of Return (FIRR)

To examine the feasibility of the project, consideration for FIRR should be implemented. The initial costs, operating costs and necessary light dues are shown in **Table 17.5.** Necessary light dues to achieve 1.8% of FIRR (GDP: Likeliest Case) are 6.41% of light dues.

Table 17.5. Financial Analysis for Visual Aids to Navigation and Supporting Facilities

Unit: Million US$

periode	No	Year	Visual Aids to Navigation and Supporting Facilities							Revenue					
			Civil	Consultant	Initial Cost Total	Operating & Maintenance	Grand Total	Funds (Initial Cost) 15%	Grand Total-Funds	Light Dues (GDP: Likeliest Case)		Light Dues (GDP: Optimistic Case)		Light Dues (GDP: Pesimistic Case)	
			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								0.973	0.973	1.015	1.015	0.931	0.931
	5	2004		0.597	0.597		0.597	0.090	0.508	1.055	0.547	1.125	0.617	0.988	0.481
	6	2005	8.832	0.398	9.230		9.230	1.384	7.845	1.144	-6.701	1.247	-6.598	1.049	-6.796
	7	2006	6.987	0.597	7.584		7.584	1.138	6.447	1.241	-5.205	1.382	-5.064	1.113	-5.333
1	8	2007	7.058	0.398	7.456		7.456	1.118	6.338	1.347	-4.991	1.533	-4.805	1.182	-5.156
2	9	2008				0.030	0.030		0.030	1.462	1.432	1.700	1.670	1.255	1.225
3	10	2009				0.082	0.082		0.082	1.586	1.505	1.886	1.804	1.332	1.250
4	11	2010				0.042	0.042		0.042	1.722	1.680	2.092	2.050	1.414	1.373
5	12	2011				0.290	0.290		0.290	1.828	1.538	2.258	1.968	1.476	1.186
6	13	2012				1.081	1.081		1.081	1.940	0.859	2.437	1.356	1.541	0.460
7	14	2013				0.082	0.082		0.082	2.059	1.977	2.630	2.548	1.608	1.526
8	15	2014				0.069	0.069		0.069	2.186	2.116	2.838	2.769	1.678	1.609
9	16	2015				0.680	0.680		0.680	2.320	1.640	3.063	2.383	1.752	1.072
10	17	2016				0.042	0.042		0.042	2.462	2.421	3.306	3.264	1.828	1.786
11	18	2017				4.149	4.149		4.149	2.614	-1.536	3.568	-0.582	1.908	-2.241
12	19	2018				0.042	0.042		0.042	2.774	2.732	3.850	3.809	1.992	1.950
13	20	2019				0.288	0.288		0.288	2.945	2.657	4.156	3.868	2.079	1.790
14	21	2020				0.042	0.042		0.042	3.126	3.084	4.485	4.443	2.170	2.128
15	22	2021				0.325	0.325		0.325	3.318	2.993	4.841	4.516	2.264	1.940
16	23	2022				1.097	1.097		1.097	3.522	2.425	5.225	4.128	2.363	1.267
17	24	2023				0.304	0.304		0.304	3.739	3.435	5.639	5.335	2.467	2.163
18	25	2024				0.042	0.042		0.042	3.969	3.927	6.087	6.045	2.575	2.533
19	26	2025				0.290	0.290		0.290	4.213	3.923	6.570	6.280	2.687	2.397
20	27	2026				0.042	0.042		0.042	4.472	4.430	7.091	7.050	2.805	2.763
21	28	2027				7.992	7.992		7.992	4.747	-3.245	7.654	-0.338	2.928	-5.065
22	29	2028				0.025	0.025		0.025	5.039	5.014	8.262	8.237	3.056	3.031
23	30	2029				0.290	0.290		0.290	5.349	5.059	8.918	8.628	3.190	2.900
24	31	2030				0.042	0.042		0.042	5.679	5.637	9.626	9.584	3.329	3.287
25	32	2031				0.304	0.304		0.304	6.028	5.724	10.390	10.086	3.475	3.171
26	33	2032				1.097	1.097		1.097	6.399	5.302	11.216	10.119	3.627	2.530
27	34	2033				0.289	0.289		0.289	6.793	6.504	12.107	11.817	3.786	3.497
28	35	2034				0.042	0.042		0.042	7.211	7.170	13.068	13.026	3.952	3.910
29	36	2035				0.339	0.339		0.339	7.656	7.317	14.107	13.768	4.125	3.786
30	37	2036				0.042	0.042		0.042	8.127	8.085	15.228	15.186	4.306	4.264
			22.877	1.990	24.867	19.480	44.347	3.730	40.617	121.045	80.428	190.598	149.981	78.231	37.614
						FIRR					1.80%		3.52%		-0.19%

If GOI wants to implement the project with 1.8% of FIRR (GDP: Likeliest Case), 6.41% of light dues are needed and GOI has to prepare 3.73 million USD as a down payment. It is summarized in **Table 17.6.**

Table 17.6. Summary of Necessary Funds

Unit : Million US$

	Loan	Necessary Funds of GOI	Total Initial Cost	Necessary Light Dues
	1	2	3=1+2	
Visual Aids to Navigation including Supporting Facilities	21.137	3.730	24.867	6.41%

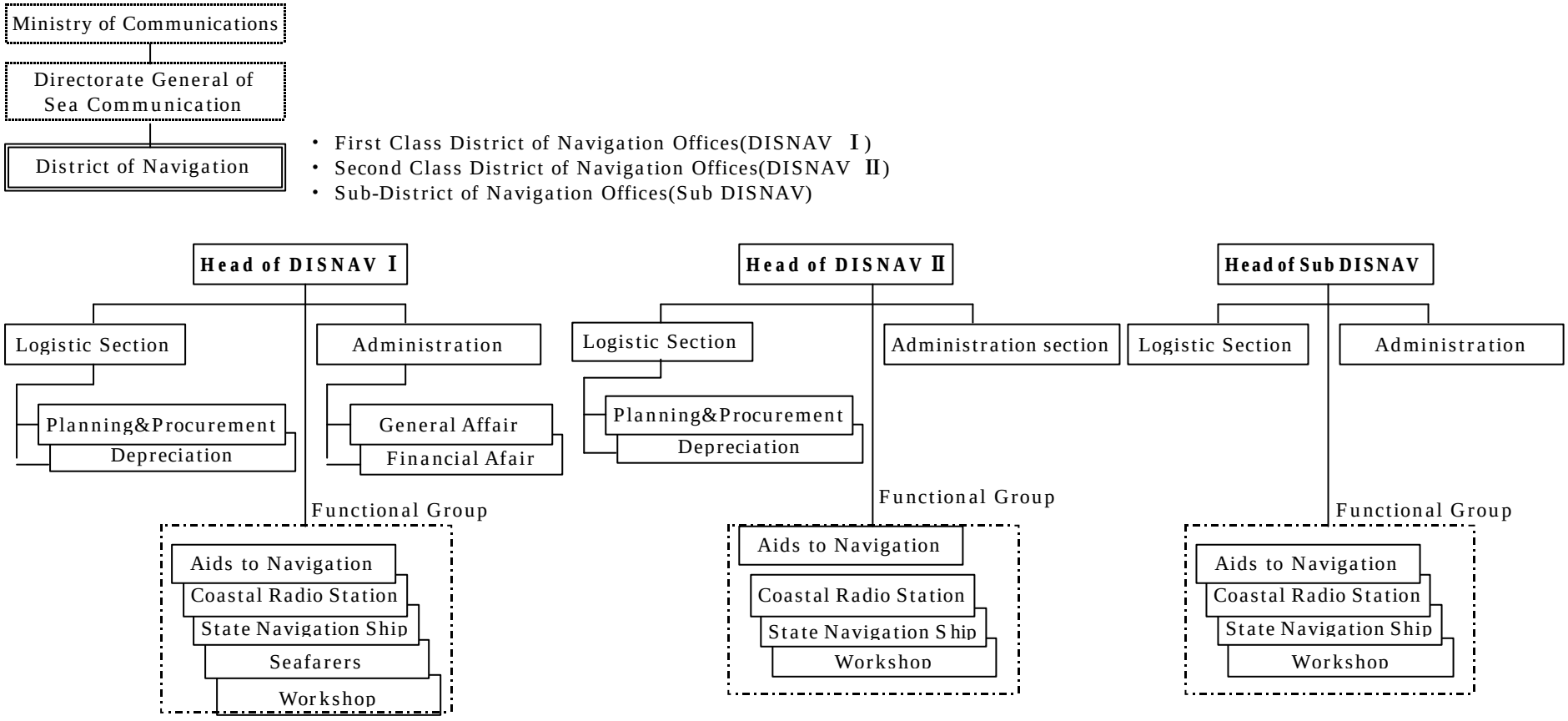
17.6. Sensitive Analysis

Sensitive analysis should be implemented among three GDP cases. To implement Aids to Navigation including Supporting Facilities, necessary light dues are 6.41% in likeliest case, 4.28% in optimistic case, 9.39% in pessimistic case. It is shown in **Table 17.7**.

Table 17.7. Sensitive Analysis

	Necessary Light Dues		
Visual Aids to Navigation including Supporting Facilities	Likeliest Case	Optimistic Case	Pessimistic Case
	6.41%	4.28%	9.39%

Appendix 4.1.1. Organization Chart of District of Navigations (DISNAV/ Sub DISNAV)



Appendix 5.1.1

Rehabilitation and Improvement of Visual ATN in proposed Priority Project

(Lighthouse)

NO.	DSI No.	Location	Construction (Rehab.) Year	Age	Operation Status	Lantern Condition	Power Supply condition	Structure Condition	DUP	Latitude	Longitude	Structure Height (m)	DISNAV	Remarks
1	10	Ie. Meule	1974	27	1	0	0	0	0	05-53-48N	095-19-48E	3	Sabang	
2	11	Rondo	1984	17	1	0	0	0	1	06-04-02N	095-06-50E	*	Sabang	
3	77	P. Bunta	1980	21	1	0	0	0	1	05-33-11N	095-09-05E	50	Sabang	
4	84	Ujung Pidie	1987	14	0	0	0	0	1	05-30-00N	095-52-60E	20	Sabang	
5	960	P.Berhala	1978	23	1	0	0	0	0	00-52-26S	104-24-30E	21	Tg.Pinang	
6	1000	Tunjuk I	1975	26	1	1	1	0	1	00-56-41N	104-12-10E	16	Tg.Pinang	
7	1110	Tunjuk II	1975	26	1	1	1	0	1	01-13-02N	104-34-30E	*	Tg.Pinang	
9	2025	P. Pengiki	1982	19	1	1	1	0	1	00-14-11N	108-02-25E	15	Pontianak	
10	2223	Tg.Sekatung	1984	17	1	0	0	0	0	04-47-31N	108-01-14E	30	Tg.Pinang	
13	2931	Ujung Raja	1988	13	0	0	0	0	1	03-44-15N	096-31-10E	40	Sabang	
14	3070	Tegal I	1983	18	0	0	0	0(co)	1	06-51-07S	109-08-13E	13	Semarang	
15	3130	Tegal II	1982	19	1	0	0	0	1	06-50-49S	109-08-17E	30	Semarang	
16	3271	P. Panjang	1989	12	1	0	0	0	1	06-34-18S	110-37-26E	40	Semarang	
17	3290	P. Mandalika	1886	115	1	0	0	0	1	06-22-22S	110-55-30E	16	Semarang	
18	3300	P. Nyamuk	1980	21	1	0	0	0	1	05-48-41S	110-11-20E	30	Semarang	
19	4150	Buleleng	1978	23	1	0	0	1	0	08-05-2S	115-05-30E	20	Benoa	
20	4170	Lembongan	1974	27	1	1	1	0	0	08-39-39S	115-27-30E	25	Benoa	
22	4311	Tg. Sasar	1988	13	0	0	0	0(co)	1	09-16-13S	119-56-30E	40	Kupang	
23	4730	Tukong Hill	1980	21	1	1	1	0	1	01-16-08S	116-48-30E	8	Samarinda	
24	4950	Tg.Bunga	1980	21	1	0	0	0	1	05-09-00S	119-24-00E	40	Makassar	
34	6205	P.Adi	1981	20	0	0	0	0(co)	0	04-18-15S	133-37-10E	20	Sorong	

Appendix 5.1.2.

Rehabilitation and Improvement of Visual ATN in proposed Priority Project (Light Beacon)

No.	DSI No.	Location	Construction Year	Age	Operation Status	Lantern Condition	Power Supply Condition	Structure Condition	DUP	Latitude	Longitude	Structure Height (m)	On/ Offshore	DISNAV	Phase
1	150	Kuala Langsa	1980	21	0	0	0	0	1	04-32-41N	098-03-02	12	Offshore	Belawan	1
2	160	Kuala Langsa	1980	21	0	0	0	0	1	04-33-08N	098-03-36	8	Offshore	Belawan	1
3	180	Kuala Langsa	1980	21	0	0	0	0	1	04-33-33N	098-04-22	10	ON	Belawan	1
4	190	Kuala Langsa	1980	21	0	0	0	0	1	04-33-01N	098-03-56	18	ON	Belawan	1
5	390	Belawan Deli	1983	18	0	0	0	0	1	03-48-54N	098-43-00	5.5	Offshore	Belawan	1
6	400	Belawan Deli	1983	18	0	0	0	0 (Collapsed)	1	03-48-06N	098-43-15	5.5	Offshore	Belawan	1
7	410	Belawan Deli	1983	18	1	0	0	1	1	03-47-22N	098-43-38	12	Offshore	Belawan	1
8	450	Sungai Nunang	1979	22	0	0	0	0 (Collapsed)	0	03-47-18N	098-40-46	10	Offshore	Belawan	1
9	451	Sungai Nunang	1984	17	0	0	0	0 (Collapsed)	0	03-47-30N	098-40-42	10	Offshore	Belawan	1
10	510	Tg Tiram	1984	17	1	0	0	1	1	03-14-54N	099-35-19	10	Offshore	Belawan	1
11	550	Bagan Asahan	1977	24	1	0	0	1	1	03-02-46N	099-51-56	15	Offshore	Belawan	1
12	551	S Asahan Depan	1993	8	0	0	0	0 (Collapsed)	0	03-01-44N	099-51-40	10	Offshore	Belawan	1
14	650	Tg Leban	1991	10	0	0	0	0	1	01-39-30N	101-50-30	10	ON	Dumai	1
17	677	Selat Rupat E	1991	10	0	0	0	0	1	01-41-23N	101-48-09	20	ON	Dumai	1
18	679	Selat Rupat G	1991	10	0	0	0	0	1	01-41-30N	101-47-53	20	Offshore	Dumai	1
20	740	Sei Siak	1984	17	0	0	0	0 (Collapsed)	0	01-12-30N	102-10-00	10	Offshore	Dumai	1
21	750	Sei Siak	1961	40	0	0	0	0	0	01-11-30N	102-09-30	10	Offshore	Dumai	1
25	928	Tg Bakau	1978	23	0	0	0	1	1	00-20-00S	103-47-30	10	Offshore	Dumai	1
30	1088	P Kambat	1989	12	0	0	0	0 (Collapsed)	1	00-48-30N	104-39-54	10	Offshore	Tg Pinang	1
31	1112	Kr Heluputan	1992	9	0	0	0	0 (Collapsed)	0	00-37-15N	105-08-30	10	Offshore	Tg Pinang	1
34	1180	Pelab. Dabo	1990	11	0	0	0	0 (Collapsed)	0	00-29-30S	104-33-30	10	ON	Tg Pinang	1
35	1190	P Saya	1994	7	0	0	0	0 (Collapsed)	0	00-46-50S	104-55-58	20		Tg Pinang	1
36	1270	Hendrik	1982	19	0	0	0	0	0	01-58-00S	104-57-10	20	ON	Palembang	1
37	1271	Tg. Kampeh	1980	21	0	0	0	0 (Collapsed)	0	02-11-27S	104-54-04	20	ON	Palembang	1
38	1300	Bak I	1996	5	1	0	0	0	1	02-13-11S	104-55-34	10	Offshore	Palembang	1
39	1310	Bak II	1981	20	0	0	0	0 (Collapsed)	1	02-12-50S	104-55-42	20	Offshore	Palembang	1
41	1682	Maspari	1986	15	0	0	0	0 (Collapsed)	0	03-13-08S	106-13-00	40	ON	Tg. Priok	1
42	1684	Tg. Menjangan	1995	6	0	0	0	1	0	03-49-14S	106-00-03	10	ON	Tg. Priok	1
43	1687	Tg. Bungin	1999	2	0	0	0	1	0	04-33-28S	106-03-29	10	ON	Tg. Priok	1
44	1689	Gs. Serdang	1994	7	0	0	0	1	0	05-04-30S	106-16-36	10	ON	Tg. Priok	1
46	1708	Tg. Priok	1993	8	0	0	0	0 (Collapsed)	0	06-05-41S	106-52-40	10	ON	Tg. Priok	1
47	1710	Beting Eka	1792	9	0	0	0	0 (Collapsed)	1	05-17-32S	106-54-30	10	Offshore	Tg. Priok	1
48	1740	Tg. Kerawang	1979	22	0	0	0	0 (Collapsed)	1	05-54-18S	107-00-28	10	Offshore	Tg. Priok	1
49	1751	P. Putri	1983	18	0	0	0	0	0	06-04-07S	106-51-18	10	ON	Tg. Priok	1
50	1752	Kr. Lamteri	1983	18	0	0	0	0	0	06-04-25S	106-49-50	10	ON	Tg. Priok	1

Appendix 5.1.2.

Rehabilitation and Improvement of Visual ATN in proposed Priority Project (Light Beacon)

No.	DSI No.	Location	Construction Year	Age	Operation Status	Lantern Condition	Power Supply Condition	Structure Condition	DUP	Latitude	Longitude	Structure Height (m)	On/ Offshore	DISNAV	Phase
51	1820	Pel. Pertamina	1982	19	0	0	0	0	0	06-05-49S	105-53-41	10	ON	Tg. Priok	1
52	1821	Pel. Pertamina	1982	19	0	0	0	0 (Collapsed)	0	06-05-38S	106-54-18	10	ON	Tg. Priok	1
53	1822	Pel. Pertamina	1982	19	0	0	0	0 (Collapsed)	0	06-05-51S	106-54-14	10	ON	Tg. Priok	1
54	1823	Pel. Pertamina	1985	16	0	0	0	0 (Collapsed)	0	06-05-40S	106-53-41	10	ON	Tg. Priok	1
55	1831	Kr. Belikat	1995	6	0	0	0	1	0	02-28-00S	106-58-20	20	ON	Palembang	1
56	1910	Tg. Pandang	1973	28	0	0	0	0 (Collapsed)	0	02-44-10S	107-35-42	10	Offshore	Tg. Priok	1
57	1911	Kr. Tanjung Pandan	1993	8	0	0	0	0 (Collapsed)	0	02-43-58S	107-35-30	10	Offshore	Palembang	1
58	1916	Magdalena	1994	7	0	0	0	0 (Collapsed)	0	02-01-18S	106-32-24	10	ON	Palembang	1
59	1950	Pangkal baran depan	1979	22	0	0	0	0	0	02-05-40S	106-09-57	20	Offshore	Palembang	1
60	1970	Fox Bank	1989	12	1	0	0	1	1	03-30-40S	110-11-00	10	Offshore	Tg. Priok	1
61	2010	Kanis	1973	28	0	0	0	0 (Collapsed)	0	02-37-18S	108-12-20	10	ON	Tg. Priok	1
63	2041	Telok Air	1995	6	0	0	0	0 (Collapsed)	0	00-40-54S	109-22-10	10	ON	Pontianak	1
64	2042	Telok Air	1997	4	0	0	0	0 (Collapsed)	0	00-12-32S	109-23-50	10	ON	Pontianak	1
65	2043	Telok Air	1997	4	0	0	0	0 (Collapsed)	0	00-43-48S	109-27-11	10	ON	Pontianak	1
66	2044	Telok Air	1997	4	0	0	0	0 (Collapsed)	0	00-45-12S	109-25-50	10	ON	Pontianak	1
67	2045	Telok Air	1997	4	0	0	0	0 (Collapsed)	0	00-44-00S	109-32-55	10	ON	Pontianak	1
68	2068	Telok Air	1983	18	0	0	0	0 (Collapsed)	0	00-00-16N	109-18-04	10	ON	Pontianak	1
69	2075	Wajok hulu	1986	15	0	0	0	0 (Collapsed)	0	00-00-55N	109-16-45	10	ON	Pontianak	1
71	2080	Lemanbudi	1986	15	0	0	0	0 (Collapsed)	0	01-16-20S	108-52-25	10	ON	Pontianak	1
72	2091	Sambas Belakang	1993	8	0	0	0	0 (Collapsed)	0	01-11-29N	108-59-02	10		Pontianak	1
73	2132	Pemangkat	1977	24	0	0	0	0 (Collapsed)	0	01-11-52N	108-55-10	10	ON	Pontianak	1
77	2139	Kerbau Ketapang	1989	12	0	0	0	0 (Collapsed)	0	01-45-24S	109-56-03	10		Pontianak	1
78	2143	Kr. P. Buan	1994	7	0	0	0	0 (Collapsed)	0	01-28-05S	109-03-00	10	ON	Pontianak	1
80	2201	Kr.Serval	1988	13	0	0	0	0 (Collapsed)	0	03-04-30N	108-02-04	10	Offshore	Tg.Pinang	1
81	2272	Merak Besar	1976	25	0	0	0	0 (Collapsed)	1	05-56-04S	105-59-31	10	Offshore	Tg. Priok	1
85	2381	Tg. Tua	1981	20	0	0	0	1	0	05-54-22S	105-43-00	20	ON	Tg. Priok	1
86	2420	Gs. Jong	1974	27	0	0	0	0	1	05-51-09S	106-38-44	10	Offshore	Tg. Priok	1
87	2430	Kroe	1971	30	0	0	0	0	0	05-11-00S	103-56-00	10	ON	Tg. Priok	1
88	2477	Malakoni	1993	8	0	0	0	0 (Collapsed)	0	05-20-26S	102-17-19	10	ON	Tg. Priok	1
92	2673	Gs. Moller	1990	11	0	0	0	0	1	00-04-20S	099-24-00	10	Offshore	Tlk. Bayur	1
93	2691	Uj.Marit	1990	11	0	0	0	0	0	00-00-56N	098-15-40	20	ON	Sibolga	1
96	2714	P.Sidakah	1984	17	0	0	0	0	1	00-51-34N	098-56-18	20	ON	Sibolga	1
98	2735	P. Bintana	1993	8	0	0	0	0	0	01-28-35N	098-10-20	20	ON	Sibolga	1
99	2760	P. Baleh	1984	17	1	0	0	0	0	02-17-36N	097-24-12	10		Sibolga	1
108	2840	Sikabaluan	*		0	0	0	0 (Collapsed)	1	01-07-18N	098-59-42	10	Offshore	Tlk. Bayur	1

Appendix 5.1.2.

Rehabilitation and Improvement of Visual ATN in proposed Priority Project (Light Beacon)

No.	DSI No.	Location	Construction Year	Age	Operation Status	Lantern Condition	Power Supply Condition	Structure Condition	DUP	Latitude	Longitude	Structure Height (m)	On/ Offshore	DISNAV	Phase
109	2850	Gs.Baohi Lahewa	1981	20	0	0	0	0	1	01-26-05N	097-10-10	10	Offshore	Sibolga	1
110	2855	P. Sumbawga	1992	9	0	0	0	0	0	00-54-26N	098-00-48	30	ON	Sibolga	1
111	2870	Tg Hele	1974	27	0	0	0	0	1	00-32-40N	097-49-17	10	ON	Sibolga	1
113	2960	P. Rusa	1978	23	1	0	0	0	0	05-16-40N	095-12-00	10	ON	Sabang	1
114	3062	Tg. Sengarong	1980	21	0	0	0	0	0	06-45-20S	108-49-10	10	Offshore	Tg. Priok	1
121	3273	Alur Ma. Pel. Juana	1991	10	0	0	0	0 (Collapsed)	1	06-39-00S	111-10-00	10	Offshore	Semarang	1
122	3275	Luwana	1990	11	0	0	0	0	1	06-39-05S	111-10-30	10	ON	Semarang	1
123	3276	Luana	1990	11	0	0	0	0	1	06-40-15S	111-10-30	10	ON	Semarang	1
124	3277	Alur Ma. Pel. Juana	1991	10	0	0	0	0 (Collapsed)	0	06-40-18S	111-10-42	10	Offshore	Semarang	1
126	3293	Tg. Pudak	1986	15	0	0	0	0	0	05-53-21S	110-26-52	20		Semarang	1
130	4122	Kr. Wuni Wates	1991	10	0	0	0	0	1	07-55-42S	110-06-16	30	ON	Cilacap	1
132	4167	Tg. Sari	1976	25	0	0	0	0	1	08-31-43S	115-30-17	20	ON	Benoa	1
134	4190	Gendang	1992	9	0	0	0	0	0	08-45-06S	115-49-12	10	ON	Benoa	1
135	4200	Petagan	1981	20	1	1	1	0	1	08-26-05S	116-45-17	20	Offshore	Benoa	1
136	4201	Sekunci	1984	17	0	0	0	0	1	07-51-30S	117-12-30	20	ON	Benoa	1
137	4220	Tg. Mankun	1994	7	0	0	0	0	1	09-00-38S	116-43-52	30	ON	Benoa	1
139	4331	Lawandau Kotawaringin	1987	14	0	0	0	0	0	02-55-25S	111-23-00	10	ON	Banjarmasin	1
140	4336	Tg. Keluang	1990	11	1	0	0	0	0	02-54-15S	111-42-11	10	ON	Banjarmasin	1
141	4337	Tg. Serambut	1987	14	1	0	0	0 (Collapsed)	1	02-59-11S	113-03-12	17	Offshore	Banjarmasin	1
142	4338	Tg. Serambut	1986	15	0	0	0	0 (Collapsed)	1	02-59-24S	113-03-12	10	Offshore	Banjarmasin	1
143	4468	Gosong Keramat	1993	8	0	0	0	1	0	03-32-06S	116-00-20	10	Offshore	Banjarmasin	1
146	4641	Telk Apar	1985	16	0	0	0	0	0	02-02-42S	116-33-00	20	ON	Samarinda	1
147	4645	Teluk Adang	1983	18	0	0	0	0	0	01-45-00S	116-28-20	10	ON	Samarinda	1
148	4658	P. Seturian	1991	10	0	0	0	0	0	02-16-20S	117-39-40	10	ON	Samarinda	1
149	4731	Baliknapan	1990	11	0	0	0	0	0	01-13-32S	116-48-20	10	ON	Samarinda	1
150	4748	Tg. Nibung	1982	19	0	0	0	0 (Collapsed)	0	00-48-30S	117-17-51	10	ON	Samarinda	1
151	4749	Tg. Nibung	1982	19	0	0	0	0	0	00-48-06S	117-17-45	20	ON	Samarinda	1
153	4763	Kutai River	1990	11	0	0	0	0 (Collapsed)	0	00-34-20S	117-16-20	10		Samarinda	1
154	4768	Mahakam River	1990	11	0	0	0	0 (Collapsed)	0	00-20-15S	117-29-42	10	ON	Samarinda	1
155	4911	Sibald Bank	1994	7	0	0	0	0 (Collapsed)	1	05-46-00S	117-07-00	20	Offshore	Makassar	1
159	5012	Batu Nombongan	1985	16	0	0	0	0 (Collapsed)	0	04-52-45S	119-22-00	10	Offshore	Makassar	1
164	5160	Kr.Malalungun	1985	16	1	1	1	0	1	01-55-32N	118-26-40	10	Offshore	Tarakan	1
167	5176	Tg.Ulingan	1992	9	0	0	0	0	1	02-12-08N	118-02-40	10	Offshore	Tarakan	1
169	5312	Tg.Harapan	1991	10	1	1	1	0	1	04-03-30N	117-45-05	10	Offshore	Tarakan	1
172	5351	Pel.Inobonto	*		0	0	0	0 (Collapsed)	0	00-55-30N	124-06-00	20	ON	Manado/Bitung	1

Appendix 5.1.2.

Rehabilitation and Improvement of Visual ATN in proposed Priority Project (Light Beacon)

No.	DSI No.	Location	Construction Year	Age	Operation Status	Lantern Condition	Power Supply Condition	Structure Condition	DUP	Latitude	Longitude	Structure Height (m)	On/ Offshore	DISNAV	Phase
173	5410	Pel.Tagulandang	*		0	0	0	0 (Collapsed)	0	02-20-30N	125-23-00	20	ON	Manado/Bitung	1
174	5440	Pel.Peta	*		0	0	0	0 (Collapsed)	0	03-39-30N	125-32-30	10	ON	Manado/Bitung	1
176	5468	Pel.Belang	*		0	0	0	0 (Collapsed)	0	00-56-00N	124-47-00	20	ON	Manado/Bitung	1
177	5469	Pel.Kotabunan	*		0	0	0	0 (Collapsed)	0	00-47-50N	124-38-31	20	ON	Manado/Bitung	1
178	5492	Pel.Tilamuta	*		0	0	0	0 (Collapsed)	0	00-30-00N	122-20-11	20	ON	Manado/Bitung	1
179	5495	Pel.Moutong	*		0	0	0	0 (Collapsed)	0	00-27-20N	121-13-30	20	ON	Manado/Bitung	1
182	5540	Pel.Una-Una	*		0	0	0	0 (Collapsed)	0	00-08-00S	121-39-00	20	ON	Manado/Bitung	1
190	5578	Bunk toko	1977	24	0	0	0	0 (Collapsed)	0	03-58-24S	122-36-23	10	ON	Kendari	1
194	5583	Twelling Barat	1992	9	0	0	0	0 (Collapsed)	0	04-12-54S	122-55-00	10	Offshore	Kendari	1
197	5614	P.Siompu	1985	16	0	0	0	0 (Collapsed)	1	05-41-30S	122-27-40	20	ON	Kendari	1
198	5673	Padamarang	1978	23	1	0	0	0	0	04-03-20S	121-22-48	10	Offshore	Kendari	1
204	5851	Waitidal	1981	20	0	0	0	0 (Collapsed)	0	07-07-25S	131-43-14	20	ON	Ambon	1
208	5886	Pel. Tual	1978	23	0	0	0	0	0	05-34-10S	132-40-16	20		Ambon	1
209	5915	Kr.Dododahohe	1988	13	0	0	0	0 (Collapsed)	1	01-59-05S	128-12-36	10	Offshore	Ambon	1
211	5974	Daruba	*		0	0	0	1	0	02-35-55N	128-17-05	10	Offshore	Ambon	1
212	5980	Hatilang	1978	23	0	0	0	0	0	02-47-20S	129-29-30	10	Offshore	Ambon	1
213	6005	Tg. Yatung	1981	20	0	0	0	0	0	08-26-53S	140-18-26	20	ON	Merauke	1
214	6008	Merauke	1992	9	0	0	0	0 (Collapsed)	0	08-28-36S	140-21-07	20	ON	Merauke	1
215	6020	Ujung Digul	1991	10	0	0	0	0	1	06-55-58S	138-31-47	10	ON	Merauke	1
216	6046	Ma.Keakwa	1985	16	0	0	0	0	1	04-45-21S	136-30-31	30	ON	Sorong	1
217	6060	Pel.Fakfak	1989	12	0	0	0	0 (Collapsed)	0	02-56-16S	132-17-40	10	ON	Sorong	1
218	6160	Kr.Membok	1980	21	0	0	0	0	1	01-24-25S	130-54-40	10	Offshore	Sorong	1
220	6200	Saokorem	1984	17	0	0	0	0	0	00-33-05S	133-09-00	30		Sorong	1
224	6280	Balbili	1948	53	0	0	0	0	1	01-05-30S	131-11-00	10	Offshore	Sorong	1
230	132005	Rambu suar	1994	7	0	0	0	0 (Collapsed)	0	00-51-00N	107-37-06	10	ON	Pontianak	1
231	132006	Rambu suar	1994	7	0	0	0	0 (Collapsed)	0	00-45-03N	107-19-200	10	ON	Pontianak	1

Appendix 5.1.3.

Rehabilitation and Improvement of Visual ATN in proposed Priority Project (Light Buoy)

No.	No. (DSI)	Location	Establishement	Age	Operation Status	Condition of Lighting Apparatus	Energy	Condition of Power Supply	Range required	Color of Structure	Condition of Structure/ Buoy Body	ATN Office
1	82	Krueng Raya	1983	19	1	1	SC	1	4	Red	0	Sabang
2	320	Belawan Deli Alur Masuk	1971	31	0	0	A	0	6	Red/White V Strip	0	Belawan
3	641	Pelsu No1. Selat Bengkalis	1969	33	1	1	SC/EB	1	4	Green	0 (Broken)	Dumai
4	651	Pelsu No.5 Selat Bengkalis	1993	9	1	1	SC/EB	1	4	Green	0 (Damaged)	Dumai
5	693	Pelsu No.8 Selat Rupat	1994	8	1	1	SC/EB	1	4	Red	0 (Damaged)	Dumai
6	702	Pelsu No.18 Selat Rupat	1995	7	0	0 (Missing)	SC	0 (Missing)	4	Red	0 (Damaged)	Dumai
7	720	Pelsu Selat Rupat	1993	9	0 (Missing)	0 (Missing)	SC/EB	0 (Missing)	4	Green	0 (Missing)	Dumai
8	722	Pelsu MPMT Sei Pakning	1994	8	0 (Missing)	0 (Missing)	A	0 (Missing)	6	Red/White V Strip	0 (Missing)	Dumai
9	723	Pelsu Sei Pakning	1994	8	1	0	A	0	4	Green	0	Dumai
10	729	Pelsu Sei Siak	1994	8	0	0	A	0	4	Red	0	Dumai
11	752	Pelsu P.Tengah Sei Siak	1995	7	0	0 (Missing)	A	0 (Missing)	4	Green	0	Dumai
12	862	Pelsu Batu Ampar	1990	12	0	1	EB	1	5	Red/White V Strip	0	Tg. Pinang
13	926	Pelsu MPMT Kuala Kijang	1996	6	0 (Missing)	0 (Missing)	A	0 (Missing)	6	Red/White V Strip	0 (Missing)	Dumai
14	1200	Sungai Jambi	1980	22	0	0	SC	0	6	Red/White V Strip	0	Palembang
15	1205	SungaiJambi (No.6)	1980	22	0	0 (Missing)	SC	0	6	Red	0	Palembang
16	1290	Katung	1976	26	0 (Missing)	0 (Missing)	SC	0 (Missing)	6	Red	0 (Missing)	Palembang
17	1350	Carat	1976	26	0 (Missing)	0 (Missing)	SC	0 (Missing)	6	Green	0 (Missing)	Palembang
18	1351	S. Palembang sebelah	1976	26	0 (Missing)	0 (Missing)	SC	0 (Missing)	6	Red	0 (Missing)	Palembang
19	1370	Tg.Gede	1976	26	0 (Missing)	0 (Missing)	SC	0 (Missing)	6	Red	0 (Missing)	Palembang
20	1400	Selatan Payang	1976	26	0 (Missing)	0 (Missing)	SC	0 (Missing)	6	Red	0 (Missing)	Palembang
21	1712	Pulau Bulat	1987	15	0 (Missing)	0 (Missing)	SC	0 (Missing)	4	Red/White V Strip	0 (Missing)	Tg. Pinang
22	1721	Tanjung Priok	1993	9	0	0 (Missing)	SC	0	5	Yellow	0 (Damaged)	Tg. Pinang
23	1722	Tanjung Priok	1993	9	0	0 (Missing)	SC	0	5	Yellow	0 (Damaged)	Tg. Pinang
24	1824	Pelita Bahari	1990	12	0	0 (Missing)	SC	0	6	Green	0 (Broken)	Tg. Pinang
25	2030	MPMT Ambang Luar	1992	10	0	0	SC	0	6	Red/White V Strip	0	Pontianak
26	2131	Pelsu Pemangkat	1991	11	0	0 (Broken)	EB	0 (Broken)	4	Red/White V Strip	0 (Broken)	Pontianak
27	2134	Ma. Kuala Paniang	1995	7	0	0 (Broken)	A	0 (Broken)	7	Red/White V Strip	0 (Broken)	Pontianak
28	2988	Delta Dorav	1970	32	0 (Missing)	0 (Missing)	SC	0 (Missing)	4	Black/Red H Band	0 (Missing)	Tg. Pinang
29	3119	Tegal	1990	12	1	1	SC	1	4	Red/White V Strip	0	Semarang
30	3140	Pelampung suar Pemalang	1990	12	1	1	SC	1	4	BY Hband	0	Semarang
31	3190	Pelampung suar	1995	7	0 (Missing)	0 (Missing)	SC	0 (Missing)	6	BY Hband	0 (Missing)	Semarang
32	3203	Semarang Tg. Mas (No.1)	1984	18	1	1	SC	1	4	Green	0	Semarang
33	3204	Semarang Tg. Mas	1985	17	0 (Sunken)	0 (Sunken)	EB	0 (Sunken)	4	Red	0 (Sunken)	Semarang
34	3205	Semarang Tg. Mas	1985	17	0 (Sunken)	0 (Sunken)	EB	0 (Sunken)	4	Green	0 (Sunken)	Semarang
35	3206	Semarang Tg. Mas	1985	17	0 (Sunken)	0 (Sunken)	EB	0 (Sunken)	4	Red	0	Semarang

Appendix 5.1.3.

Rehabilitation and Improvement of Visual ATN in Master Plan (Light Buoy)

No.	No. (DSI)	Location	Establishement	Age	Operation Status	Condition of Lighting Apparatus	Energy	Condition of Power Supply	Range required	Color of Structure	Condition of Structure/ Buoy Body	ATN Office
36	3207	Semarang Tg. Mas	1985	17	0 (Sunken)	0 (Sunken)	EB	0 (Sunken)	4	Green	0	Semarang
37	3208	Semarang Tg. Mas (No.6)	1984	18	1	1	SC	1	4	Red	0	Semarang
38	3209	Semarang Tg. Mas	1984	18	1	1	SC	1	4	Yellow	0	Semarang
39	3260	Pelampung suar Tg. Emas	1984	18	1	1	SC	1	4	Red/White V Strip	0	Semarang
40	3291	Pelampung suar Pemalang	1988	14	0 (Sunken)	0 (Sunken)		0 (Sunken)	4	Black/Red H Band	0 (Sunken)	Semarang
41	4088	Pelsu N0.8 Alur Benoa	1983	19	0	0	SC/EB	0	4	Red	0	Benoa
42	4341	Pelsu Merah (Gs. Malang)	1985	17	0 (Sunken)	0 (Sunken)	SC	0 (Sunken)	4	Red	0 (Sunken)	Baniarmasin
43	4363	Sungai Barito (No.2)	1983	19	0 (Sunken)	0 (Sunken)	SC	0 (Sunken)	4	Red	0 (Sunken)	Baniarmasin
44	4364	Sungai Barito (No.3)	1994	8	0 (Sunken)	0 (Sunken)	SC	0 (Sunken)	4	Green	0 (Sunken)	Baniarmasin
45	4365	Sungai Barito (No.4)	1994	8	0 (Sunken)	0 (Sunken)	SC	0 (Sunken)	5	Red	0 (Sunken)	Baniarmasin
46	4367	Sungai Barito (No.6)	1994	8	0 (Missing)	0 (Missing)	SC	0 (Missing)	5	Red	0 (Missing)	Baniarmasin
47	4371	Pelsu No. 7 Sei Barito	*	----	0 (Missing)	0 (Missing)	SC	0 (Missing)	5	Green	0 (Missing)	Baniarmasin
48	4430	Sungai Kahayan	1980	22	0 (Missing)	0 (Missing)	SC	0 (Missing)	4	Red	0 (Missing)	Baniarmasin
49	4431	Sungai Kahayan (No.2)	1980	22	0 (Missing)	0 (Missing)	SC	0 (Missing)	4	Red	0 (Missing)	Baniarmasin
50	4754	Kutai River (Ma. Pegah)	1987	15	0	0	SC	0	4	Green	0	Samarinda
51	4756	Kutai River (Ma. Pegah)	1987	15	0	0	SC	0	4	Green	0	Samarinda
52	4870.1	S. Sanekuling	1987	15	0	0	SC	0	4	Red	0	Samarinda
53	5113	Pantoloan	1992	10	0	0	SC	0	4	Red	0 (Broken)	Bitung
54	5165	Sungai Berau	1976	26	0	0	SC	0	4	Red/White V Strip	0 (Missing)	Tarakan
55	6004	Merauke Sungai Merauke	1995	7	0 (Missing)	0	SC	0 (Broken)	6	Red	0	Merauke
56	6034	Aikawariver	1981	21	0	0	SC	0	6	Red	0	Sorong
57	6011	De Jong's Punt di muara	*	---	0	0	SC	0	6	Black	0	Merauke
58	6033	Sungai Flamingo	1981	21	0	0	A	0	5	Black	0	Merauke
59	6100	Pelsu S. Wasian	1996	6	0 (Missing)	0 (Missing)	A	0 (Missing)	4	Red/White V Strip	0 (Missing)	Sorong
60	6121	Ma. S. Kaikus	1977	25	0	0 (Missing)	SC	0 (Missing)	6	Red/White V Strip	0	Sorong
61	5761	Tenau Kupang	1970	32	0	0 (Missing)	SC	0 (Missing)	4		0	Kupng

Appendix 5.2.1.
Development of Visual ATN in proposed Priority Project (Lighthouse)

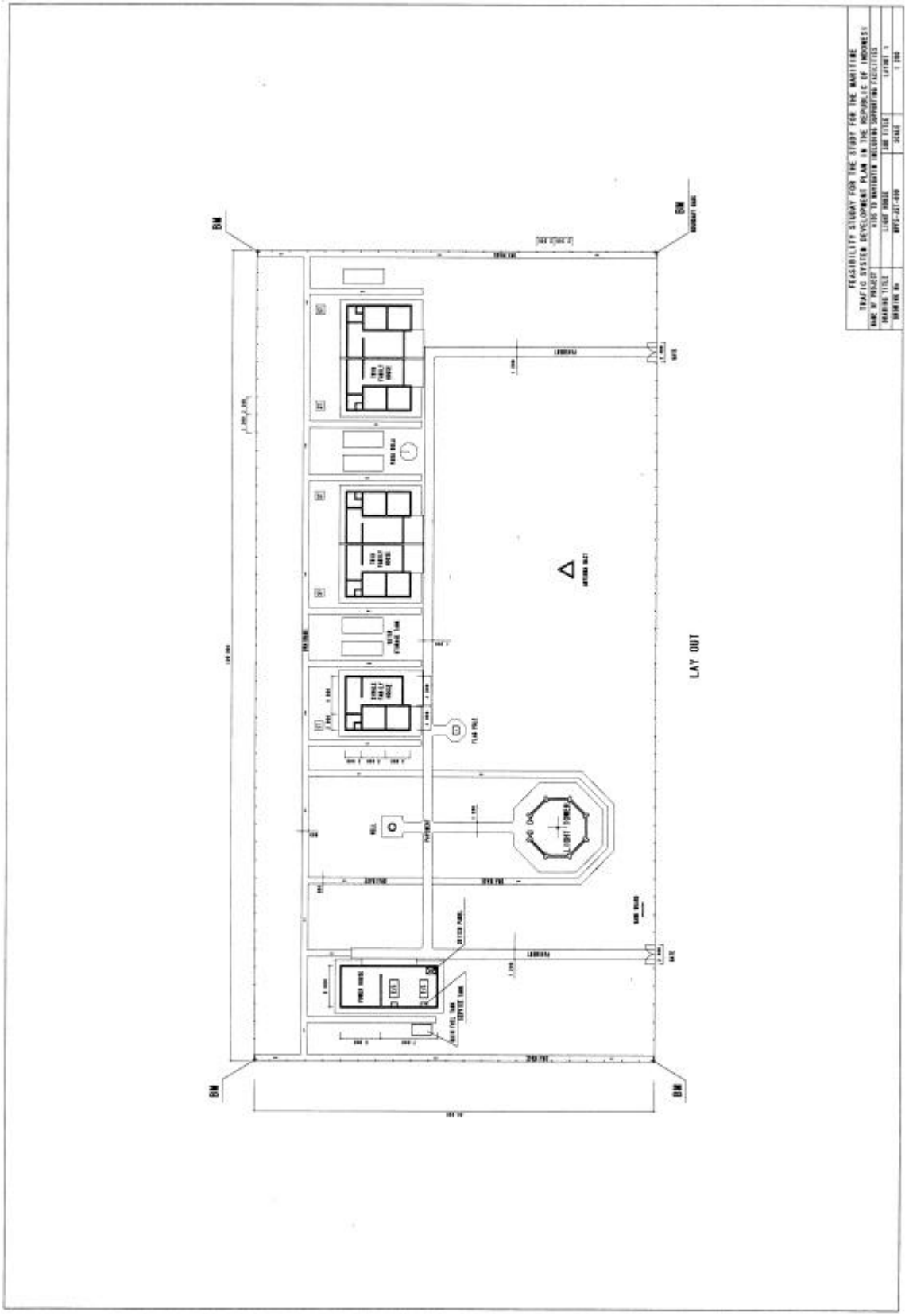
No.	DISNAV	Location	Latitude	Longitude	Structure Height (GL:)	Site	Total Score	Priority	Remarks
5	Tg.Pinang	P. Panjang	04-15-23N	108-12-37E	10	On Land	51.000	2	See Appendix 8.4.1
7	Tg.Pinang	P.Timau	03-17-19N	107-33-14E	10	On Land	43.500	3	See Appendix 8.4.1
10	Tg.Pinang	Tg. Sading	01-11-48N	104-23-40E	40	On Land	57.500	1	See Appendix 8.4.1
14	Palembang	P. Cebia	01-12-21S	105-16-02E	40	On Land	37.500	12	See Appendix 8.4.1
15	Palembang	Tg. Lesum	01-38-55S	105-20-54E	40	On Land	32.500	22	See Appendix 8.4.1
17	Palembang	Uj. Batakarang	02-00-42S	104-50-16E	40	On Land	37.500	12	See Appendix 8.4.1
26	Surabaya	Memburit	06-50-02S	115-13-00E	40	On Land	41.000	4	See Appendix 8.4.1
28	Benoa	P. Menjangan	08-05-38S	114-31-36E	40	On Land	41.500	4	See Appendix 8.4.1

Appendix 5.2.2.
Development of Visual ATN in proposed Priority Project
(Light Beacon)

No.	DISNAV	Location	Latitude	Longitude	Structure Height (GL:m)	Site	Total Score	Priority	Remarks
34	Dumai	Gs.Mumbul	02-03-17N	101-25-38E	10	Offshore	42.5	12	See Appendix 8.4.2
35	Dumai	Pel.Kuala Enok	00-31-59S	103-26-38E	10	Offshore	37.5	23	See Appendix 8.4.2
36	Dumai	Pel.Kuala Enok	03-32-51S	103-27-42E	10	Offshore	37.5	23	See Appendix 8.4.2
37	Dumai	Pel.Kuala Enok	00-34-57S	103-29-10E	10	Offshore	37.5	23	See Appendix 8.4.2
38	Dumai	Selatan P.Tengah	01-07-20N	102-09-34E	10	Offshore	38	20	See Appendix 8.4.2
39	Dumai	Tg.Layang	01-13-22N	102-10-29E	10	Offshore	38	20	See Appendix 8.4.2
40	Dumai	Utara P.Tengah	01-08-13N	102-09-35E	10	Offshore	38	20	See Appendix 8.4.2
41	Tg.Pinang	P. Ritan	02-35-47N	106-16-29E	10	On Land	45	9	See Appendix 8.4.2
45	Tg.Pinang	Kr.Nginang	00-58-50N	104-09-31E	10	Offshore	45	9	See Appendix 8.4.2
48	Tg.Pinang	P. Batuberlayar	00-24-08N	104-14-53E	10	On Land	35	31	See Appendix 8.4.2
55	Tg.Pinang	P.Selanga	00-29-15N	104-21-23E	20	On Land	35	31	See Appendix 8.4.2
52	Tg.Pinang	Pel.Midai	02-59-44N	107-44-39E	10	Offshore	46	4	See Appendix 8.4.2
53	Tg.Pinang	Pel.Midai	03-00-00N	107-44-38E	10	Offshore	46	4	See Appendix 8.4.2
54	Tg.Pinang	Pel.Midai	02-59-57N	107-44-52E	20	On Land	46	4	See Appendix 8.4.2
58	Tg.Pinang	P. Senggakang	00-55-43N	104-25-31E	10	Offshore	47.5	2	See Appendix 8.4.2
59	Tg.Pinang	P. Penyengat	00-55-16N	104-25-05E	10	Offshore	47.5	2	See Appendix 8.4.2
67	Palembang	Kr. Haji	02-05-33S	105-06-23E	10	Offshore	42.5	12	See Appendix 8.4.2
68	Palembang	Ma. Kuala Tungkal	00-47-40S	103-30-40E	10	Offshore	37.5	23	See Appendix 8.4.2
69	Palembang	Ma. Kuala Tungkal	00-46-01S	103-32-00E	10	Offshore	37.5	23	See Appendix 8.4.2
74	Palembang	Selat Nando	02-55-14S	107-26-49E	10	Offshore	35.5	23	See Appendix 8.4.2
75	Palembang	Tg. Terentang	01-34-58S	105-43-13E	10	Offshore	37.5	23	See Appendix 8.4.2
80	Tg. Priok	Kr. Gundul	05-51-20S	106-34-12E	10	Offshore	35	31	See Appendix 8.4.2
81	Tg. Priok	Kr. Kerbau	05-46-11S	106-26-29E	10	Offshore	45	9	See Appendix 8.4.2
87	Tg. Priok	Tg.Karawang	05-55-55S	106-58-48E	10	Offshore	40	16	See Appendix 8.4.2
88	Semarang	Alur Pel. Karimun Jawa	05-53-27S	110-26-18E	10	Offshore	35	31	See Appendix 8.4.2
89	Semarang	Alur Pel. Karimun Jawa	05-53-10S	110-26-18E	10	Offshore	35	31	See Appendix 8.4.2
90	Semarang	Alur Pel. Karimun Jawa	05-53-08S	110-26-55E	10	Offshore	35	31	See Appendix 8.4.2
100	Surabaya	GS. Castor	07-19-00S	112-53-00E	10	Offshore	52.5	1	See Appendix 8.4.2
104	Surabaya	P.Sepekan	07-00-57S	115-42-44E	20	On Land	42.5	12	See Appendix 8.4.2
143	Manado/Bitung	Napu Arampua	04-38-17N	127-04-47E	10	Offshore	43.5	12	See Appendix 8.4.2
156	Manado/Bitung	Awit	04-19-30N	126-41-14E	20	On Land	46	4	See Appendix 8.4.2
159	Manado/Bitung	Pel.Tamako	03-26-49N	125-29-33E	20	On Land	46	4	See Appendix 8.4.2
168	Manado/Bitung	Tg. Papalanpungan	03-58-52N	126-44-38E	30	On Land	40	16	See Appendix 8.4.2

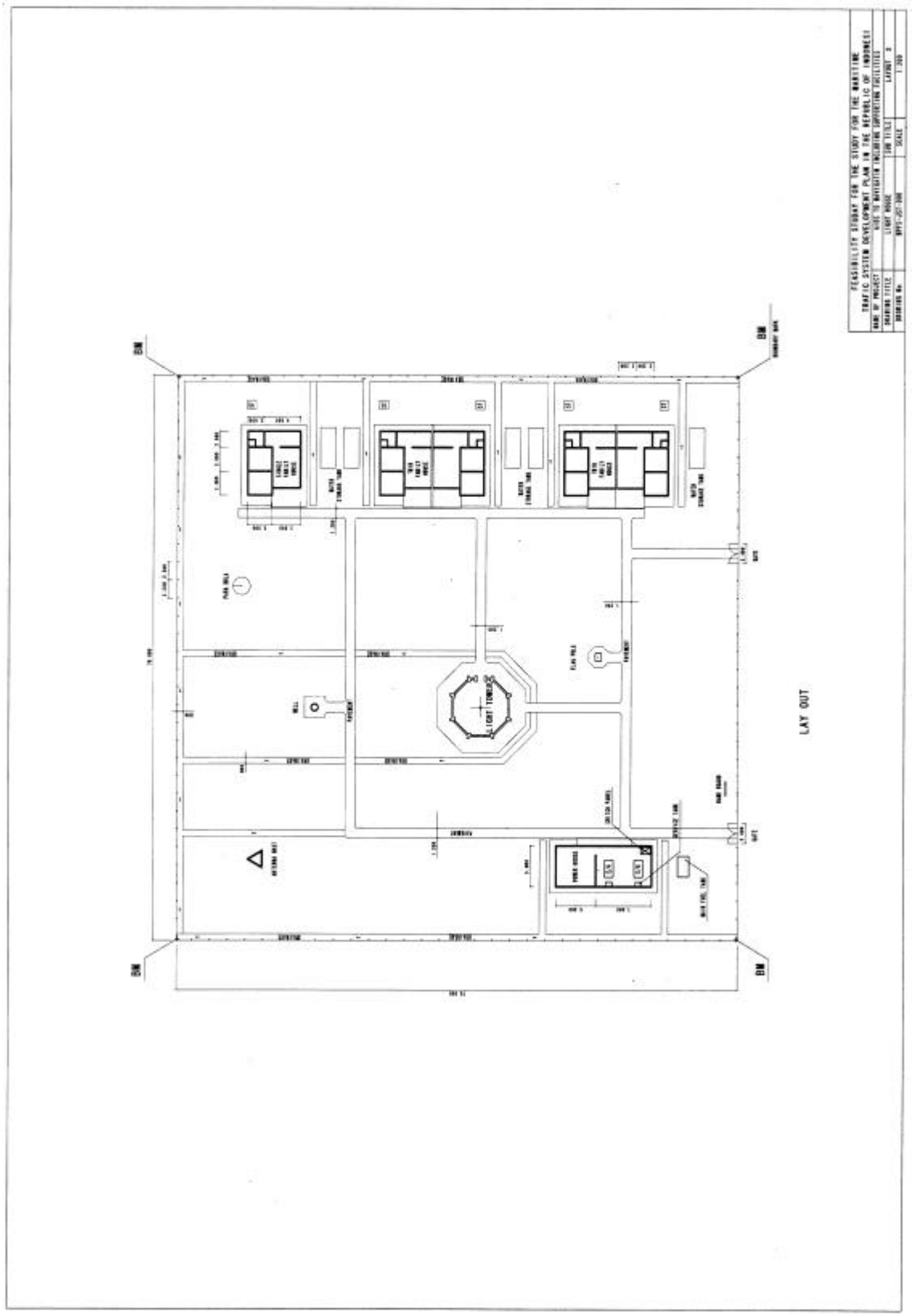
Appendix 7.3.1.

Lighthouse, Layout 1



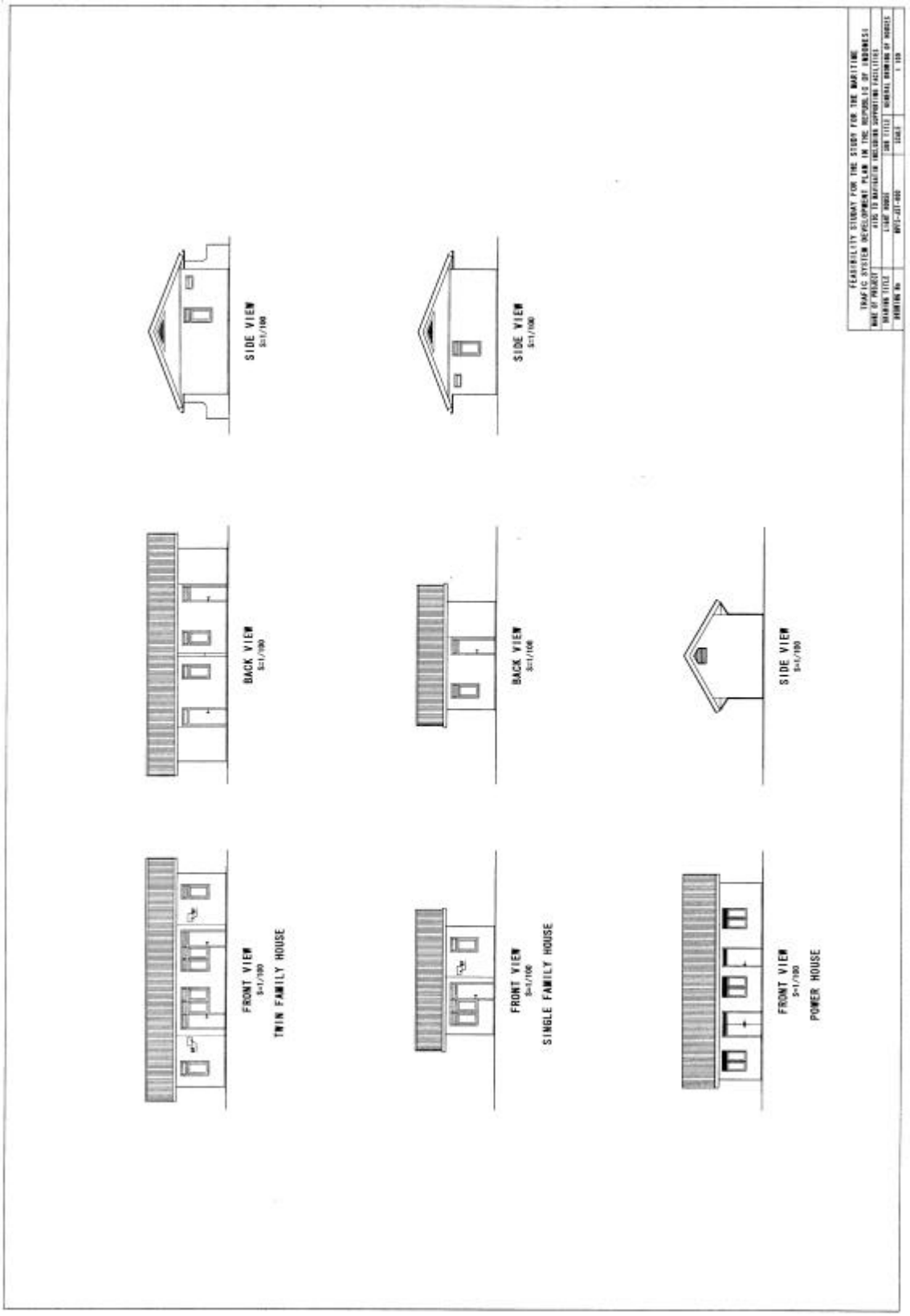
Appendix 7.3.2.

Lighthouse, Layout 2



Appendix 7.3.3.

Lighthouse, Layout 3 (General Drawing of Houses)



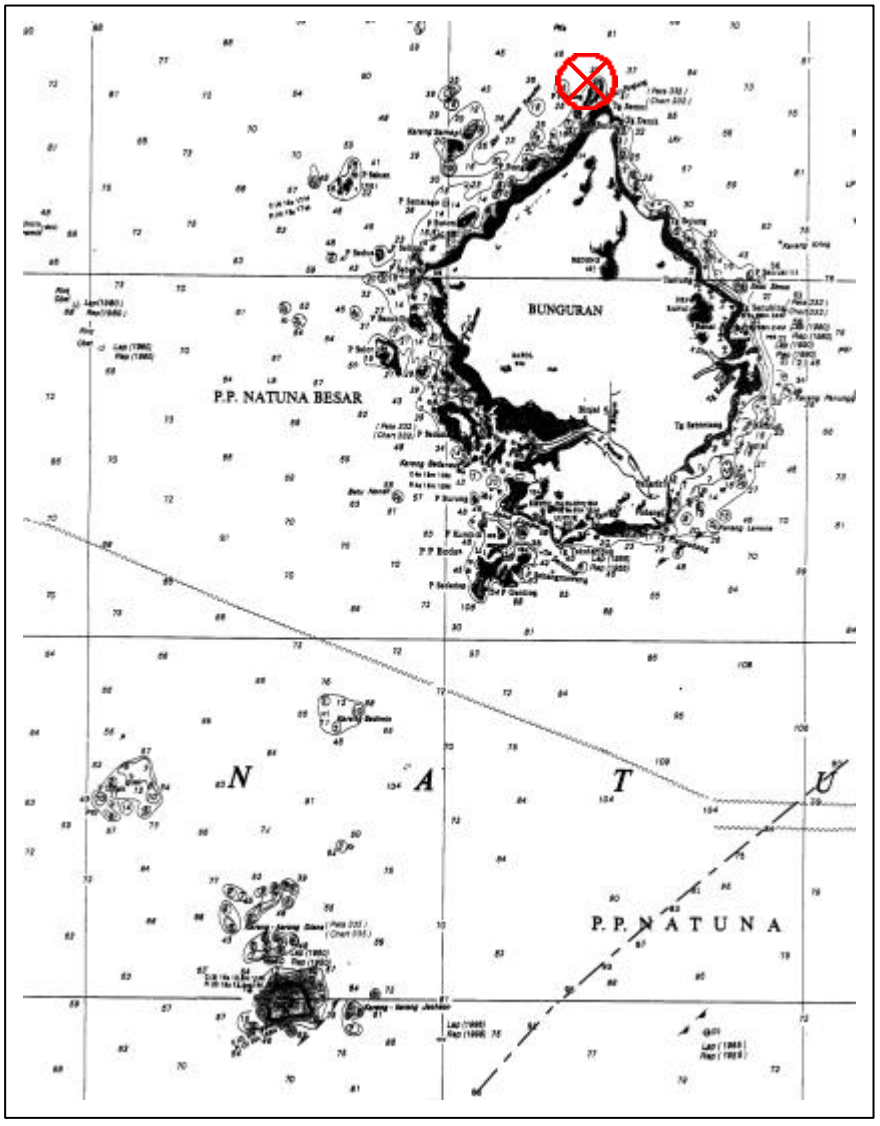
Appendix 8.2.1.

Survey Seat for LH/LB						
Site	Tg.Timau			Type	(LH) or LB	Dev.Plan No. 10
DISNAV			Date			Weather
Position	Plan Site	Lat Lat	N S	Long Long		E
Chart no.						
Approach	Near City					
	Near Port					
Direct ashore or not			Depth	off shore m	at	LT
Route and method for transportation						
Seabed Substance						
Surroundings						
GL of Site	SL+		m,at		LT	
Sector	NM		degree of clockwise			limited
Information of Site	①Area for construction					
	②Owner of land					
	③Circumstance					
	④Fundation					
	⑤Water for construction					
	⑥Obstruction for light					
	⑦Power					
	⑧Route for Material					
	⑨Approach for maintenance					
	⑩Sea condition					
	⑪Marine casualty					
Photograph						
Drawings	Chart no.					
	Map no.					
	Sketch					
	Reference					

Investigator	G2			
Counter part	Masjhuri		S.L.. Tobing	

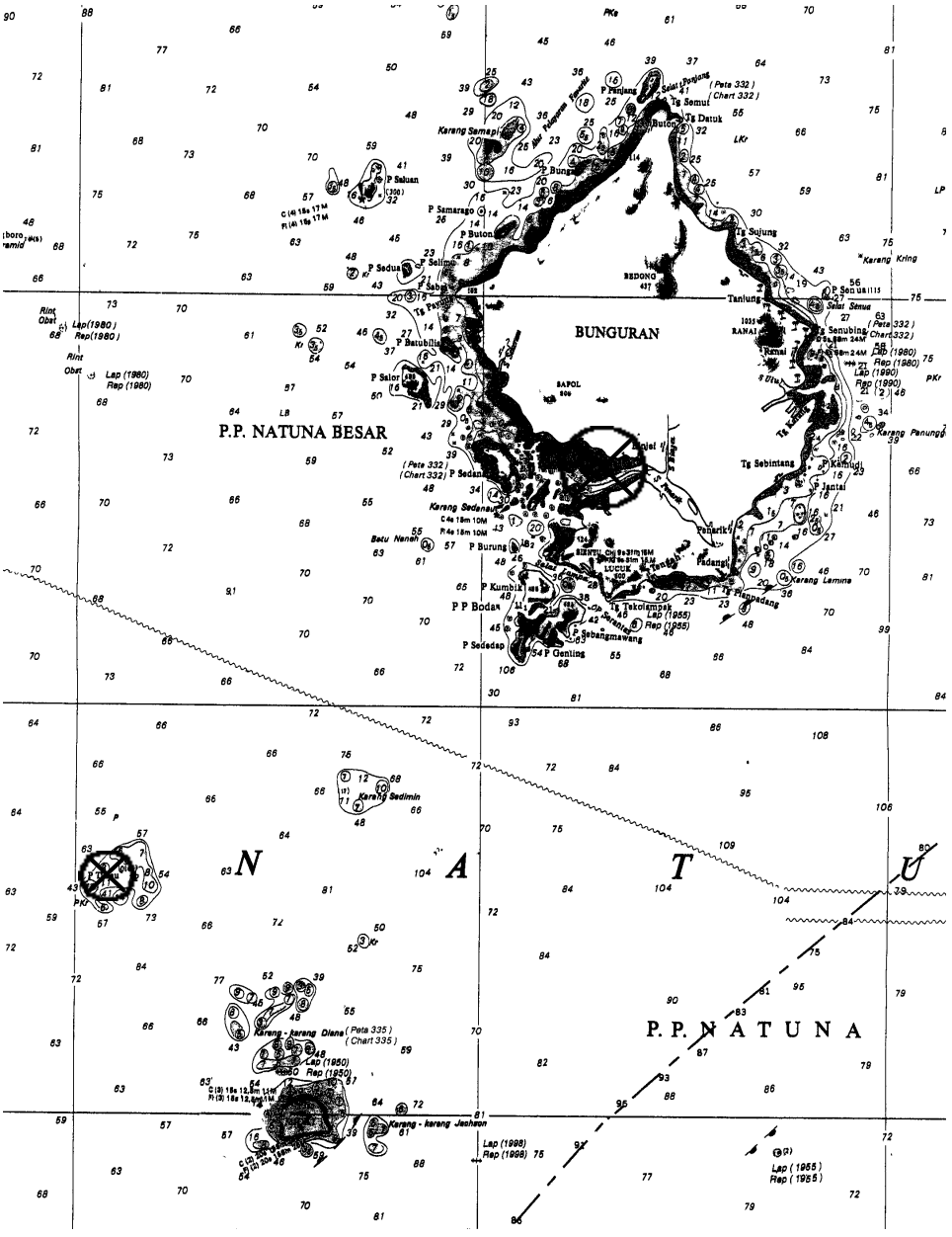
Appendix 8.4.1.
Site Survey Map

Disnav. : Tg.Pinang	Site No. LH5		
Name of Site: P.Panjang (change from Bungan Timur)			
Type of V. ATN: LH 10m	Lat: 04-15-23N	Long: 108-12-37E	
Chart No.: 280	Soil Condition: Sandstone	Height: 51 m	
Approach: Natuna Besar islands are located in South China sea at the distance of about 240 nautical miles from Tg.Pinang. The site is located in small island called Panjang situated northward offshore Bunguran island. The site is located northernmost part and top of the island. The access to the site is by walk from landing point located northwest beach.			



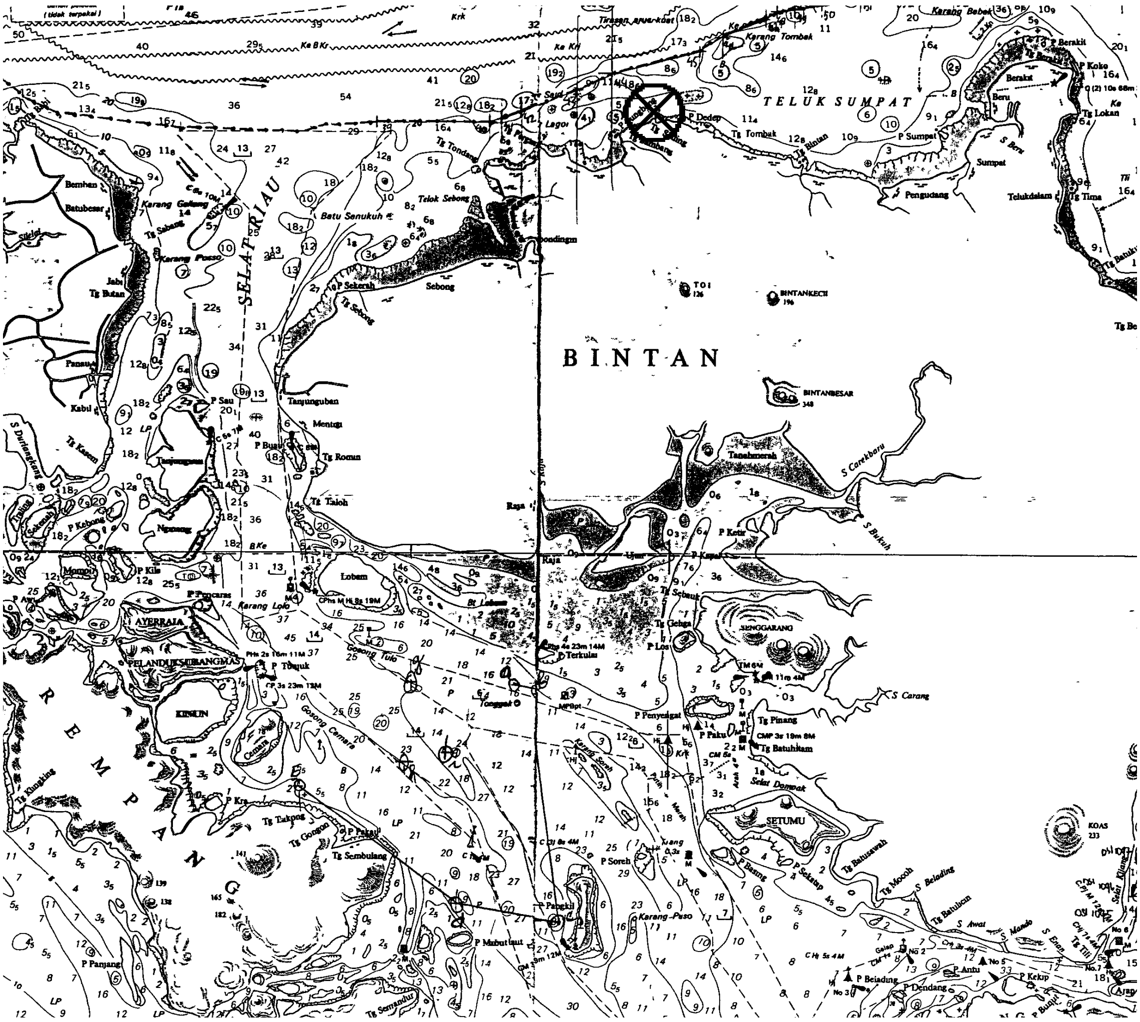
Appendix 8.4.1.
Site Survey Map

Disnav. : Tg.Pinang	Site No. LH7		
Name of Site: P.Timau			
Type of V. ATN: LH 20m	Lat: 03-17-19N	Long: 107-33-14E	
Chart No.: 280	Soil Condition: Rock and Mad	Depth: 65 m	
Approach: Timau island is one of Natuna Besar islands in South China Sea, located southwestward of Bunguran island. The site is top of Timau islands.			



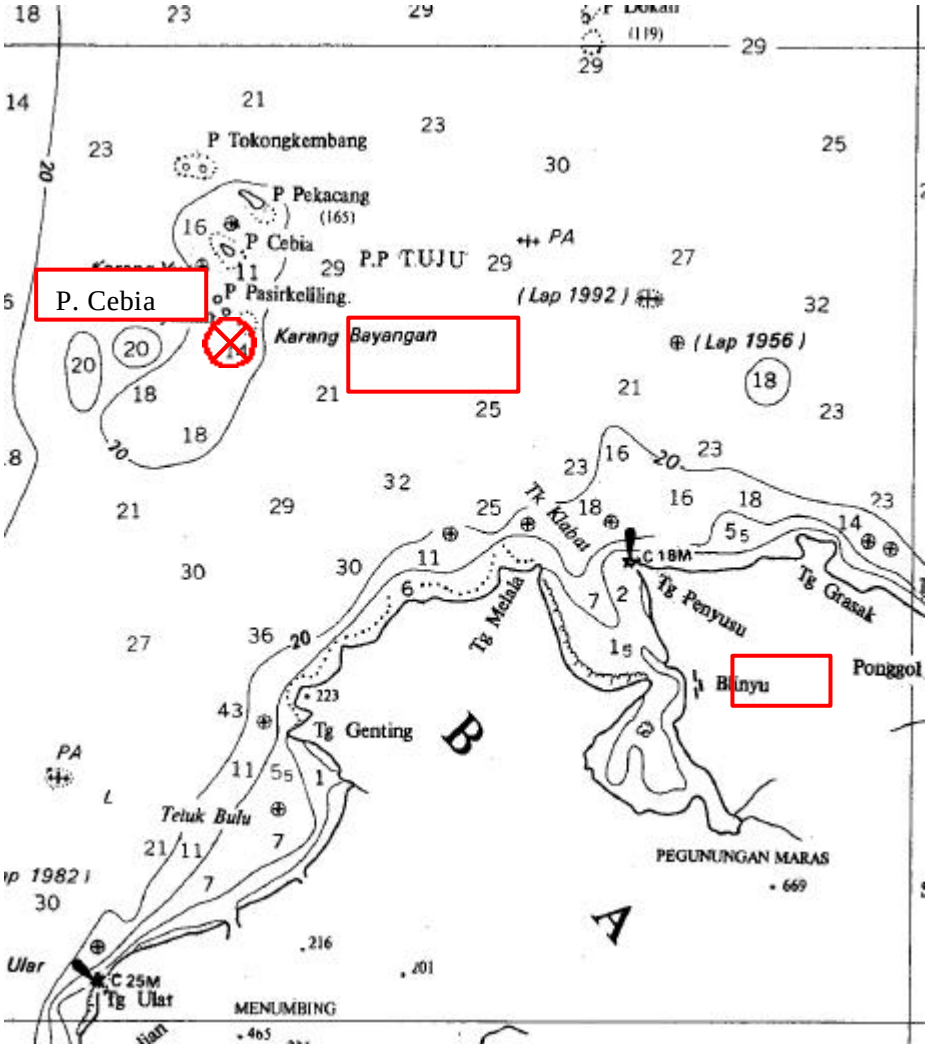
Appendix 8.4.1.
Site Survey Map

Disnav. : Tg.Pinang	Site No. LH10	
Name of Site: Tg.Sading		
Type of V. ATN: LH 40m	Lat: 01-11-48N	Long: 104-23-40E
Chart No.: 42	Soil Condition: Stone	Height:15m
Approach: The site is located in north side of Bintan island at the distance of 60 nautical miles from Tg. Pinang.		



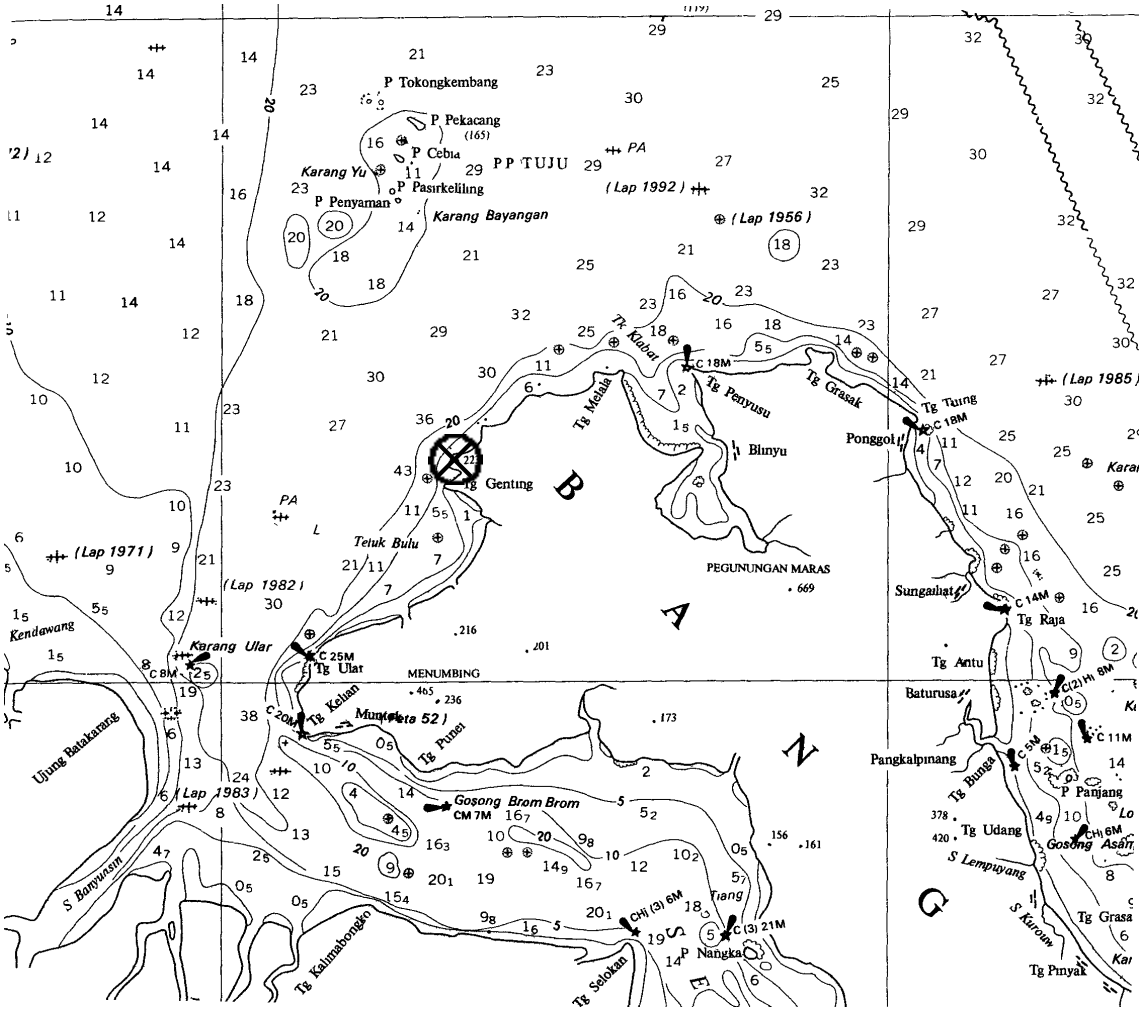
Appendix 8.4.1.
Site Survey Map

Disnav. : Palembang	Site No. LH14	
Name of Site : P. Cebia (P. Pekatyang)		
Type of V. ATN : LH 40m	Lat : 01-12-21S	Long : 105-16-02E
Chart No. : 60,159	Soil condition :	Height:
Approach : Cebia island is one of Tuju islands located northwestward of Bangka island. The distance is about 45 nautical miles from Belinyu in western part of Bangka island. The site located in northwest part of Cebia island. Distance from village named Pekajang Kec. Lingga is around 300m.		



Appendix 8.4.1.
Site Survey Map

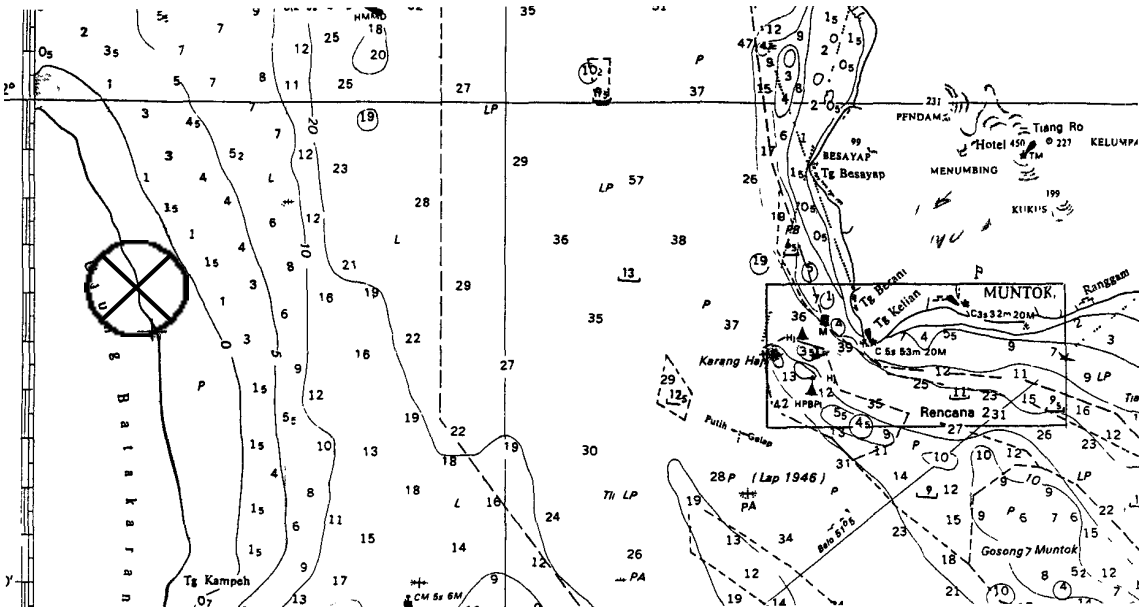
Disnav. : Palembang	Site No. LH15	
Name of Site: Tg.Lesum (change from Tg.Genting)		
Type of V. ATN: LH 40m	Lat: 01-38-55S	Long: 105-20-54E
Chart No.: 52	Soil Condition: Stone and Mud	Height: 50 m
Approach: The site is located in northwest part of Bangka island. The island is about 40 nautical miles from Muntok.		



Appendix 8.4.1.
Site Survey Map

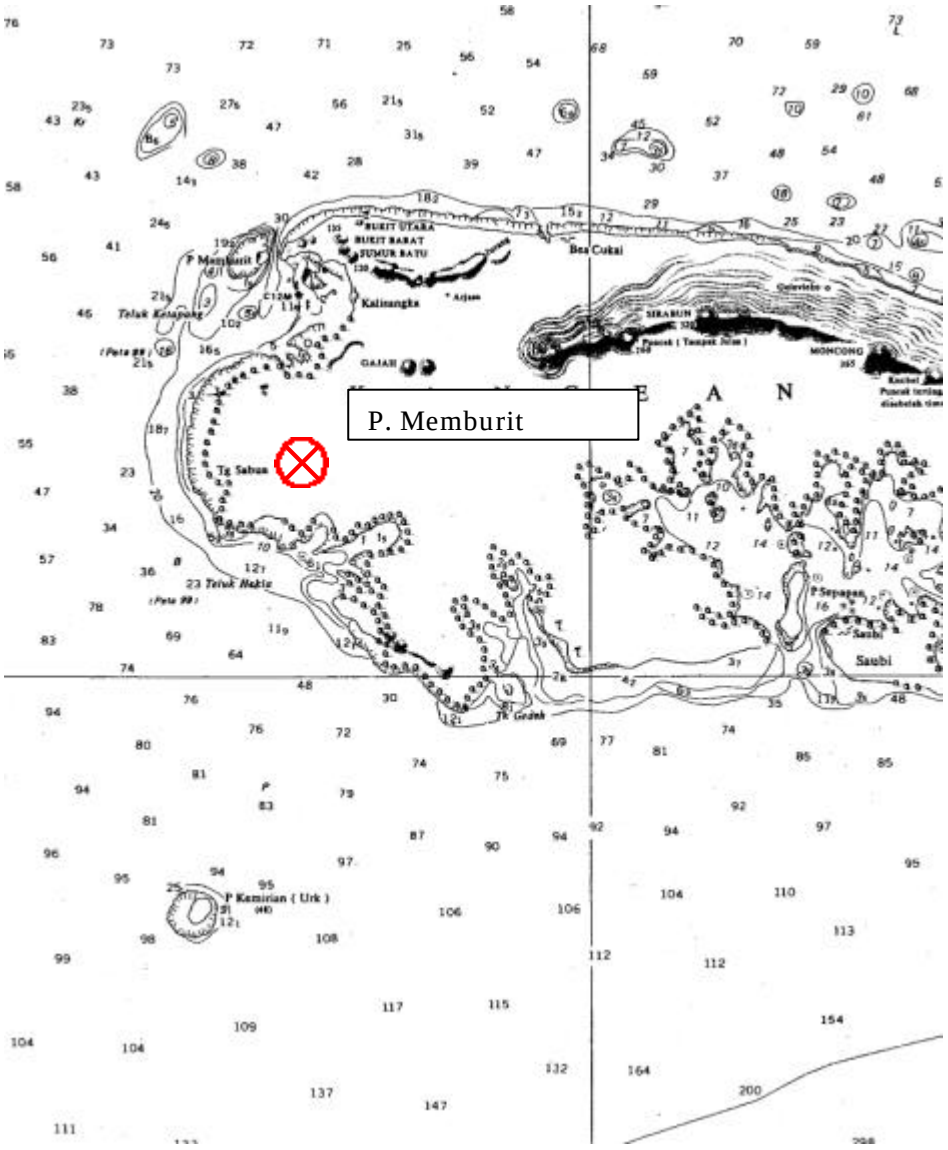
Disnav. : Palembang	Site No. LH17		
Name of Site: Uj.Batakarang			
Type of V. ATN: LH 40m	Lat: 02-00-43S	Long: 104-50-16E	
Chart No.: 52	Soil Condition: Mud	Depth: -2.3 m	

Approach: Uj. Batakarang is approached by ship from Palembang. The distance is about 65 nautical miles. Approach to the site has to go through the creek of mangroves of about 300 m in length.



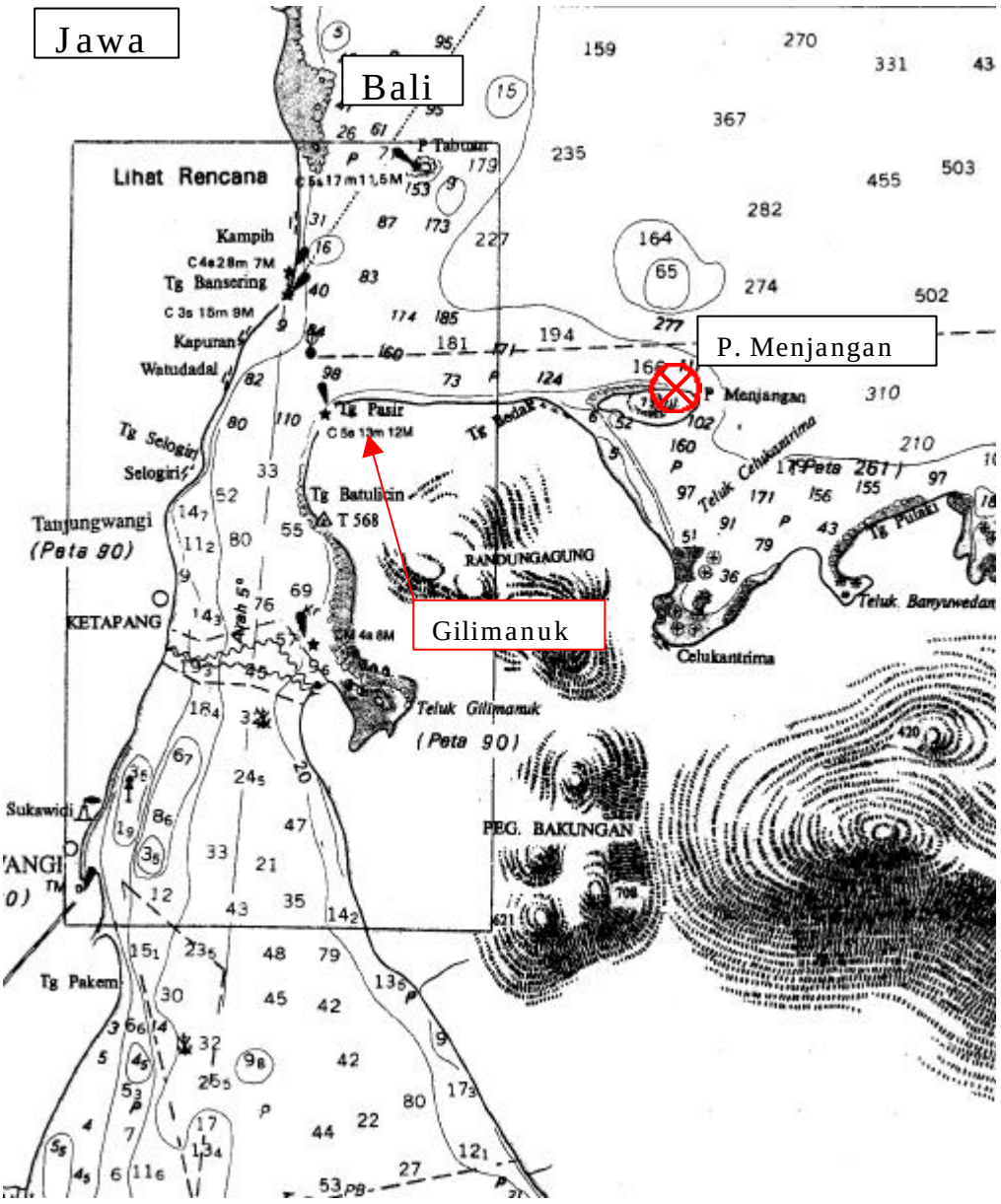
Appendix 8.4.1.
Site Survey Map

Disnav. : Surabaya	Site No. LH 26	
Name of Site : P. Memburit		
Type of V. ATN : LH 40m	Lat : 06-50-02S	Long :115-13-00E
Chart No. : 99	Soil condition :	Depth :
Approach : The site is located in western part of Kangean island. It is approached by boat from Gilimanuk in Bali. The distance is about 100 nautical miles.		



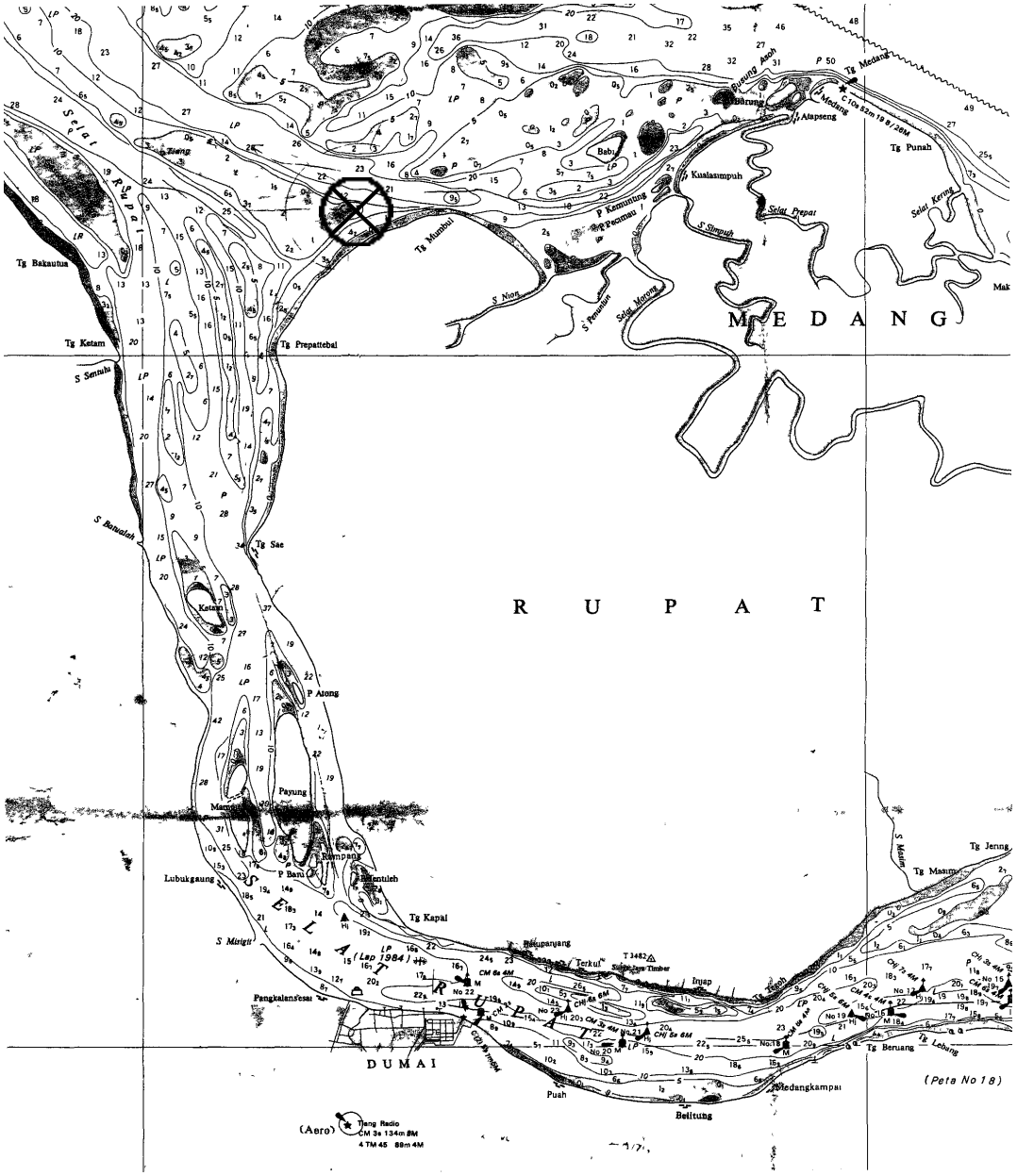
Appendix 8.4.1.
Site Survey Map

Disnav. : Benoa	Site No. LH28	
Name of Site : P. Menjangan		
Type of V. ATN : LH 40m	Lat : 08-05-38S	Long :114-31-36 E
Chart No. : 113, 290	Soil condition :	Depth :
Approach : The site is located in eastern head of Menjangan island. The approach is by boat about 12 nautical miles.from Gilimanuk.		



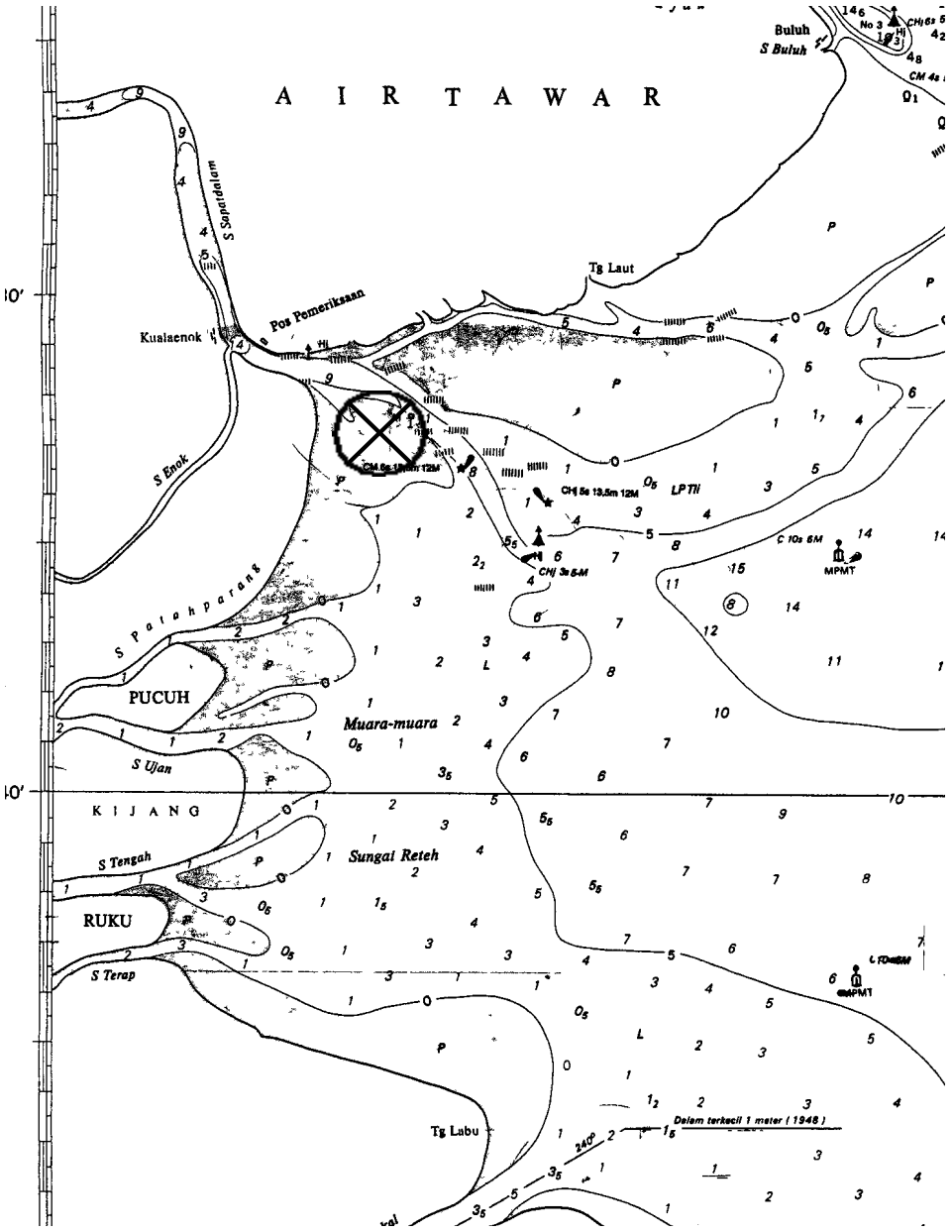
Appendix 8.4.2.
Site Survey Map
(Light Beacon)

Disnav. : Dumai	Site No. LB34	
Name of Site : Gs.Mumbul		
Type of V. ATN : LB 10m	Lat : 02-03-17N	Long : 101-25-38E
Chart No. : 12	Soil Condition :Sand(Seabed)	Depth : -0.2m
Approach : The site is located in northwest part of Rupat island. Approach to the island is by boat of 25 nautical miles from Dumai.		



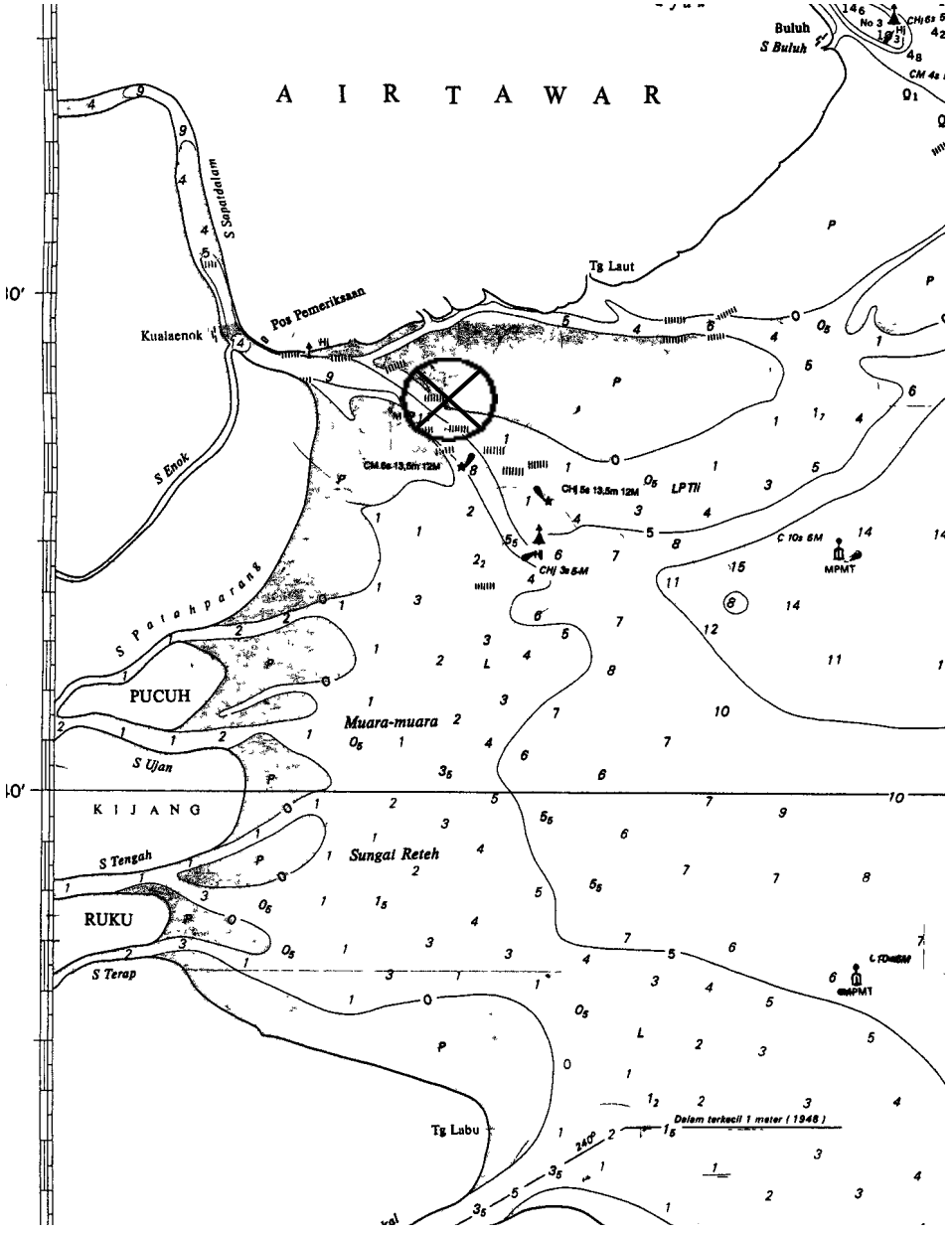
Appendix 8.4.2.
Site Survey Map
(Light Beacon)

Disnav.: Dumai	Site No. LB35	
Name of Site: Pel.Kuala Enok		
Type of V. ATN: LB 10m	Lat: 00-31-59S	Long: 103-26-38E
Chart No.: 43	Soil Condition: Mud (Seabed)	Depth: 4.6 m
Approach: The site is approached by boat from Pel. Kuala Enok in the distance of 4 nautical miles. Distance from Dumai is about 220 nautical miles.		



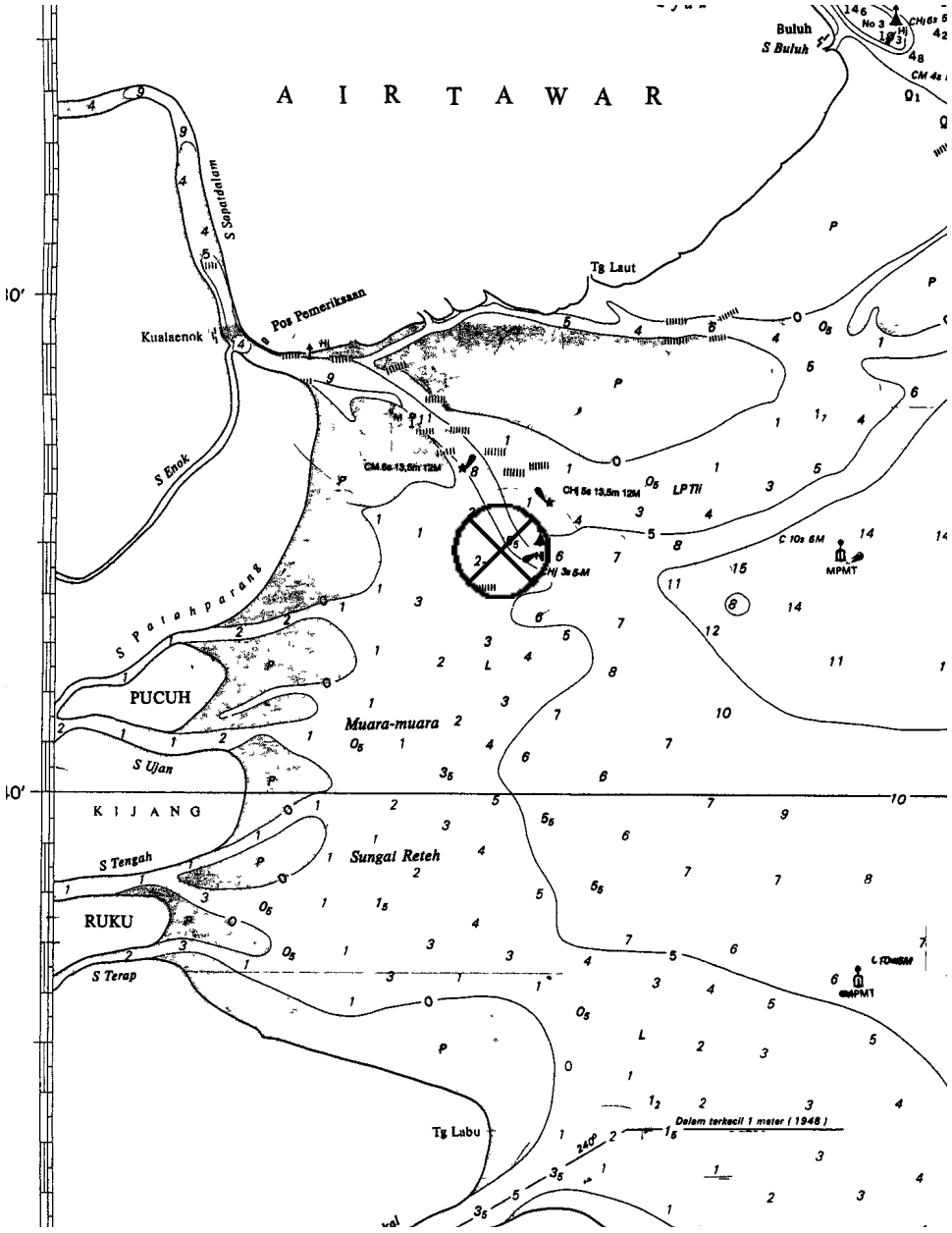
Appendix 8.4.2.
Site Survey Map
(Light Beacon)

Disnav. : Dumai	Site No. LB36		
Name of Site: Pel.Kuala Enok			
Type of V. ATN: LB 10m	Lat: 00-32-51S	Long: 103-27-42E	
Chart No.: 43	Soil Condition: Mud (Seabed)	Depth: 4.4 m	
Approach: Approach to the island is by boat about 6 nautical miles from Pel. Kuala Enok.			



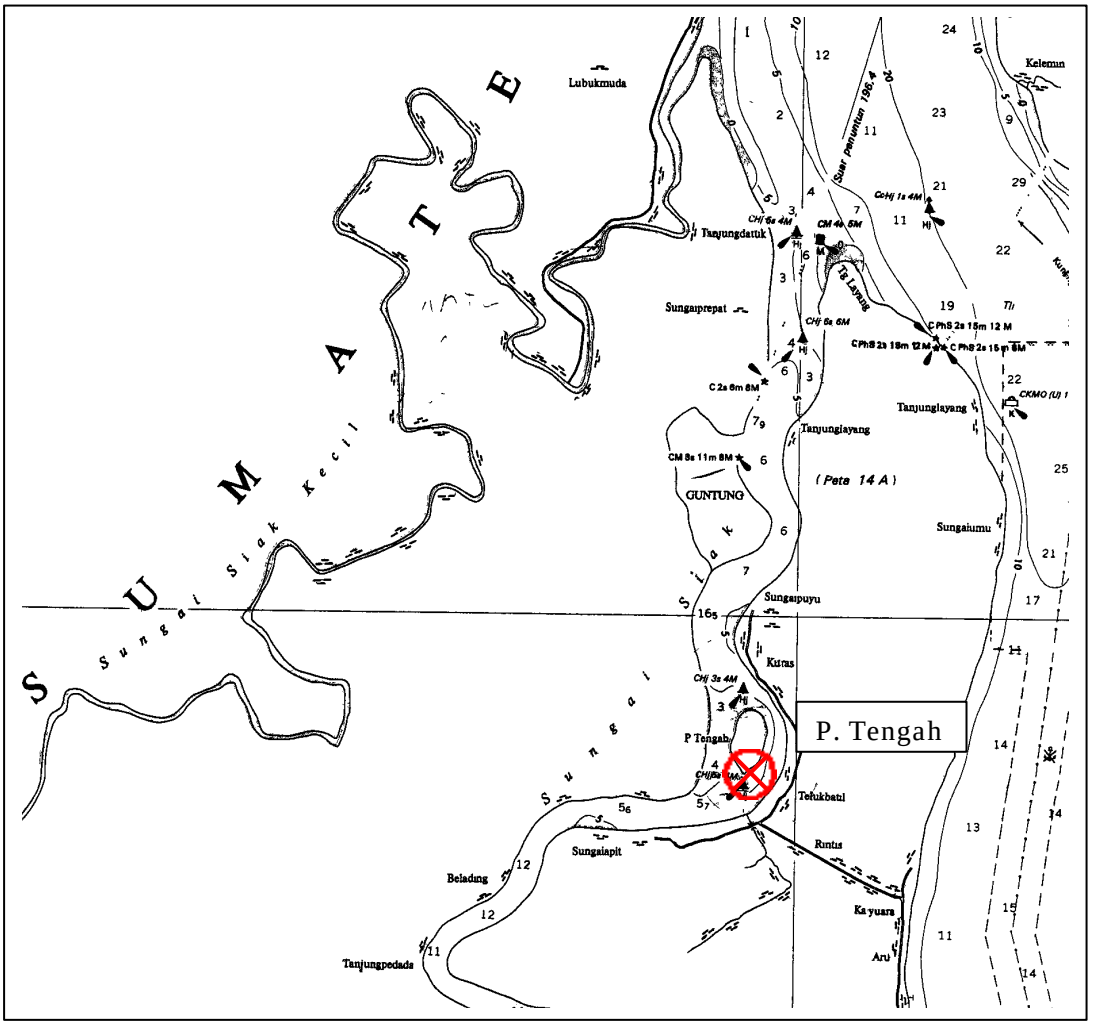
Appendix 8.4.2.
Site Survey Map
(Light Beacon)

Disnav. : Dumai	Site No. LB37		
Name of Site: Pel.Kuala Enok			
Type of V. ATN: LB 10m	Lat: 00-34-57S	Long: 103-29-10E	
Chart No.: 43	Soil Condition: Mud (Seabed)	Depth: 1.4 m	
Approach: Approach to the site is by boat about 4 nautical miles from Pel. Kuala Enok.			



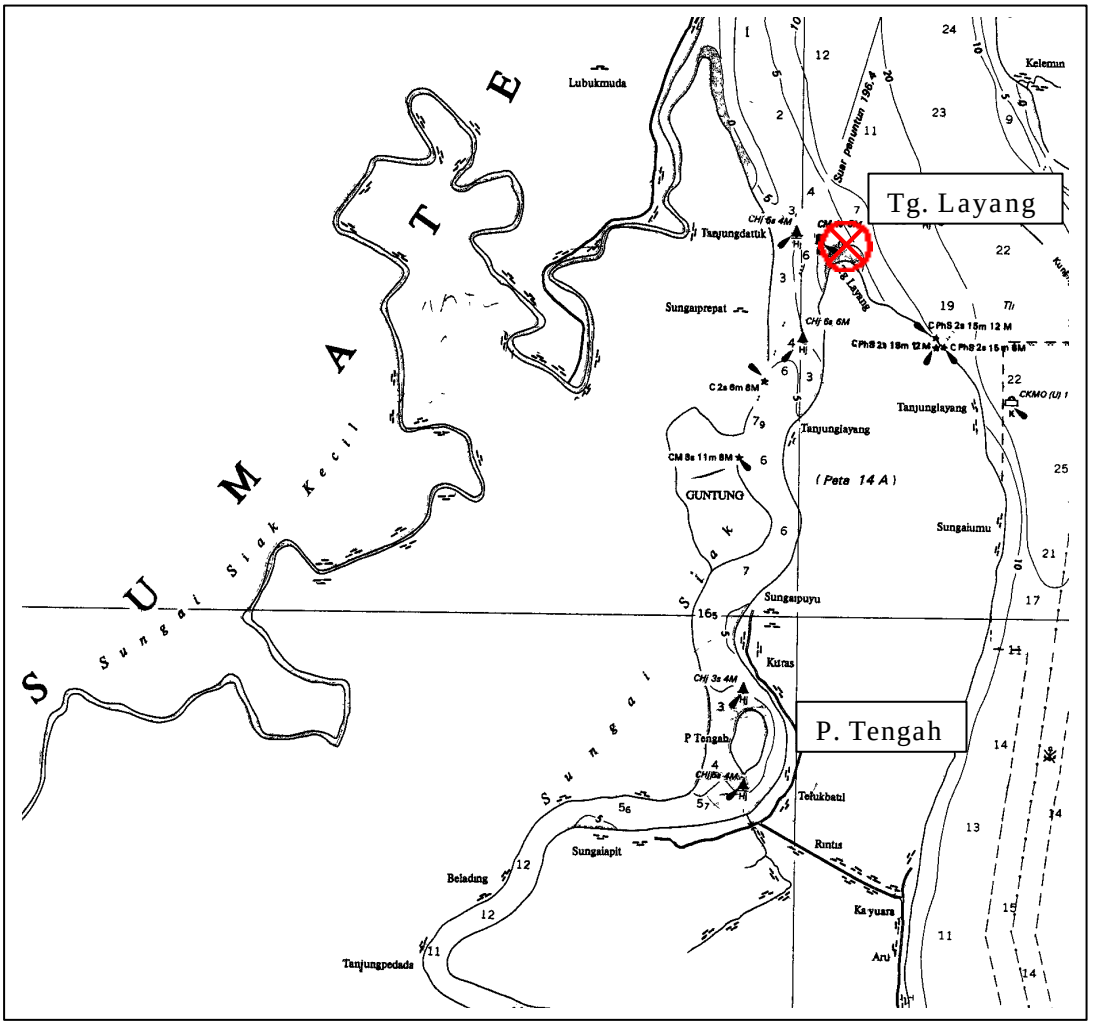
Appendix 8.4.2.
Site Survey Map
(Light Beacon)

Disnav. : Dumai	Site No. LB38	
Name of Site : Selatan P.Tengah		
Type of V. ATN : LB 10m	Lat : 01-07-20N	Long : 102-09-34E
Chart no. : 24	Soil Condition :Mud(Seabed)	Depth : 0.8m
Approach : Approach to the site is by boat about 13 nautical miles from Sungai Pakuing. .		



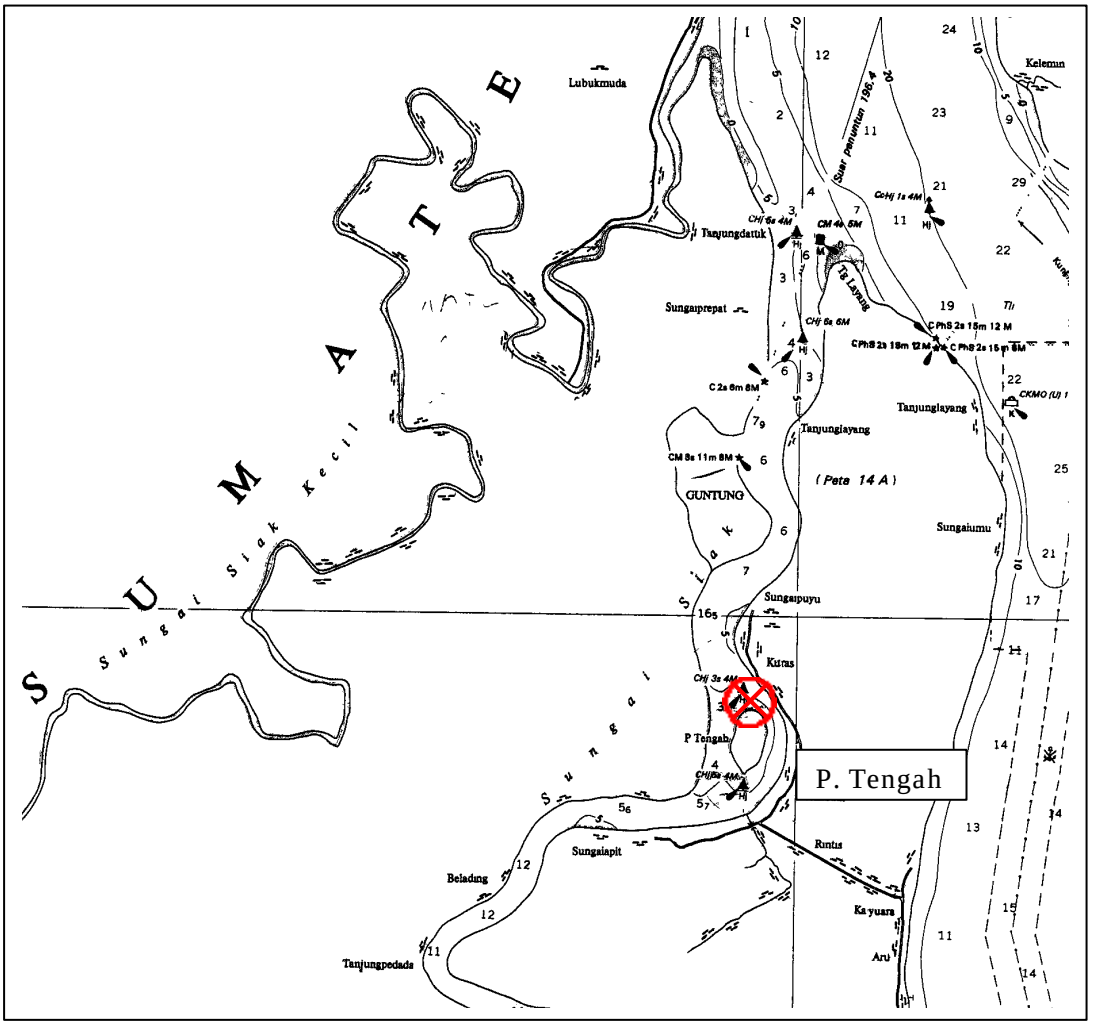
Appendix 8.4.2.
Site Survey Map
(Light Beacon)

Disnav. : Dumai	Site No. LB39	
Name of Site : Tg.Layang		
Type of V. ATN : LB 10m	Lat : 01-13-22N	Long : 102-10-29E
Chart No. : 24	Soil Condition :Clayey Mud(Seabed)	Depth : 0.8m
Approach : The site is located in estuary of Siak river which is approached by boat from Sungai Pakuing. The distance is 7 nautical miles.		



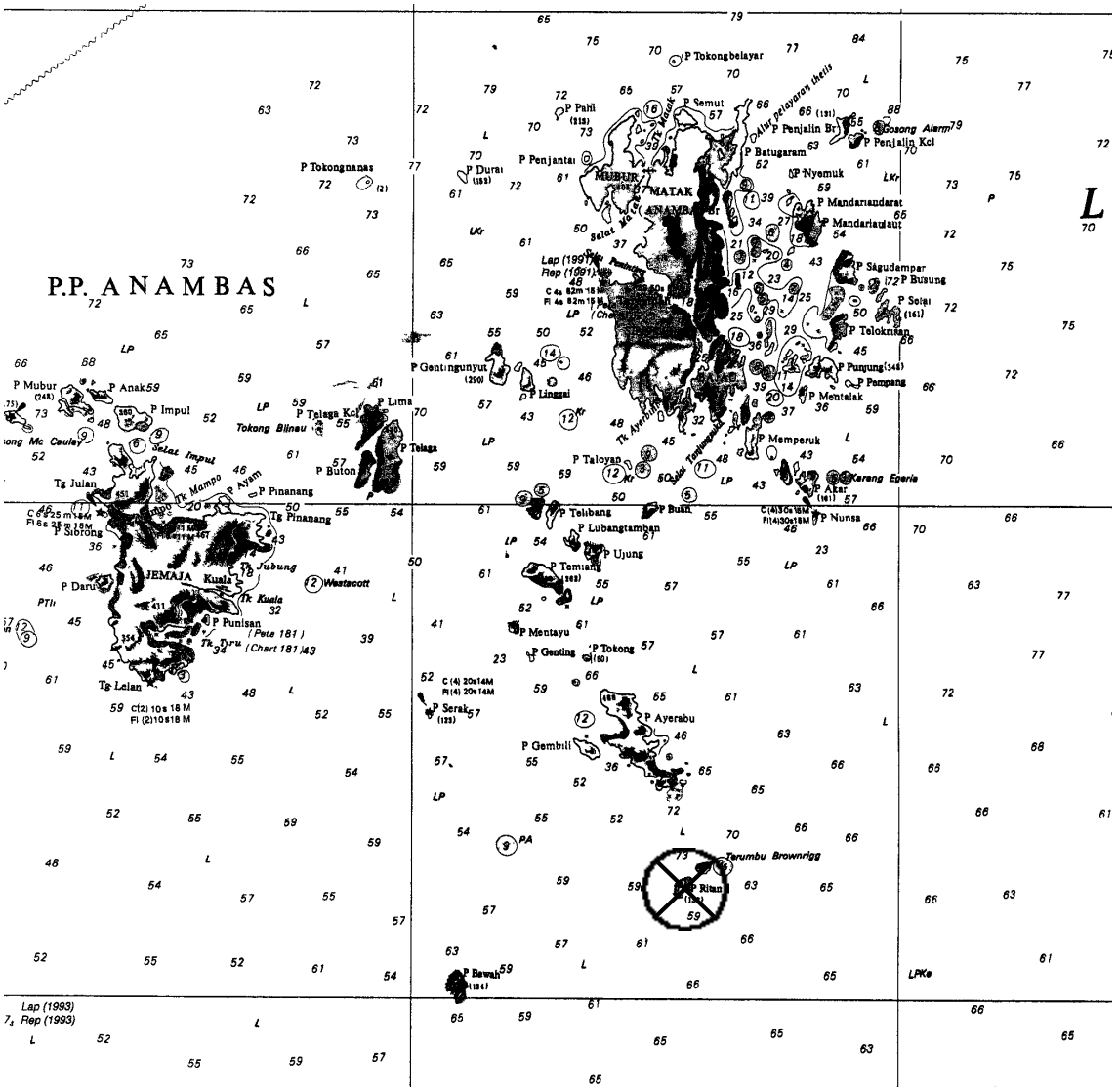
Appendix 8.4.2.
Site Survey Map
(Light Beacon)

Disnav. : Dumai	Site No. LB40	
Name of Site : Utara P.Tengah		
Type of V. ATN : LB 10m	Lat : 01-08-13N	Long : 102-09-35E
Chart No. : 24	Soil Condition :Clayey Mud(Seabed)	Depth : 0.8m
Approach : The site is approached by boat from Sungai Pakuing. The distance is 12 nautical miles.		



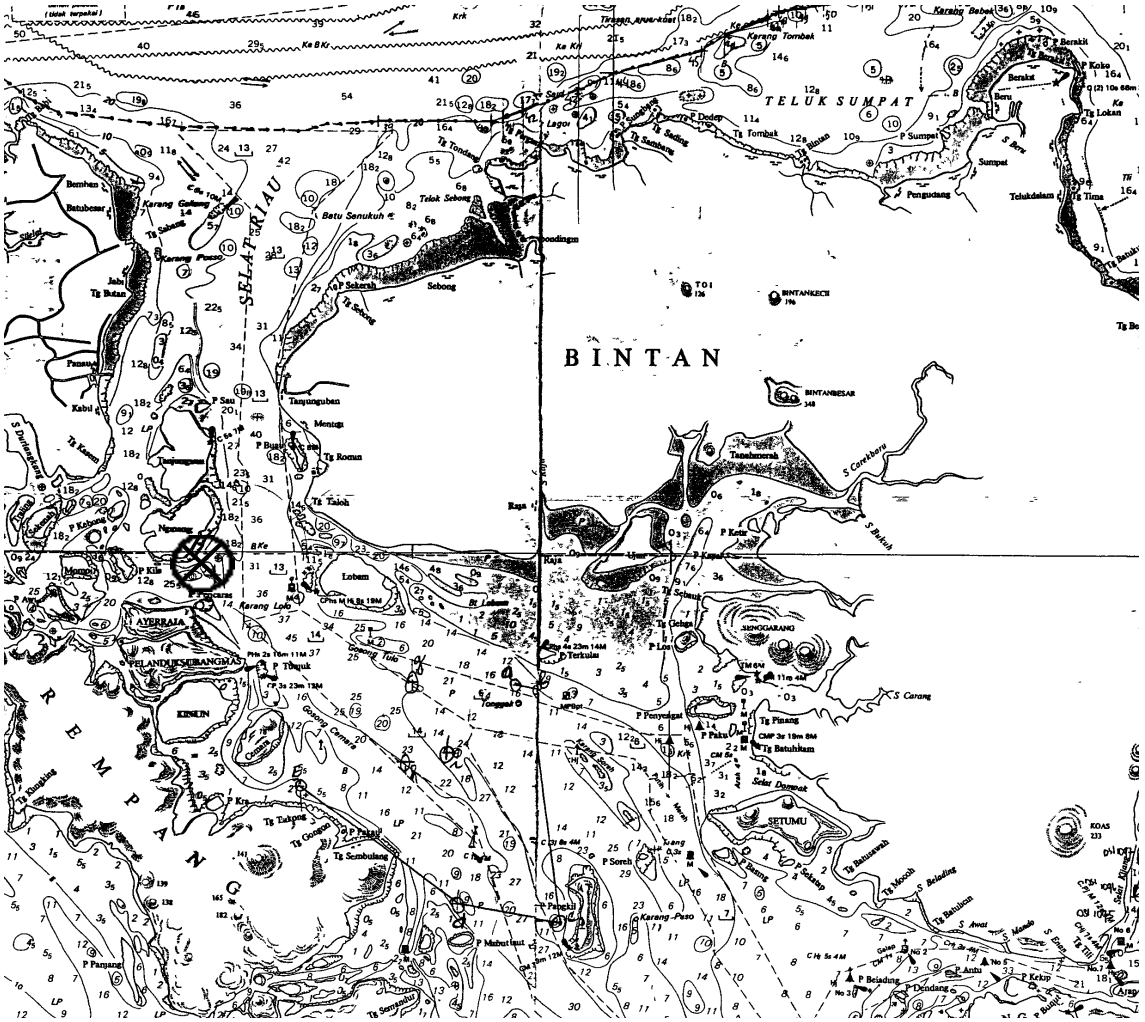
Appendix 8.4.2.
Site Survey Map
(Light Beacon)

Disnav. : Tg.Pinang	Site No. LB41	
Name of Site: P. Ritan (change from Serasan)		
Type of V. ATN: LB 10m	Lat: 02-35-47N	Long: 106-16-29E
Chart No.: 147	Soil Condition: Rock and Stone	Depth:
Approach: The site is located in Anambas island in South China sea at the distance About 150 nautical miles from Tg. Pinang. Ritan island is about 1 km in circumference of coral. The site is located west side of the island.		



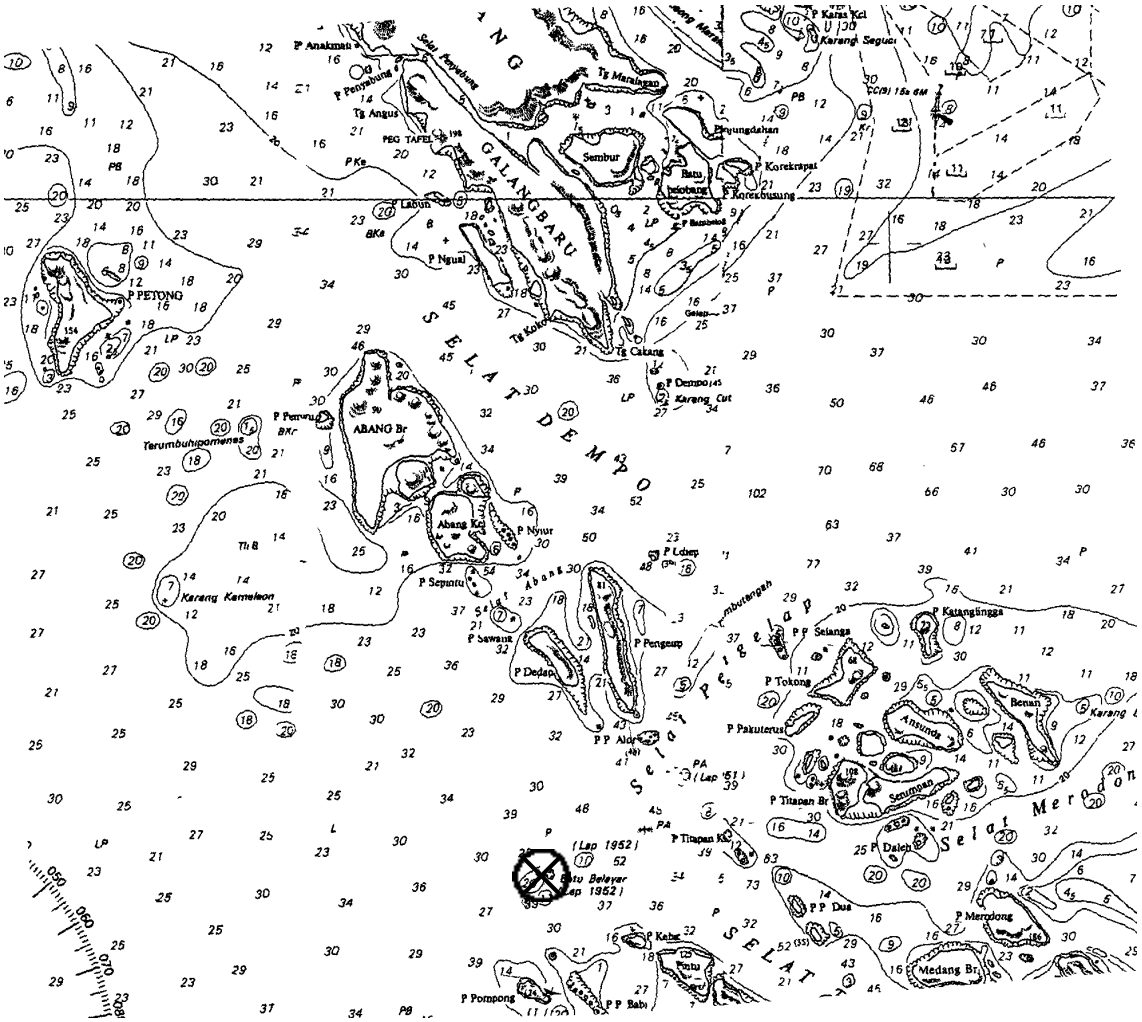
Appendix 8.4.2.
Site Survey Map
(Light Beacon)

Disnav. : Tg.Pinang	Site No. LB45		
Name of Site: Kr.Nginang			
Type of V. ATN: LB 10m	Lat: 00-58-50N	Long: 104-09-31E	
Chart No.: 42	Soil Condition: Rock (Seabed)	Depth: 0 m	
Approach: The site is located in southeast of Nginang island at the distance of 15 Nautical miles from Tg.Pinang.			



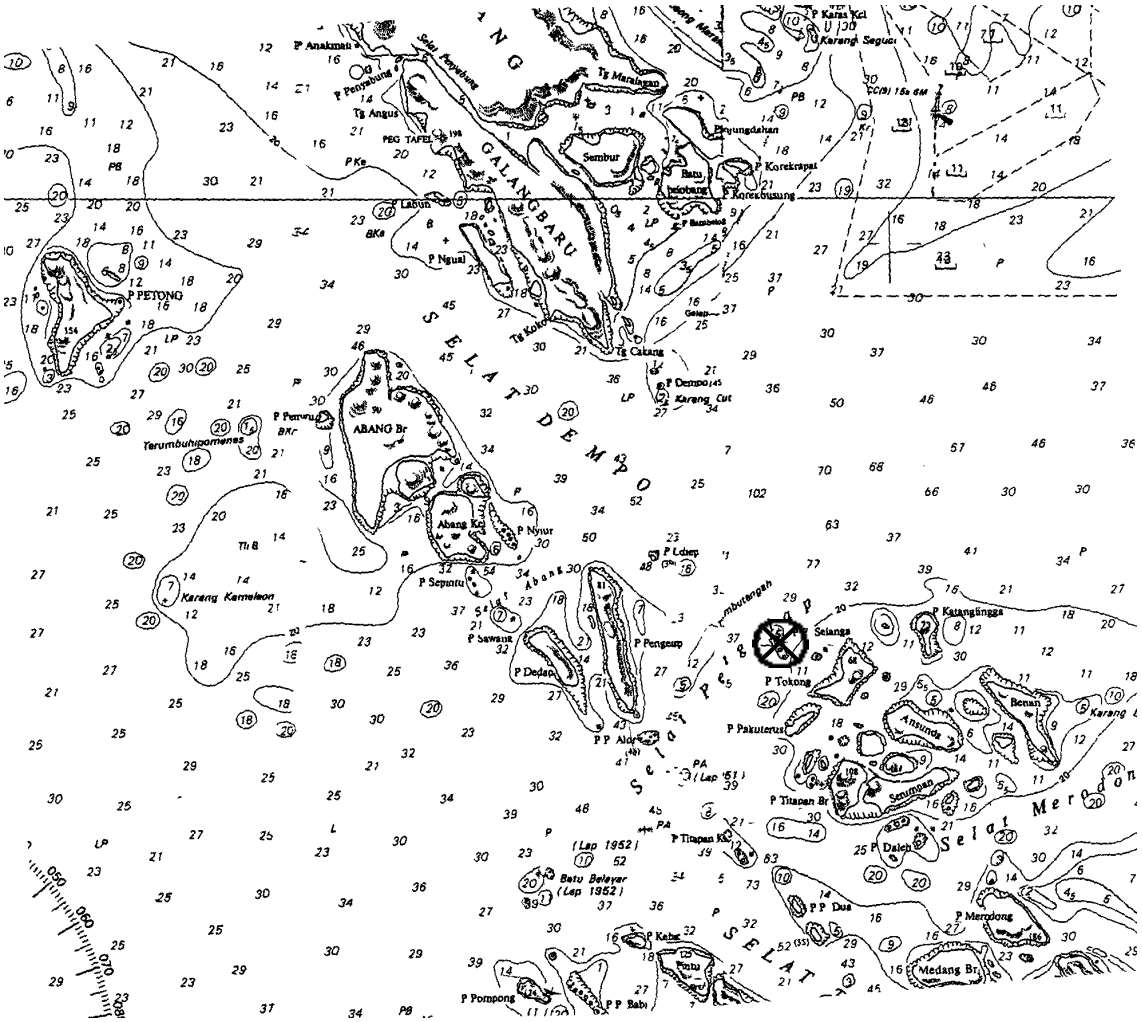
Appendix 8.4.2.
Site Survey Map
(Light Beacon)

Disnav. : Tg.Pinang	Site No. LB48		
Name of Site: P.Batuberlayar			
Type of V. ATN: LB 20m	Lat: 00-24-08N	Long: 104-15-53E	
Chart No.: 46	Soil Condition: Rock and Mud	Height: 15 m	
Approach: The site is located in north side of Batuberlayar island at the distance of 33 nautical miles from Tg. Pinang. Landing point is west side of island where is rocky shore. The site is approached by walk from landing point.			



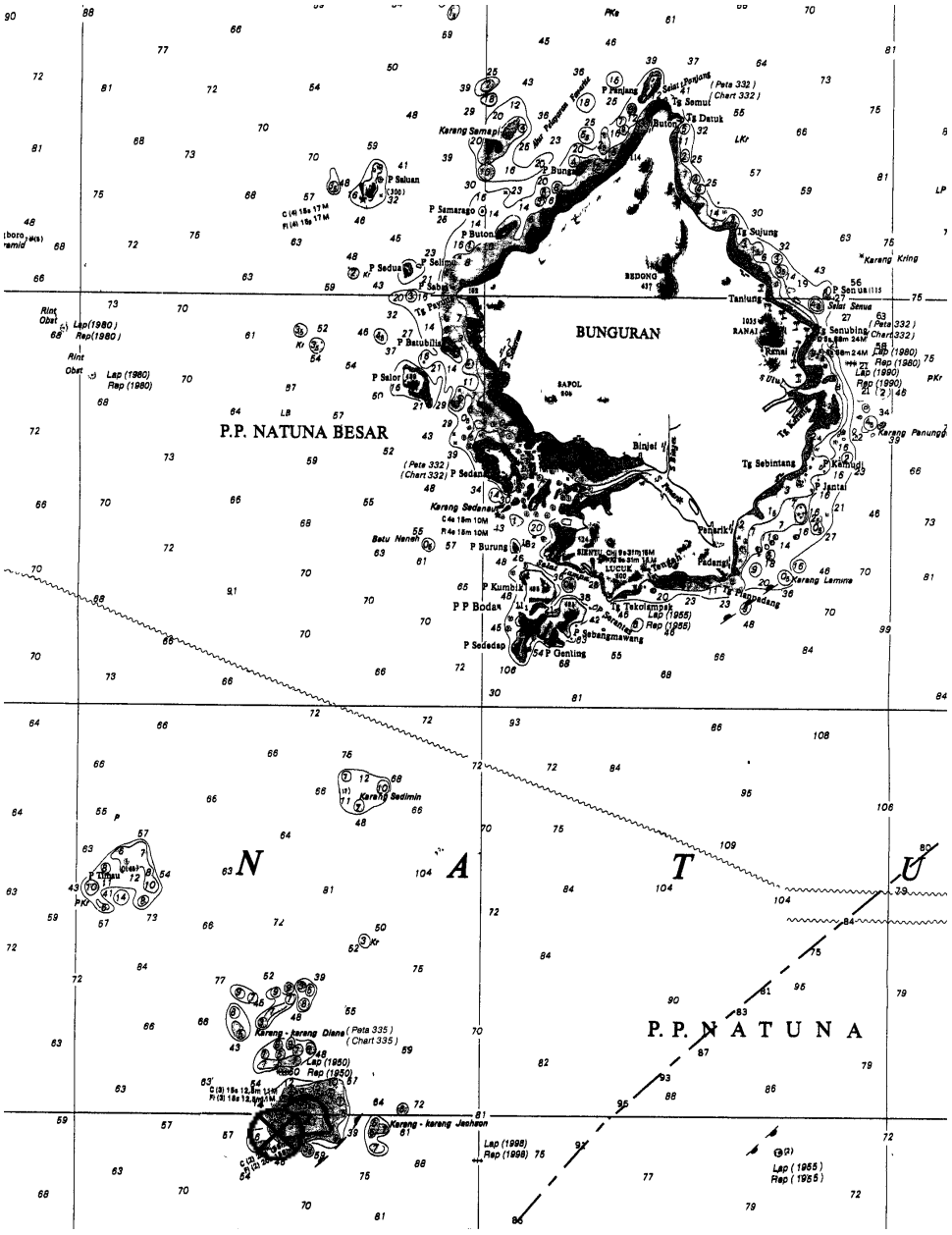
Appendix 8.4.2.
Site Survey Map
(Light Beacon)

Disnav. : Tg.Pinang	Site No. LB55		
Name of Site: P. Selanga			
Type of V. ATN: LB 20m	Lat: 00-29-15N	Long: 104-21-23E	
Chart No.: 46	Soil Condition: Rock and Mud	Depth: 30 m	
Approach: The site is the northernmost island of Selanga islands consisted of three islands. The island is 27 nautical miles from Tg. Pinang. Landing point is rocky shore of west side of the island. There is no road to the site from landing point. The distance is about 200m.			



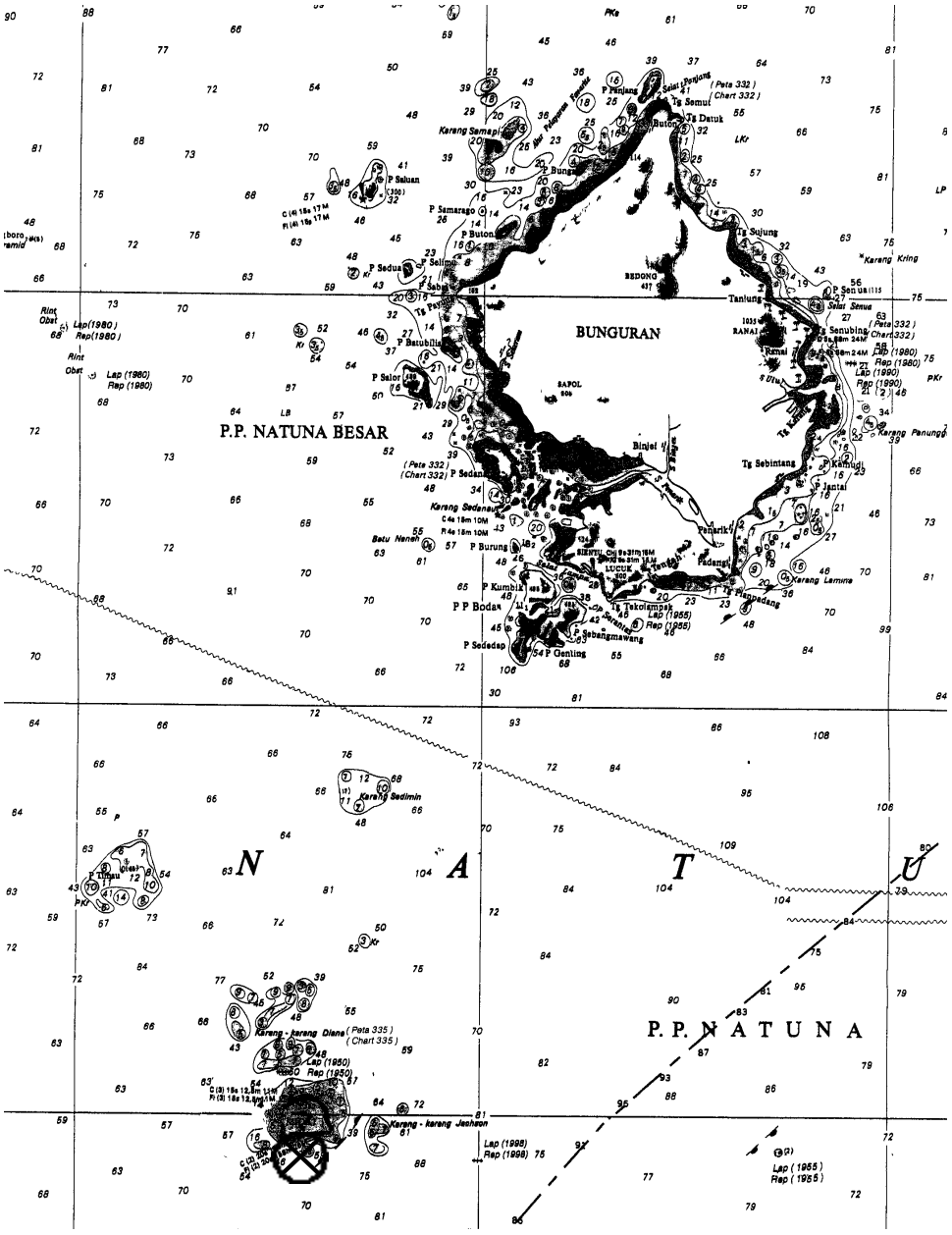
Appendix 8.4.2.
Site Survey Map
(Light Beacon)

Disnav. : Tg.Pinang	Site No. LB52		
Name of Site : Pel.Midai			
Type of V. ATN : LB 10m	Lat : 02-59-44N		Long : 107-44-39E
Chart No. : 335	Soil Condition :Reef and Sand(Seabed)		Depth : -4.1m
Approach : Midai island is located in South China Sea at the distance of 240 nautical miles from Tg. Pinang. The site is rock on the bottom of the sea, and the location is northward of piers.			



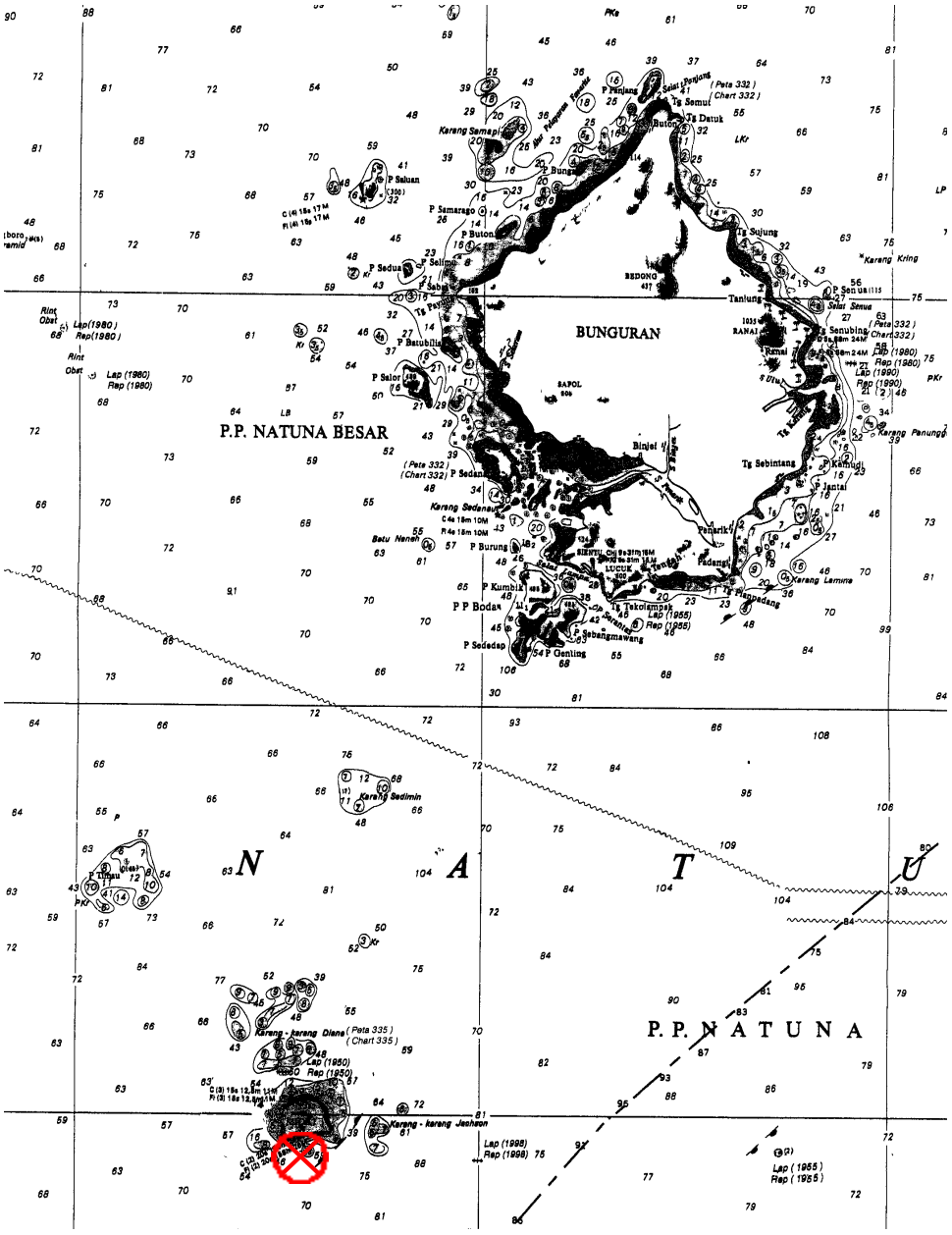
Appendix 8.4.2.
Site Survey Map
(Light Beacon)

Disnav. : Tg.Pinang	Site No. LB53		
Name of Site : Pel.Midai			
Type of V. ATN : LB 10m	Lat : 03-00-00N		Long : 107-44-38E
Chart No. : 335	Soil Condition :Reef and Sand(Seabed)		Depth : -3.4m
Approach : Midai island is located in South China Sea at the distance of 240 nautical miles from Tg. Pinang. The site is shoal that disturbs the entrance of ships to port. The location is south side of port.			



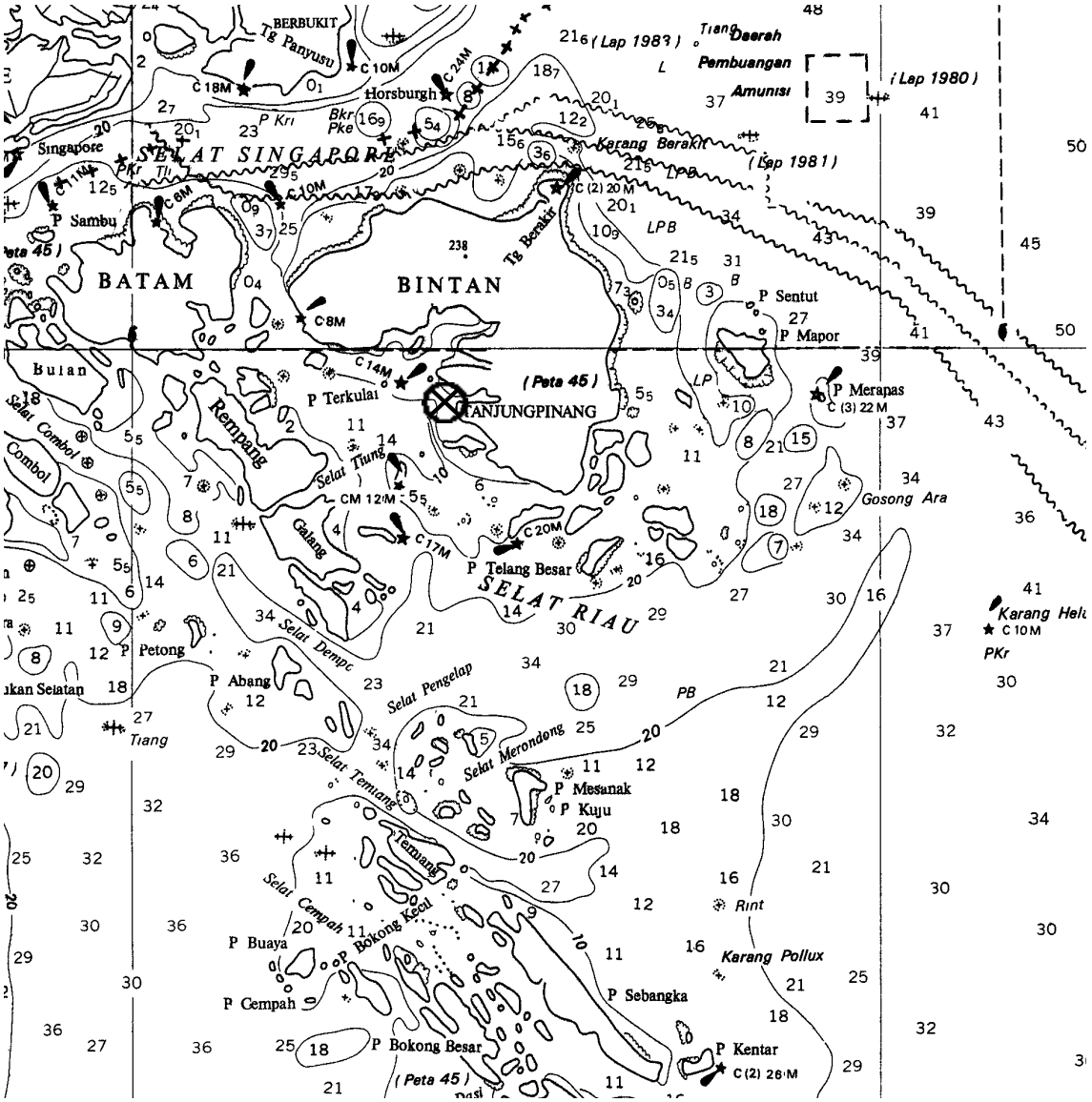
Appendix 8.4.2.
Site Survey Map
(Light Beacon)

Disnav. : Tg.Pinang	Site No. LB54		
Name of Site: Pel.Midai			
Type of V. ATN: LB 20m	Lat: 02-59-57N	Long: 107-44-52E	
Chart no. : 335	Soil Condition :Mud	Depth: 2m	
Approach: Midai island is located in South China sea at the distance of 240 nautical miles from Tg. Pinang. The site is located to south of harbor office.			



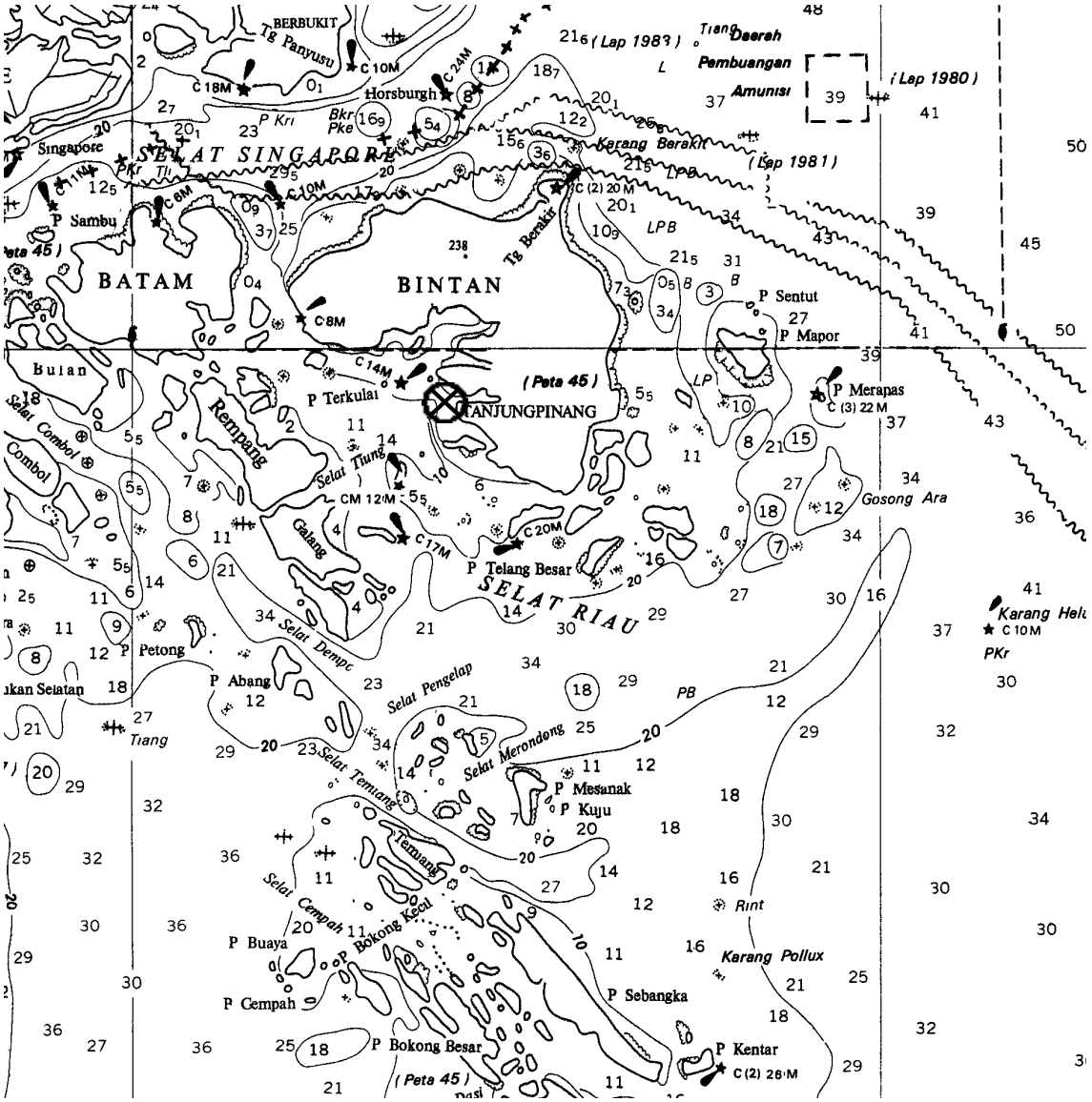
Appendix 8.4.2.
Site Survey Map
(Light Beacon)

Disnav. : Tg.Pinang	Site No. LB58		
Name of Site: P. Senggakang (change from Tg.Pinang)			
Type of V. ATN: LB 10m	Lat: 00-55-43N		Long: 104-25-31E
Chart No.: 45	Soil Condition: Rock and Sand (Seabed)		Depth: 0.9 m
Approach: The site is located in west of Tg. Pinang at the distance of 1 nautical mile.			



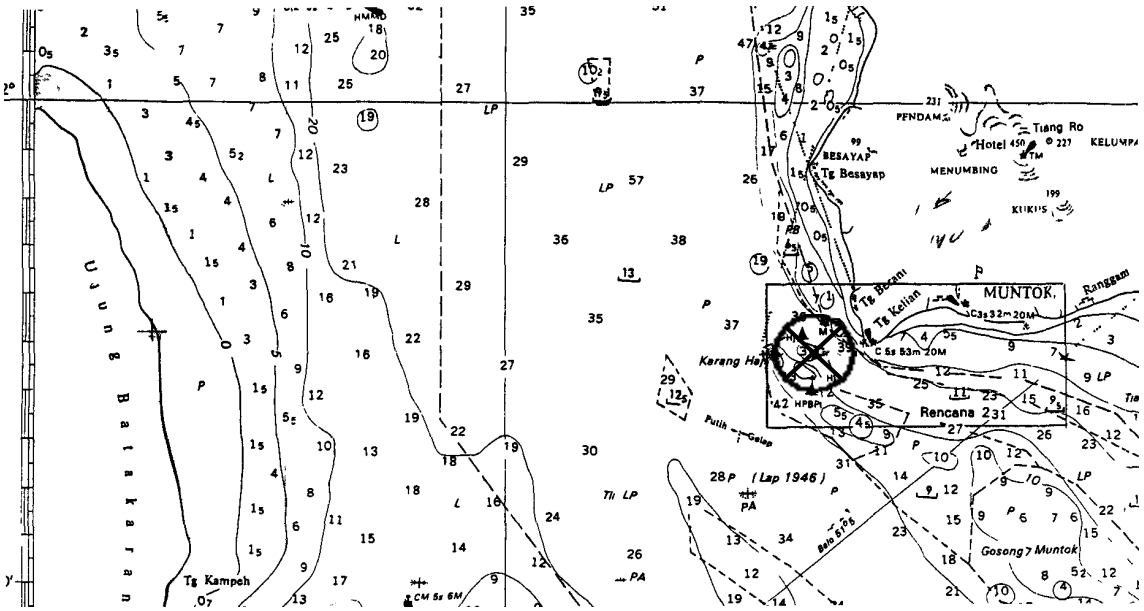
Appendix 8.4.2.
Site Survey Map
(Light Beacon)

Disnav. : Tg.Pinang	Site No. LB59		
Name of Site: P.Penyengat (change from Tg.Pinang)			
Type of V. ATN: LB 10m	Lat: 00-55-16N	Long: 104-25-05E	
Chart No.: 45	Soil Condition: Rock and Sand (Seabed)	Depth: -0.1 m	
Approach: The site is located in west of Tg. Pinang at the distance of 1.5 nautical miles.			



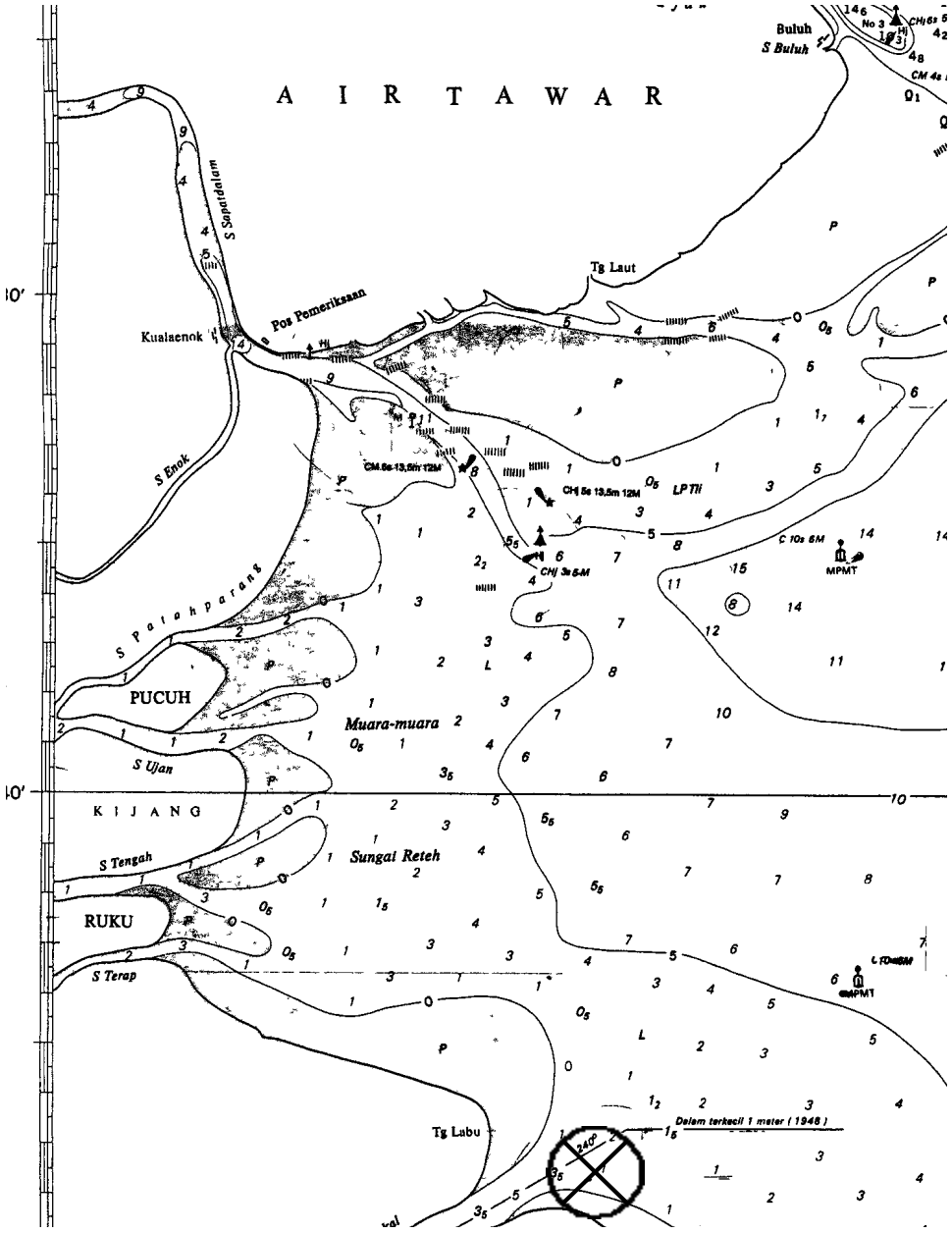
Appendix 8.4.2.
Site Survey Map
(Light Beacon)

Disnav. : Palembang	Site No. LB67		
Name of Site: Kr.Haji			
Type of V. ATN: LB 10m	Lat: 02-05-33S	Long: 105-06-23E	
Chart No.: 52	Soil Condition: Rock and Sand (Seabed)	Depth: 3.7 m	
Approach: The site is approached by boat from Muntok at the distance of 3 nautica miles.			



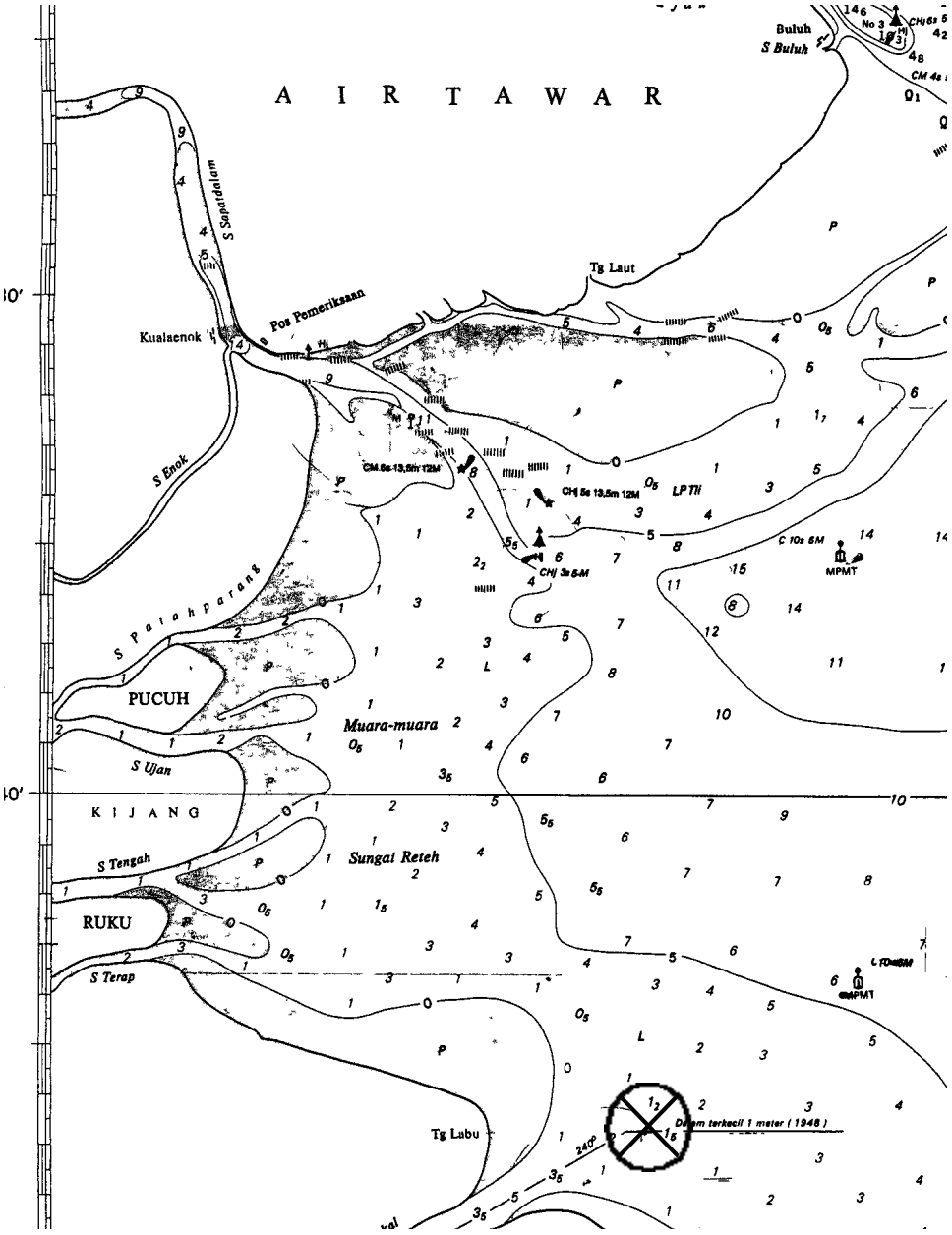
Appendix 8.4.2.
Site Survey Map
(Light Beacon)

Disnav. : Dumai	Site No. LB68		
Name of Site: Ma Kuala Tungkal			
Type of V. ATN: LB 10m	Lat: 00-47-40S	Long: 103-30-40E	
Chart No.: 41	Soil Condition: Mud (Seabed)	Depth: 1.1 m	
Approach: The site is approached by boat from Kualaenok in the distance of about 20 nautical miles.			



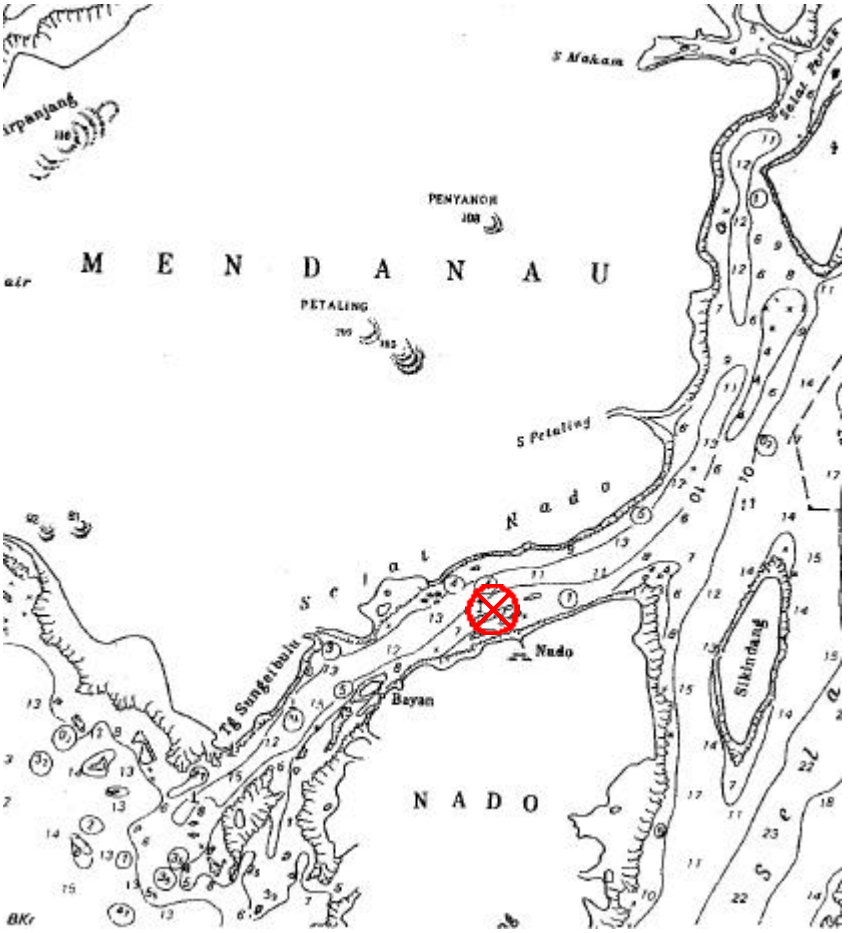
Appendix 8.4.2.
Site Survey Map
(Light Beacon)

Disnav. : Dumai	Site No. LB69		
Name of Site: Ma Kuala Tungkal			
Type of V. ATN: LB 10m	Lat: 00-46-01S	Long: 103-32-00E	
Chart No.: 41	Soil Condition: Mud (Seabed)	Depth: 1.9 m	
Approach: The site is approached by boat from Kualaenok in the distance of abou 20 nautical miles.			



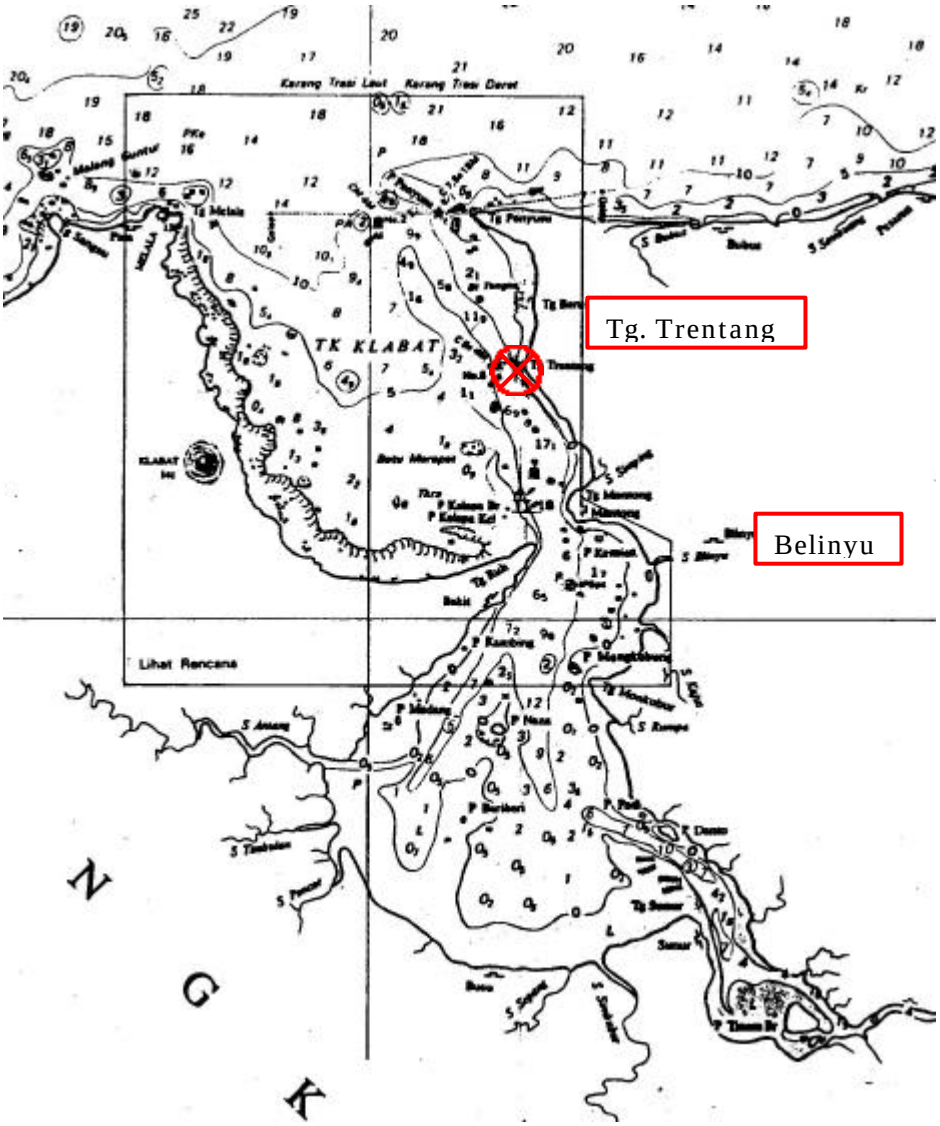
Appendix 8.4.2.
Site Survey Map
(Light Beacon)

Disnav. : Palembang	Site No. LB74	
Name of Site : Selat Nando		
Type of V. ATN : LB 10 m	Lat : 02-55-14S	Long : 107-26-49E
Chart No. : 60,159	Soil condition : Coral, gravel,	Depth :-0.5m
Approach : Nado strait is located between Mendanau island and Nado island t west of Delitung island. The site is approached by boat from Tg. Pandang as taking 2.5 hour.		



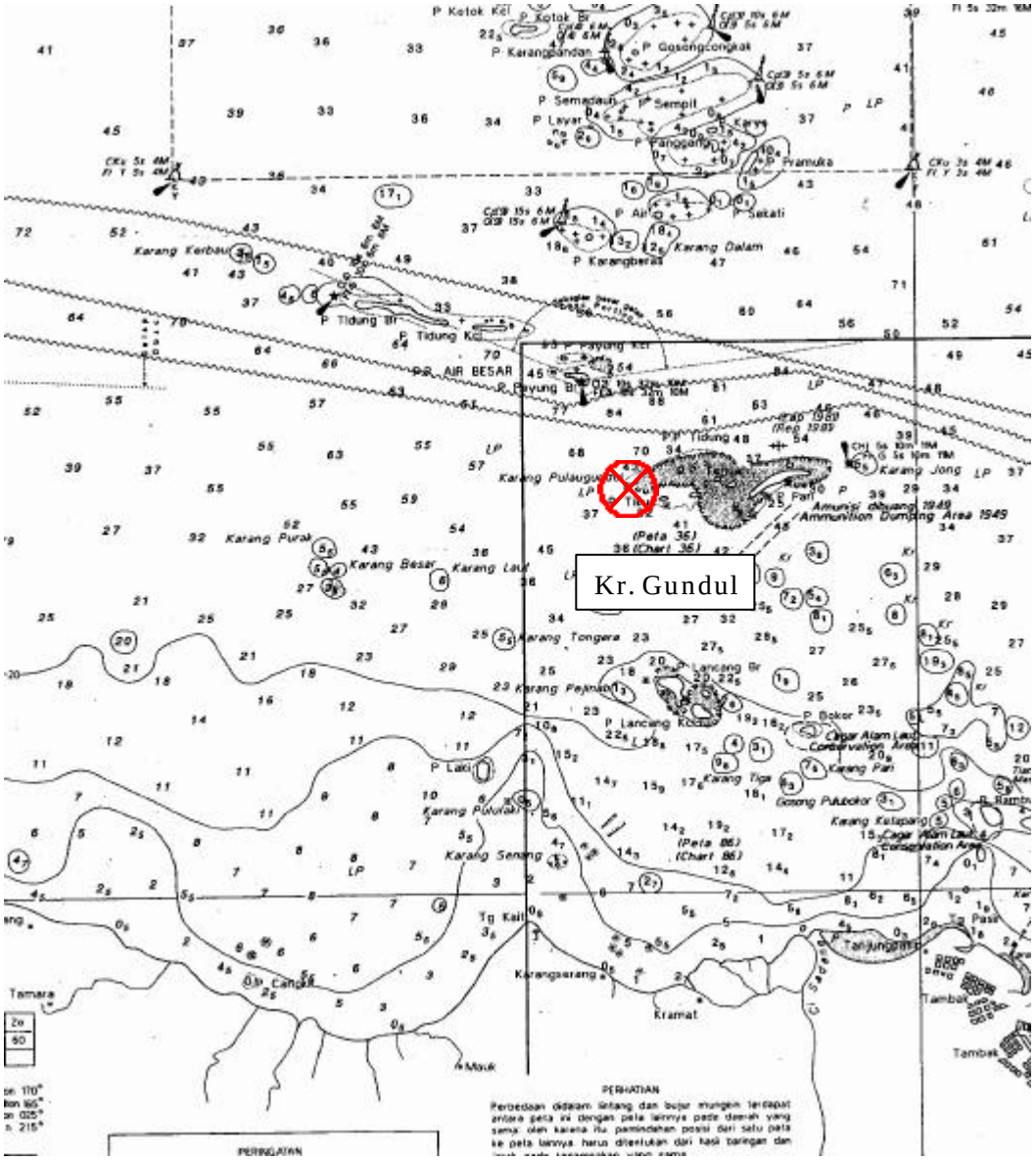
Appendix 8.4.2.
Site Survey Map
(Light Beacon)

Disnav. : Palembang	Site No. LB75	
Name of Site : Tg. Terentang		
Type of V. ATN : LB m	Lat : 01-34-58S	Long : 105-43-13E
Chart no. : 60,159	Soil condition :	Depth :
Approach : Tg.Terentang is located in east of Klabat bay of Bangka island. The site is approached by boat from Belinyu in the distance of about 5 nautical miles.		



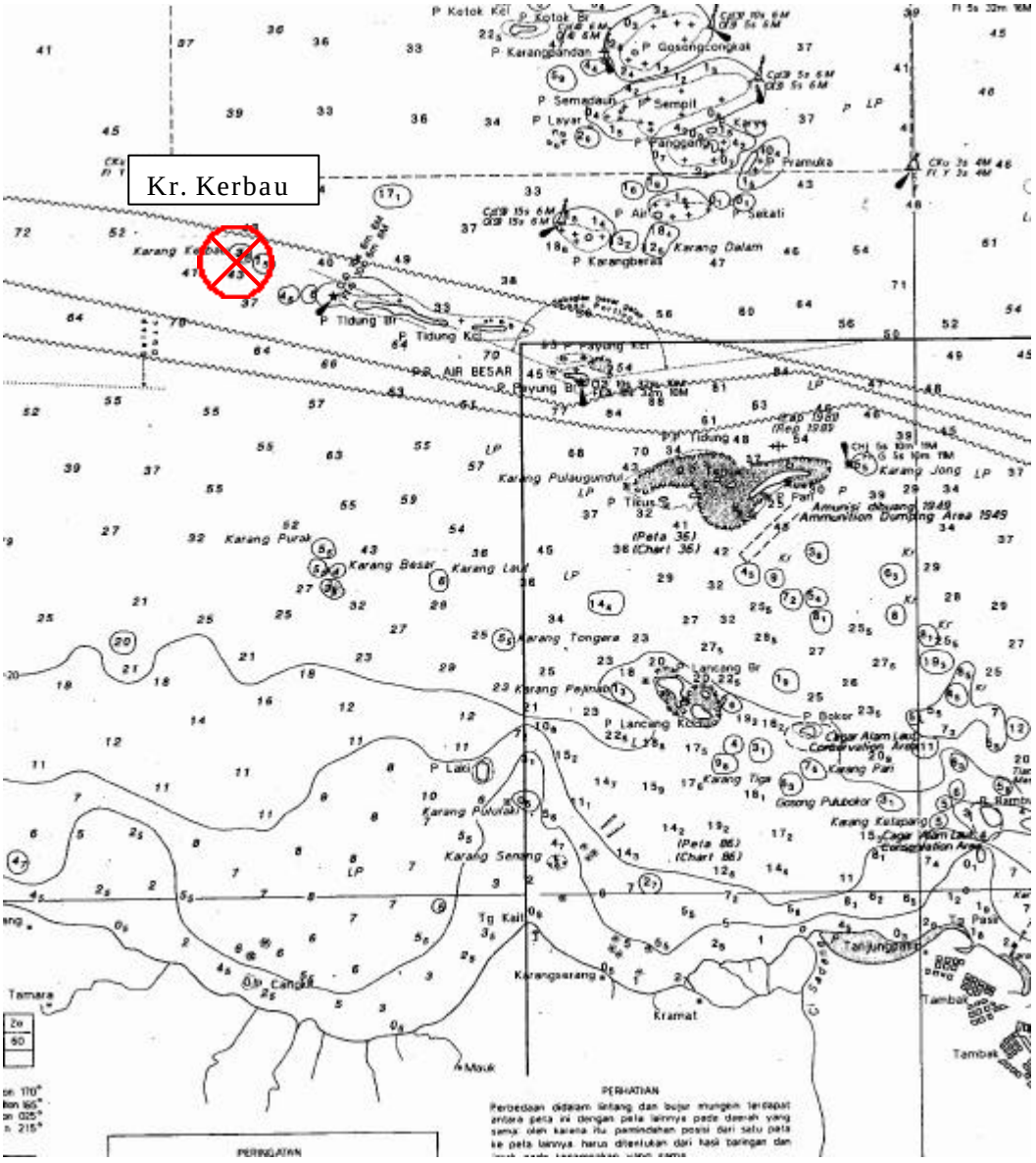
Appendix 8.4.2.
Site Survey Map
(Light Beacon)

Disnav. : Tg. Priok	Site No. LB80		
Name of Site : Kr. Gundul			
Type of V. ATN : LB 10 m	Lat : 05-51-20S	Long : 106-34-12E	
Chart No. : 86	Soil condition	Height : 2.1m	
Approach : The site is approached by boat. The distance is about 20 nautical miles from Tg. Priok.			



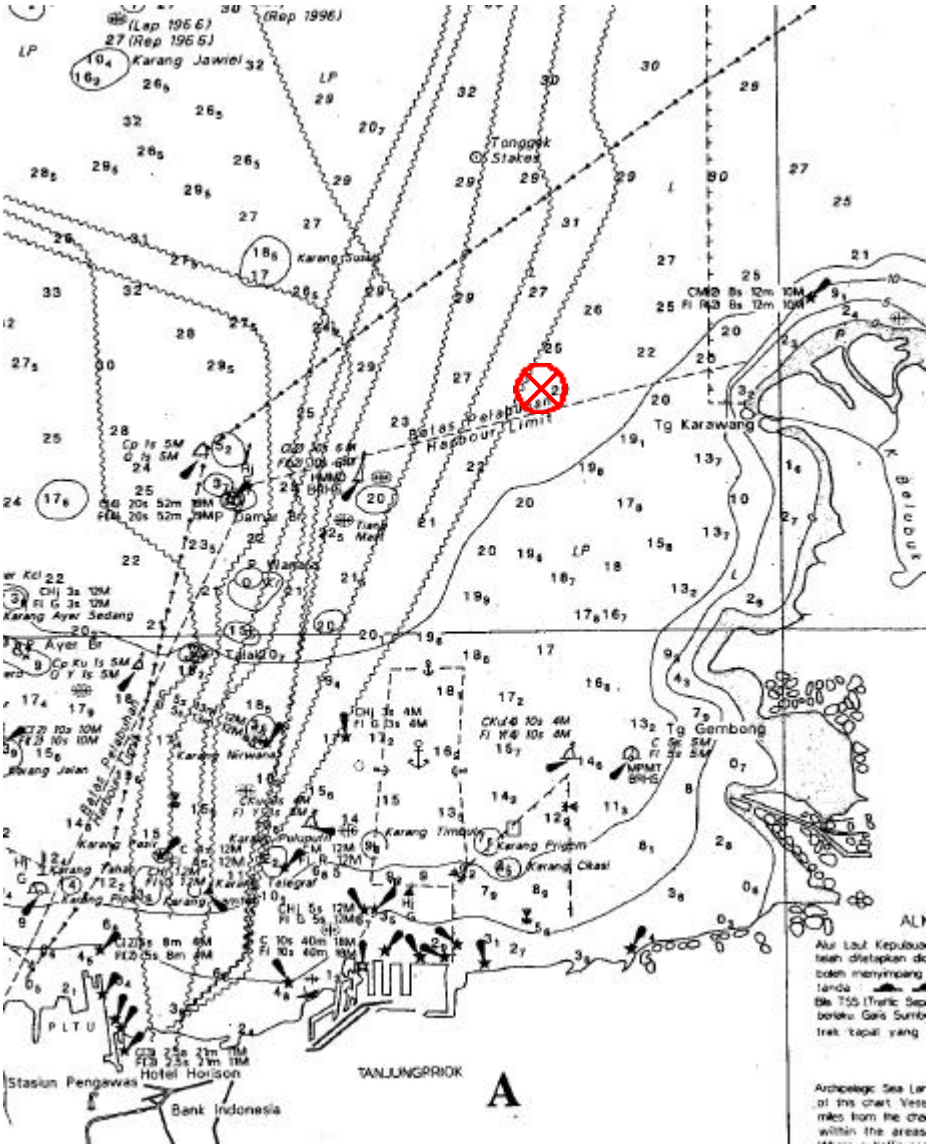
Appendix 8.4.2.
Site Survey Map
(Light Beacon)

Disnav. : Tg. Priok	Site No. LB81	
Name of Site : Kr. Kerbau		
Type of V. ATN : LB 10m	Lat : 05-46-11S	Long :106-16-29 E
Chart no. : 86	Soil condition :	Height : 4.2m
Approach : The site is approached by boat at a distance of about 35 nautical miles.		



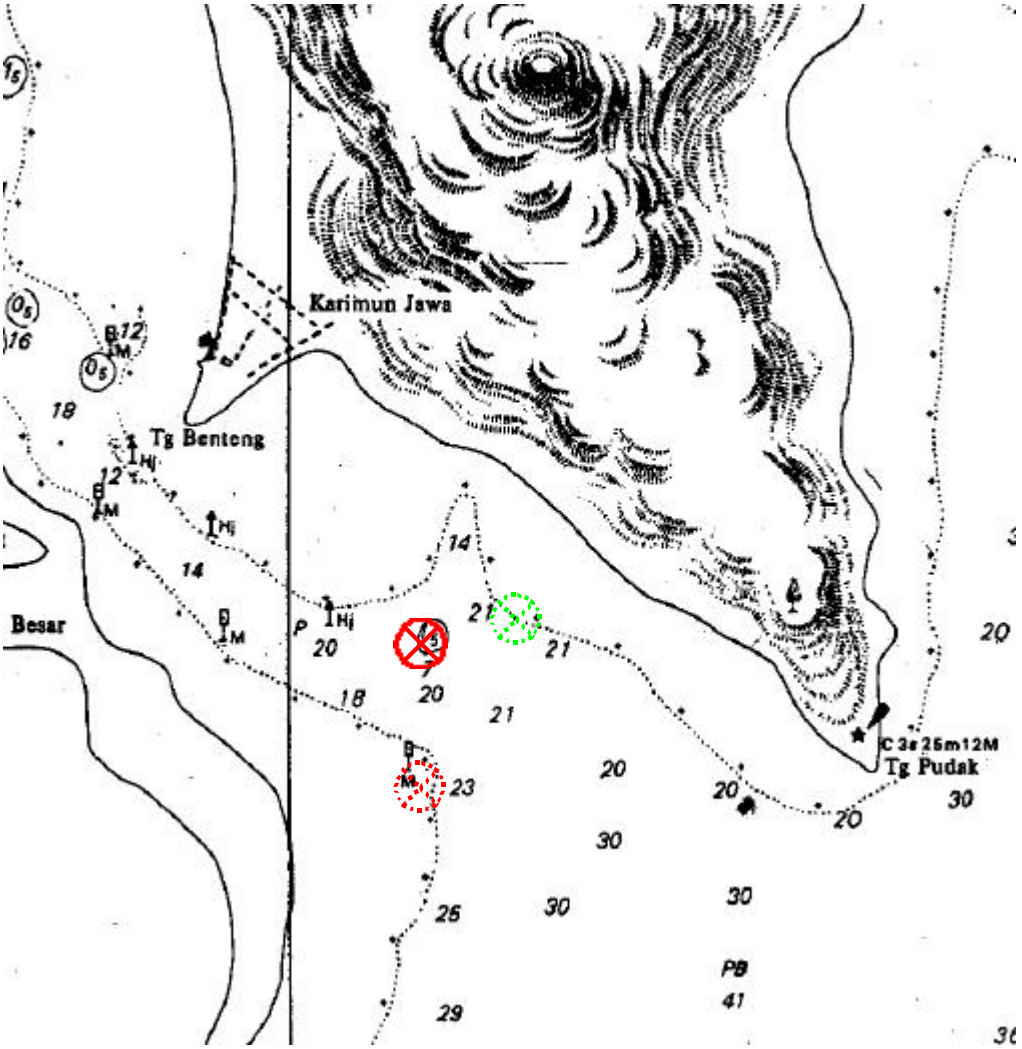
Appendix 8.4.2.
Site Survey Map
(Light Beacon)

Disnav. : Tg. Priok	Site No. LB87		
Name of Site : Tg. Kerawang			
Type of V. ATN : LB 10 m	Lat : 05-55-55S	Long : 106-58-48 E	
Chart no. : 86	Soil condition :	Height : 2.2m	
Approach : The site is approached by boat at a distance of 18 nautical miles from Tg. Priok.			



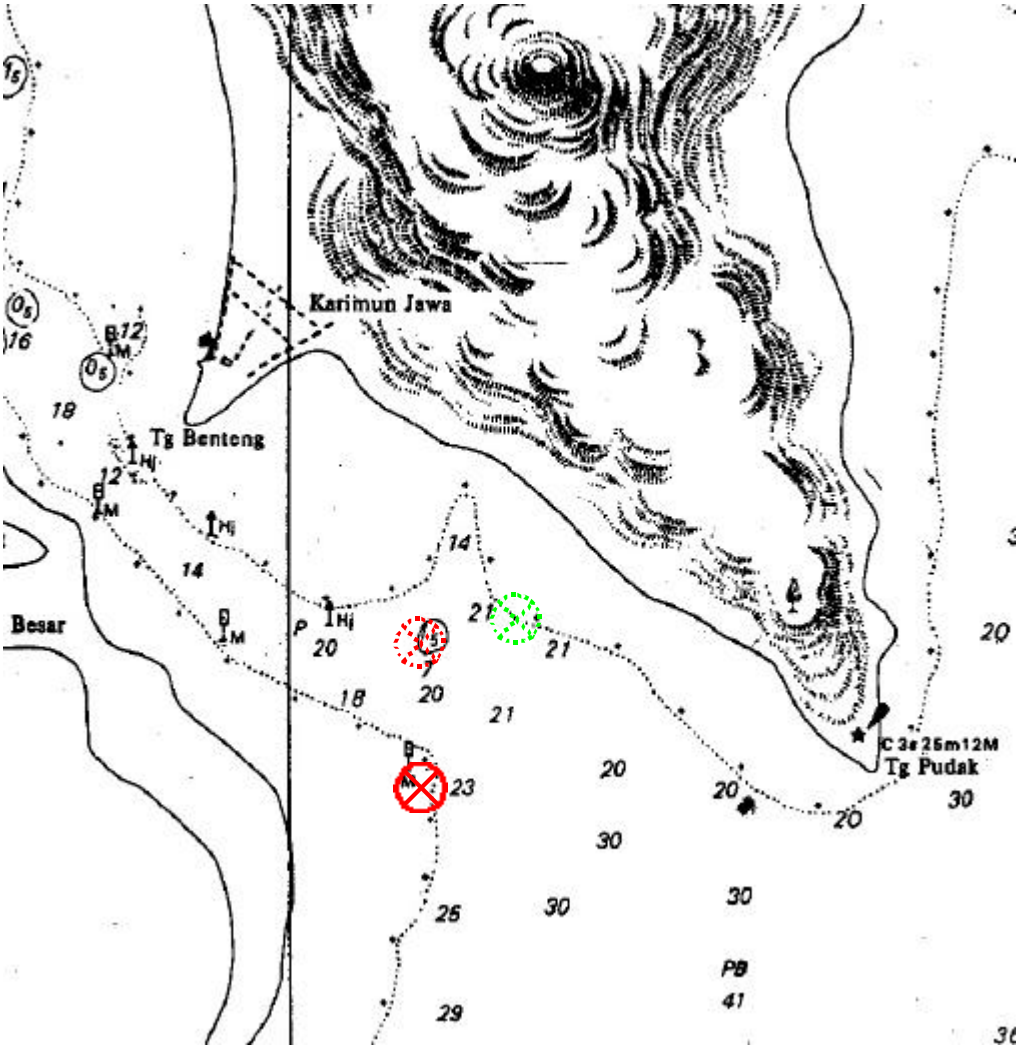
Appendix 8.4.2.
Site Survey Map
(Light Beacon)

Disnav. : Semarang	Site No. LB88	
Name of Site : Alur Pel. Karimun Jawa (Lateral red)		
Type of V. ATN : LB 10 m	Lat : 05-53-27S	Long : 110-26-18E
Chart no. : 88	Soil condition :	Height : 2.7m
Approach : The site is approached by boat from Jepara. The distance is about 50 nautical miles.		



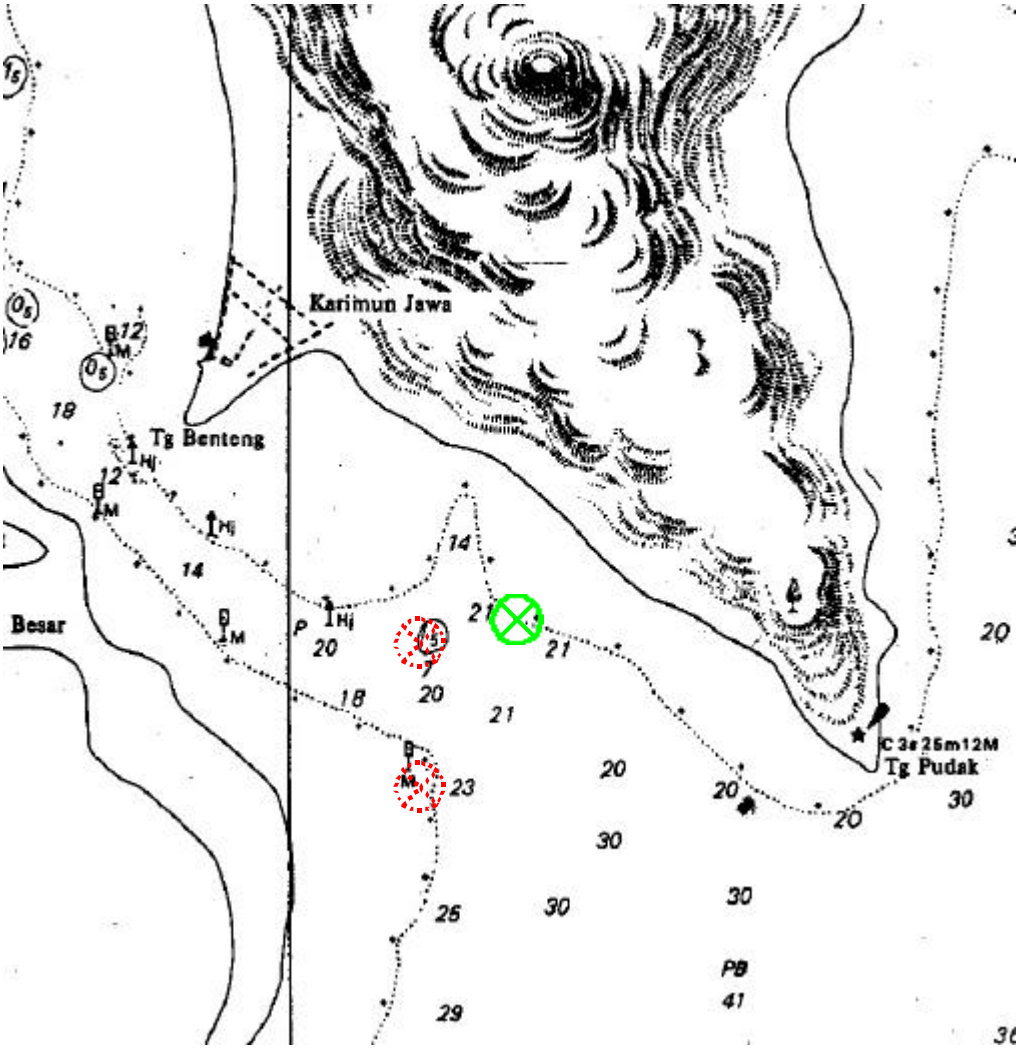
Appendix 8.4.2.
Site Survey Map
(Light Beacon)

Disnav. : Semarang	Site No. LB89	
Name of Site : Alur Pel. Karimun Jawa (Lateral red)		
Type of V. ATN : LB 10 m	Lat : 05-53-10S	Long : 110-26-18E
Chart no. : 88	Soil condition :	Height : 2.2m
Approach : The site is approached by boat. The distance is about 50 nautical miles.		



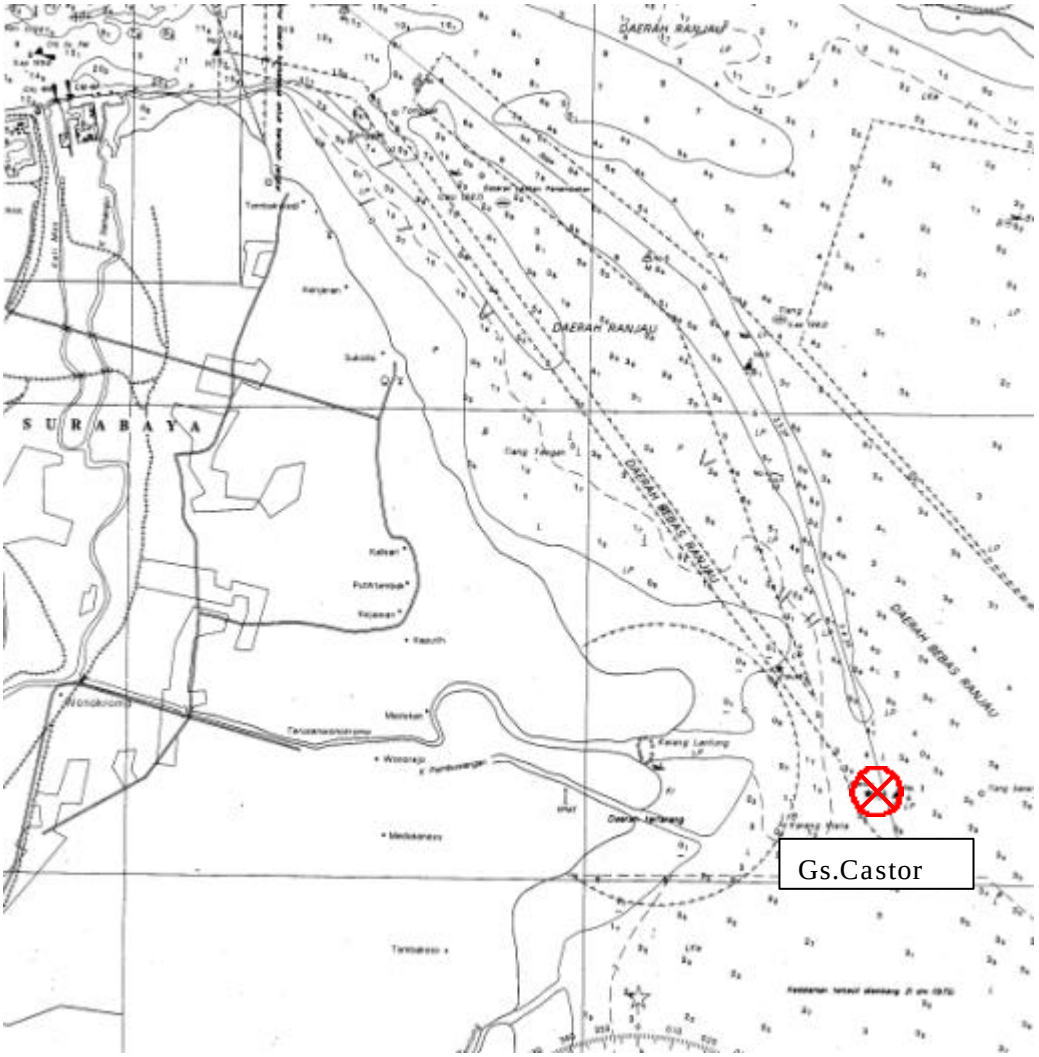
Appendix 8.4.2.
Site Survey Map
(Light Beacon)

Disnav. : Semarang	Site No. LB90	
Name of Site : Alur Pel. Karimun Jawa (Lateral Green)		
Type of V. ATN : LB 10 m	Lat : 05-53-08S	Long : 110-26-55E
Chart no. : 88	Soil condition :	Height : 3.3m
Approach : The site is approached by boat from Jepara. The distance is about 50 nautical miles.		



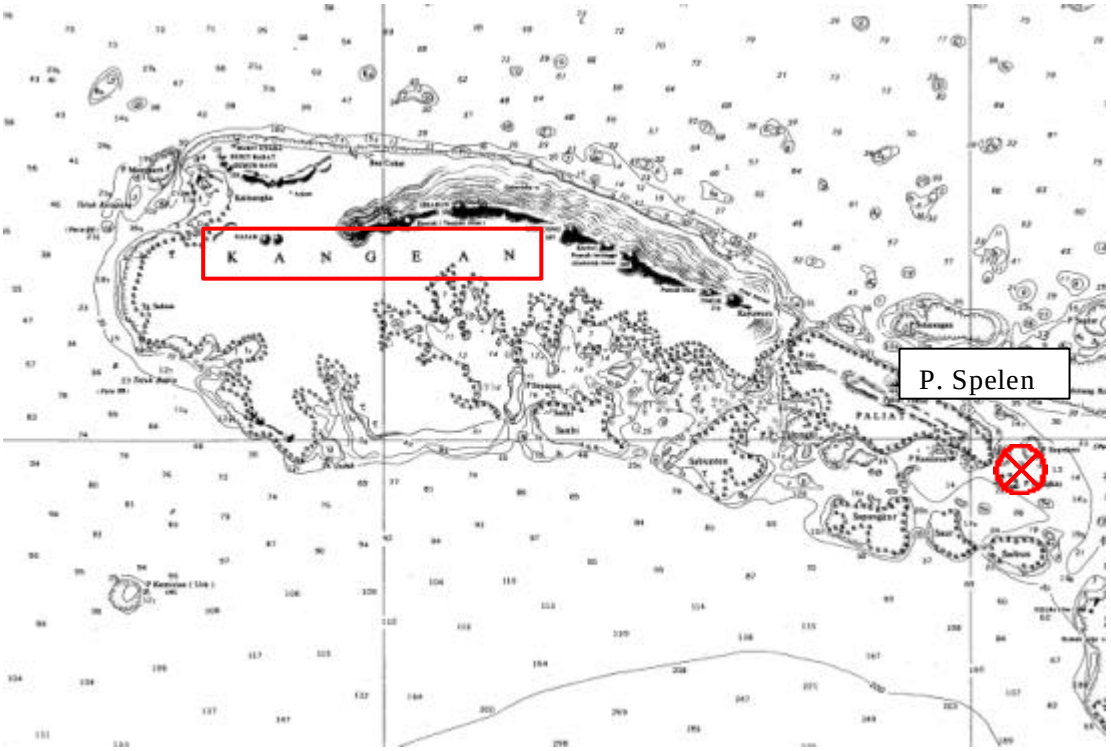
Appendix 8.4.2.
Site Survey Map
(Light Beacon)

Disnav. : Surabaya	Site No. LB100	
Name of Site : Gs. Castor		
Type of V. ATN : LB 10m	Lat : 07-19-00S	Long :112-53-00 E
Chart no. : 70,82	Soil condition :	Depth : 4.1m
Approach : The site is approached by boat. The distance is about 15 miles from Surabaya.		



Appendix 8.4.2.
Site Survey Map
(Light Beacon)

Disnav. : Surabaya	Site No. LB 104	
Name of Site : P. Sepekan		
Type of V. ATN : LB 20 m	Lat : 07-00-57S	Long :115-42-44E
Chart no. : 99	Soil condition :	Height : 2.1m
Approach : The site is located in eastern part of Kangean island. It is approached by boat from Gilimanuk of Bali in a distance of about 110 nautical miles.		

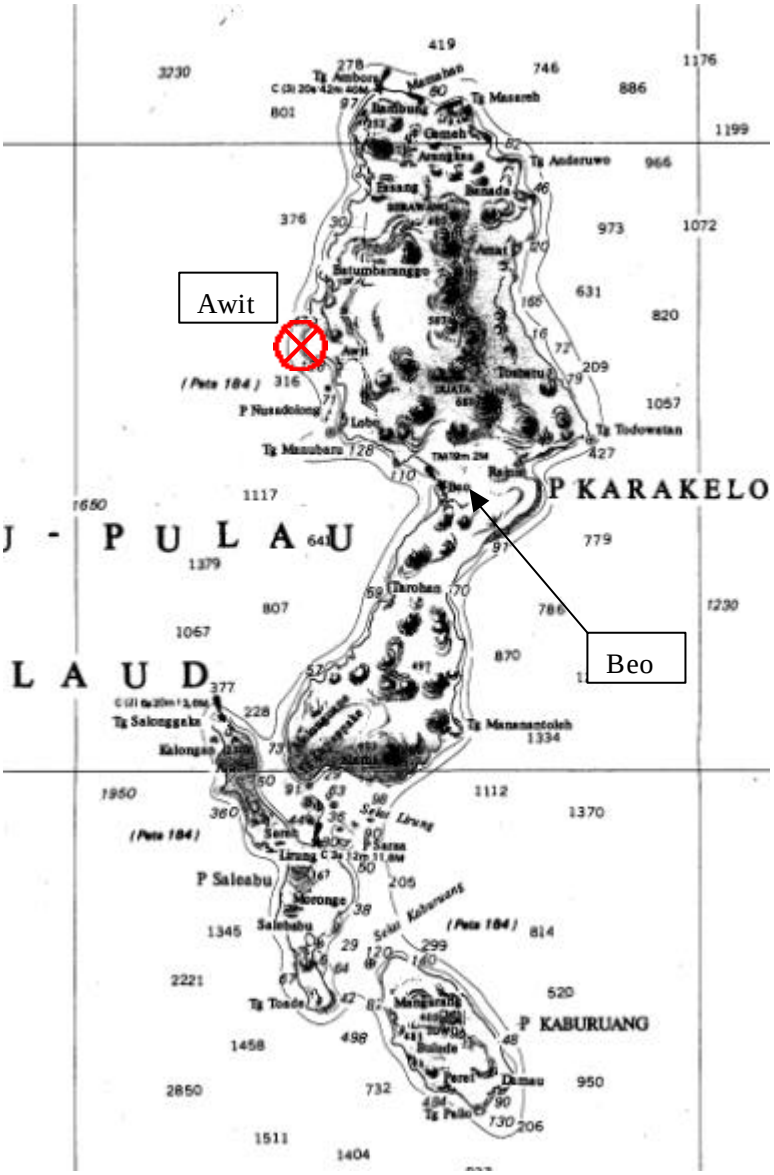


Appendix 8.4.2.
Site Survey Map
(Light Beacon)

Disnav. : Manado/Bitung	Site No. LB143	
Name of Site : Napu Arampua		
Type of V. ATN : LB 10m	Lat : 04-38-17N	Long :127-04-47E
Chart no. : 184, 403	Soil condition :Coral	Depth : 3.2m
Approach : The site is in Nasusa islands that is located at eastward of Karakelong island. The approach is by boat from Beo in western coast of Karakelong Island at the distance of about 60 nautical miles.		

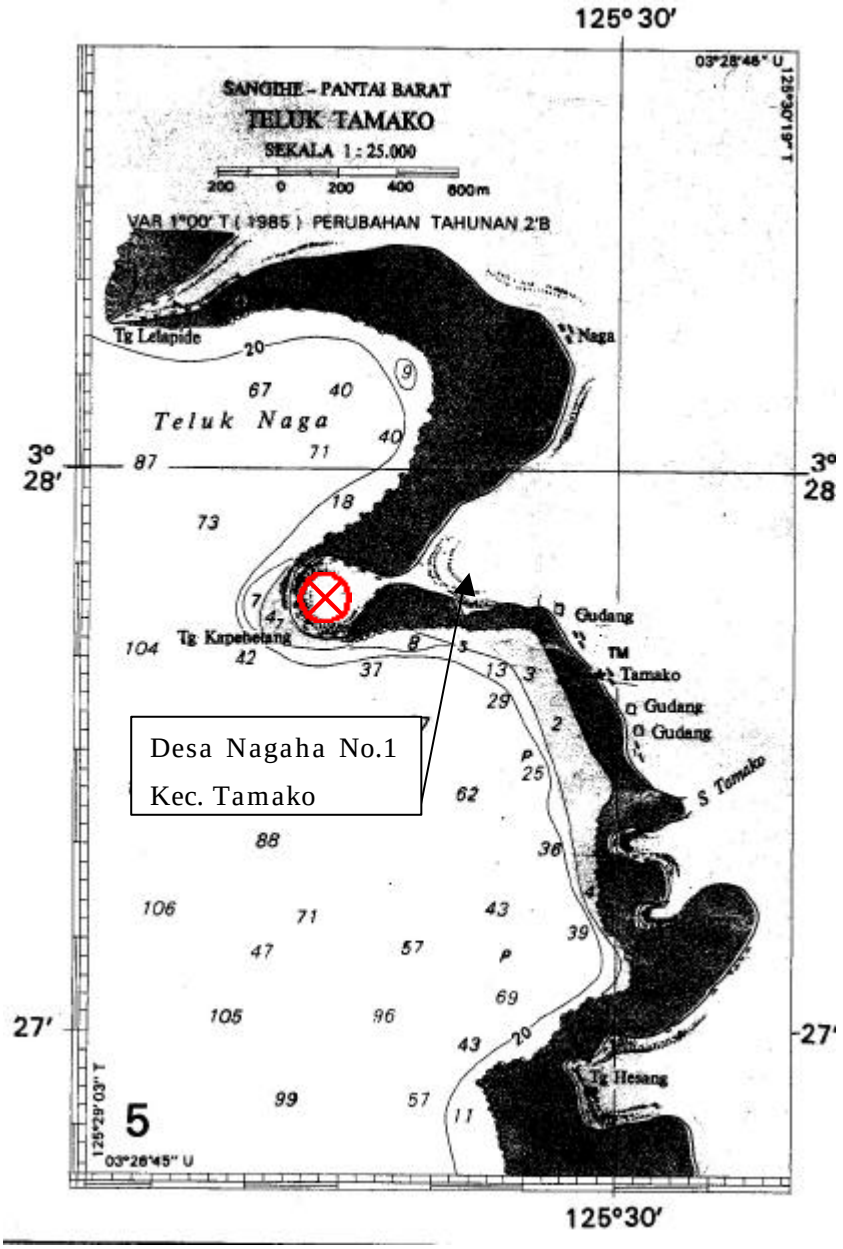
Appendix 8.4.2.
Site Survey Map
(Light Beacon)

Disnav. : Manado/Bitung	Site No. LB156	
Name of Site : Awit (Essang)		
Type of V. ATN : LB 20 m	Lat : 04-19-03N	Long :126-41-14 E
Chart no. : 183,403	Soil condition :	Depth :
Approach : Awit is located in the middle of marine route between Essang and Beo along west coast of Karakelong island. It is around 1 hour from Beo by vehicle, and around 40 minutes by walk from the center of Awit to the site.		



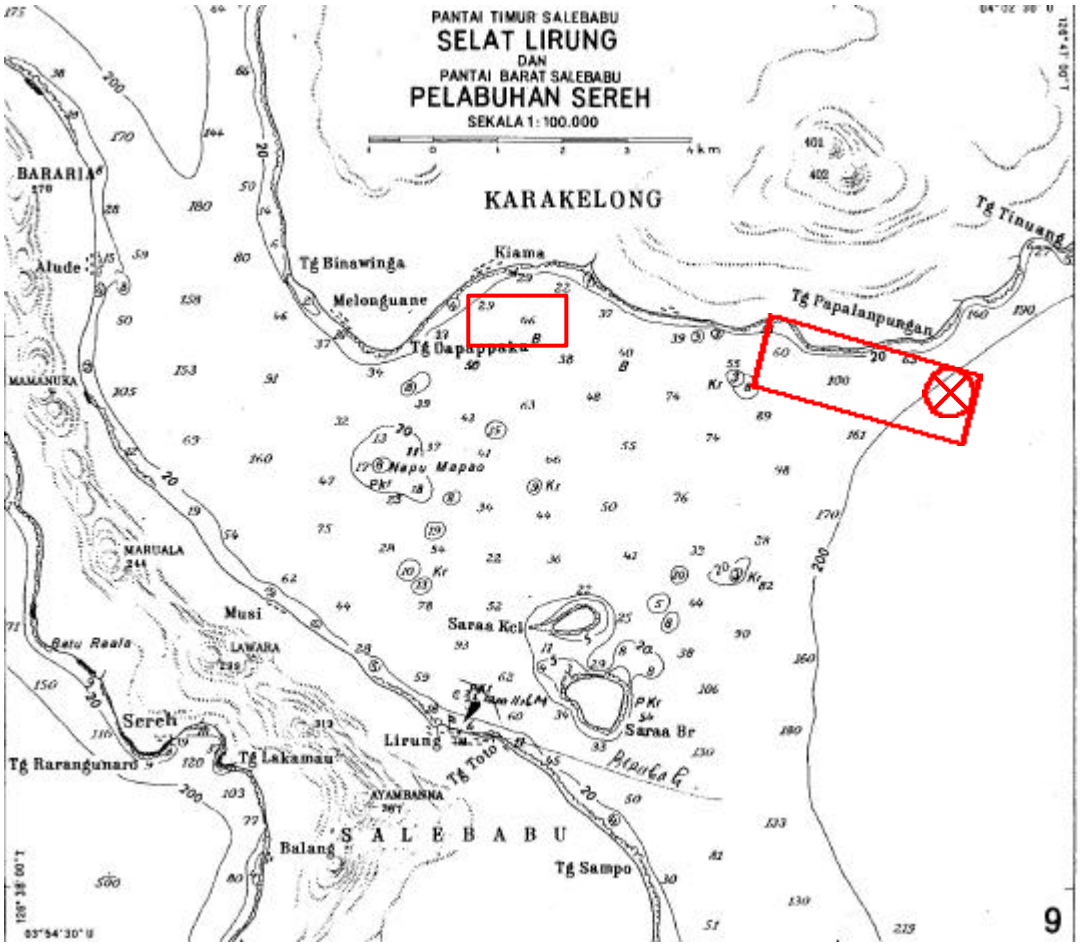
Appendix 8.4.2.
Site Survey Map
(Light Beacon)

Disnav. : Manado/Bitung	Site No. LB159	
Name of Site : Pel. Tamako		
Type of V. ATN : LB 20m	Lat : 03-26-49N	Long : 125-29-33E
Chart no. : 183,403	Soil condition :	Depth :
Approach : The site is located in west coast of Sangihe island. Distance from Tahuna that is around the middle of Sangihe island is about 1 hour and half by vehicle. There is a direction board beside the road for entrance " Desa Nagaha No.1 Kec. Tamako".		



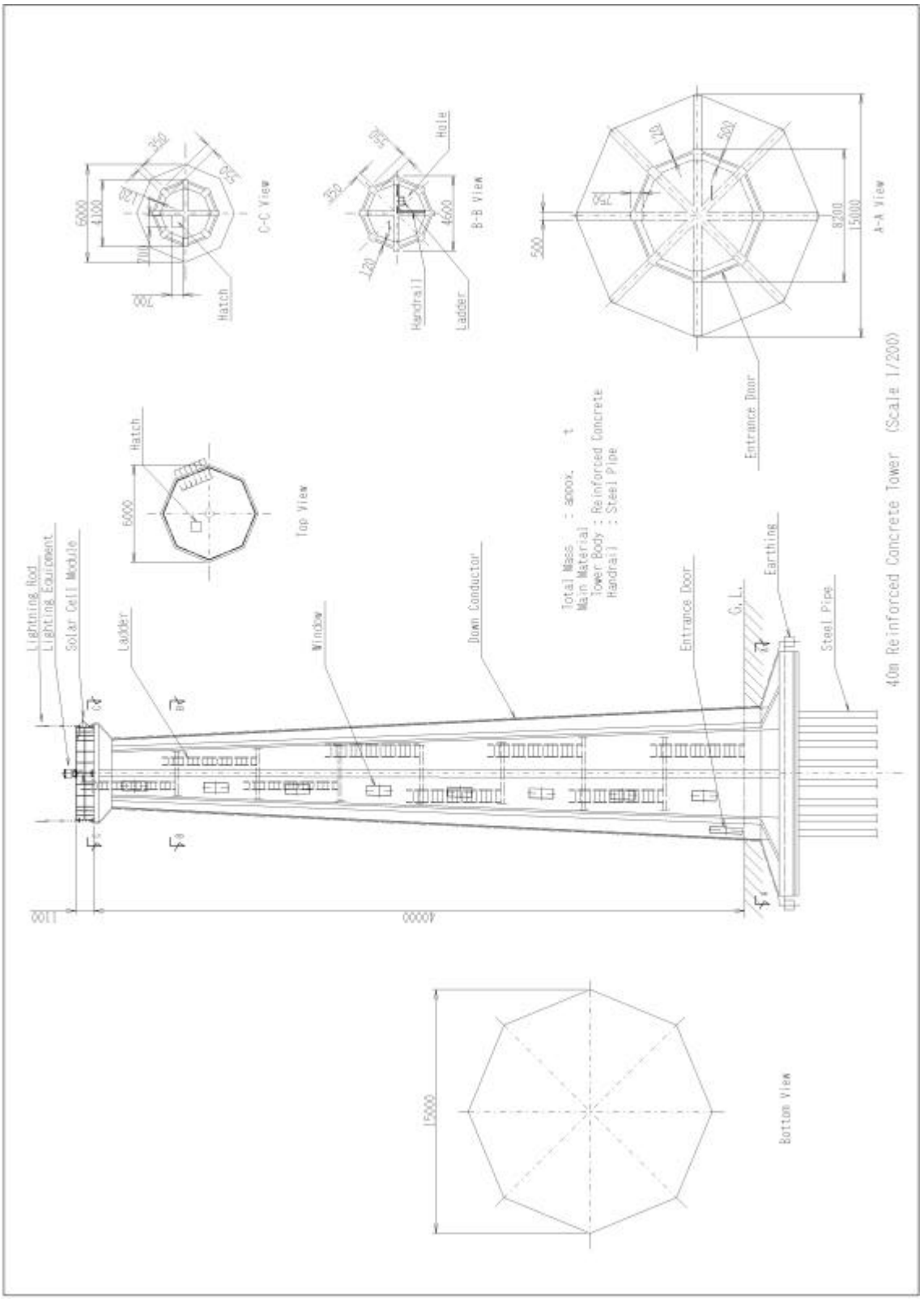
Appendix 8.4.2.
Site Survey Map
(Light Beacon)

Disnav.: Manado/Bitung	Site No. LB168		
Name of Site : Tg. Papalanpungan (Tg. Dapappaka)			
Type of V. ATN : LB 30 m	Lat : 03-58-52 N	Long : 126-44-38 E	
Chart no. : 184, 403	Soil condition :	Height :	
Approach : The site is located in the south coast of Karakelong island. There is a road from Kiama passing through this site to eastern caost. Distance from Kiama to the site is approximately 6km. Road is flat and width is 2 m.			



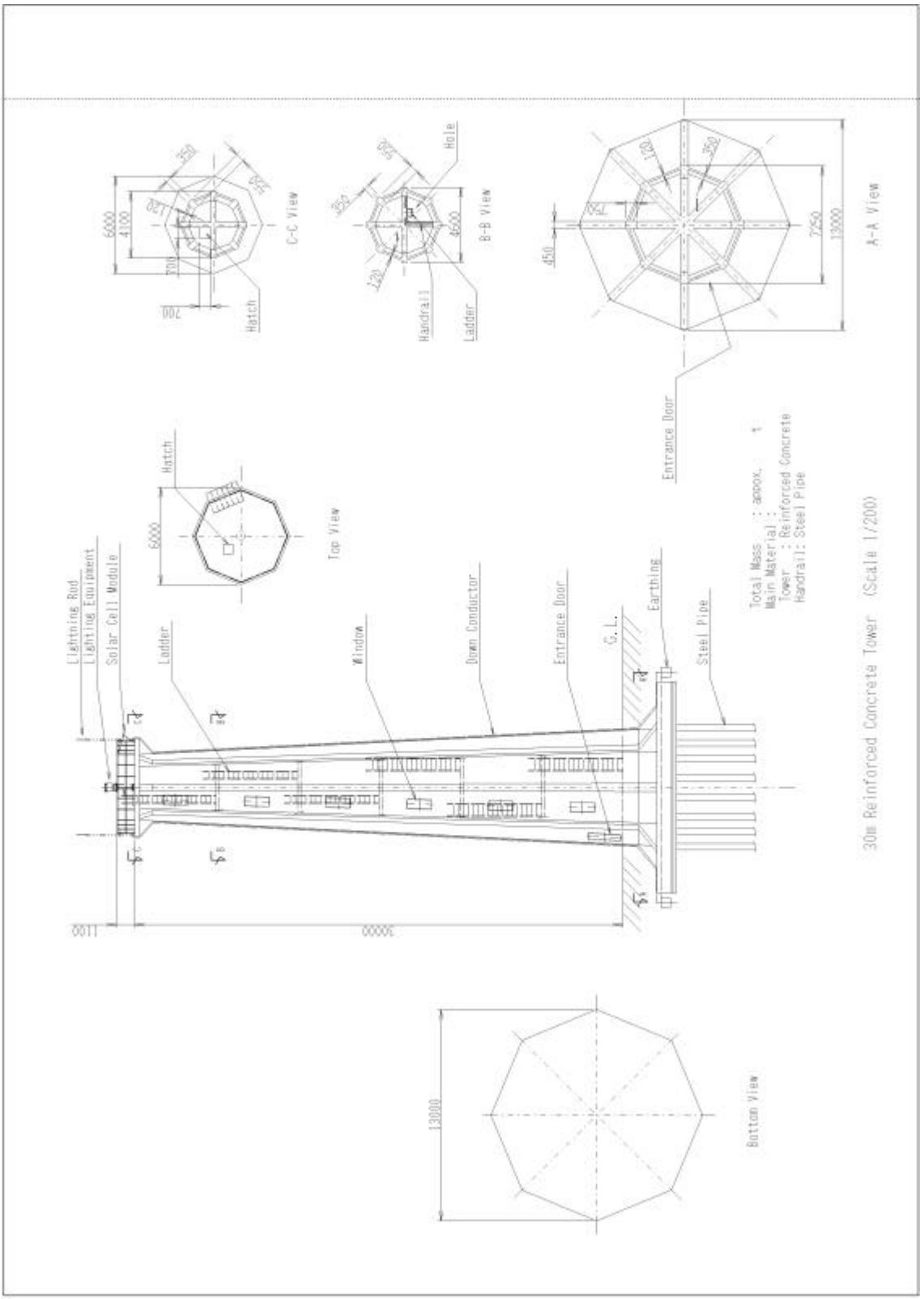
Appendix 10.2.1.

40m Reinforced Concrete Tower



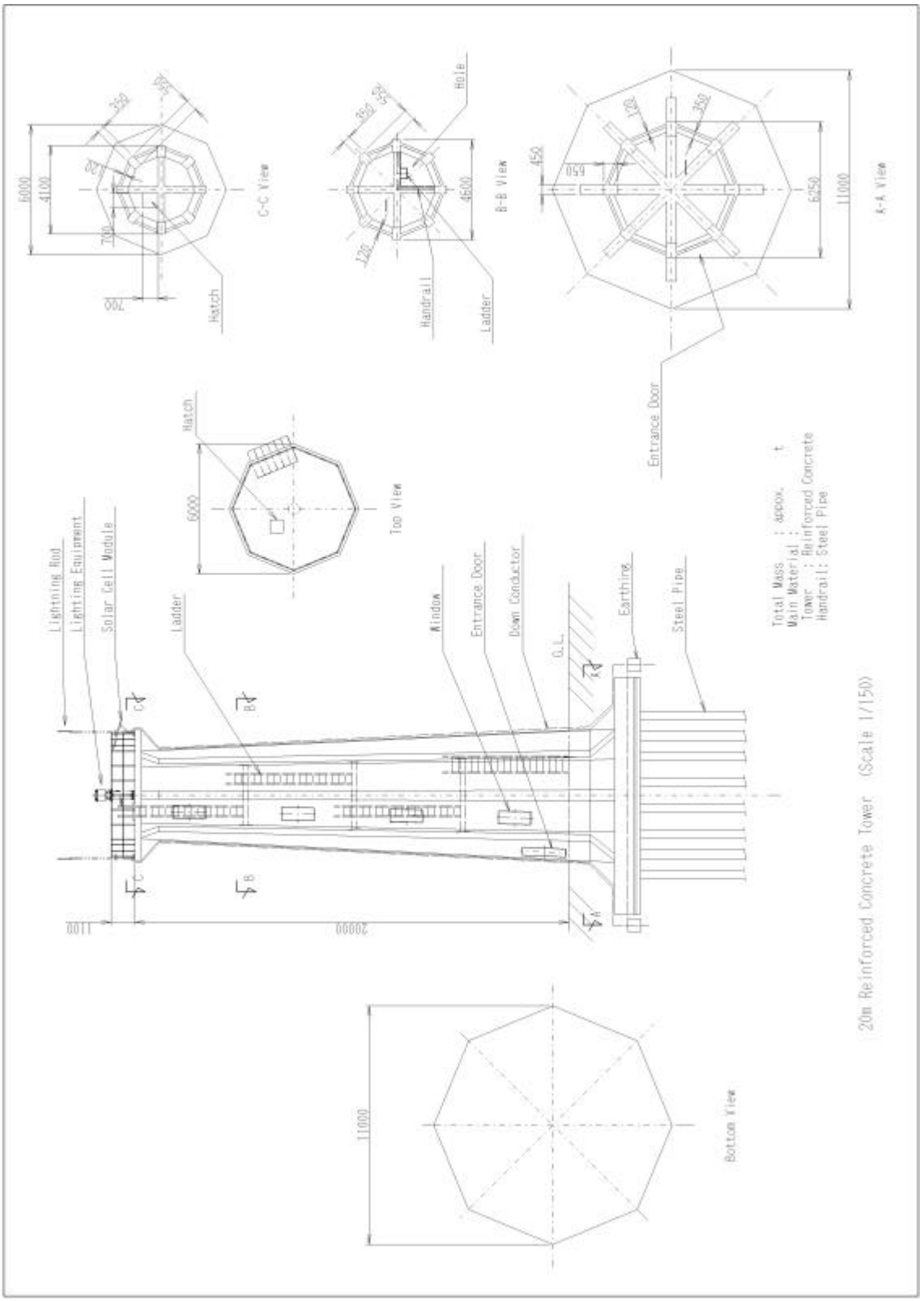
Appendix 10.2.2.

30m Reinforced Concrete Tower



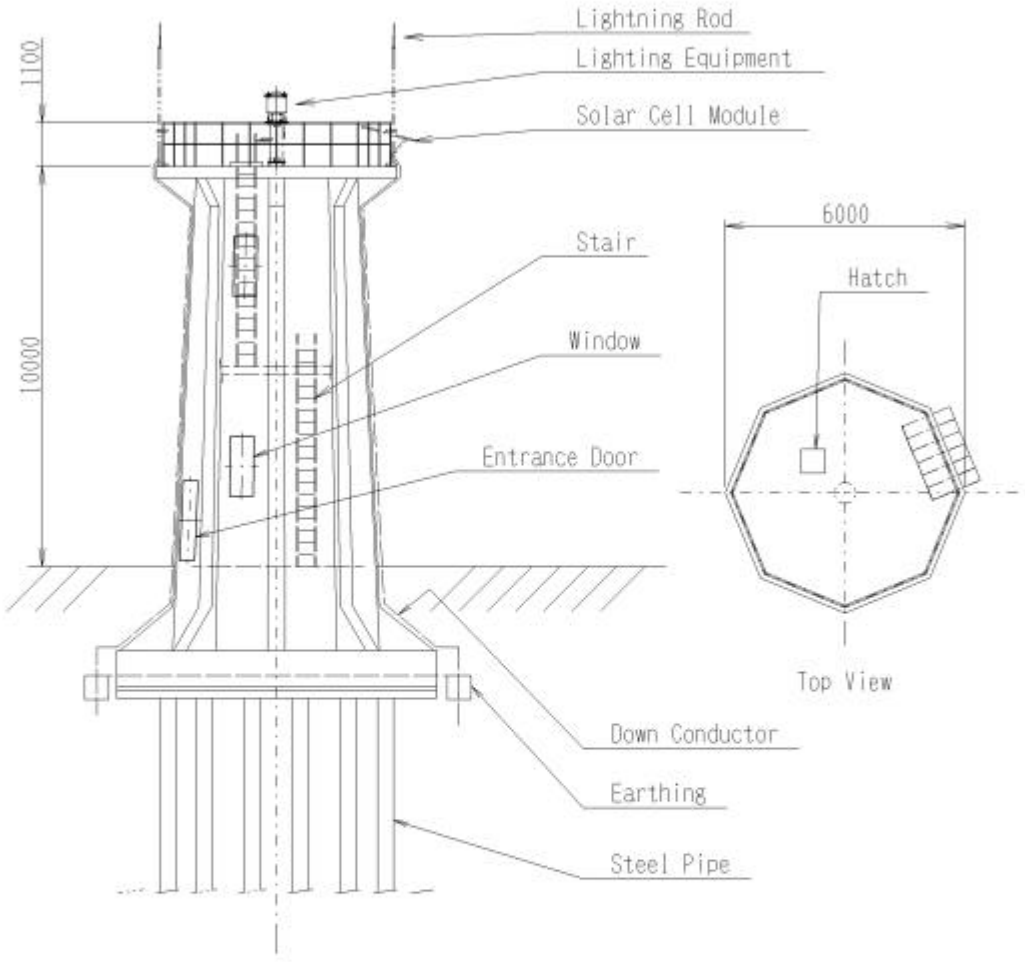
Appendix 10.2.3.

20m Reinforced Concrete Tower



Appendix 10.2.4.

10m Reinforced Concrete Tower

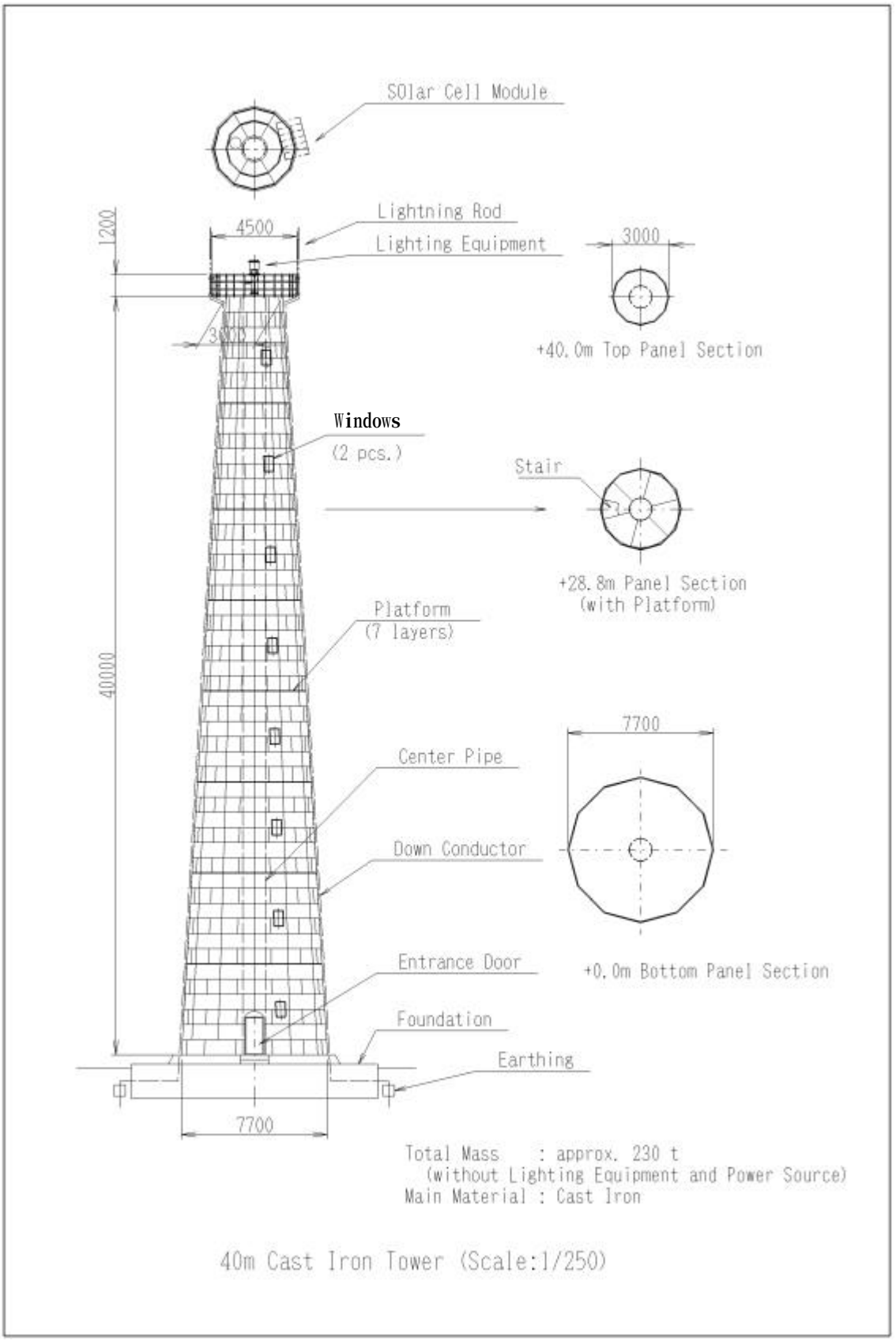


Total Mass : appox. 240t
Main Material :
Tower : Reinforced Concrete
Handrail: Steel Pipe

10m Reinforced Concrete Tower (Scale 1/150)

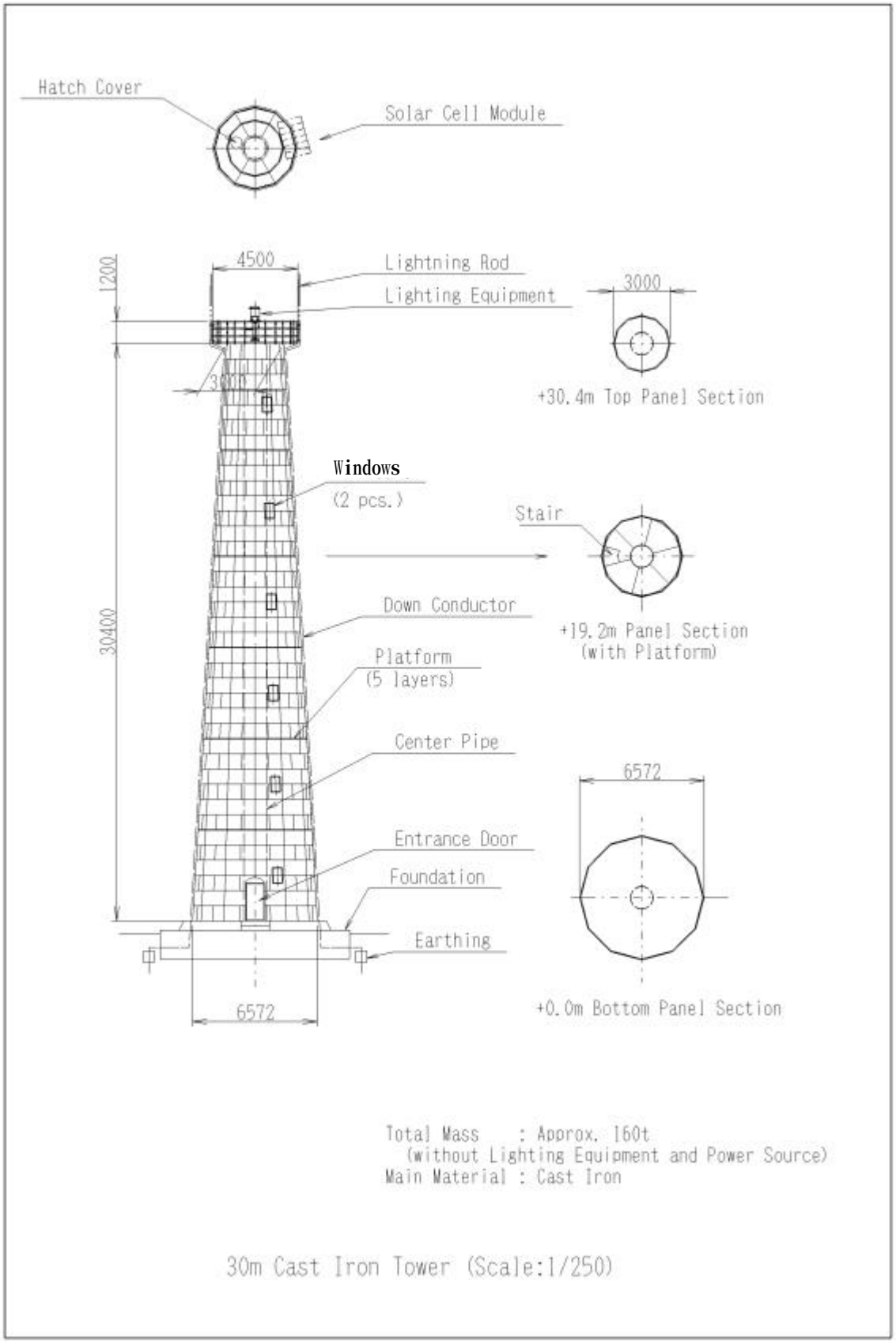
Appendix 10.2.5.

40m Cast Iron Tower



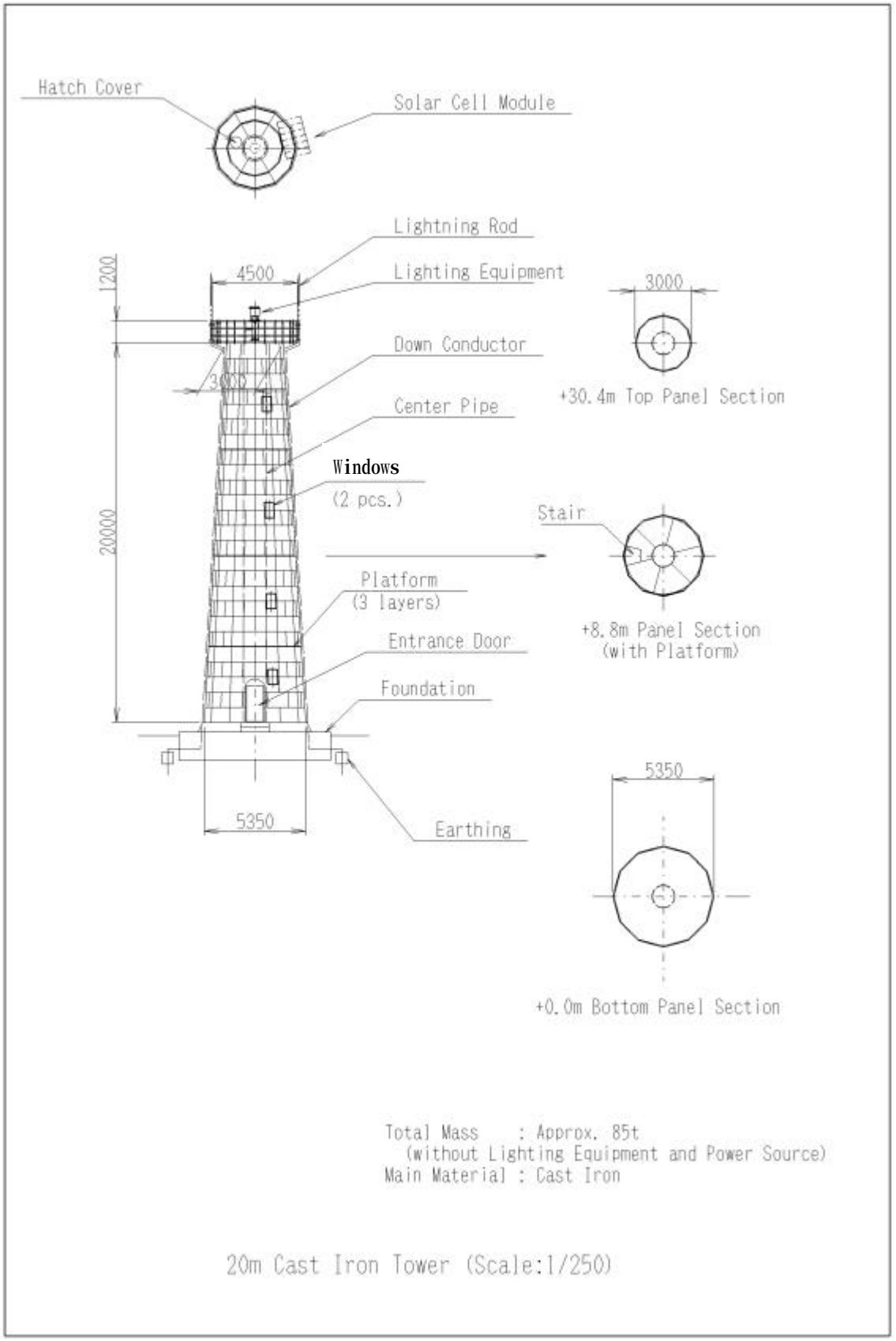
Appendix 10.2.6.

30m Cast Iron Tower



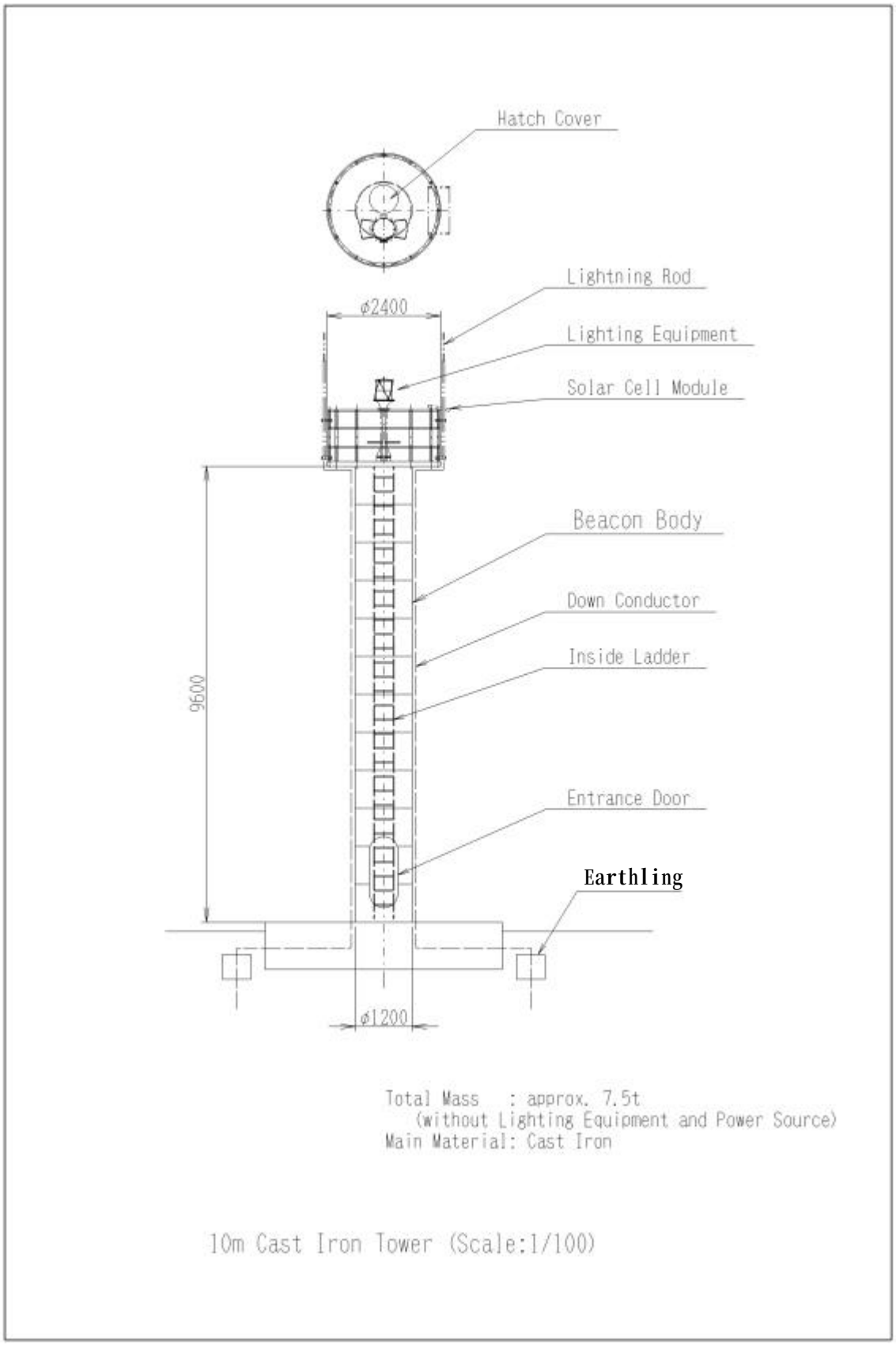
Appendix 10.2.7.

20m Cast Iron Tower



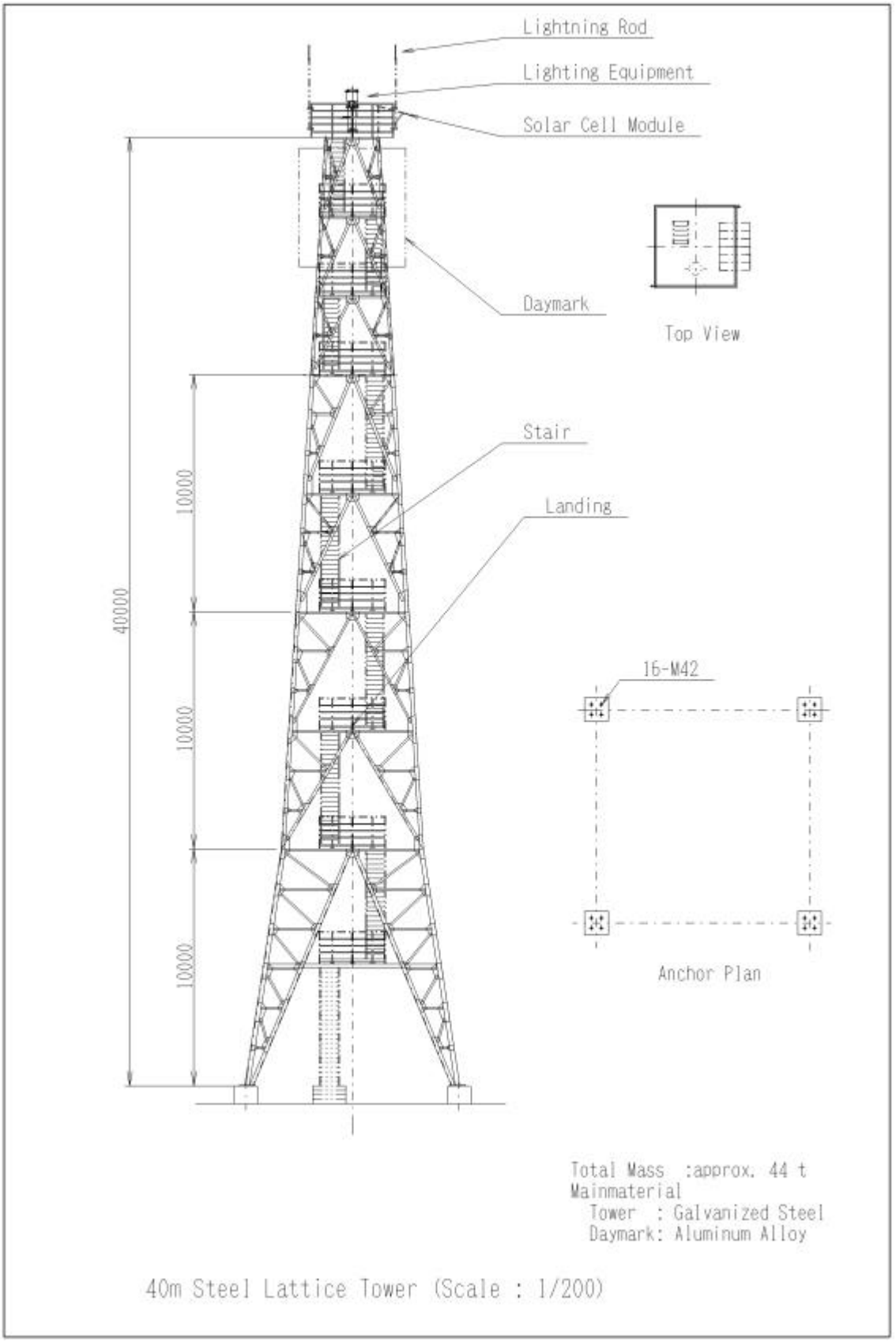
Appendix 10.2.8.

10m Cast Iron Tower



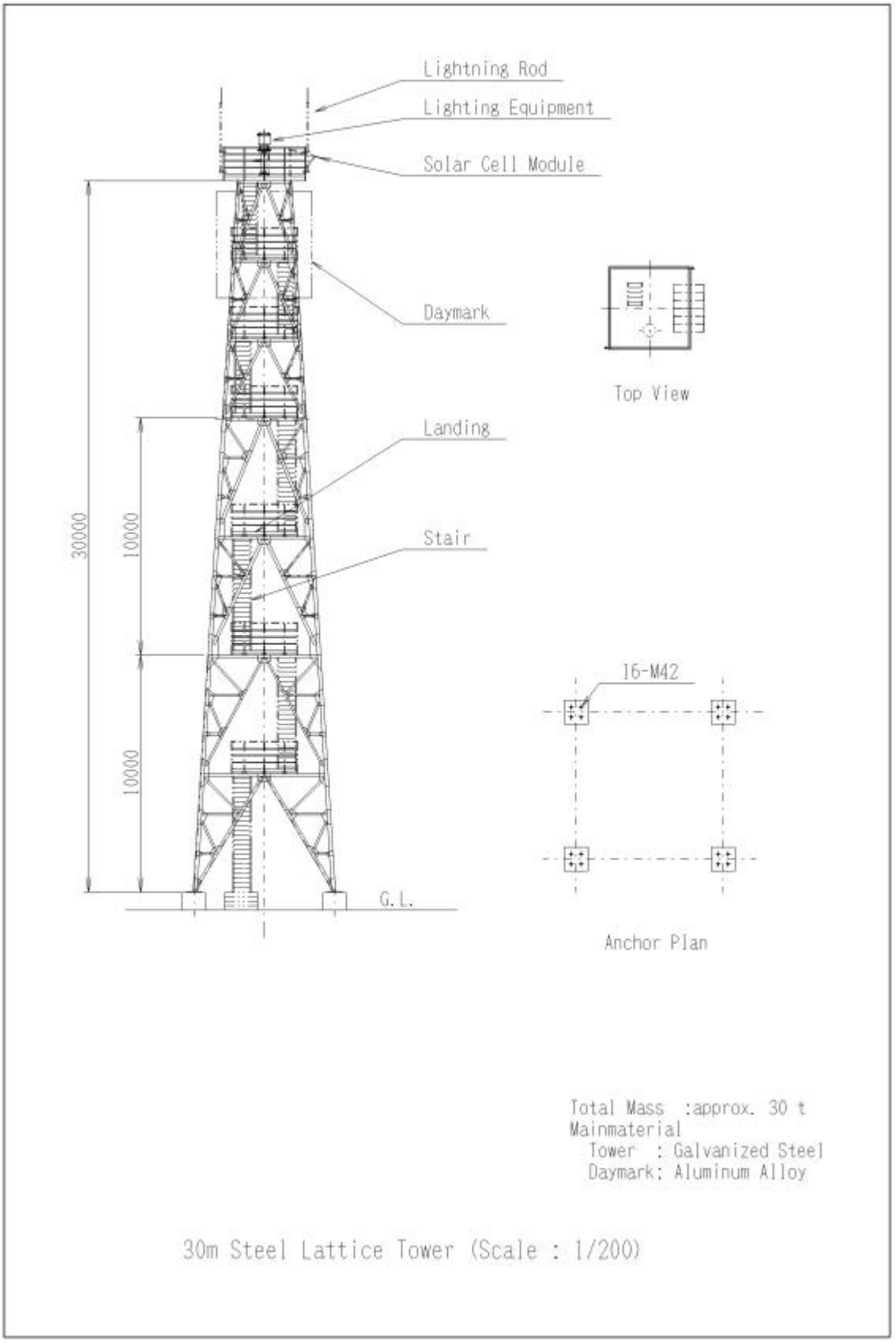
Appendix 10.2.9.

40m Steel Lattice Tower



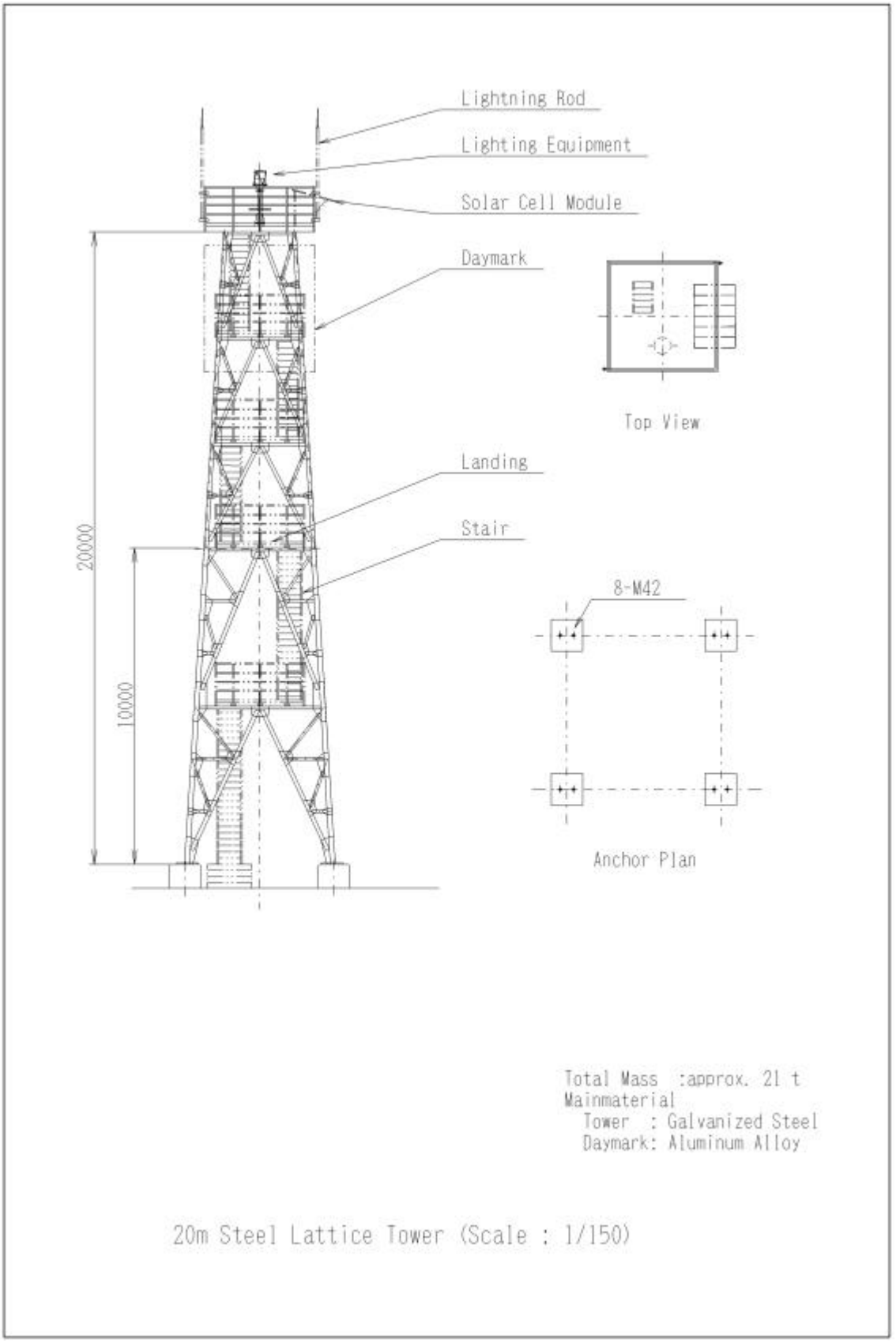
Appendix 10.2.10.

30m Steel Lattice Tower



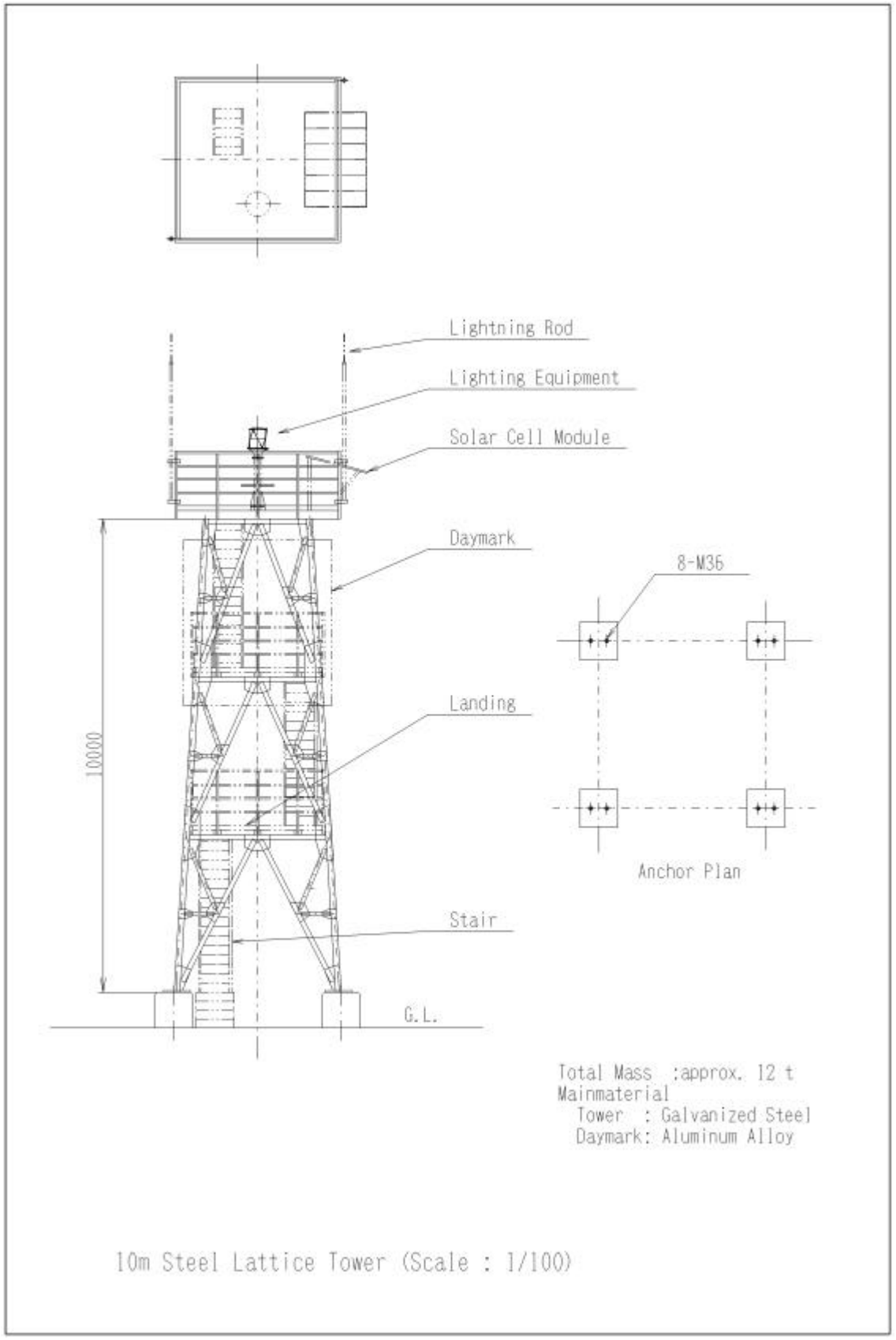
Appendix 10.2.11.

20m Steel Lattice Tower



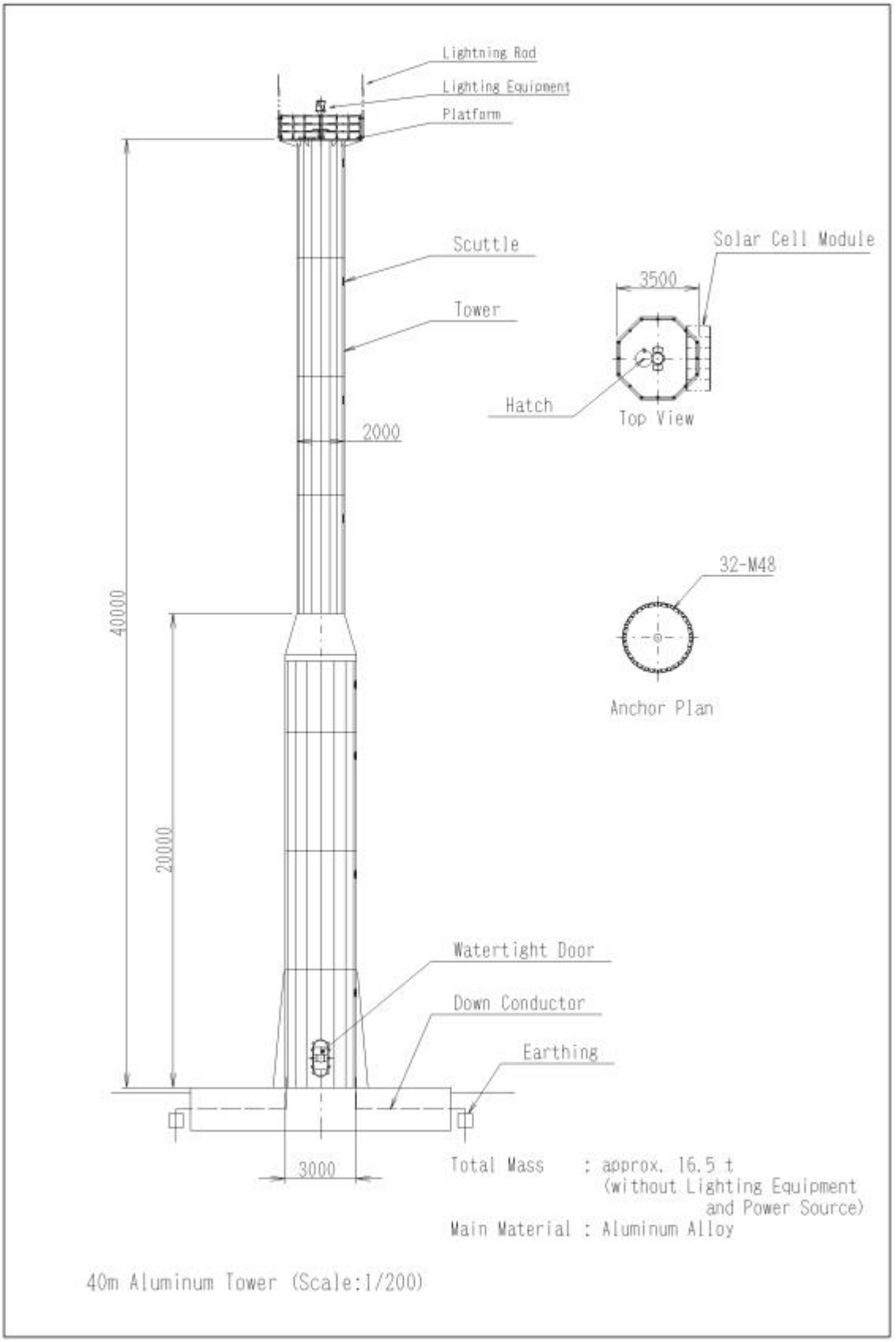
Appendix 10.2.12.

10m Steel Lattice Tower



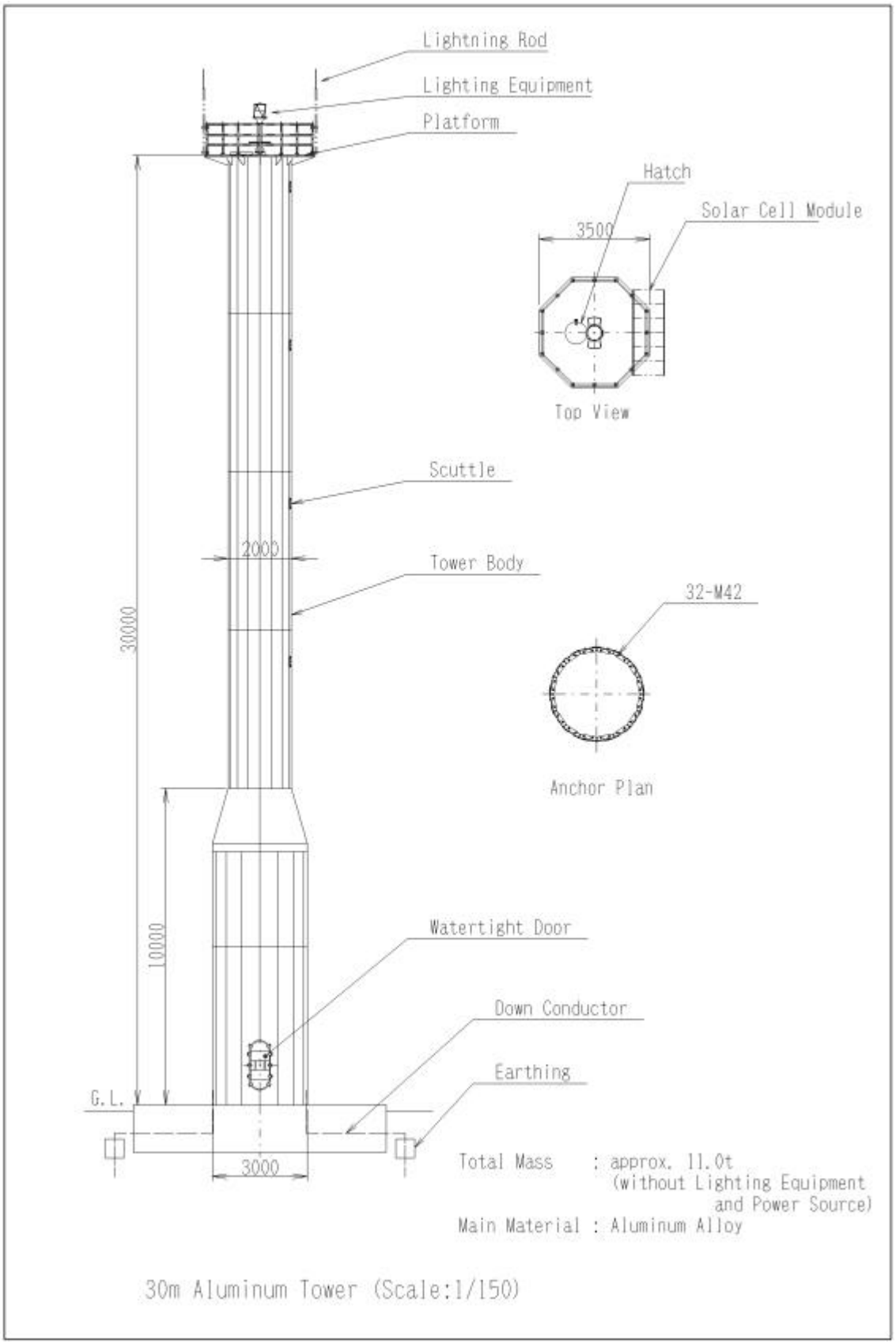
Appendix 10.2.13.

40m Aluminum Tower



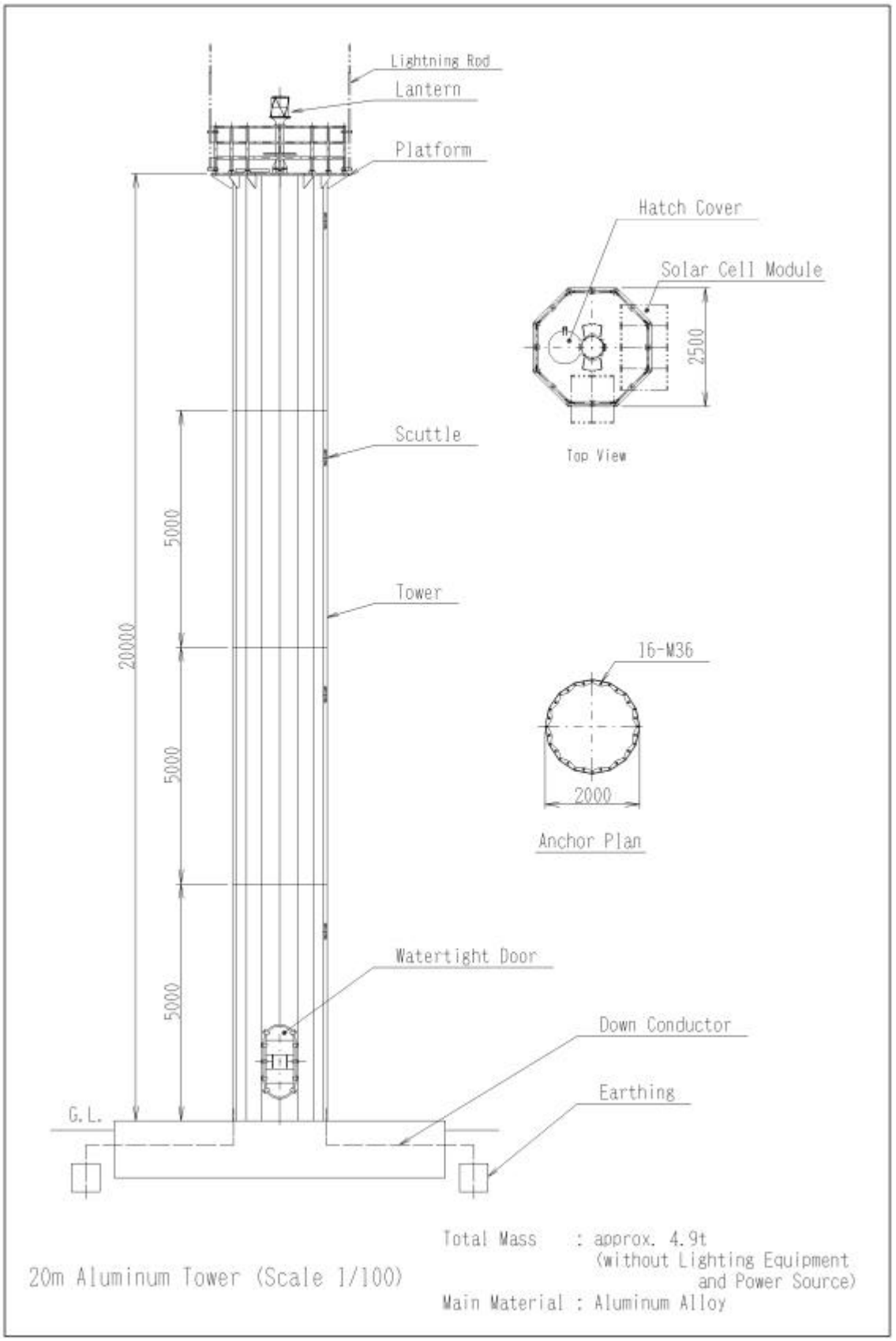
Appendix 10.2.14.

30m Aluminum Tower



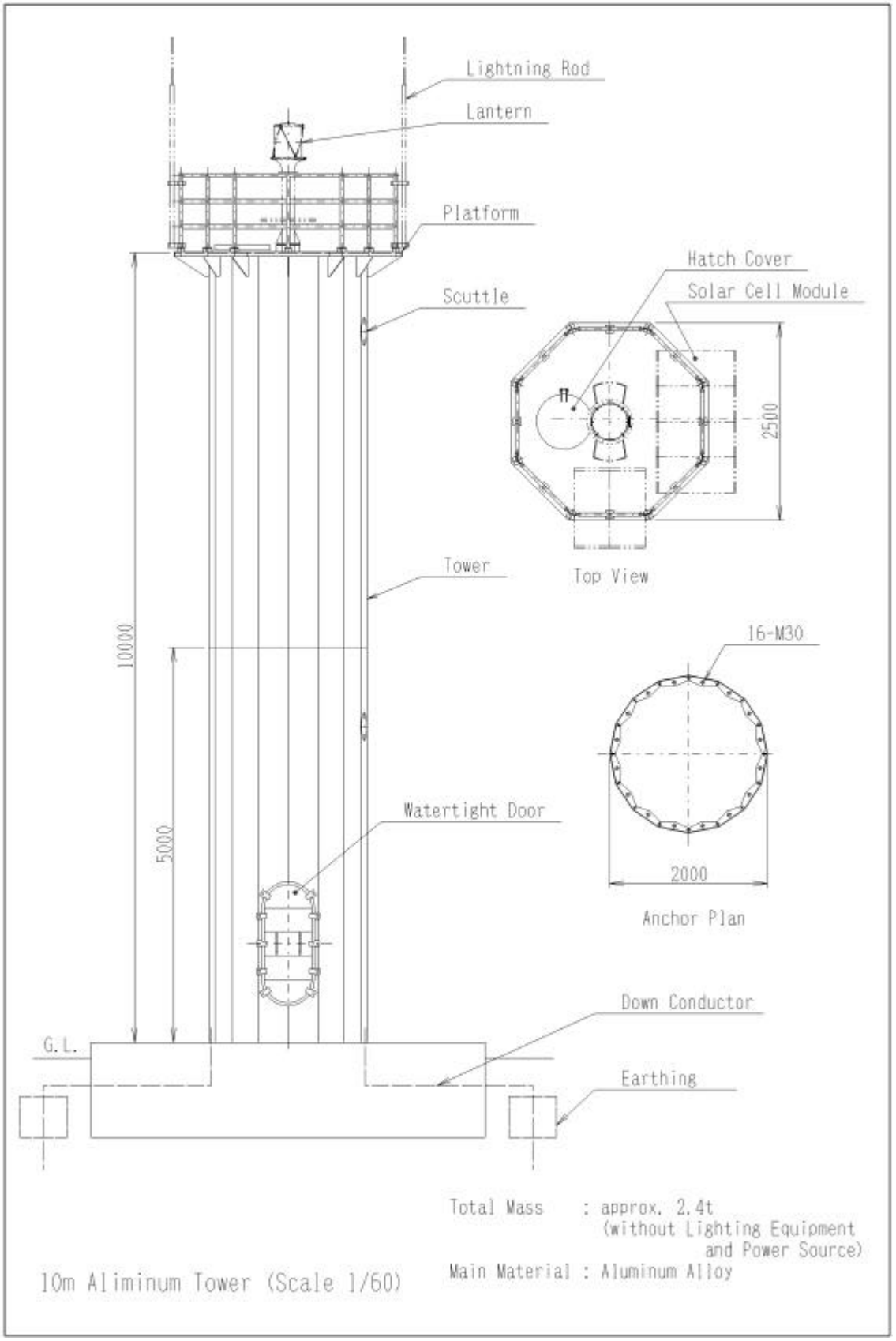
Appendix 10.2.15.

20m Aluminum Tower



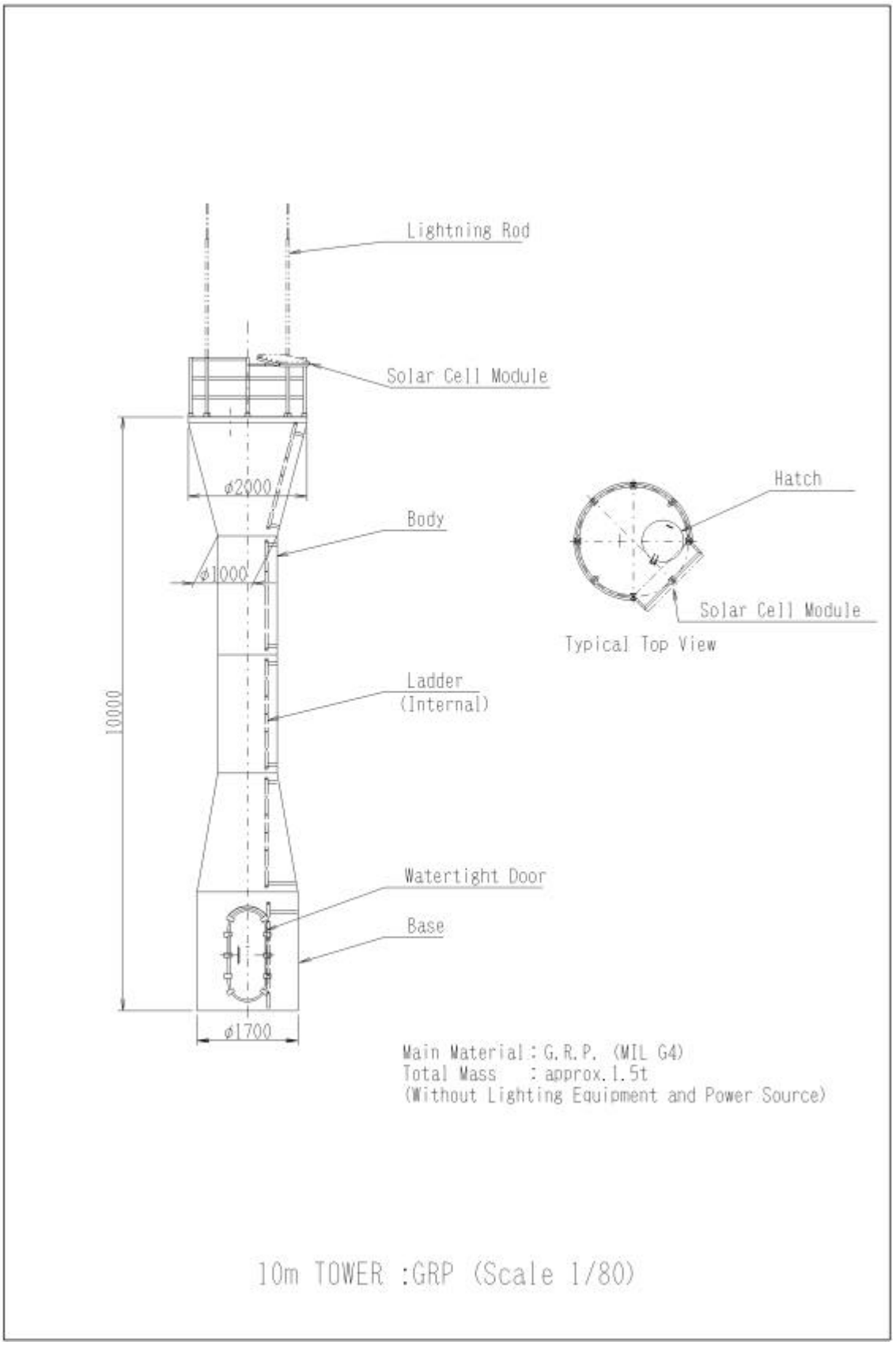
Appendix 10.2.16.

10m Aluminum Tower



Appendix 10.2.17.

10m GRP Tower



Appendix 10.3.1.

Workload Calculation and Number of Aids Tender & Inspection Boat required up to Year 2007

No.	ATN Office	Class	Total Mile in 2001	Light House				Light Beacon				Increase ratio at 2007	Total Mile in 2007	For Sailing								Work at Site							Total days	Margin (10%)	Work load (Days)	Number of vessels to be required:	
				Existing	On going	2003-2007	2007 Total	Existing	On going	2003-2007	2007 Total			F	P	SP	L	H/ Days	V	PO	Days	Lighthouse			Light Beacon			Sub-total				A/T	IB
																						LS	MM	Days	SM	MM	Days						
1	SABANG	Sub	1,002	9	0	0	9	31	0	0	31	0.0%	1,002	12	2	4	1,002	24	9	2	152	27	3	30	30	4	34	64	216	22	238	1	1
2	BELAWAN	II	661	5	0	0	5	45	0	0	45	0.0%	661	12	2	4	661	24	9	2	133	15	2	17	43	6	49	66	199	20	219	1	1
3	SIBOLGA	Sub	734	7	0	0	7	46	0	0	46	0.0%	734	12	2	4	734	24	9	2	137	21	2	23	44	6	50	73	210	21	231	1	1
4	DUMAI	I	1,031	5	0	0	5	34	0	7	41	17.9%	1,216	12	2	4	1,216	24	9	2	164	15	2	17	39	6	45	62	226	23	249	1	1
5	TG. PINANG	I	1,692	22	1	3	26	71	3	7	81	15.1%	1,947	12	2	4	1,947	24	9	2	205	77	7	84	76	11	87	171	376	38	414	1	1
6	TLK. BAYUR	II	915	8	0	0	8	40	0	0	40	0.0%	915	12	2	4	915	24	9	2	147	24	2	26	38	5	43	69	216	22	238	1	1
7	PALEMBANG	II	1,127	4	0	3	7	63	0	5	68	11.9%	1,262	12	2	4	1,262	24	9	2	167	21	2	23	64	9	73	96	263	27	290	1	1
8	TG.PRIOK	I	3,043	27	0	0	27	96	2	3	101	4.1%	3,167	12	2	4	3,167	24	9	2	272	80	7	87	95	13	108	195	467	47	514	1	1
9	SEMARANG	II	452	7	0	0	7	31	0	3	34	7.9%	488	12	2	4	488	24	9	2	124	21	2	23	32	5	37	60	184	19	203	1	1
10	CILACAP	Sub	373	6	0	0	6	17	0	0	17	0.0%	373	12	2	4	373	24	9	2	117	18	2	20	16	3	19	39	156	16	172	1	1
11	SURABAYA	I	1,625	19	0	1	20	58	0	2	60	3.9%	1,688	12	2	4	1,688	24	9	2	190	59	5	64	57	8	65	129	319	32	351	1	1
12	BENOA	II	1,609	15	0	1	16	57	0	0	57	1.4%	1,631	12	2	4	1,631	24	9	2	187	47	4	51	54	8	62	113	300	30	330	1	1
13	PONTIANAK	Sub	980	3	1	0	4	42	1	0	43	4.4%	1,024	12	2	4	1,024	24	9	2	153	12	1	13	41	6	47	60	213	22	235	1	1
14	BANJARMASIN	II	1,205	7	0	0	7	38	1	0	39	2.2%	1,232	12	2	4	1,232	24	9	2	165	21	2	23	37	5	42	65	230	23	253	1	1
15	SAMARINDA	I	754	5	0	0	5	48	0	0	48	0.0%	754	12	2	4	754	24	9	2	138	15	2	17	45	6	51	68	206	21	227	1	1
16	TARAKAN	II	534	2	0	0	2	24	0	0	24	0.0%	534	12	2	4	534	24	9	2	126	6	1	7	23	3	26	33	159	16	175	1	1
17	BITUNG	I	3,180	21	0	0	21	84	2	4	90	5.7%	3,362	12	2	4	3,362	24	9	2	283	62	6	68	85	12	97	165	448	45	493	2	1
18	KENDARI	Sub	1,358	6	0	0	6	62	0	0	62	0.0%	1,358	12	2	4	1,358	24	9	2	172	18	2	20	59	8	67	87	259	26	285	1	1
19	UJ.PANDANG	I	2,450	18	0	0	18	50	2	0	52	2.9%	2,522	12	2	4	2,522	24	9	2	237	53	5	58	49	7	56	114	351	36	387	1	1
20	KUPANG	II	1,887	13	4	0	17	48	8	0	56	19.7%	2,258	12	2	4	2,258	24	9	2	222	50	5	55	53	7	60	115	337	34	371	1	1
21	AMBON	I	3,340	12	5	0	17	71	4	0	75	10.8%	3,702	12	2	4	3,702	24	9	2	302	50	5	55	71	10	81	136	438	44	482	1	1
22	JAYAPURA	II	1,386	7	0	0	7	34	0	0	34	0.0%	1,386	12	2	4	1,386	24	9	2	173	21	2	23	32	5	37	60	233	24	257	1	1
23	SORONG	I	2,370	6	0	0	6	52	0	0	52	0.0%	2,370	12	2	4	2,370	24	9	2	228	18	2	20	49	7	56	76	304	31	335	1	1
24	MERAUKE	Sub	959	1	0	0	1	26	0	0	26	0.0%	959	12	2	4	959	24	9	2	150	3	1	4	25	4	29	33	183	19	202	1	1
TOTAL																																25	24

Note:

F: Frequency of Sailing
P: Days of Preparation
SP: Days of Sailing Preparation
L: Sailing Distance
V: Sailing Speed
PO: Post Operation
LS: Logistic Supply
SM: Standard Maintenance
MM: Major Maintenance (Overhaul)
A/T: Aids Tender
I/B: Inspection Boat

Appendix 10-3-2

Appendix 10.3.2.

Workload Calculation and Number of Aids Tender & Inspection Boat required up to Year 2020

No.	ATN Office	Class	Total Mileof in 2001	Light House				Light Beacon				Increase ratio at 2020	Total Mile in 2020	For Sailing								Work at Site								Total days	Margin (10%)	Work load (Days)
				Exist-ing	On going	2003-2020	2020 Total	Exist-ing	On going	2003-2020	2020 Total			F	P	SP	L	H/ Days	V	PO	Days	Lighthouse				Light Beacon				Sub-total			
																						LS	MM	Days		SM	MM	Days					
1	SABANG	Sub	1,002	9	0	2	11	31	0	12	43	350%	1,353	12	2	4	1,353	24	9	2	172	33	3	36		41	6	47		83	255	26	281
2	BELAWAN	II	661	5	0	1	6	45	0	3	48	88%	714	12	2	4	714	24	9	2	136	18	2	20		45	6	51		71	207	21	228
3	SIBOLGA	Sub	734	7	0	0	7	46	0	17	63	321%	969	12	2	4	969	24	9	2	150	21	2	23		60	8	68		91	241	25	266
4	DUMAI	I	1,031	5	0	0	5	34	0	8	42	208%	1,242	12	2	4	1,242	24	9	2	166	15	2	17		40	6	46		63	229	23	252
5	TGPINANG	I	1,692	22	1	7	30	71	3	20	94	333%	2,256	12	2	4	2,256	24	9	2	222	89	8	97		89	12	101		198	420	42	462
6	TLKBAYUR	II	915	8	0	2	10	40	0	6	46	167%	1,068	12	2	4	1,068	24	9	2	156	30	3	33		44	6	50		83	239	24	263
7	PALEMBANG	II	1,127	4	0	5	9	63	0	10	73	224%	1,379	12	2	4	1,379	24	9	2	173	27	3	30		69	10	79		109	282	29	311
8	TGPRIOK	I	3,043	27	0	7	34	96	2	11	109	163%	3,538	12	2	4	3,538	24	9	2	293	100	9	109		103	14	117		226	519	52	571
9	SEMARANG	II	452	7	0	1	8	31	0	8	39	237%	559	12	2	4	559	24	9	2	128	24	2	26		37	5	42		68	196	20	216
10	CILACAP	Sub	373	6	0	0	6	17	0	3	20	130%	422	12	2	4	422	24	9	2	120	18	2	20		19	3	22		42	162	17	179
11	SURABAYA	I	1,625	19	0	2	21	58	0	7	65	117%	1,815	12	2	4	1,815	24	9	2	197	62	6	68		61	9	70		138	335	34	369
12	BENOA	II	1,609	15	0	5	20	57	0	3	60	111%	1,788	12	2	4	1,788	24	9	2	196	59	5	64		57	8	65		129	325	33	358
13	PONTIANAK	Sub	980	3	1	1	5	42	1	5	48	178%	1,154	12	2	4	1,154	24	9	2	161	15	2	17		45	6	51		68	229	23	252
14	BANJARMASIN	II	1,205	7	0	2	9	38	1	14	53	378%	1,660	12	2	4	1,660	24	9	2	189	27	3	30		50	7	57		87	276	28	304
15	SAMARINDA	I	754	5	0	4	9	48	0	4	52	151%	868	12	2	4	868	24	9	2	145	27	3	30		49	7	56		86	231	24	255
16	TARAKAN	II	534	2	0	1	3	24	0	4	28	192%	637	12	2	4	637	24	9	2	132	9	1	10		27	4	31		41	173	18	191
17	BITUNG	I	3,960	21	0	8	29	84	2	35	121	429%	4,543	12	2	4	4,543	24	9	2	349	86	8	94		114	16	130		224	573	58	631
18	KENDARI	Sub	1,358	6	0	3	9	62	0	46	108	721%	2,337	12	2	4	2,337	24	9	2	226	27	3	30		102	14	116		146	372	38	410
19	UJPANDANG	I	2,450	18	0	2	20	50	2	28	80	471%	3,603	12	2	4	3,603	24	9	2	297	59	5	64		75	10	85		149	446	45	491
20	KUPANG	II	887	13	4	7	24	48	8	22	78	672%	3,155	12	2	4	3,155	24	9	2	272	71	6	77		74	10	84		161	433	44	477
21	AMBON	I	3,340	12	5	18	35	71	4	6	81	398%	4,668	12	2	4	4,668	24	9	2	356	103	9	112		76	11	87		199	555	56	611
22	JAYAPURA	II	1,346	7	0	3	10	34	0	26	60	707%	2,366	12	2	4	2,366	24	9	2	228	30	3	33		57	8	65		98	326	33	359
23	SORONG	I	2,370	6	0	10	16	52	0	20	72	517%	3,596	12	2	4	3,596	24	9	2	296	47	4	51		68	9	77		128	424	43	467
24	MERAUKE	Sub	959	1	0	0	1	26	0	4	30	149%	1,101	12	2	4	1,101	24	9	2	158	3	1	4		29	4	33		37	195	20	215
TOTAL																																	

Note:

F: Frequency of Sailing
P: Days of Preparation
SP: Days of Sailing Preparation
L: Sailing Distance
V: Sailing Speed
PO: Post Operation
LS: Logistic Supply
SM Standard Maintenance
MM Middle Maintenance (Overhaul)
AT: Aids Tender
B: Inspection Boat

Appendix 10.3.3.
Workload Calculation and Number of Buoy Tender required up to Year 2020

(1) Work Load at Year 2007 for Operation and Maintenance of Buoy

No.	ATN Office	Total Mile of in 2001	Number of Light Buoy				Increase ratio in 2007	Total Mile in 2007	For Sailing								Work at Site				Sub-total	Margin (10%)	Work load (Days)
			Existing	On going	2003-2007	2007 Total			F	P	SP	L	H/day	V	PO	Days	SM	MM	RP	Days			
4	DUMAI	1,900	85	28	6	119	40.0%	2,660	4.75	2	4	2,660	24	10	2	91	30	40	30	99	190	19	209
5	TG. PINANG	1,450	40	16	3	59	47.5%	2,139	4.75	2	4	2,139	24	10	2	80	15	20	15	49	130	13	143
8	TG.PRIOK	3,200	66	33	6	105	59.1%	5,091	4.75	2	4	5,091	24	10	2	139	26	35	26	88	227	23	250
11	SURABAYA	2,000	59	18	5	82	39.0%	2,780	4.75	2	4	2,780	24	10	2	93	21	27	21	68	162	17	179
15	SAMARINDA	2,650	41	13	3	57	39.0%	3,684	4.75	2	4	3,684	24	10	2	111	14	19	14	48	159	16	175
17	Bitung	520	7	0	0	7	0.0%	520	4.75	2	4	520	24	10	2	48	2	2	2	6	55	6	61
19	UJ.PANDANG	400	8	5	1	14	75.0%	700	4.75	2	4	700	24	10	2	52	4	5	4	12	64	7	71
21	AMBON	2,300	9	0	0	9	0.0%	2,300	4.75	2	4	2,300	24	10	2	84	2	3	2	8	92	10	102
23	SORONG	2,000	17	6	2	25	47.1%	2,941	4.75	2	4	2,941	24	10	2	96	6	8	6	21	118	12	130
Total																					1,197	123	1,320

1,320 days /215 days = 6.139535

Number of Buoy Tender to be required for operation and maintenance at year of 2007: 7units

(2) Work Load at Year 2020 for Operation and Maintenance of Buoy

No.	ATN Office	Total Mile of in 2001	Number of Light Buoy				Increase ratio in 2020	Total Mile in 2020	For Sailing								Work at Site				Sub-total	Margin (10%)	Work load (Days)
			Existing	On going	2003-2020	2020 Total			F	P	SP	L	H/day	V	PO	Days	SM	MM	RP	Days			
4	DUMAI	1,900	85	28	40	153	80.0%	3,420	4.75	2	4	3,420	24	10	2	106	38	51	38	128	234	24	258
5	TG. PINANG	1,450	40	16	20	76	90.0%	2,755	4.75	2	4	2,755	24	10	2	93	19	25	19	63	156	16	172
8	TG.PRIOK	3,200	66	33	33	132	100.0%	6,400	4.75	2	4	6,400	24	10	2	165	33	44	33	110	275	28	303
11	SURABAYA	2,000	59	18	27	104	76.3%	3,525	4.75	2	4	3,525	24	10	2	108	26	35	26	87	195	20	215
15	SAMARINDA	2,650	41	13	19	73	78.0%	4,718	4.75	2	4	4,718	24	10	2	131	18	24	18	61	193	20	213
17	Bitung	520	7	0	2	9	28.6%	669	4.75	2	4	669	24	10	2	51	2	3	2	8	59	6	65
19	UJ.PANDANG	400	8	5	5	18	125.0%	900	4.75	2	4	900	24	10	2	56	5	6	5	15	71	8	79
21	AMBON	2,300	9	0	3	12	33.3%	3,067	4.75	2	4	3,067	24	10	2	99	3	4	3	10	109	11	120
23	SORONG	2,000	17	6	8	31	82.4%	3,647	4.75	2	4	3,647	24	10	2	110	8	10	8	26	137	14	151
Total																					1429	147	1576

1,576 days /215 days = 7.330233

Number of Buoy Tender to be required for operation and maintenance at year of 2020: 8 units

Note: F: Frequency of Sailing; L: Sailing Distance; SM: Standard Maintenance
P: Days of Preparation; V: Sailing Speed; MM: Maior Maintenance (Overhaul)
SP: Days of Sailing Preparation; PO: Post Operation; RP: Replacement of Buoy

Appendix 10.3.4.
Proposed Scrap and Rehabilitation Plan of Vessels

1	ATN Office	Name of Ship	Class / Type	Built Year	Age	GRT (GT)	Technical Condition	2002	Up to 2005	Up to 2010	Up to 2015	Up to 2020
1	Sabang	KN Antares	I AT	1999	2	550.00	100%					
2		KN B-133	III AT	1965	36	34.08	65%		○	○	●	
3	Belawan	KN Arcturus	I AT	1999	2	550.00	92.93%					
4		KN Suar008	III AT	1973	28	--	61.74%		○			●
5		KN B-118	III AT	1961	40	45.10	51.41%			●		
6	Sibolga	KN Altair	I AT	1999	2	550.00	100%					
7	Dumai	KN Karakata	I BT	1972	29	589.10	85%		○	○		●
8		KN Mitra-III	III AT	1975	26	50.00	71%		○	○		
9		KN Suar-006	III AT	1973	28	--	63%		○			●
10		KN AE-025	III IB	1969	32	82.65	55%		○		●	
11		KN Dudat D-045	III AT	1953	48	83.51	59%		●			
12	Tg. Pinang	KN Adhara	I AT	1999	2	550.00	100%					
13		KN Pari	I BT	1978	23	644.46	61.70%		◎	◎		
14		KN Mitra IV	III AT	1975	26	65.00	54.40%		○			
15		KN Suar-004	III AT	1971	30	--	60.68%		○			●
16		KN Mantang	III IB	2000	1	30.00	100%					
17	Tlk. Bayur	KN Muci	I AT	1975	26	698.83	61.10%		◎			
18	Palembang	KN Daik (D-044)	III AT	1953	48	65.19	50%		●			
19		KN Data D-047	III AT	1953	48	57.97	65.76%		*	●		
20		KN Suar-001	III AT	1951	50	36.12	59.99%		●			
21		KN AE-028	III IB	1969	32	59.02	64.44%		○	○	●	
22		KN B-125	III AT	1961	40	34.54	57.13%			●		
23	Tg. Priok	KN Pamancasa	I AT	1978	23	904.52	60.00%		◎	◎		
24		KN Permata	I AT	1953	48	684.89	46.21%	●				
25		KN Mitra I	III AT	1960	41	75.00	62.97%			●		
26		KN Suar-014	III AT	1980	21	108.58	42.64%			○		
27		KN AP-027	IV AT	1966	35	46.67	56.41%		○		●	
28		KN AB-P3	IV AT	1971	30	8.16	58.11%		○			●
29	Semarang	KN B-126	III AT	1961	40	34.01	61.35%			●		
30		KN Suar-011	III AT	1980	21	--	53.92%			○		
31		KN B-008	III AT	1945	56	39.63	58.53%		●			
32		KN B-124	III AT	1961	40	44.37	54.92%			●		
33	Cilacap	KN Suar-005	III AT	1971	30	--	70.21%		○	○		●
34		KN Suar-007	III AT	1973	28	--	68.70%		○	○		●
35	Surabaya	KN Prajapati	I BT	1979	22	684.68	67.95%		◎	◎		
36		KN Mandalika	I AT	1975	26	767.62	54.54%		◎			
37		KN Damara	III AT	1953	48	72.98	59.23%		●			
38		KN Suar-002	III AT	1951	50	--	59.55%		●			
39		KN AE-029	III IB	1969	32	82.65	59.47%		○		●	
40	Benoa	KN Mizan	I AT	1996	5	257.20	98%					
41		KN Boga	II AT	1952	49	194.34	60%		*	●		
42	Pontianak	KN Balam	II AT	1952	49	192.87	44%		*	●		
43		KN AE-012	III IB	1967	34	47.99	58%		○		●	
44	Banjarmasin	KN Bido	II AT	1952	49	194.34	50.12%	●				
45		KN Suar-003	III AT	1971	30	--	58%		○			●
46		KN AE-032	III IB	1971	30	82.65	76.75%		○	○		●
47		KN Mokmer	III IB	1999	2	37.00	97.95%					
48	Samarinda	KN Mithuna	I BT	1975	26	644.23	57%		◎			
49		KN Dagong	III AT	1953	48	79.22	39%		●			
50		KN Suar-010	III AT	1975	26	--	62%		○			
51		KN Maranas	III IB	1999	2	37.00	100%					
52	Tarakan	KN Blekok	II AT	1952	49	191.50	41%	●				
53		KN Duku (D-043)	III AT	1953	48	77.52	49%		*	●		
54	Bitung	KN Merak	I AT	1996	5	257.20	89.59%					
55		KN Suar-009	III AT	1974	27	49.71	62.75%		○			●
56		KN B-134	III AT	1964	37	34.68	67.49%			●		
57	Kendari	KN Barau	II AT	1952	49	192.87	41%		●			
58	Makassar	KN Mengkara	I AT	1996	5	257.20	73.98%					
59		KN Mitra II	III AT	1960	41	150.00	55.10%			●		
60		KN B-120	III AT	1961	40	41.38	60%			●		
61	Kupang	KN Mina	I AT	1997	4	257.20	98%					
62		KN Dingki D-045	III AT	1953	48	79.22	51%		●			
63	Ambon	KN Mayang	I AT	1996	5	257.20	98%					
64	Jayapura	KN Aldebaran	I AT	1999	2	550.00	100%					
65		KN TNH. Merah	II AT	1966	35	142.96	64%		○	○	●	
66		KN FIS Rmainum	IV IB	1972	29	84.45	60%		○			●
67	Sorong	KN Mahkota	I AT	1997	4	257.20	98%					
68		KN Pradawana	I BT	1979	22	762.78	85%			○		
69		KN Raja Ampat	II IB	1954	47	397.79	36%		●			
70		KN S.Kaibus	IV AT	1955	46	29.57	50%		●			
71	Merauke	KN Mernati	I AT	1997	4	257.20	98%					
72		KN Tk. Kabare	III IB	1962	39	207.50	61%			●		
73		KN Bintanggor	IV IB	1967	34	133.08	73%		○	○	●	
74	BTKP	KN Bimasakti	I SV	1984	17	1,373.00	82%				○	
75		KN Kumba	I BT	1972	29	589.23	60%		◎			●

Note "BT". "AT". "IB" and "SV" means "Buoy Tender". "Aids Tender". "Inspection Boat" and "Survey Vessel". respectively.
● shows to be time of scrapping ○ shows to be time of rehabilitation
* shows to be repaired ◎ shows to be time of rehabilitation with first priority.

Appendix 14.5.1.

Unit Price of Rehabilitation and Improvement of Lighthouses

Unit: US$

Type	Item	Equipment	Civil & Housing	Installation
Type 1	Light Tower	113,205	105,899	10,188
	Lighting Equipment + Power Supply System	89,572		3,225
Type 2	Light Tower	113,205	105,899	10,188
	Lighting Equipment + Power Supply System	89,572		3,225
Type 3 (40m)	Repair of Light Tower			20,377
	Lighting Equipment + Power Supply System	89,572		3,225
Type 3 (30m)	Repair of Light Tower			13,776
	Lighting Equipment + Power Supply System	89,572		3,225
Type 3 (20m)	Repair of Light Tower			9,068
	Lighting Equipment + Power Supply System	89,572		3,225
Type 3 (10m)	Repair of Light Tower			5,298
	Lighting Equipment + Power Supply System	89,572		3,225
Type 4 (40m)	Repair of Light Tower			20,377
				0
Type 4 (30m)	Repair of Light Tower			13,776
				0
Type 4 (20m)	Repair of Light Tower			9,068
				0
Type 4 (10m)	Repair of Light Tower			5,298
				0
Type 5	Lighting Equipment + Power Supply System	89,572		3,225

Note: Column of “Type” shows type of rehabilitation and improvement.

Appendix 14.5.2.

Unit Price of Rehabilitation and Improvement of Light Beacons

Unit: US$

Type	Item	40m LB	30m LB	30m LB Off	20m LB	20m LB off	10M LB	10m LB off	Remarks
Type 1	Equipment	202,777	93,092	93,092	63,325	63,325	44,070	44,070	Light Tower, Lighting Equipment, Power Supply
	Civil	31,241	22,480	45,340	16,672	34,159	10,766	21,713	Foundation of Light Tower, etc.
	Installation	13,413	7,484	7,484	5,000	5,000	3,176	3,176	Light Tower, Lighting Equipment, Power Supply
Type 2	Equipment	89572	16,556	16,556	12,946	12,946	14,633	14,633	Lighting Equipment, Power Supply
	Civil								
	Installation	23,602	14,372	14,372	9,534	9,534	5,825	5,825	Lighting Equipment, Power Supply, Repair of Light Tower
Type 3	Equipment								
	Civil								
	Installation	20,377	13,776	13,776	9,068	9,068	5,298	5,298	Repair of Light Tower
Type 4	Equipment	89572	16,556	16,556	12,946	12,946	14,633	14,633	Lighting Equipment, Power Supply
	Civil								
	Installation	3,225	596	596	466	466	527	527	Lighting Equipment, Power Supply
Type 5	Equipment	89572	16,556	16,556	12,946	12,946	14,633	14,633	Lighting Equipment, Power Supply
	Civil								
	Installation	23,602	14,372	14,372	9,534	9,534	5,825	5,825	Lighting Equipment, Power Supply, Repair of Light Tower
Type 6	Equipment								
	Civil								
	Installation	20,377	13,776	13,776	9,068	9,068	5,298	5,298	Repair of Light Tower
Type 7	Equipment	89572	16,556	16,556	12,946	12,946	14,633	14,633	Lighting Equipment, Power Supply
	Civil								
	Installation	3,225	596	596	466	466	527	527	Lighting Equipment, Power Supply

Note: Column of “Type” shows type of rehabilitation and improvement.

Appendix 14.5.3.

Unit Price of Development of Visual ATN(Lighthouse)

Unit: US$

Type	Equipment	Civil & Housing	Installation	Remarks
Type 1	202,777	105,899	10,189	Light Tower (Steel Lattice), Lighting Equipment, Power Supply
			3,583	
Total	202,777	105,899	13,772	
Type 2	208,833	116,664	6,201	Light Tower (Alminum), Lighting Equipment, Power Supply
			3,225	
Total	208,833	116,664	9,426	

(Light Beacons)

Unit: US$

Type	Equipment	Civil & Housing Work	Installation	Remarks
Type 1 (30m)	93,092	22,480	7,484	Light Tower, Lighting Equipment, Power Supply
Type 2(20m)	63,325	16,672	5,000	Light Tower, Lighting Equipment, Power Supply
Type 3 (10m)	44,070	10,766	3,176	Light Tower, Lighting Equipment, Power Supply
Type 4 (10m Offshore)	44,070	21,713	3,176	Light Tower, Lighting Equipment, Power Supply

(Light Buoys)

Unit: US$

Item	Equipment	Installation	Remarks
Light Buoy 2.5m	30,245	396	Buoy Body, Lighting Equipment, Power Supply, Superstructure, Mooring, Accessaries
Light Buoy 3.5m	50,813	396	Buoy Body, Lighting Equipment, Power Supply, Superstructure, Mooring, Accessaries

Appendix 14.5.4.

Unit Price of Development of Workshop Equipment (1/6)

Unit : US$

No.	Equipment	Main Specification	US$	Workshop Class I		Workshop Class II (Type 1)		Workshop Class II (type 2)		BTKP	
				Q'ty	Amount	Q'ty	Amount	Q'ty	Amount	Q'ty	Amount
A	MACHINE TOOLS				458,000		405,086		405,086		229,868
1	Lathe	2000 x 250 mm	22,178	2	44,356	1	22,178	1	22,178	1	22,178
2	Precision Lathe	400 x 50 mm	19,538	1	19,538	1	19,538	1	19,538	1	19,538
3	Universal Milling Machine	270 x 1350 mm	44,357	1	44,357	1	44,357	1	44,357	-	
4	Vertical Milling Machine		7,692	1	7,692	-		-		-	
5	Radial Drilling Machine	0 40 mm	11,090	1	11,090	-		-		-	
6	Vertical Drilling Machine	0 25 mm	3,262	2	6,524	1	3,262	1	3,262	1	3,262
7	Bench Drilling Machine	13 mm	1,000	2	2,000	1	1,000	1	1,000	1	1,000
8	Shaping Machine	Pj. Langkah 500 mm	32,420	1	32,420	1	32,420	1	32,420	1	32,420
9	Hack Saw Machine	ö350 mm	7,692	2	15,384	1	7,692	1	7,692	1	7,692
10	Bench Grinder	ö250 mm,3000rpm	923	2	1,846	2	1,846	2	1,846	1	923
11	Bending Machine	1800 x 15 mm	32,615	1	32,615	1	32,615	1	32,615	1	32,615
12	Shearing Plat	1800 x 15 mm	103,846	1	103,846	1	103,846	1	103,846	-	
13	Press Machine	25ton	26,092	1	26,092	1	26,092	1	26,092	1	26,092
14	Pipe Bender	ö80 mm	78,277	1	78,277	1	78,277	1	78,277	1	78,277
15	Combined Punching And Shearing	Tebal 16 mm, ö28	26,092	1	26,092	1	26,092	1	26,092	-	
16	Table Circular Saw	min 100mm	5,871	1	5,871	1	5,871	1	5,871	1	5,871
B	WOOD WORK MACHINE				44,293		17,678		17,678		7,371
1	Wood Milling Machine	500 x 2000 mm	1,957	1	1,957	1	1,957	1	1,957	1	1,957
2	Wood Band Saw	500 x 2000 mm	3,588	1	3,588	1	3,588	1	3,588	1	3,588
3	Circular Saw	Table 220 mm	1,826	1	1,826	1	1,826	1	1,826	1	1,826
4	Wood Lathe	400 x 1000 mm	3,538	1	3,538	-		-		-	
5	Multipurpose Wood Work Machine		23,077	1	23,077	-		-		-	
6	Profile Wood Machine		9,785	1	9,785	1	9,785	1	9,785	-	
7	Jig saw	220 - 400 V / 50 - 60	522	1	522	1	522	1	522	-	
C	WELDINGS MACHINE				68,511		44,040		44,040		24,471
1	Engine Welder	200 kVA, 300 A	19,569	3	58,707	2	39,138	2	39,138	1	19,569
2	Acetylene Gas Set	Complete set	923	2	1,846	1	923	1	923	1	923
3	Welding Transformer	16kVA, 260 A	3,979	2	7,958	1	3,979	1	3,979	1	3,979

Appendix 14.5.4.

Unit Price of Development of Workshop Equipment (2/6)

Unit : US$

No.	Equipment	Main Specification	US$	Workshop Class I		Workshop Class II (Type 1)		Workshop Class II (type 2)		BTKP	
				Q'ty	Amount	Q'ty	Amount	Q'ty	Amount	Q'ty	Amount
D	Machine Compressor and Pump				148,843		145,386		22,309		3,457
1	Blower	15M3 / min	587	3	1,761	2	1,174	2	1,174	1	587
2	Water Jet Pump	25 m , 10M3 / h	2,870	2	5,740	1	2,870	1	2,870	1	2,870
3	Mobil Air Compressor	8 ber / 102 Psi	18,265	1	18,265	1	18,265	1	18,265	-	
4	High Pressure Water Jet	1000 ber	123,077	1	123,077	1	123,077	-		-	
E	HAND TOOLS				18,298		11,239		11,239		5,472
1	Air Hammer	5 kg/cm2, 1500/min	607	2	1,214	1	607	1	607	-	
2	Hand Pneumatic Chisel	5 kg/cm2, 1500/min	623	2	1,246	2	1,246	2	1,246	-	
3	Hand Surface Chisel	0 150 mm, 3000 rpm	652	3	1,956	2	1,304	2	1,304	-	
4	Hand Drilling	0-12 mm, 2600 rpm	326	3	978	2	652	2	652	1	326
5	Universal Hand Drill	0-25 mm, 250 rpm	1,109	2	2,218	1	1,109	1	1,109	1	1,109
6	Hand Circular Saw	0 270 mm, 3000rpm	1,239	2	2,478	1	1,239	1	1,239	1	1,239
7	Soldering	200 Watt	326	4	1,304	2	652	2	652	2	652
8	Hand Pneumatic Chipper	1/1500 min, 1.2	654	2	1,308	1	654	1	654	-	
9	Spray Gun For Painting	0.6 ltr, 130-200 l/min	326	2	652	2	652	2	652	1	326
10	Hand Hack Saw	Length 300 mm	652	4	2,608	3	1,956	3	1,956	1	652
11	Magnetic base for dial gauge		85	2	170	1	85	1	85	1	85
12	Hand Surface Grinder	350 - 500 Watt	652	2	1,304	1	652	1	652	1	652
13	Accu-Drilling Machine	1 - 10 mm , 9 - 12 V	431	2	862	1	431	1	431	1	431
F	BENCH TOOLS				62,888		40,527		40,527		38,342
1	Parallel Vice	100 x 200 mm	822	3	2,466	2	1,644	2	1,644	2	1,644
2	Steel Anvil	313 x 416 mm	1,174	4	4,696	2	2,348	2	2,348	1	1,174
3	Hammer for Smith Set	2.7 kg, 5.0kg	33	4	132	2	66	2	66	1	33
4	Hammer Set	Claw & Test	196	2	392	1	196	1	196	1	196
5	Tracker	No.1 - 6	130	2	260	1	130	1	130	1	130
6	Petroleum Oil Torch		215	2	430	1	215	1	215	1	215
7	Slide Hammer Puller Set	No.1 - 6	1,044	2	2,088	1	1,044	1	1,044	1	1,044

Appendix 14.5.4.

Unit Price of Development of Workshop Equipment (3/6)

Unit : US$

No.	Equipment	Main Specification	US$	Workshop Class I		Workshop Class II (Type 1)		Workshop Class II (type 2)		BTKP	
				Q'ty	Amount	Q'ty	Amount	Q'ty	Amount	Q'ty	Amount
8	Pipe Cutter Set	ö10 - 90 mm	150	2	300	1	150	1	150	1	150
9	Pipe Wrench	10 - 40 & 40 - 90 mm	222	2	444	2	444	2	444	2	444
10	Chain Thong	19 - 100 & 38 - 200	215	2	430	2	430	2	430	2	430
11	Die Set	8 - 50 mm	1,826	2	3,652	2	3,652	2	3,652	1	1,826
12	File Set For Machinist	L=150 , 200 , 250	209	3	627	2	418	2	418	2	418
13	Adjustable Wrench	20 - 60 mm	130	4	520	3	390	3	390	2	260
14	Reamer Set Taper Shank Type	10- 45 mm	4,501	3	13,503	2	9,002	2	9,002	2	9,002
15	Wire Rope Cutter & Clamp Set	S/d 0 1.5 inc	2,427	2	4,854	1	2,427	1	2,427	1	2,427
16	Screw Driver Set	Complete set	2,609	4	10,436	2	5,218	2	5,218	2	5,218
17	Socket Wrench	8 - 27 mm	965	3	2,895	2	1,930	2	1,930	2	1,930
18	Caliper Outside & Inside Set	150,300 mm	65	4	260	2	130	2	130	2	130
19	Tool Box	Complete set	652	4	2,608	2	1,304	2	1,304	3	1,956
20	Steele Compass	150,300,400 mm	85	3	255	3	255	3	255	3	255
21	Spanner Adjustable	0 - 30 mm,0 - 50 mm	72	2	144	2	144	2	144	2	144
22	Bearing Scrapper	Approx 80 x 16	65	2	130	2	130	2	130	2	130
23	Ideal Pattern Snip	260 R, 260L	65	2	130	2	130	2	130	2	130
24	Mechanical Tool Box	Complete set	365	2	730	2	730	2	730	2	730
25	Torque Wrench Set	20 - 120& 40 - 200	561	2	1,122	2	1,122	2	1,122	2	1,122
26	Locker		444	12	5,328	8	3,552	8	3,552	8	3,552
27	Monkey Wrench		300	3	900	2	600	2	600	2	600
28	Filter Wrench		326	2	652	1	326	1	326	2	652
29	Bearing Puller Set	Complete set	287	2	574	2	574	2	574	2	574
30	Work Bench	basic model	861	2	1,722	2	1,722	2	1,722	2	1,722
31	Steel Pipe Vices	up to 90 mm	104	2	208	1	104	1	104	1	104
G	TESTING AND MEASURING				54,944		42,928		43,169		269,376
1	Vernier Caliper	150,300,mm	1,350	4	5,400	2	2,700	2	2,700	2	2,700
2	Outside Micrometer	0 - 100 mm	254	2	508	1	254	1	254	2	508
3	Tubular Inside Micrometer	25 - 300 mm	1,005	2	2,010	1	1,005	1	1,005	2	2,010
4	Ruler Set	30 - 60 mm	65	2	130	2	130	2	130	2	130
5	Hand Tachometer Contact and Non	50 - 20,000 rpm	561	2	1,122	2	1,122	2	1,122	2	1,122
6	Digital Multimeter	0 - 2 k,0 - 25k	522	3	1,566	2	1,044	2	1,044	2	1,044
7	Vibrometer	10 - 1000 Hz	1,957	2	3,914	1	1,957	1	1,957	1	1,957
8	Megger Tester		444	2	888	1	444	1	444	1	444
9	Digital Thickness Gage		1,957	2	3,914	1	1,957	1	1,957	2	3,914

Appendix 14.5.4.

Unit Price of Development of Workshop Equipment (4/6)

Unit : US$

No.	Equipment	Main Specification	US$	Workshop Class I		Workshop Class II (Type 1)		Workshop Class II (type 2)		BTKP	
				Q'ty	Amount	Q'ty	Amount	Q'ty	Amount	Q'ty	Amount
10	Fuel Injection Tester	Pressure test	718	1	718	1	718	1	718	1	718
11	Gas Pressure Indicator		33	1	33	1	33	1	33	1	33
12	GPS		652	1	652	1	652	1	652	1	652
13	Luminous Intensity		3,196	1	3,196	1	3,196	1	3,196	1	3,196
14	Hipendance Meter LCR		1,305	2	2,610	1	1,305	1	1,305	1	1,305
15	Demy Load	10kW	1,305	1	1,305	1	1,305	1	1,305	1	1,305
16	Altimeter		1,631	2	3,262	1	1,631	1	1,631	1	1,631
17	Solar Module Test	0.5 V - 0.5 A	326	1	326	1	326	1	326	1	326
18	Battery Charger	DC 24 V , 20A	802	1	802	1	802	1	802	1	802
19	Ultrasonic Thickness Gauge	0.5 - 500 mm	9,132	1	9,132	1	9,132	1	9,132	1	9,132
20	Thermometer Infrared		241	1	241	1		1	241	1	241
21	Digital Anemometer		1,370	1	1,370	1	1,370	1	1,370	1	1,370
22	Digital Barometer		1,376	1	1,376	1	1,376	1	1,376	1	1,376
23	Hail Hygrometer		228	1	228	1	228	1	228	1	228
24	Sound Level Meter		1,239	1	1,239	1	1,239	1	1,239	1	1,239
25	Digital Concrete Test Hammer		2,935	1	2,935	1	2,935	1	2,935	1	2,935
26	Tensile Strength Tester 5-1000kg		65,231	-		-		-		1	65,231
27	Impact Tester		3,914	-		-		-		1	3,914
28	Universal Testing M/C 10-200ton		153,846	-		-		-		1	153,846
29	Earth Tester		2,479	1	2,479	1	2,479	1	2,479	1	2,479
30	PH Meter		196	1	196	1	196	1	196	1	196
31	Wet Film Thickness Gage		2,609	1	2,609	1	2,609	1	2,609	1	2,609
32	Ultrasonic Hardness Gauge		783	1	783	1	783	1	783	1	783
H	ELECTRONIC EQUIPMENT				32,169		29,460		29,460		29,493
1	Oscilloscope	min 20MHz. 2-ch.	3,196	1	3,196	1	3,196	1	3,196	1	3,196
2	Voltmeter	300uV - 100V	183	1	183	1	183	1	183	1	183
3	Frequency Counter	10 Hz - 500 MHz	489	1	489	1	489	1	489	1	489
4	Regulated DC Power Supply	300V / 7A	13,698	1	13,698	1	13,698	1	13,698	1	13,698
5	Diameter	400 KHz - 200MHz	978	1	978	1	978	1	978	1	978
6	Function Power Meter	400 KHz - 200MHz	652	1	652	1	652	1	652	1	652
7	Digital Multimeter	100 K Ohm	1,142	3	3,426	2	2,284	2	2,284	2	2,284
8	Current Meter	250 A	2,609	1	2,609	1	2,609	1	2,609	1	2,609
9	Signal Generator	30 KHz - 40 MHz	1,566	1	1,566	1	1,566	1	1,566	1	1,566

Appendix 14.5.4.

Unit Price of Development of Workshop Equipment (5/6)

Unit : US$

No.	Equipment	Main Specification	US$	Workshop Class I		Workshop Class II (Type 1)		Workshop Class II (type 2)		BTKP	
				Q'ty	Amount	Q'ty	Amount	Q'ty	Amount	Q'ty	Amount
10	Fuel Injection Tester	Pressure test	718	1	718	1	718	1	718	1	718
11	Gas Pressure Indicator		33	1	33	1	33	1	33	1	33
12	GPS		652	1	652	1	652	1	652	1	652
13	Luminous Intensity		3,196	1	3,196	1	3,196	1	3,196	1	3,196
14	Hipendance Meter LCR		1,305	2	2,610	1	1,305	1	1,305	1	1,305
15	Demy Load	10kW	1,305	1	1,305	1	1,305	1	1,305	1	1,305
16	Altimeter		1,631	2	3,262	1	1,631	1	1,631	1	1,631
17	Solar Module Test	0.5 V - 0.5 A	326	1	326	1	326	1	326	1	326
18	Battery Charger	DC 24 V , 20A	802	1	802	1	802	1	802	1	802
19	Ultrasonic Thickness Gauge	0.5 - 500 mm	9,132	1	9,132	1	9,132	1	9,132	1	9,132
20	Thermometer Infrared		241	1	241	1		1	241	1	241
21	Digital Anemometer		1,370	1	1,370	1	1,370	1	1,370	1	1,370
22	Digital Barometer		1,376	1	1,376	1	1,376	1	1,376	1	1,376
23	Hail Hygrometer		228	1	228	1	228	1	228	1	228
24	Sound Level Meter		1,239	1	1,239	1	1,239	1	1,239	1	1,239
25	Digital Concrete Test Hammer		2,935	1	2,935	1	2,935	1	2,935	1	2,935
26	Tensile Strength Tester 5-1000kg		65,231	-		-		-		1	65,231
27	Impact Tester		3,914	-		-		-		1	3,914
28	Universal Testing M/C 10-200ton		153,846	-		-		-		1	153,846
29	Earth Tester		2,479	1	2,479	1	2,479	1	2,479	1	2,479
30	PH Meter		196	1	196	1	196	1	196	1	196
31	Wet Film Thickness Gage		2,609	1	2,609	1	2,609	1	2,609	1	2,609
32	Ultrasonic Hardness Gauge		783	1	783	1	783	1	783	1	783
H	ELECTRONIC EQUIPMENT				32,169		29,460		29,460		29,493
1	Oscilloscope	min 20MHz. 2-ch.	3,196	1	3,196	1	3,196	1	3,196	1	3,196
2	Voltmeter	300uV - 100V	183	1	183	1	183	1	183	1	183
3	Frequency Counter	10 Hz - 500 MHz	489	1	489	1	489	1	489	1	489
4	Regulated DC Power Supply	300V / 7A	13,698	1	13,698	1	13,698	1	13,698	1	13,698
5	Diameter	400 KHz - 200MHz	978	1	978	1	978	1	978	1	978
6	Function Power Meter	400 KHz - 200MHz	652	1	652	1	652	1	652	1	652
7	Digital Multimeter	100 K Ohm	1,142	3	3,426	2	2,284	2	2,284	2	2,284
8	Current Meter	250 A	2,609	1	2,609	1	2,609	1	2,609	1	2,609
9	Signal Generator	30 KHz - 40 MHz	1,566	1	1,566	1	1,566	1	1,566	1	1,566

Appendix 14.5.4.

Unit Price of Development of Workshop Equipment (6/6)

Unit : US$

No.	Equipment	Main Specification	US$	Workshop Class I		Workshop Class II (Type 1)		Workshop Class II (type 2)		BTKP	
				Q'ty	Amount	Q'ty	Amount	Q'ty	Amount	Q'ty	Amount
10	TTL / CMOS Book		33	2	66	1	33	1	33	2	66
11	Electrician Tool Set	Complete set	718	4	2,872	2	1,436	2	1,436	2	1,436
12	EDM		1,305	1	1,305	1	1,305	1	1,305	1	1,305
13	Electronic Soldering Unit	150 - 450 deg C	98	4	392	3	294	3	294	3	294
14	Digital Clamp Meter AC/DC	up to 350A rasp.	228	1	228	1	228	1	228	1	228
15	Insulation Tester	ACV and Ohm	509	1	509	1	509	1	509	1	509
I	HANDLING EQUIPMENT				248,153		233,538		233,538		81,882
1	Cain Hoist	1.5 Ton, 3 Ton	737	2	1,474	2	1,474	2	1,474	2	1,474
2	Electric Hoist	5 Ton	6,523	1	6,523	1	6,523	1	6,523	1	6,523
3	Overhead Traveling Crane	7.5 Ton	38,462	1	38,462	1	38,462	1	38,462	1	38,462
4	Fork Liht	7.5 Ton	14,615	2	29,230	1	14,615	1	14,615	1	14,615
5	Mobile Crane	10 Ton	76,923	1	76,923	1	76,923	1	76,923	-	
6	Hydraulic Jack	30 Ton	615	1	615	1	615	1	615	1	615
7	Truck	7.5 Ton	68,846	1	68,846	1	68,846	1	68,846	-	
8	Maintenance Car		19,231	1	19,231	1	19,231	1	19,231	1	19,231
9	Hydraulic Hand Pallet	2400 - 2600 kg	962	1	962	1	962	1	962	1	962
10	Traveling Unit Geared Trolley	min 5000 kg	502	1	502	1	502	1	502	-	
11	Hydraulic Workshop Crane	900 - 1200 kg	5,385	1	5,385	1	5,385	1	5,385	-	
J	GENERATOR SET ENGINE DIESEL				60,000		60,000		60,000		60,000
1	Diesel Generator	55 kVA / 45 kVA	31,538	1	31,538	1	31,538	1	31,538	1	31,538
2	Mobile Generator	30 kVA	28,462	1	28,462	1	28,462	1	28,462	1	28,462
		Total			1,196,099		1,029,882		907,046		749,732

Appendix 14.5.5.

Estimated Project Cost for ATN

A. Aids to Navigation Unit : US$

No. Items	Q'ty	Unit	Foreign Currency	Local Currency
1. Procurement of Equipment	1	lot	12,955,324	0
(1) Rehabilitation and Imrovement of AT	1	lot	8,027,895	
a. Lighthouse	21	units	1,999,177	
b. Light Beacon	131	units	4,183,773	
c. Light Buoy	61	units	1,844,945	
(2) Development of ATN	1	lot	4,082,009	
a. Lighthouse	8	units	1,634,328	
b. Light Beacon	33	units	1,599,607	
c. Light Buoy	26	units	848,074	
(3) Supporting Facilities	1	lot	0	
1) Workshops & Buoy Bases	1	lot	0	
a. Improvement	4	locations		
(4) Spares for ATN	1	lot	624,562	
(5) Training for ATN	1	lot	220,858	
2. Civil & Housing Works	1	lot	0	3,137,903
(1) Rehabilitation & Improvement of AT	1	lot	0	1,598,979
a. Lighthouse	21	units		529,493
b. Light Beacon	131	units		1,069,486
(2) Development of ATN	1	lot	0	1,538,924
a. Lighthouse	8	units		868,720
b. Light Beacon	33	units		670,205
(3) Supporting Facilities	1	lot		
1) Workshop & Buoy Bases	1	lot		
a. Improvement	6	locations		
b. Development	7	locations		
3. Installation Works	1	lot	0	1,248,287
(1) Rehabilitation & Imprvement of ATN	1	lot	0	1,018,267
a. Lighthouse	21	units		326,179
b. Light Beacon	131	units		667,932
c. Light Buoy	61	units		24,156
(2) Development of ATN	1	lot	0	230,020
a. Lighthouse	8	units		101,483
b. Light Beacon	33	units		118,241
c. Light Buoy	26	units		10,296
(3) Supporting Facilities	1	lot		
1) Workshops & Buoy Bases	1	lot		
a. Improvement	4	locations		
4. Transportation	1	lot	259,106	173,415
5. Consultaning Fee	1	lot	1,321,443	455,961
6. Sub Total			14,535,873	5,015,566
7. Contingency (5%)			726,794	250,778
Total			15,262,667	5,266,344
Grand Total				20,529,011

Appendix 14.5.6.

Estimated Project Cost for Rehabilitation and Improvement of Lighthouse

Unit:US$

DSI No.	DISNAV	Type of Rehabilitation and Improvement of Lighthouse											Equipment	Civil Work	Installation	Total
		Type 1	Type 2	Type 3 (40m)	Type 3 (30m)	Type 3 (20m)	Type3 (10m)	Type 4 (40m)	Type 4 (30m)	Type 4 (20m)	Type 4 (10m)	Type 5				
10	Sabang						◎						89,572	0	8,523	98,095
11	Sabang			◎									89,572	0	23,602	113,174
77	Sabang			◎									89,572	0	23,602	113,174
84	Sabang		◎										202,777	105,899	13,413	322,088
960	Tg.Pinang				◎								89,572	0	17,001	106,573
1000	Tg.Pinang									◎			0	0	9,068	9,068
1110	Tg.Pinang							◎					0	0	20,377	20,377
2025	Pontianak									◎			0	0	9,068	9,068
2223	Tg.Pinang				◎								89,572	0	17,001	106,573
2931	Sabang		◎										202,777	105,899	13,413	322,088
3070	Semarang	◎											202,777	105,899	13,413	322,088
3130	Semarang				◎								89,572	0	17,001	106,573
3271	Semarang			◎									89,572	0	23,602	113,174
3290	Semarang					◎							89,572	0	12,292	101,864
3300	Semarang				◎								89,572	0	17,001	106,573
4150	Benoa											◎	89,572	0	3,225	92,797
4170	Benoa								◎				0	0	13,776	13,776
4311	Kupang	◎											202,777	105,899	13,413	322,088
4730	Samarinda							◎					0	0	20,377	20,377
4950	Makassar			◎									89,572	0	23,602	113,174
6205	Sorong	◎											202,777	105,899	13,413	322,088
Total		3	2	4	4	1	1	2	1	2	0	1	1,999,177	529,493	326,179	2,854,848

Appendix 14.5.7.
Estimated Project Cost for Rehabilitation and Improvement of Light Beacon (1/4)

Unit: US$

DSI No.	DISNAV	Type 1					Type 2					Type 4			Type 5		Type 6		Type 7		Equipment	Civil Work	Installation	Total
		40m	20m	20m off	10m	10m off	30m	20m	20m off	10m	10m off	20m	10m	10m off	10m	10m off	20m off	10m off	20m off	10m off				
2960	Sabang														◎						14,633	0	5,824	20,457
150	Belawan										◎										14,633	0	5,824	20,457
160	Belawan										◎										14,633	0	5,824	20,457
180	Belawan									◎											14,633	0	5,824	20,457
190	Belawan							◎													12,946	0	9,533	22,479
390	Belawan										◎										14,633	0	5,824	20,457
400	Belawan					◎															44,070	21,713	3,176	68,959
450	Belawan					◎															44,070	21,713	3,176	68,959
451	Belawan					◎															44,070	21,713	3,176	68,959
551	Belawan					◎															44,070	21,713	3,176	68,959
410	Belawan																			◎	14,633	0	526	15,159
510	Belawan																			◎	14,633	0	526	15,159
550	Belawan																		◎		12,946	0	466	13,412
2691	Sibolga							◎													12,946	0	9,533	22,479
2714	Sibolga							◎													12,946	0	9,533	22,479
2735	Sibolga							◎													12,946	0	9,533	22,479
2850	Sibolga										◎										14,633	0	5,824	20,457
2855	Sibolga						◎														16,556	0	14,372	30,928
2870	Sibolga									◎											14,633	0	5,824	20,457
2760	Sibolga														◎						14,633	0	5,824	20,457
650	Dumai									◎											14,633	0	5,824	20,457
677	Dumai							◎													12,946	0	9,533	22,479
679	Dumai								◎												12,946	0	9,533	22,479
740	Dumai					◎															44,070	21,713	3,176	68,959
750	Dumai										◎										14,633	0	5,824	20,457
928	Dumai													◎							14,633	0	526	15,159
1088	Tg.Pinang					◎															44,070	21,713	3,176	68,959
1112	Tg.Pinang					◎															44,070	21,713	3,176	68,959
1180	Tg.Pinang				◎																44,070	10,765	3,176	58,011
1190	Tg.Pinang		◎																		63,325	16,671	5,000	84,996
2201	Tg.Pinang					◎															44,070	21,713	3,176	68,959

Appendix 14.5.7.
Estimated Project Cost for Rehabilitation and Improvement of Light Beacon (2/4)

Unit: US$

DSI No.	DISNAV	Type 1					Type 2					Type 4			Type 5		Type 6		Type 7		Equipment	Civil Work	Installation	Total
		40m	20m	20m off	10m	10m off	30m	20m	20m off	10m	10m off	20m	10m	10m off	10m	10m off	20m off	10m off	20m off	10m off				
2673	Tlk. Bayur										◎										14,633	0	5,824	20,457
2840	Tlk. Bayur					◎															44,070	21,713	3,176	68,959
1270	Palembang							◎													12,946	0	9,533	22,479
1271	Palembang		◎																		63,325	16,671	5,000	84,996
1310	Palembang			◎																	63,325	34,158	5,000	102,483
1831	Palembang											◎									12,946	0	466	13,412
1911	Palembang					◎															44,070	21,713	3,176	68,959
1916	Palembang				◎																44,070	10,765	3,176	58,011
1950	Palembang								◎												12,946	0	9,533	22,479
1300	Palembang															◎					14,633	0	5,824	20,457
1682	Tg. Priok	◎																			202,777	31,240	13,412	247,429
1684	Tg. Priok												◎								14,633	0	526	15,159
1687	Tg. Priok												◎								14,633	0	526	15,159
1689	Tg. Priok												◎								14,633	0	526	15,159
1708	Tg. Priok				◎																44,070	10,765	3,176	58,011
1710	Tg. Priok					◎															44,070	21,713	3,176	68,959
1740	Tg. Priok					◎															44,070	21,713	3,176	68,959
1751	Tg. Priok									◎											14,633	0	5,824	20,457
1752	Tg. Priok									◎											14,633	0	5,824	20,457
1820	Tg. Priok									◎											14,633	0	5,824	20,457
1821	Tg. Priok				◎																44,070	10,765	3,176	58,011
1822	Tg. Priok				◎																44,070	10,765	3,176	58,011
1823	Tg. Priok				◎																44,070	10,765	3,176	58,011
1910	Tg. Priok					◎															44,070	21,713	3,176	68,959
2010	Tg. Priok				◎																44,070	10,765	3,176	58,011
2272	Tg. Priok					◎															44,070	21,713	3,176	68,959
2381	Tg. Priok											◎									12,946	0	466	13,412
2420	Tg. Priok										◎										14,633	0	5,824	20,457
2430	Tg. Priok									◎											14,633	0	5,824	20,457
2477	Tg. Priok				◎																44,070	10,765	3,176	58,011
3062	Tg. Priok										◎										14,633	0	5,824	20,457
1970	Tg. Priok																			◎	14,633	0	526	15,159
3273	Semarang					◎															44,070	21,713	3,176	68,959

Appendix 14.5.7.
Estimated Project Cost for Rehabilitation and Improvement of Light Beacon (3/4)

Unit: US$

DSI No.	DISNAV	Type 1					Type 2					Type 4			Type 5		Type 6		Type 7		Equipment	Civil Work	Installation	Total
		40m	20m	20m off	10m	10m off	30m	20m	20m off	10m	10m off	20m	10m	10m off	10m	10m off	20m off	10m off	20m off	10m off				
3275	Semarang									◎											14,633	0	5,824	20,457
3276	Semarang									◎											14,633	0	5,824	20,457
3277	Semarang					◎															44,070	21,713	3,176	68,959
3293	Semarang							◎													12,946	0	9,533	22,479
4122	Cilacap						◎														16,556	0	14,372	30,928
4167	Benoa							◎													12,946	0	9,533	22,479
4190	Benoa									◎											14,633	0	5,824	20,457
4201	Benoa							◎													12,946	0	9,533	22,479
4220	Benoa						◎														16,556	0	14,372	30,928
4200	Benoa																◎				0	0	9,067	9,067
2041	Pontianak				◎																44,070	10,765	3,176	58,011
2042	Pontianak				◎																44,070	10,765	3,176	58,011
2043	Pontianak				◎																44,070	10,765	3,176	58,011
2044	Pontianak				◎																44,070	10,765	3,176	58,011
2045	Pontianak				◎																44,070	10,765	3,176	58,011
2068	Pontianak				◎																44,070	10,765	3,176	58,011
2075	Pontianak				◎																44,070	10,765	3,176	58,011
2080	Pontianak				◎																44,070	10,765	3,176	58,011
2091	Pontianak				◎																44,070	10,765	3,176	58,011
2132	Pontianak				◎																44,070	10,765	3,176	58,011
2139	Pontianak				◎																44,070	10,765	3,176	58,011
2143	Pontianak				◎																44,070	10,765	3,176	58,011
132005	Pontianak				◎																44,070	10,765	3,176	58,011
132006	Pontianak				◎																44,070	10,765	3,176	58,011
4331	Banjarmasin									◎											14,633	0	5,824	20,457
4338	Banjarmasin					◎															44,070	21,713	3,176	68,959
4468	Banjarmasin													◎							14,633	0	526	15,159
4336	Banjarmasin														◎						14,633	0	5,824	20,457
4337	Banjarmasin			◎																	63,325	34,158	5,000	102,483
4641	Samarinda							◎													12,946	0	9,533	22,479
4645	Samarinda									◎											14,633	0	5,824	20,457
4658	Samarinda									◎											14,633	0	5,824	20,457
4731	Samarinda									◎											14,633	0	5,824	20,457
4748	Samarinda				◎																44,070	10,765	3,176	58,011

Appendix 14.5.7.
Estimated Project Cost for Rehabilitation and Improvement of Light Beacon (4/4)

Unit: US$

DSI No.	DISNAV	Type 1					Type 2					Type 4			Type 5		Type 6		Type 7		Equipment	Civil Work	Installation	Total
		40m	20m	20m off	10m	10m off	30m	20m	20m off	10m	10m off	20m	10m	10m off	10m	10m off	20m off	10m off	20m off	10m off				
4749	Samarinda							◎													12,946	0	9,533	22,479
4763	Samarinda				◎																44,070	10,765	3,176	58,011
4768	Samarinda				◎																44,070	10,765	3,176	58,011
5176	Tarakan										◎										14,633	0	5,824	20,457
5160	Tarakan																	◎			0	0	5,298	5,298
5312	Tarakan																	◎			0	0	5,298	5,298
5351	Manado/Bitung		◎																		63,325	16,671	5,000	84,996
5410	Manado/Bitung		◎																		63,325	16,671	5,000	84,996
5440	Manado/Bitung				◎																44,070	10,765	3,176	58,011
5468	Manado/Bitung		◎																		63,325	16,671	5,000	84,996
5469	Manado/Bitung		◎																		63,325	16,671	5,000	84,996
5492	Manado/Bitung		◎																		63,325	16,671	5,000	84,996
5495	Manado/Bitung		◎																		63,325	16,671	5,000	84,996
5540	Manado/Bitung		◎																		63,325	16,671	5,000	84,996
5578	Kendari				◎																44,070	10,765	3,176	58,011
5583	Kendari					◎															44,070	21,713	3,176	68,959
5614	Kendari		◎																		63,325	16,671	5,000	84,996
5673	Kendari															◎					14,633	0	5,824	20,457
4911	Makassar			◎																	63,325	34,158	5,000	102,483
5012	Makassar					◎															44,070	21,713	3,176	68,959
5851	Ambon		◎																		63,325	16,671	5,000	84,996
5886	Ambon							◎													12,946	0	9,533	22,479
5915	Ambon					◎															44,070	21,713	3,176	68,959
5974	Ambon													◎							14,633	0	526	15,159
5980	Ambon										◎										14,633	0	5,824	20,457
6046	Sorong						◎														16,556	0	14,372	30,928
6060	Sorong				◎																44,070	10,765	3,176	58,011
6160	Sorong										◎										14,633	0	5,824	20,457
6200	Sorong						◎														16,556	0	14,372	30,928
6280	Sorong										◎										14,633	0	5,824	20,457
6005	Merauke							◎													12,946	0	9,533	22,479
6008	Merauke		◎																		63,325	16,671	5,000	84,996
6020	Merauke									◎											14,633	0	5,824	20,457
Total		1	12	3	28	20	5	13	2	15	12	2	3	3	3	2	1	2	1	3	4,183,773	1,069,486	667,932	5,921,191

Appendix 14.5.8.

Estimated Project Cost for Rehabilitation and Improvement of Light Buoy

Unit: US$

No	ATN Office	ID No.	Class	Light Buoy 2.5m	Equipment	Installation	Total
1	SABANG	1	Sub	1	30,245	396	30,641
2	BELAWAN	2	II	1	30,245	396	30,641
3	SIBOLGA	3	Sub	0	0	0	0
4	DUMAI	4	I	10	302,450	3,960	306,410
5	TG. PINANG	5	I	6	181,470	2,376	183,846
6	TLK. BAYUR	6	II	0	0	0	0
7	PALEMBANG	7	II	7	211,715	2,772	214,487
8	TG.PRIOK	8	I	0	0	0	0
9	SEMARANG	9	II	12	362,940	4,752	367,692
10	CILACAP	10	Sub	0	0	0	0
11	SURABAYA	11	I	0	0	0	0
12	BENOA	12	II	1	30,245	396	30,641
13	PONTIANAK	13	Sub	3	90,735	1,188	91,923
14	BANJARMASIN	14	II	8	241,960	3,168	245,128
15	SAMARINDA	15	I	3	90,735	1,188	91,923
16	TARAKAN	16	II	1	30,245	396	30,641
17	MANADO/BITUNG	17	I	1	30,245	396	30,641
18	KENDARI	18	Sub	0	0	0	0
19	UJ.PANDANG	19	I	0	0	0	0
20	KUPANG	20	II	0	0	0	0
21	AMBON	21	I	0	0	0	0
22	JAYAPURA	22	II	0	0	0	0
23	SORONG	23	I	3	90,735	1,188	91,923
24	MERAUKE	24	Sub	4	120,980	1,584	122,564
	TOTAL			61	1,844,945	24,156	1,869,101

Appendix 14.5.9.

Estimated Project Cost for Development of Lighthouses

Unit : US$

No.	Ser. No.	DISNAV	Location	Type 1 (40)	Type 2 (10m)	Equipment	Civil & Housing	Installation	Total
1	5	Tg.Pinang	P. Panjang		◎	208,833	116,664	9,426	334,923
2	7	Tg.Pinang	P.Timau		◎	208,833	116,664	9,426	334,923
4	10	Tg.Pinang	Tg. Sading	◎		202,777	105,899	13,772	322,448
6	16	Palembang	P. Cebia	◎		202,777	105,899	13,772	322,448
7	17	Palembang	Tg. Lesum	◎		202,777	105,899	13,772	322,448
8	19	Palembang	Uj. Batakarang	◎		202,777	105,899	13,772	322,448
10	28	Surabaya	Memburit	◎		202,777	105,899	13,772	322,448
11	31	Benoa	P. Menjangan	◎		202,777	105,899	13,772	322,448
	Total			6	2	1,634,328	868,720	101,483	

Appendix 14.5.10.

Estimated Project Cost for Development of Light Beacon

Unit: US$

No.	MP No.	DISNAV	Location	Height (FM GL:)	Site	Type 1 (30m)	Type 2 (20m)	Type 3 (10m)	Type 4 (10m offshore)	Equipment	Civil & Housing	Installation	Total
1	36	Dumai	Gs.Mumbul	10	Offshore				◎	44,070	21,713	3,176	68,959
2	37	Dumai	Pel.Kuala Enok	10	Offshore				◎	44,070	21,713	3,176	68,959
3	38	Dumai	Pel.Kuala Enok	10	Offshore				◎	44,070	21,713	3,176	68,959
4	39	Dumai	Pel.Kuala Enok	10	Offshore				◎	44,070	21,713	3,176	68,959
5	40	Dumai	Selatan P.Tengah	10	Offshore				◎	44,070	21,713	3,176	68,959
6	41	Dumai	Tg.Layang	10	Offshore				◎	44,070	21,713	3,176	68,959
7	42	Dumai	Utara P.Tengah	10	Offshore				◎	44,070	21,713	3,176	68,959
8	43	Tg.Pinang	P. Ritan	10	On Land			◎		44,070	10,766	3,176	58,012
9	47	Tg.Pinang	Kr.Nginang	10	Offshore				◎	44,070	21,713	3,176	68,959
10	50	Tg.Pinang	P. Batuberlayar	10	On Land			◎		44,070	10,766	3,176	58,012
11	51	Tg.Pinang	P.Selanga	20	On Land		◎			63,325	16,672	5,000	84,997
12	54	Tg.Pinang	Pel.Midai	10	Offshore				◎	44,070	21,713	3,176	68,959
13	55	Tg.Pinang	Pel.Midai	10	Offshore				◎	44,070	21,713	3,176	68,959
14	56	Tg.Pinang	Pel.Midai	20	On Land		◎			63,325	16,672	5,000	84,997
15	60	Tg.Pinang	P. Senggakang	10	Offshore				◎	44,070	21,713	3,176	68,959
16	61	Tg.Pinang	P. Penyengat	10	Offshore				◎	44,070	21,713	3,176	68,959
17	69	Palembang	Kr. Haji	10	Offshore				◎	44,070	21,713	3,176	68,959
18	70	Palembang	Ma. Kuala Tungkal	10	Offshore				◎	44,070	21,713	3,176	68,959
19	71	Palembang	Ma. Kuala Tungkal	10	Offshore				◎	44,070	21,713	3,176	68,959
20	77	Palembang	Selat Nando	10	Offshore				◎	44,070	21,713	3,176	68,959
21	78	Palembang	Tg. Terentang	10	Offshore				◎	44,070	21,713	3,176	68,959
22	83	Tg. Priok	Kr. Gundul	10	Offshore				◎	44,070	21,713	3,176	68,959
23	84	Tg. Priok	Kr. Kerbau	10	Offshore				◎	44,070	21,713	3,176	68,959
24	90	Tg. Priok	Tg.Karawang	10	Offshore				◎	44,070	21,713	3,176	68,959
25	91	Semarang	Alur Pel. Karimun Jawa	10	Offshore				◎	44,070	21,713	3,176	68,959
26	92	Semarang	Alur Pel. Karimun Jawa	10	Offshore				◎	44,070	21,713	3,176	68,959
27	93	Semarang	Alur Pel. Karimun Jawa	10	Offshore				◎	44,070	21,713	3,176	68,959
28	103	Surabaya	GS. Castor	10	Offshore				◎	44,070	21,713	3,176	68,959
29	107	Surabaya	P.Sepekan	20	On Land		◎			63,325	16,672	5,000	84,997
30	146	Manado/Bitung	Napu Arampua	10	Offshore				◎	44,070	21,713	3,176	68,959
31	160	Manado/Bitung	Awit	20	On Land		◎			63,325	16,672	5,000	84,997
32	166	Manado/Bitung	Pel.Tamako	20	On Land		◎			63,325	16,672	5,000	84,997
33	175	Manado/Bitung	Tg. Papalanpungan	30	On Land	◎				93,092	22,480	7,484	123,056
Total						1	5	2	25	1,599,607	670,205	118,241	2,388,053

Appendix 14.5.11.

Estimated Project Cost for Development of Light Buoy

Unit: US$

No	ATN Office	ID No.	Class	Development	Type 1 2.5m	Type 2 3.5m	Equipment	Installation	Total
1	SABANG	1	Sub	0	0		0	0	0
2	BELAWAN	2	II	2	2		60,490	792	61,282
3	SIBOLGA	3	Sub	0	0		0	0	0
4	DUMAI	4	I	4	3	1	141,548	1,584	143,132
5	TG. PINANG	5	I	2	2		60,490	792	61,282
6	TLK. BAYUR	6	II	0	0		0	0	0
7	PALEMBANG	7	II	2	2		60,490	792	61,282
8	TG.PRIOK	8	I	4	3	1	141,548	1,584	143,132
9	SEMARANG	9	II	1	1		30,245	396	30,641
10	CILACAP	10	Sub	0	0		0	0	0
11	SURABAYA	11	I	3	2	1	111,303	1,188	112,491
12	BENOA	12	II	1	1		30,245	396	30,641
13	PONTIANAK	13	Sub	1	1		30,245	396	30,641
14	BANJARMASIN	14	II	1	1		30,245	396	30,641
15	SAMARINDA	15	I	2	2		60,490	792	61,282
16	TARAKAN	16	II	0	0		0	0	0
17	MANADO/BITUNG	17	I	0	0		0	0	0
18	KENDARI	18	Sub	0	0		0	0	0
19	UJ.PANDANG	19	I	1	1		30,245	396	30,641
20	KUPANG	20	II	0	0		0	0	0
21	AMBON	21	I	0	0		0	0	0
22	JAYAPURA	22	II	0	0		0	0	0
23	SORONG	23	I	2	2		60,490	792	61,282
24	MERAUKE	24	Sub	0	0		0	0	0
	TOTAL			26	23	3	848,074	10,296	858,370

Appendix 14.5.12

Estimated Project Cost of Spares for Visual ATN

Unit: US$

No.	ATN Office	Class	Lighting Equipment & Power Supply LH	Lighting Equipment & Power Supply 30m	Lighting Equipment & Power Supply 20m	Lighting Equipment & Power Supply 10m	Light Buoy 2.5m	Equipment Total
1	SABANG	Sub	0	0	0	0	0	0
2	BELAWAN	II	0	0	0	0	1	30,245
3	SIBOLGA	Sub	0	0	0	0	0	0
4	DUMAI	I	0	0	0	0	2	60,490
5	TG. PINANG	I	0	0	0	0	1	30,245
6	TLK. BAYUR	II	0	0	0	0	0	0
7	PALEMBANG	II	0	0	0	0	0	0
8	TG.PRIOK	I	2	1	4	12	2	443,092
9	SEMARANG	II	0	0	0	0	0	0
10	CILACAP	Sub	0	0	0	0	0	0
11	SURABAYA	I	0	0	0	0	1	30,245
12	BENOA	II	0	0	0	0	0	0
13	PONTIANAK	Sub	0	0	0	0	0	0
14	BANJARMASIN	II	0	0	0	0	1	30,245
15	SAMARINDA	I	0	0	0	0	0	0
16	TARAKAN	II	0	0	0	0	0	0
17	MANADO/BITUNG	I	0	0	0	0	0	0
18	KENDARI	Sub	0	0	0	0	0	0
19	UJ.PANDANG	I	0	0	0	0	0	0
20	KUPANG	II	0	0	0	0	0	0
21	AMBON	I	0	0	0	0	0	0
22	JAYAPURA	II	0	0	0	0	0	0
23	SORONG	I	0	0	0	0	0	0
24	MERAUKE	Sub	0	0	0	0	0	0
	TOTAL		2	1	4	12	8	624,562

Appendix 14.5.13.

Estimated Project Cost for Training

Item	Unit	Person	day	Amount (\)	Amount (US$)
1. Over-seas Training					
a. Trainees					
① Flight Fare	305,000	32		9,760,000	
② Daily Allowance	3,300	32	30	3,168,000	
③ Accommodation	10,000	32	29	9,280,000	
				22,208,000	170,831
2. OJT					
a. Lecturer					
① Man-month	2,000,000	2		4,000,000	
② Flight Fare	305,000	1		305,000	
③ Daily Allowance	3,000	1	60	180,000	
④ Accommodation	12,000	1	59	708,000	
				5,193,000	39,946
b. Trainees					
① Flight Fare	50,000	20		1,000,000	
② Daily Allowance	675	20	7	94,500	
③ Accommodation	1,800	20	6	216,000	
				1,310,500	10,081
Sub-total a. + b.					50,027
Total					220,858

Appendix 14.5.14.

Estimated Project Cost for Workshop and Buoy Base

B. Supporting Facilities (Workshop & Buoy Bases) Unit : US$

No. Items	Q'ty	Unit	Foreign Currency	Local Currency
1. Procurement of Equipment	1	lot	2,512,236	818,860
(1) Rehabilitation and Imrovement of AT	1	lot	0	0
a. Lighthouse	21	units		
b. Light Beacon	131	units		
c. Light Buoy	61	units		
(2) Development of ATN	1	lot	0	0
a. Lighthouse	8	units		
b. Light Beacon	33	units		
c. Light Buoy	26	units		
(3) Supporting Facilities	1	lot	2,512,236	818,860
1) Workshops & Buoy Bases	1	lot	2,512,236	818,860
a. Improvement	3	locations	2,512,236	818,860
(4) Spares for ATN	1	lot		
(5) Training for ATN	1	lot		
2. Civil & Housing Works	1	lot	0	278,029
(1) Rehabilitation & Improvement of ATI	1	lot	0	0
a. Lighthouse	21	units		
b. Light Beacon	131	units		
(2) Development of ATN	1	lot	0	0
a. Lighthouse	8	units		
b. Light Beacon	33	units		
(3) Supporting Facilities	1	lot		278,029
1) Workshop & Buoy Bases	1	lot		278,029
a. Improvement	6	locations		225,117
b. Development	7	locations		52,912
3. Installation Works	1	lot	0	220,801
(1) Rehabilitation & Imprvement of ATN	1	lot	0	0
a. Lighthouse	21	units		
b. Light Beacon	131	units		
c. Light Buoy	61	units		
(2) Development of ATN	1	lot	0	0
a. Lighthouse	8	units		
b. Light Beacon	33	units		
c. Light Buoy	26	units		
(3) Supporting Facilities	1	lot		220,801
1) Workshops & Buoy Bases	1	lot		220,801
a. Improvement	3	locations		220,801
4. Transportation	1	lot	50,245	38,299
5. Consultaning Fee (3%)	1	lot	76,874	135,599
6. Sub Total			2,639,355	1,491,587
7. Contingency			131,968	74,579
Total			2,771,323	1,566,166
Grand Total				4,337,489

Appendix 14.5.15.

Estimated Project Cost for Workshop and Buoy Base (Equipment)

Unit : US$

No.	ATN Office	Class	Improvement						Total
			Workshop (Foreign)			Workshop (Local)			
			Class I	Class II	Sub-total	Class I	Class II	Sub-total	
1	SABANG	Sub	0	0	0	0	0	0	0
2	BELAWAN	II	0	0	0	0	0	0	0
3	SIBOLGA	Sub	0	0	0	0	0	0	0
4	DUMAI	I	0	0	0	0	0	0	0
5	TG. PINANG	I	0	0	0	0	0	0	0
6	TLK. BAYUR	II	0	0	0	0	0	0	0
7	PALEMBANG	II	0	736,344	736,344	0	264,184	264,184	1,000,528
8	TG.PRIOK	I	0	0	0	0	0	0	0
9	SEMARANG	II	0	0	0	0	0	0	0
10	CILACAP	Sub	0	0	0	0	0	0	0
11	SURABAYA	I	887,946	0	887,946	277,338	0	277,338	1,165,284
12	BENOA	II	0	0	0	0	0	0	0
13	PONTIANAK	Sub	0	0	0	0	0	0	0
14	BANJARMASIN	II	0	0	0	0	0	0	0
15	SAMARINDA	I	887,946	0	887,946	277,338	0	277,338	1,165,284
16	TARAKAN	II	0	0	0	0	0	0	0
17	MANADO/BITUNG	I	0	0	0	0	0	0	0
18	KENDARI	Sub	0	0	0	0	0	0	0
19	UJ.PANDANG	I	0	0	0	0	0	0	0
20	KUPANG	II	0	0	0	0	0	0	0
21	AMBON	I	0	0	0	0	0	0	0
22	JAYAPURA	II	0	0	0	0	0	0	0
23	SORONG	I	0	0	0	0	0	0	0
24	MERAUKE	Sub	0	0	0	0	0	0	0
25	B T K P		0	0	0	0	0	0	0
Total			1,775,892	736,344	2,512,236	554,675	264,184	818,860	3,331,096

Note: Class II Workshop Equipment for Palembang is Type 1.

Appendix 14.5.16.

Estimated Project Cost for Workshop and Buoy Base (Civil & Housing Work)

Unit: US$

No.	ATN Office	Class	Improvement			Development						Total
			Workshop		Buoy base	Storage		Buoy base		Open Storage		
			Class I	Class II	Class I	Class I	Class II	Class I	Class II	Class I	Class II	
1	SABANG	Sub	0	0	0	0	0	0	0	0	0	0
2	BELAWAN	II	0	0	0	0	0	0	0	0	281	281
3	SIBOLGA	Sub	0	0	0	0	0	0	0	0	0	0
4	DUMAI	I	0	0	0	0	0	0	0	0	0	0
5	TG. PINANG	I	0	0	0	0	0	0	0	0	0	0
6	TLK. BAYUR	II	0	0	0	0	0	0	0	0	281	281
7	PALEMBANG	II	0	4,617	0	0	0	0	0	0	281	4,898
8	TG.PRIOK	I	0	0	132,750	0	0	0	0	0	0	132,750
9	SEMARANG	II	0	0	0	0	0	0	2,808	0	281	3,089
10	CILACAP	Sub	0	0	0	0	0	0	0	0	0	0
11	SURABAYA	I	21,239	0	0	0	0	0	0	0	0	21,239
12	BENOA	II	0	0	0	0	46,173	0	2,808	0	0	48,981
13	PONTIANAK	Sub	0	0	0	0	0	0	0	0	0	0
14	BANJARMASIN	II	0	0	0	0	0	0	0	0	0	0
15	SAMARINDA	I	0	0	66,510	0	0	0	0	0	0	66,510
16	TARAKAN	II	0	0	0	0	0	0	0	0	0	0
17	MANADO/BITUNG	I	0	0	0	0	0	0	0	0	0	0
18	KENDARI	Sub	0	0	0	0	0	0	0	0	0	0
19	UJ.PANDANG	I	0	0	0	0	0	0	0	0	0	0
20	KUPANG	II	0	0	0	0	0	0	0	0	0	0
21	AMBON	I	0	0	0	0	0	0	0	0	0	0
22	JAYAPURA	II	0	0	0	0	0	0	0	0	0	0
23	SORONG	I	0	0	0	0	0	0	0	0	0	0
24	MERAUKE	Sub	0	0	0	0	0	0	0	0	0	0
25	B T K P		0	0	0	0	0	0	0	0	0	0
Total			21,239	4,617	199,260	0	46,173	0	5,616	0	1,123	278,029

Appendix 14.5.17.

Estimated Project Cost for Workshop and Buoy Base (Installation Works)

Unit: US$

No.	ATN Office	Class	Improvement		Total
			Workshop		
			Class I	Class II	
1	SABANG	Sub	0	0	0
2	BELAWAN	II	0	0	0
3	SIBOLGA	Sub	0	0	0
4	DUMAI	I	0	0	0
5	TG. PINANG	I	0	0	0
6	TLK. BAYUR	II	0	0	0
7	PALEMBANG	II	0	72,000	72,000
8	TG.PRIOK	I	0	0	0
9	SEMARANG	II	0	0	0
10	CILACAP	Sub	0	0	0
11	SURABAYA	I	74,400	0	74,400
12	BENOA	II	0	0	0
13	PONTIANAK	Sub	0	0	0
14	BANJARMASIN	II	0	0	0
15	SAMARINDA	I	74,400	0	74,400
16	TARAKAN	II	0	0	0
17	MANADO/BITUNG	I	0	0	0
18	KENDARI	Sub	0	0	0
19	UJ.PANDANG	I	0	0	0
20	KUPANG	II	0	0	0
21	AMBON	I	0	0	0
22	JAYAPURA	II	0	0	0
23	SORONG	I	0	0	0
24	MERAUKE	Sub	0	0	0
25	B T K P		0	0	0
Total			148,801	72,000	220,801

Appendix 16.1.
Number of Collisions

(Ships / Year)

Year	Number of Collisions		
	Without Case	With Case	Difference
2007	91.94	82.69	9.2
2008	107.93	97.05	10.9
2009	123.92	111.41	12.5
2010	139.91	125.76	14.1
2011	155.90	140.12	15.8
2012	171.89	154.48	17.4
2013	187.88	168.83	19.0
2014	203.87	183.19	20.7
2015	219.86	197.55	22.3
2016	235.86	211.90	24.0
2017	251.85	226.26	25.6
2018	267.84	240.62	27.2
2019	283.83	254.97	28.9
2020	299.82	269.33	30.5
2021	315.81	283.68	32.1
2022	331.80	298.04	33.8
2023	347.79	312.40	35.4
2024	363.78	326.75	37.0
2025	379.77	341.11	38.7
2026	395.77	355.47	40.3
2027	411.76	369.82	41.9
2028	427.75	384.18	43.6
2029	443.74	398.54	45.2
2030	459.73	412.89	46.8
2031	475.72	427.25	48.5
2032	491.71	441.60	50.1
2033	507.70	455.96	51.7
2034	523.69	470.32	53.4
2035	539.68	484.67	55.0
2036	555.68	499.03	56.6

Appendix 16.2.
Damage and Loss per Vessel

1. Outline of Indonesian vessel

Table 1. Summary of Indonesian Vessels

No.	Type	Number of vessels (Ships)	Average GT (Ton)	Average DWT (Ton)	Average Age (Years)	Ship's Price (US$)	H/B (US$)
1	Bulk Carrier	28	13,569.78	21,991.28	22.48	1,750,000	505,562
2	Dry Cargo / Passenger	1,324	1,486.78	2,311.18	25.72	200,000	92,392
3	Fishing	338	241.00	262.89	28.08	21,219	10,509
4	Miscellaneous	529	349.10	619.52	21.08	34,676	24,766
5	Non-merchant	6	1,631.00	-	20.83	194,247	0
6	Offshore	54	626.00	916.38	23.43	69,144	36,633
7	Tanker	288	3,073.92	5,639.51	25.90	300,000	225,446
	Total / Average	2,567	1,379.84	2,839.64	25.14	167,750	85,720

Source: Lloyds Register of Shipping, 2000

Price: PT.Samudera Indonesia & The Study Team

H/B : The study team

2. Ship's damage Ratio

When vessel collides, damage ratio is shown in **Table 2**. Average age of vessels is very old in Indonesia, so that total damage and half damage are considered 100% damage and light damage is considered 25% damage.

Table 2. Damage Ratio of Indonesian Vessels

	Ratio (%)	Passenger	Cargo Boat	Tanker	Fishing	Leisure	Tug	Etc	Total	
Total Damage	100	1	5	0	9	10	3	0	28	6.0%
Heavy Damage	100	1	21	4	15	8	3	2	54	11.5%
Light Damage	25	19	226	34	56	21	26	6	388	82.6%
Total		21	252	38	80	39	32	8	470	100.0%
							Average Damage Ratio			0.3815

Note: 1994 January ~ 1998 December

Source: Marine Accident Inquiry Agency

3. Damage when an Indonesian vessel collides

Total damage and heavy damage are scrapped and light damage calculated as follows.

167,750 x 0.3815 = 63,997 US$ / vessel

4. Cargo damage

2,839.64 x 34 x 0.3815 = 36,833 US$

5. Inoperable loss

Hire Base should be used for inoperable loss. In case of light loss, inoperable loss is 7 days. When average Indonesian vessel collides, inoperable loss/vessel are as follows.

85,720 x 0.826 x 7 days = 495,633 US$ / vessel

6. Damage of oil spill from tanker

(a) Probability of oil spill

When tanker collides, probability of oil spill is shown in **Table 3**.

Table 3. Probability of Oil Spill When Tankers collides.

	1977	1978	1979	1980	1981	1982	Total
All Collision	14	14	5	27	9	11	80
Collision with oil spill	7	1	5	11	2	4	30

Source: The study on the safety improvement of the Suez Canal in the Arab Republic of Egypt, JICA

According to **Table 3**., probability of oil spill is as follows.

30/80=0.375

(b) Amount of spilling oil

$Q=0.018K^{1.19}$ (formula 1)

$K=28.5Q^{0.838}$ (formula 2)

Where

Q: Amount of oil spills

K: Tanker size (G.T.)

Spilling oil quantity, when average Indonesian tanker collides, should be calculated by formula 1.

$0.018 \times 3{,}073.92^{1.19} = 95.4$ Kl 78.5MT

(Source: The study on the safety improvement of the Suez Canal in the Arab Republic of Egypt, JICA)

Percentage of Indonesian tanker among all vessels is 11.22%; Spilling oil from average Indonesian vessel should be calculated as follows.

$0.1122 \times 78.5 = 8.81$ MT

(c) Clean up cost

Clean up cost should be calculated as follows.

$3{,}830 \times 8.81 = 33{,}743$ US$

(Source: Manual on oil pollution, Section **Ⅳ**, Combating oil spill, IMO)

(d) Compensation expense

Compensation expense was calculated referring to off Singapore oil spill.

(Compensation Expense 25,230,000 S$ against 29,000 ton of oil spill.)

401 x 8.81 = 3,533 US$

7. Total Damage

Total damages are shown in **Table 4.**

Table 4. Total Damage

	Amount loss (US$)
Damage by collision (Hull)	63,997
Damage by collision (Cargo)	36,833
Inoperable loss	495,633
Oil spill, clean up cost	33,743
Compensation	3,533
Total Loss	633,739

JICA