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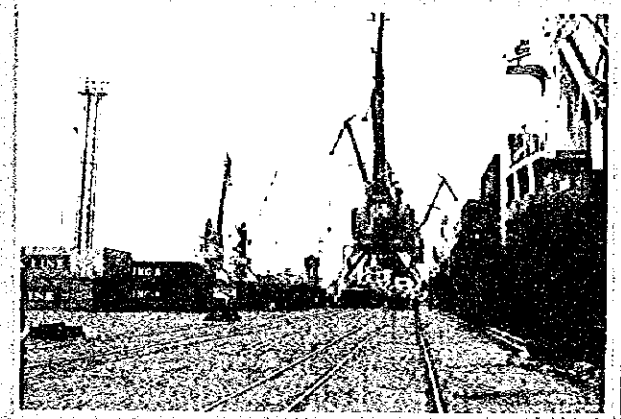

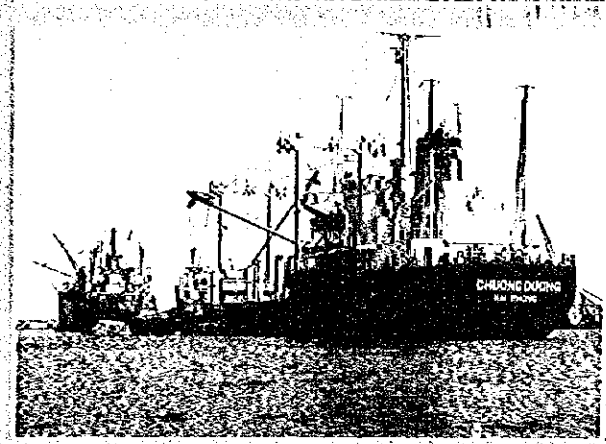

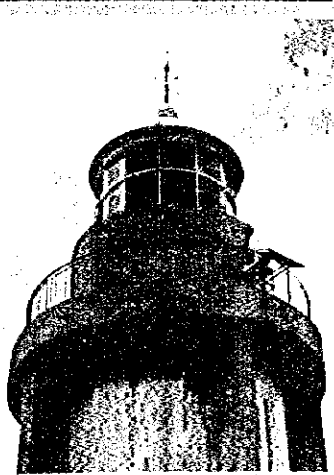

MASTER PLAN STUDY ON COASTAL SHIPPING REHABILITATION AND DEVELOPMENT PROJECT IN VIETNAM

Final Report

SUPPLEMENTARY REPORTS Vol.4

Maritime
Safety
and

March 1997

The Maritime International Cooperation Center of Japan (MICC)
Overseas Shipbuilding Cooperation Centre (OSCC)
ALMEC Corporation

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JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
MINISTRY OF TRANSPORT (MOT), VIETNAM

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ALMEC CORPORATION

SUPPLEMENTARY REPORTS VOLUME 4

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GLOSSARY OF TERMS

ADB	Asian Development Bank
ARPA	Automated Rader Plotting Aid
ATN	Aids To Navigation
BOT	Building, Operation and Transfer
CCID	Cement Consulting, Investment & Development Corporation
CRS	Coastal Radio Station
DGPS	Differential Global Positioning System
DWT	Dead Weight Tonnage
EIA	Environmental Impact Assessment
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
GMDSS	Global Maritime Distress and Safety System
GPC	Government Pricing Committee
GRT	Gross Registered Tonnage
GSO	General Statistics Office
HP	Horse Power
IEE	Initial Environmental Examination
IMO	International Maritime Organization
IWB	Inland Waterways Bureau
JICA	Japan International Cooperation Agency
JV	Joint Venture
LASH	Lighter Aboad Ship
MARPOL	International Convention for the Prevention of Pollution from Ships
MOSTE	Ministry of Science, Technology and Environment
MOT	Ministry of Transport
MPI	Ministry of Planning and Investment
MTTS	Maritime Technical and Training School
NTSR	National Transport Sector Review
OD	Origin - Destination
ODA	Official Development Assistance
OECF	Overseas Economic Cooperation Fund of Japan
OPRC	International Convention on Oil Pollution Preparedness, Response and Cooperation
OSRAP	Oil Spill Response Action Plan ASEAN
RCC	Rescue Coordination Center

RO-RO	Roll-On Roll-Off ship
SAR	Search And Rescue
SOLAS	Safety Of Life At Sea
STCW	Standards for Training, Certification & Watchkeeping
TEDI	Transport Engineering Design Incorporation
TESI	Transport Economic Scientific Institute
UNDP	United Nations Development Program
VIMARU	Vietnam Maritime University
VINALINES	Vietnam National Shipping Lines
VINAMARINE	Vietnam National Maritime Bureau
VINASHIN	Vietnam Shipping Industry Corperation
VIRES	Vietnam Register of Shipping
VISAL	Vietnam Salvage Corporation
VMS	Vietnam Maritime Safety Agency
VNR	Vietnam National Railways
VRA	Vietnam Road Administration Bureau
VISHIPEL	Vietnam Ship Communications and Electronic Company
VTS	Vessel Traffic Service

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PART 1

AIDS TO NAVIGATION

PART I AIDS TO NAVIGATION

Chapter 1. Introduction

Vietnam has successfully carried out its post-war reconstruction through a 5-year program, (completed the 5 stages) and it is now undertaking the 6th stage of the program which runs from year 1996 to 2000.

Under this program, recommended plans in the past shall continue and introduce further rational economic measures to stabilize the economy and improve its economic performance with the use of its vast resources.

There is a plan to expand its international relations with foreign countries to promote its economic development.

(a) Objective

It is expected that maritime transportation, both ocean going and coastal, will increase its present fleet to meet the continuing demand for cargo movement. However, the Navaids facilities of the country, which are key to the safety of maritime transportation are outmoded and sustained damages during the war.

Most of the lighthouses which are in operation are obsolete and do not comply with the IALA's international standards for Navaids.

In addition, since these lighthouses were constructed in different location (South and North) their equipments are diverse making it difficult to procure required units/parts for their maintenance and operation. Further, it is even more difficult to maintain a good quality of the light for a lighthouse.

Based on the existing situation, the long-term development and reconstruction program for Navaids is established for the target year 2010. A short-term priority development program for the year 2000 is likewise undertaken to cope with the immediate repair needs of lighthouse facilities.

(b) Coverage

Several surveys were carried out to look into the existing situation of the coastal maritime transportation and Navaids which area installed along the sea lanes, ports and water channels.

Based on these surveys, a master plan was formulated to improve the existing Navaids and to develop new Navaids required to ensure safe navigation in the future. In addition, a program to develop support facilities to maintain and administer these Navaids is formulated.

(c) Major Activities Undertaken

1) The Present Status of Navaids

Although rehabilitation work is ongoing, most of the existing lighthouses have outmoded facilities.

Further, in the northern part of the country there exist lighthouses still operating which were built during the French occupation in addition to those made in the former Soviet Union, China, and Czechoslovakia after 1954.

In the southern part of the country, however, existing lighthouses are equipped with American-made devices at the time of Vietnam War. The worn-out parts cause operational problems and some lighthouses are not functioning properly.

The ratings and specifications of the lighting apparatus, control device and power supply are different, depending upon the time of installation or improvement as well as their location. Therefore, it is difficult to control and operate all the existing Navaids economically and effectively.

2) Formulation of Priority Project

The study for the formulation of priority project will be based on the difference between the ratings and specifications of the principal devices which relate to their location and the date of installation or improvement. It is noted that the number of the lighthouses is less than what is required as per international standards.

Under this priority project, rehabilitation will be undertaken for the existing lighthouses together with the development of new Navaids and support facilities.

3) Preparation of Development Program

Based on the results of the field surveys, the analysis was undertaken and a development plan is formulated for the year 2010 taking into account international trends and development.

4) Formulation of Priority Projects

In order to formulate a short-term program for the year 2000, a priority project list was prepared to select those which need to be prioritized within the Navaids program.

5) Preparation of Priority Projects

Taking into account the different characteristics and types of individual Navaids, the priority development program in the coastal and principal water areas was prepared for the year 2000.

6) Implementation Program of Priority Project

A short term development and rehabilitation program of Navaids for the Year 2000 was prepared taking into account the on-going projects and available information and materials.

Chapter 2. Administrative Framework

The new administrative framework was formed on the 1st of January 1995, and Vietnam Maritime Safety Agency (VMS), was established in May 1975, as the sole agency responsible for maritime safety in Vietnam.

VMS is an organization under the Vietnam National Maritime Bureau (VINAMARINE). In the past, the Office of Maritime Safety (OMS) and the Service of Maritime Safety (SMS) were under the VINAMARINE and they are responsible for Navaids in the Southern and Northern parts of Vietnam respectively.

VINAMARINE is the agency under the Ministry of Transportation (MOT) responsible to oversee the maritime transportation as a whole.

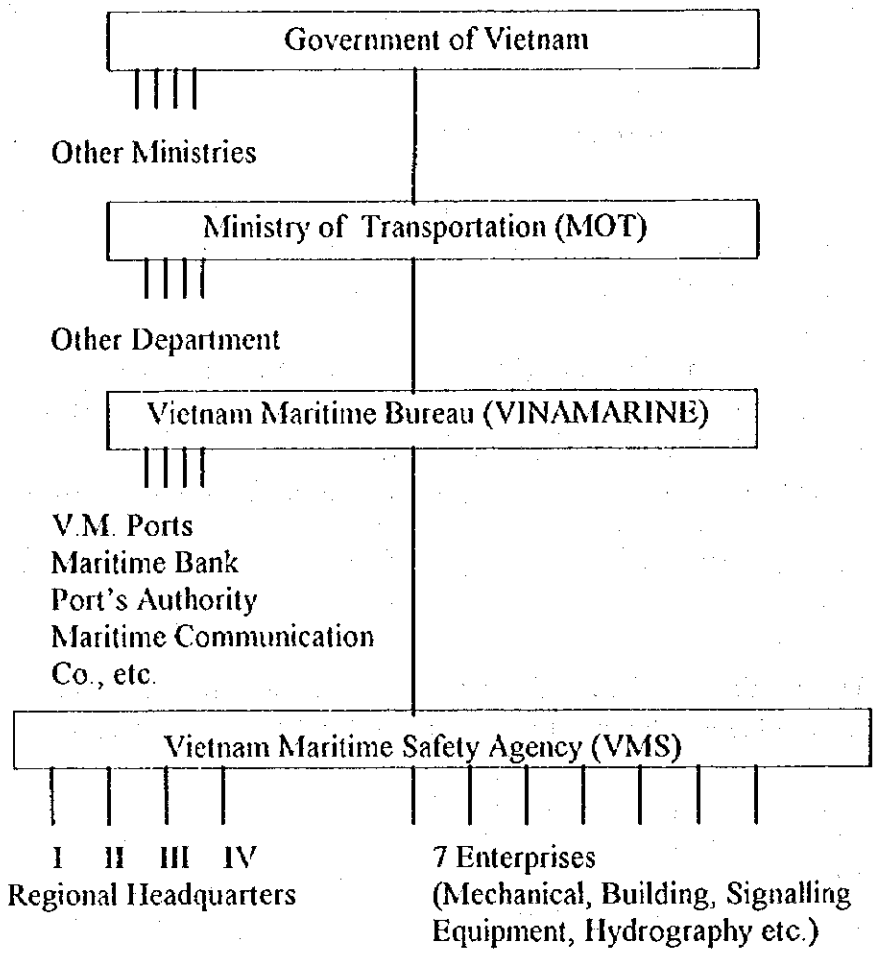
The position of VMS in the government of Vietnam is shown in Figure 2.1. VMS is responsible for all the duties and functions related to maritime safety.

Chapter 3. Existing Condition

The existing lighthouses are a combination of different types of lighting apparatus, control devices and supplies depending on the date of construction.

Since they were manufactured in different countries, the Government found it difficult to maintain and control these lighthouses. And since the lighthouse towers are also outmoded, their immediate rehabilitation is recommended.

Figure 3.1
POSITION OF VMS IN THE GOVERNMENT OF VIETNAM



3.1 Aids To Navigation and Support Facilities

It is reported that, as of August 1996, there are 54 units of lighthouses, 38 units of light beacons, 8 units of leading lights, 170 units of lighted buoys and 76 units of unlighted buoys presently operating all over Vietnam.

3.1.1 Lighthouses

There are 55 units of lighthouses existing and are listed in Table 3.1. However, many of them do not reflect clearly their geographical coordinates. Since most of them are very old they become difficult to maintain and thus, require immediate upgrading.

It is likewise necessary to issue TABLE of LIGHT LIST from an authorized entity.

Table 3.1
EXISTING LIGHTHOUSES (1/2)

Regional Office	Name of Lighthouse	Class of Light	Height Tower/Sea level (in meter)	Visual range (in n.m.)	Year of Built	Geographical Co-ordinate
I	1. DAO TRAN	I	148/186	28	1996	21° 14' 14" N 107° 57' 32" E
Haiphong	2. VINH THUC	I	18/85	16	1995	21° 23'48" N 109° 59' 30" E
	3. CO TO	I	15/101	15	1961	20° 59' 58" N 107° 45' 10" E
	4. SOI DEN	IV	4/38	8	1964	20° 49' 37" N 107° 17' 25" E
	5. HON DAU	II	18/46	22		20° 40' 03" N 106° 48' 42" E
	6. LONG CHAU	I	30/80	27	1894	20° 37' 24" N 106° 48' 42" E
	7. BACH LONG VI	II	23/80	26	1995	20° 08' 00" N 107° 43' 26" E
	8. BA LAT	III	15/4	15	1962	20° 18' 00" N 106° 34' 00" E
	9. QUAT LAM	III	22/4	15	1966	20° 11' 05" N 106° 21' 30" E
	10. LACH TRAO	III	15/4	14	1965	19° 47' 30" N 105° 55' 24" E
	11. HON M.E		/	28		19° 21' 30" N 106° 56' 00" E
	12. BIEN SON	IV	6/23	12	1962	19° 20' 20" N 105° 49' 14" E
II	13. CUA HOI	III	15/5	14	1966	18° 45' 41" N 105° 45' 14" E
Vinh	14. CUA SOT	II	6/42	15	1969	18° 27' 23" N 105° 56' 07" E
	15. CUA NHUONG	IV	17/27	16	1994	18° 14' 40" N 106° 07' 20" E
	16. CUA GIANHI		/	15	1995	17° 05' 00" N 106° 29' 00" E
	17. NHAT LE	II	17/27	15	1902	17° 28' 45" N 106° 37' 06" E
	18. MUI LAY (CAP LAY)	II	13/24	12	1984	17° 05' 00" N 107° 06' 37" E
	19. CUA VIET	III	22/28	15		16° 54' 06" N 107° 36' 45" E
	20. THUAN AN	III	18/34	15		16° 34' 24" N 107° 36' 445" E
	21. TIEN SHA	I	9/151	28	1902	16° 08' 15" N 108° 19' 36" E
	22. LY SON	III	17/95	16	1984	15° 23' 10" N 109° 08' 45" E
	23. BALANG AN		/	10		15° 14' 00" N 108° 56' 00" E
III	24. PHUOC MAI	IV	8/46	6	1987	13° 45' 34" N 109° 15' 23" E
Qui Nhon	25. CU LAO XANH	I	16/103	27		13° 36' 46" N 109° 21' 46" E
	26. MUI CHUT		/	9		12° 21' 00" N 109° 17' 00" E
	27. HON LON	I	16/86	26	1890	12° 12' 35" N 109° 20' 12" E

Regional Office	Name of Lighthouse	Class of Light	Height Tower/Sea level (in meter)	Visual range (in n.m.)	Year of Built	Geographical Co-ordinate
III	28. HON CHUT		/	10		11° 46' 40" N 109° 13' 00 E
Qui Nhon	29. MUI DINH	I	16/170	33	1904	11° 21' 30" N 109° 01' 11" E
	30. PHU QUI		/	23		10° 32' 30" N 108° 56' 00 E
	31. KE GA	II	41/24	22	1897	10° 41' 30" N 109° 59' 38" E
IV	32. VUNG TAU		/	34		10° 20' 00" N 107° 06' 00" E
Vung Tau	33. CAN GIOHA		/	10		10° 14' 30" N 106° 48' 00" E
	34. BA DONG		/	10		09° 36' 00" N 106° 33' 00" E
	35. DINH AN		/	12		09° 32' 00" N 106° 24' 00" E
	36. BAY CANH	I	16/196	34	1885	08° 39' 50" N 106° 46' 36" E
	37. HON KHOIA	I	15/284	34	1899	08° 25' 36" N 104° 50' 06" E
	38. HON CHUOI	II	10/147	12	1993	08° 50' 06" N 104° 31' 00" E
	39. NAM DUT	II	15/309	12	1993	09° 40' 30" N 104° 39' 00" E
	40. RACH GIANG		/	10		10° 01' 00" N 105° 04' 30" E
	41. NUI NAI	III	8/54	12	1896	10° 21' 30" N 104° 26' 00" E
	42. THO CHU	II	15/138	10	1993	9° 17' 30" N 103° 27' 30" E
	43. AN THOI		/	10		10° 01' 00" N 104° 01' 00" E
	44. DUONG DONG		/	10		10° 13' 00" N 103° 57' 00" E
Trunong sa	45. PHUC TA		/	12	(1994)	08° 09' 25" N 110° 35' 28" E
	46. HUYEN TRAN		/	12	( )	08° 09' 25" N 110° 37' 00" E
	47. BA KE		/	12	(1994)	07° 52' 14" N 111° 44' 32" E
	48. QUE DUONG		/	12	(1994)	07° 48' 49" N 110° 28' 40" E
	49. PHUC NGUYEN		/	12	(1994)	07° 55' 72" N 109° 57' 06" E
	50. TU CHINH A		/	12	(1994)	07° 14' 00" N 109° 19' 00" E
	51. TU CHINH B		/36	17	(1993)	07° 27' 00" N 109° 54' 00" E
	52. SONG TU TAY		/20	14	(1994)	11° 25' 43" N 114° 19' 50" E
	53. DA TAY					08° 50' 41" N 112° 11' 42" E
Trunong sa	54. DA LAT		/40	16	(1994)	08° 40' 01" N 111° 39' 50" E
	55. AN BANG		/	14	(1994)	07° 53' 00" N 112° 54' 00" E
	Total 55 stns					

This is based on information provided by VMS except that the information in ( ) is from IALA BULLETIN 1995/3.

I ----- Long Range Type A
II----- Long Range Type B
III ----- Medium Range Type
IV ----- Short Range Type (Port and Harbor Entrance)

3.1.2 Light Beacon

According to the VMS report, there are 69 units of light beacon presented in Table 3.2. In addition, there are 20 units of Beacons which are not under the control of VMS, as shown in Table 3.2.

Table 3.2
EXISTING LIGHT BEACONS (MANAGED BY VMS)

	No.	Name of Site		No.	Name of Site
Hai Phong	1	DT Hon Bong	Hon Gai	1	DT Con Chim
	2	DT A Van		2	DT Hon 1
	3	Den Bai Cat		3	DT Bai Chay
	4	DT Ario	Quy Nhon	1	DTA chap AB
	5	Den Rung		2	DTB chap ab
	6	Den Cut	Vung Tau	1	DT Cao Trang
	7	Do Dinh Vu		2	DT Can Gio ha
	8	Dong Dinh Vu		3	DT Can Gio Thuong
	9	Tay Dinh Vu		4	DTA1 chap A1 A2
	10	Ke 8 Song Cm		5	DTA2 chap A1 B2
	11	Ke 5 Song Cm		6	DT 31 (15 cu)
	12	Ke 4 Song Cm		7	DTL1 chap L1-L2 (19)
	13	Ke 1 Song Cm		8	DTL2 chap L1 - L2 (19)
	14	DTA chap Nha Vang		9	DTK1 chap K1 - K2 (21)
	15	DTB chap Nha Vang		10	DTK2 chap K1 - K2 (21)
	16	DT Tay Vang Chau		11	DT 41 (17 old)
	17	Deiu tiet Station Bach Dang		12	DT 36 (12 old)
	18	Ke 1		13	DT 38 (14 old)
	19	Ke 3		14	DT 50 (16 old)
	20	Ke 5		15	DT 60 (18 old)
	21	Ke 2		16	DT 59 (23 old)
	22	Ke 4		17	DT 62 (24 old)
Da Nang	1	- Tieu 3		18	DT01 chap 01-02 (DD)
	2,3	- Tieu 5; Hon 1o		19	DT02 chap 01-02 (DD)
	4	DT Quan Tuong	Dinh An	1	DT 11
	5	DT Ke Xanh Bac		2	DT 13
	6	DT Ke Xanh Nam	Ha Tien	1	DR A chap AB
	7	DT Ke Ngang Do		2	DT B chap AB
	8	DTA Chap AB			
	9	DTB Chap ab	Total		69

Table 3.3
EXISTING LIGHT BEACON (MANAGED BY OTHER PARTY)

No.	Name of site
	Luong Cua Ong
1	DT Lo Muc
2	DT Hon Goi
3	DT Doi Dau Giuong
4	DT Dau Gieng Cut
5	DT Bo Can
6	DT Mo Da Con
7	DT The Vang
8	DT Con Ong
9	DTA chap A-B
10	DTB chap A-B
11	DTC chap C - D
12	DTD chap C - D
13	DTE chap E - F
14	DTF chap E - F

No.	Name of site
	Dien Cong
1	DTA chap A - B
2	DTA chap A - B
	Pha Rung
1	DT 18
2	DTA Chap AB
3	DTA Chap AB
	Ky Ha
1	DT Ky Ha
	Total 20

3.1.3 Illuminated Buoys

As reported by VMS, there are 273 units of light buoys, as presented in Table 3.4. In addition to this, there are 82 units of light buoys outside the control of VMS, indicated in Table 3.5.

Table 3.4
EXISTING LIGHT BUOYS (MANAGED BY VMS)

No.	Name of location	Quantity
1	Hai Phong	42
2	Pha Rung	19
3	Hon Gai	26
4	Thanh Hoa	16
5	Cua Lo	8
6	Cua Hoi	23
7	Da Nang	11
8	Quy Nhon	8+

No.	Name of location	Quantity
9	Nha Trang	9
10	Cua Tieu	14
11	Ding An	14
12	Sai Gon	60
13	Thi Vai	23
Total		273

Table 3.5
EXISTING LIGHT BUOY
(MANAGED BY OUTSIDE PARTY)

No.	Location	Quantity
1	Cua Ong	17
2	Ky Ha	9
3	Pha Rung	31
	Total	35

3.1.4 Radio Aids Navigation

The existing Radio Aids to Navigation have only 5 units available of RACOn which are installed at Vung Tau, Bat Lat, An Bang, D Tay and Song Tu Tay.

3.1.5 Support Facilities

The present status of support facilities is described as follows. They consist of workshops which undertake repair and improvement of equipment and materials, supply vessels to transport materials to lighthouses, inspection boats to watch ATN and buoy tenders used for installation of buoys.

Table 3.6
EXISTING SUPPORT FACILITIES

Facilities		Region					Remarks
		I	II	III	IV	Total	
Factory		1	0	0	1	2	
Workshop		1	1	1	1	4	
Vessel	Buoy tender	0	0	0	1	1	400t
	Supply	2	1	1	1	5	50t
	Inspection	1	1	0	1	3	50t
	Supporting	1	0	0	0	1	50t
	Training	0	0	0	0	0	

Note: Refer to Appendix: List of Existing Shops Managed by VMS.

3.2 Management

The nation is divided into four region (4) regions for Regional Maritime Safety with the central headquarters located in Haiphong as shown in Figure 3.1. Each region has its own regional headquarters. On 1 January 1995, the VMS organization was formed and became operational.. The areas of responsibility are presented in Figure 3.2. The number of personnel of VMS is shown in Table 3.7 below:

Table 3.7

PERSONNEL FOR EACH SECTION (AS OF 1995)

Name of Section	Personnel
Region IV	407
East ocean & Islands	164
Factory (at Haipong)	46
Factory (at HCM)	40
Total	1,165
Director General	1
Vice Director General	5
Ho Chi Minh Branch	31
Region I	221
Region II	156
Region III	94

Figure 3.2

AREA OF RESPONSIBILITY OF REGIONAL MARITIME SAFETY OFFICES

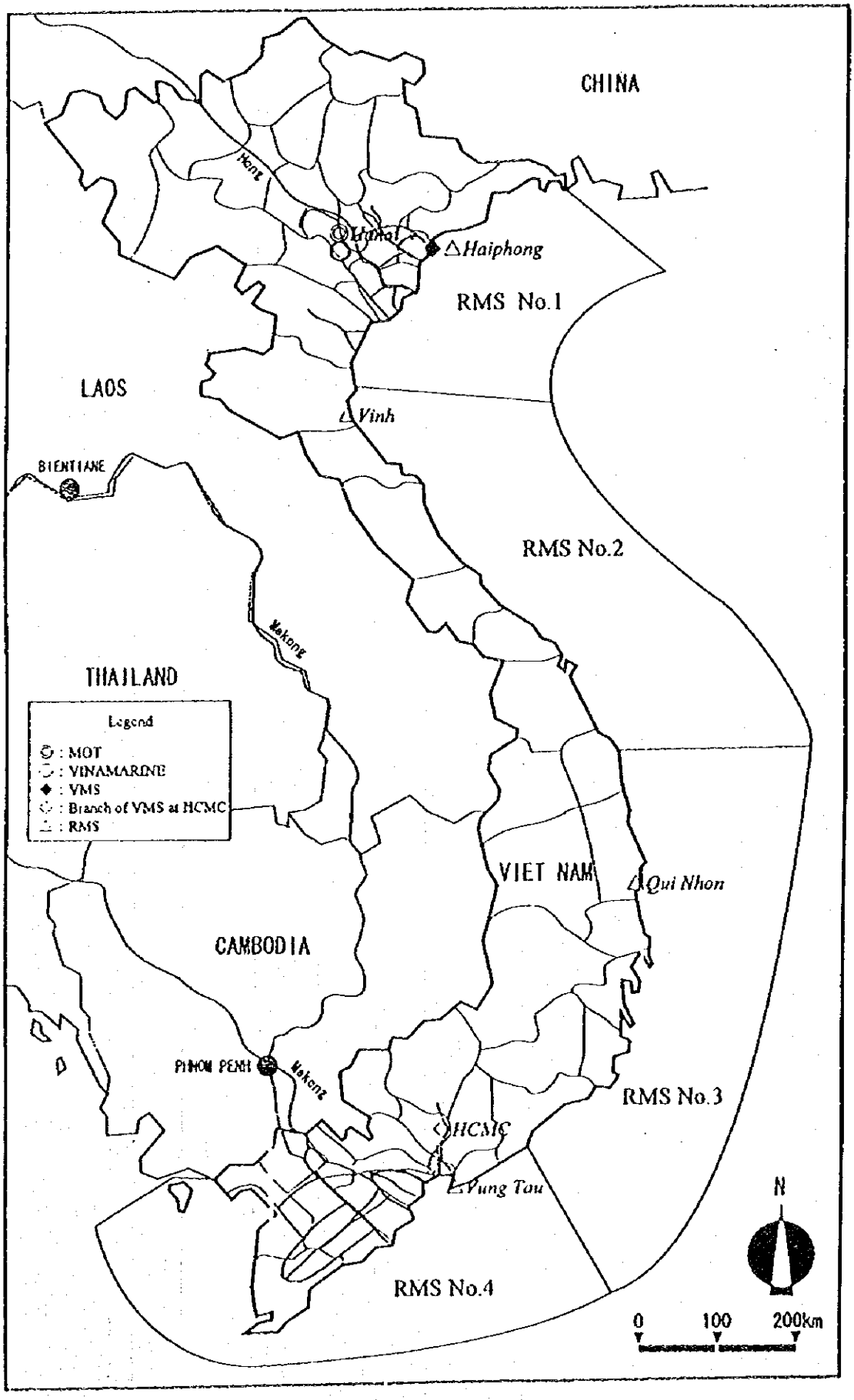
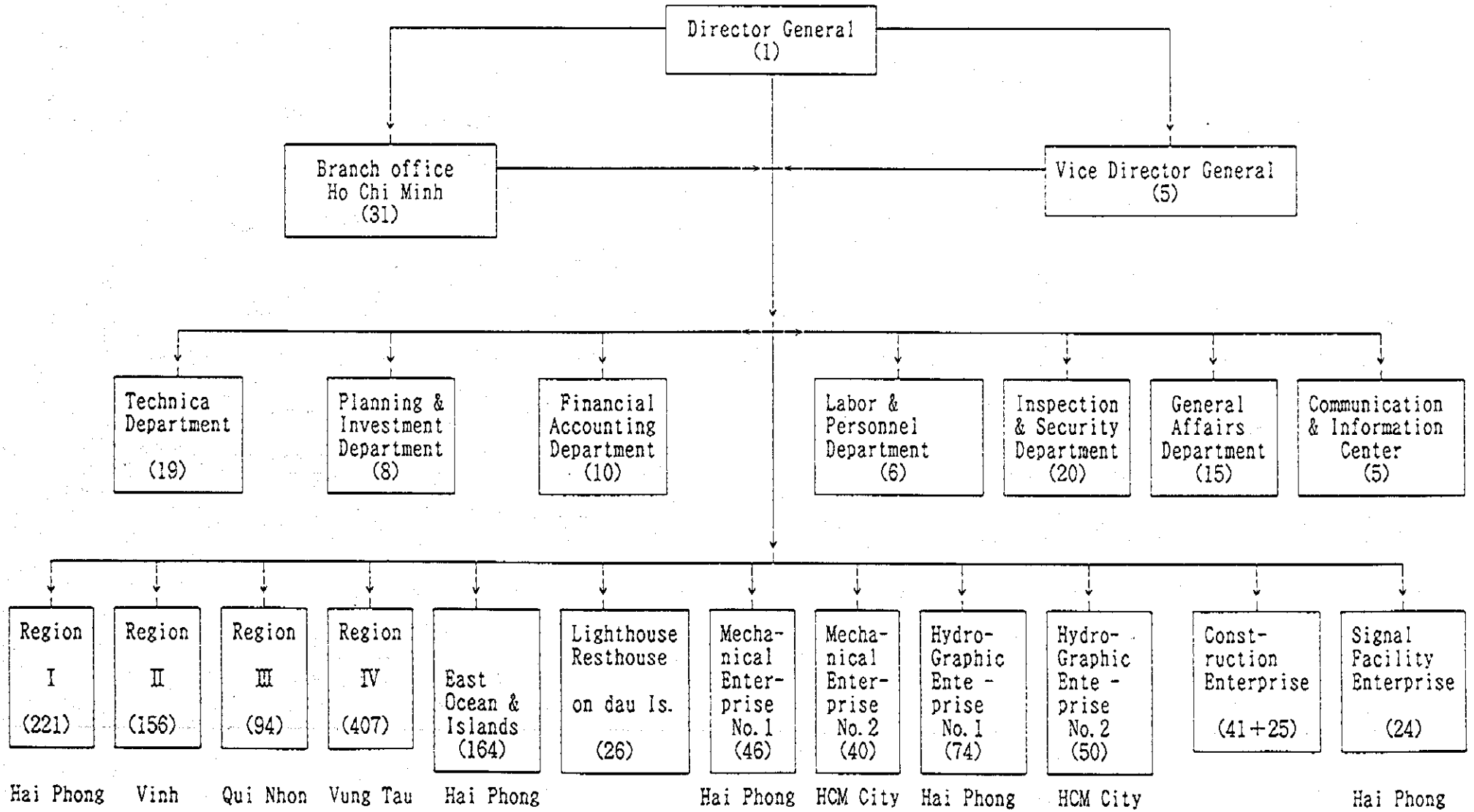


Figure 3.3
ORGANIZATION OF VIETNAM MARITIME SAFETY (VMS)



( ): Number of personnel

3.3 Problems And Issues

The Navaids for the safety of vessels at sea are being rehabilitated and upgraded since most existing lighthouses are still equipped with old equipment. They are classified into four 4 groups according to the size of their structure and the range of their lights, that is I, II, III and IV.

In the North, there are still lighthouses constructed in the 1950s which use equipments made in Russia, China and former Czechoslovakia. In contrast to the South, the equipment used by the lighthouses are made in the U.S. at the time of Vietnam war.

Most of these existing Navaids are old, and are not functioning properly. In addition, some of them do not comply with the required international IALA specifications.

It is noted that the existing Navaids are being kept in good condition, although the installation and the construction specifications differ. It was also observed that electrical wiring and connections within the structure is not properly installed and maintained.

There is a considerable number of Navaids that were constructed and presently controlled by local people's committees. Although not all have been identified, it is essential that there should be a complete list of all the lighthouses in Vietnam including those which are under the control of the people's committees.

Furthermore, the specifications of lighting apparatus, control devices and supply of Navaids are obsolete, so much so that they are difficult to operate economically and efficiently.

The situation is similar with respect to the support facilities of Navaids. They are obsolete, and their equipment as well as their parts are in short supply. It is necessary to provide maintenance workshops with the necessary facilities and spare parts.

Equally important is to equip these support vessels with Navaids. Further, workmanship of the staff must be acceptable. It is likewise necessary to prepare accurate hydrographic maps so that the vessels can effectively use the Navaids to ensure their safe navigation.

Chapter 4. Formulation of Development Plan

The total length of Vietnam's coastline is 3,260 km (1,760n.m.) not including Truong Sa islands. In addition, there are numerous river routes that lead to main ports such as HaiPong and Ho Chi Minh. To ensure safety of sea navigation along these routes, it is imperative that lighthouses, light beacons and light buoys be provided to make sea navigation safe . However, there are routes such as those controlled by the Waterway Bureau and people's committees that are not included in this development plan..

4.1 Aids to Navigation

A lighthouse is defined to be "an attended" Navaid while light beacons are commonly unmanned. However this classification may no longer be appropriate because of the latest technological innovation that made it possible to operate a lighthouse unattended.

For this report, a lighthouse is differentiated from a light beacon by their light ranges. A fixed light beacon is called a lighthouse whose light range is 15 n.m. or more while a light beacon has a range of less than 15 n.m..

Under this development program, light beacons are given higher importance over Radio Aids to Navigation. However, some radio aids to navigation must be found to be economically viable before they are prioritized for rehabiltiation.

4.1.1 Lighthouse

The number of light units installed will be determined assuming that at least one light can be visually recognized by a ship from the coast line and two or more lights can be recognized whenever vessels navigate the main traffic route; in both cases, it is presumed that the distance be within 10 n.m..

Priority is given to the existing lighthouses which require repair, improvement and rehabilitation works. The reconstruction of the unoperational lighthouses is given equal importance.

In addition, small to medium size beacons will be constructed, instead of large-size lighthouses. These lighthouses will be powered by solar battery so that they can be operated unmanned and are to be inspected once every three months.

Under the short-term priority program, both the reconstruction works of existing lighthouses and the construction of new lighthouses will be undertaken so that at least one point of reference is provided to the vessels which navigate within 10 n.m. from the coast of the main sea lanes.

(a) Study of the Most Appropriate System

The study is undertaken based on the following factors: optical light range, and the economic aspects of construction and operation.

1) Optical Light Range

The relationship between geographical visual range and luminance intensity is calculated and shown in Table 4.1.

Table 4.1

LIGHT HEIGHT VS GEOGRAPHICAL VISUAL RANGE AND INTENSITY OF LIGHT

Height of Light (m)	Geographical visual range (nm) (Ship's h=5m)	Intensity of Light (cd) T=0.75
5	9.5	987
10	11.2	2,563
15	12.7	5,125
20	13.9	9,000
25	15	14,600
30	16	22,400

Height of Light (m)	Geographical visual range (nm) (Ship's h=5m)	Intensity of Light (cd) T= 0.75
50	19.3	88,500
75	22.6	328,700
100	25.4	956,500
150	30.1	5,505,000
200	24.1	23,093,000
250	37.5	80,090,000

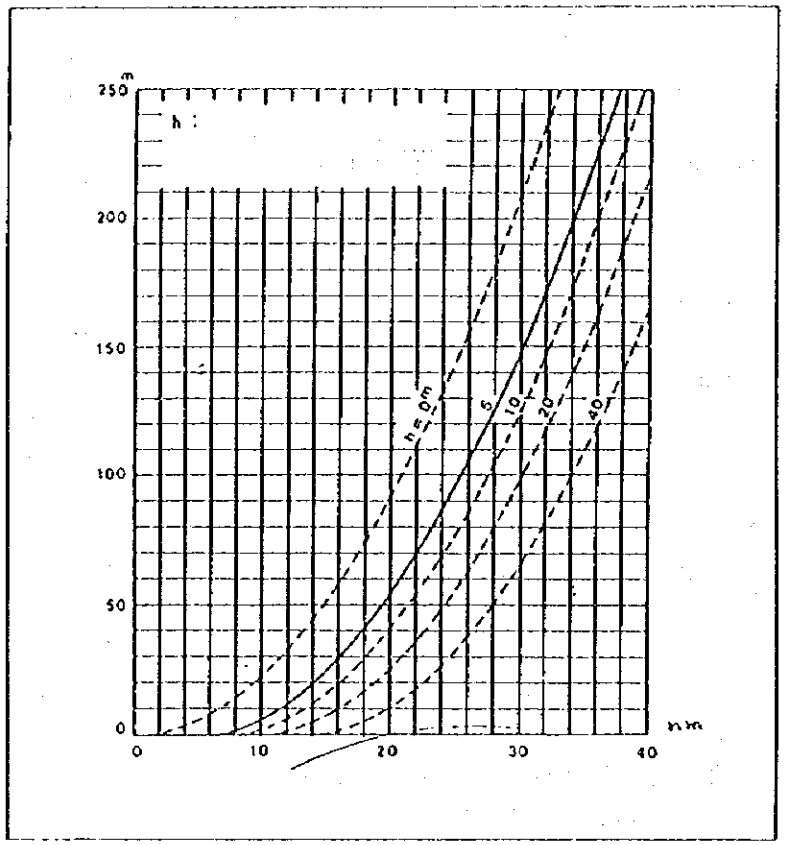
The figures in this table are derived from $I = E * (1.852d)^2 / T\ d$

Where,
- I: luminance intensity (cd)
- E: threshold value of illumination (lx) = 2x10 -7 lx = 0.686 s.m.c
- T: transmission factor of atmosphere (ordinarily 0.74)
- d: distance (n.m.)

2) Geographical Light Range

The geographical light range is presented in Table 4.2

Figure 4.1
GEOGRAPHICAL LIGHT RANGE



Geographical light range

The figures are derived from d = 2.083 (H½+h½)

Where, d: distance (n.m.)
H: high above sea level up to lighting apparatus (m)
h: eye height of observer (published figure is 5m)

(b) Study to Determine the Number of Installations

The following requirements were identified to determine the number of lights required to secure the safety of all vessels which navigate within 10 n.m. from the coast of Vietnam.

- Light range should be approximately 16 n.m..
- Altitude of lighting apparatus should be 30 meters above sea level. The height of the tower is determined based on the topography.
- Effective light intensity should be approximately 30,000 c.d.
- Power supply should be solar cell battery system.

1) Number of Lighthouses Required

The distance between two adjacent lighthouses should be approximately 25 n.m. in order to have at least one reference point available to all the vessels which navigate within 10 n.m. from the coast.

Since the total length of Vietnam coastline is 1,760 n.m., the number of units required is 70 units (1,760/25). As of March 1996, there are 54 existing lighthouses, with an average light range of 16.2 n.m., which is almost equal to the specification of new lighthouses that will be constructed.

Among these 54 units, 11 units are located in TRUONG SA islands, the remaining 43 units are located along the coast. Around 27 units (70-43) are still required.

2) Number of Units for Cross Reference

In order to make at least two reference points available for vessels which navigate within 10 n.m. from the coast, the required number will be twice the number of lighthouses, which is 140 or 70 x 2. However, if two reference points are required around main ports and critical sea routes, they will then be limited to only Haipong, Cua Lo (Vinh), Danag, Qui Nhon, Nha Trang and HCMS.

They will to approximately be equivalent to 1/5 of the total length of the coast. In this case, the required number of lighthouses will be 84 (70+ 70/5). Since there are already 43 existing units, then the remaining 41 units will be newly constructed.

3) Standard Facilities Required

Power Supply Facilities
The main source of power is solar and air-cooling type diesel engine generators will be provided as stand-by units. The standard power supply system is to be used for the above.

Lighting Apparatus, Lantern and Control Device.
Lighting apparatus is required to provide more than 16 n.m. (T = 0.74) of optical light intensity.

Light Tower and Power Supply House
The standard type of light towers should be made from reinforced concrete and/or FRP with height ranging from 10 to 30 m. The tower height will be determined based on existing site conditions.

The power house, which contains the aircooled diesel engine generators as power source will be constructed adjacent to the light tower.

Radar Reflector

Radar reflector should be installed at all lighthouses since, the efficiency of radio wave reflection of FRP is not so high.

Maintenance

The maintenance and monitoring must be conducted once every 3 months, and the safeguarding and visual checking of light facilities should be entrusted to local residents.

(c) Development Plans

Along with the establishment of a long-term Navaids development program for the year 2010, a short-term priority development program was formulated for the year 2000.

1) Improvement and Rehabilitation

Out of the 54 lighthouses presently operating in Vietnam, 30 units are functioning properly. However, the remaining 24 units, require immediate improvement and rehabilitation.

2) Re-Construction

Following are the 11 lighthouses which are presently not operational but they can be used once rehabilitation measures are taken.

Table 4.2

IMPROVEMENT AND REHABILITATION

Region	Name of Light	Geographic coordinate
I	VINH THUC	21° 23' 48" N 107° 59' 30" E
	COTO	20° 59' 48" N 107° 45' 10" E
	SOIDEN	20° 49' 37" N 107° 17' 25" E
	QUAT LAM	20° 11' 05" N 106° 21' 30" E
	LACH TRAO	19° 47' 30" N 105° 55' 24" E
	BIEN SON	19° 20' 20" N 105° 49' 14" E
II	CUA HOI	18° 45' 41" N 105° 45' 14" E
	CUA SOT	18° 27' 23" N 106° 56' 07" E
	NHAT LE	17° 28' 45" N 106° 37' 06" E
	CUA VIET	16° 54' 06" N 107° 11' 30" E
	TIEN SA	16° 08' 15" N 106° 19' 36" E
	LA SON	15° 23' 10" N 109° 08' 45" E

Region	Name of Light	Geograhic coordinate
III	PHUOC MAI	13° 45' 34" N 109° 15' 23" E
	HON CHUT	11° 46' 54" N 109° 12' 55" E
	NUI CHUT	12° 12' 00" N 109° 13' 00" E
IV	DINH AN	09° 33' 00" N 106° 33' 00" E
	HON CHUOI	08° 57' 00" E 104° 32' 00" N
	NAM DU	09° 38' 00" E 104° 39' 00" N
	NUI NAI	10° 22' 00" N 104° 26'00" E
	THO CHU	09° 28' 00" N 103° 28' 00" E
	BA DONG	09° 41' 05" N 106° 34' 55" E
	AN THOI	10° 00' 00" N 104° 03' 00" E
	DUONG DONG	10° 11' 04" N 104° 02' 08" E
	RACH GIA	10° 07' 00" N 105° 04' 00" E
Total		24

Table 4.3

EXISTING LIGHTHOUSES (NOT OPERATIONAL)

Region	Name of Light	Geographic coordinate
I	Dien Dien	20° 33' 26 N 107° 59' 30" E
	Lach Quen	19° 06' 14" N 105° 45' 14" E
II	Mui Ron	18° 07' 03" N 106° 25' 19" E
	Cua Tung	17° 01' 06" N 107° 06' 18" E
III	Ba Ngoi	11° 54' 00" N 109° 09' 00" E
	Cua Tieu	10° 15' 00" N 106° 26' 00" E

Region	Name of Light	Geographic coordinate
IV	Ong Doi	10° 00' 00" N 104° 03' 00" E
	Ba Lang	15° 14' 00" N 108° 56' 00" E
	Ham Ninh	10° 11' 04" N 104° 02' 08" E
	Con Dao	08° 41' 00" N 106° 35' 00" E
	Da Trang	08° 38' 05" N 106° 36' 05" E
Total		11

Table 4.4 presents the 26 lighthouses which are to be constructed starting from year 2000 to 2010.

Table 4.4
LIGHTHOUSES TO BE CONSTRUCTED FROM YEAR 2000 TO 2010

Name of Light	Geographic coordinate	Range (nm)
CHON MAY	16o 20' 17" N 108o 01' 02" E	16
HON HAI	09o 58' 00" N 109o 05' 00" E	25
MY THANH	09o 21' 05" N 106o 10' 00" E	14
HON DOC	10o 19' 00" N 104o 19' 00" E	14
HON CHONG	10o 38' 00" N 104o 38' 30" E	14
BAI CA MAU	08o 08' 00" N 103o 35' 00" E	14
HON BAI	20o 44' 16" N 107o 10' 26" E	15
LACH GIANG	20o 00' 00" N 106o 12' 30" E	14
CUA TU HIEN	16o 21' 20" N 107o 55' 10" E	13
VAN CA	15o 25' 30" N 108o 47' 50" E	14
CUA DAI	15o 52' 07" N 108o 23' 06" E	13
SA KY	15o 13' 00" N 108o 55' 03" E	13
TINH LUONG	15o 10' 00" N 108o 54' 00" E	13
MY A	14o 49' 07" N 108o 59' 07" E	13
GANH DEN	13o 22' 00" N 109o 17' 00" E	13
HON DO	12o 29' 00" N 109o 21' 00" E	15
PHAN RANG	11o 35' 02" N 109o 03' 00" E	13
PHAN RI	11o 10' 00" N 108o 33' 07" E	13
PHAN THIET	10o 55' 00" N 108o 06' 00" E	13
DONG TRANH	10o 22' 30" N 106o 52' 00" E	13
GANH HAO	09o 01' 00" N 105o 25' 00" E	13
CUA BO DE	08o 43' 42" N 105o 14' 30" E	13
CUA LON	08o 43' 30" N 104o 50' 30" E	13
ONG DOC	09o 02' 00" N 104o 48' 00" E	13
HON THOM	09o 57' 00" N 104o 01' 00" E	15
CON LOI	09o 52' 54" N 108o 41' 36" E	13
Total 26		

3) Summary of Development and Improvement Plan

The number of single reference points are 81 for single reference and 97 for reference points, as shown in Table 4.5.

Table 4.5
NUMBER OF LIGHTHOUSES TO BE DEVELOPED

Reference Method	Necessary	Number to be developed Year 2000	Year 2010	Total number to be develop
Single Reference	81 (70 + 11)	37 (81 - 44)		
Cross Reference	97 (84 + 13)		16 (97 - 81)	53

Note (1): These are necessary instrument to cover the coastal line

Presented in Table 4.6 presents the development and improvement plan for lighthouses.

Table 4.6
DEVELOPMENT AND IMPROVEMENT PLAN

Term and Period	Up to Year 2000	Up to Year 2010 (Supplement)	Total
Improvement and rehabilitation	24	-	24
Re-construction	11	-	11
Development	26	16	42
Total	61	16	77

4.1.2 Light Beacon and Light Buoy

The Navaids shall be installed along sea lanes approaching the main ports on the coast and water channels of Vietnam to ensure safety of vessel navigation. These ports and channels are concentrated in CUA ONG (CAM PHA port, TU LONG Channel), HON BAI (HA LONG bay, HON GAI port), HAI PHONG (river and channel), CUA LO/BEN Thuy, DANANG, QUI NHON TRANG AND SAIGON.

There are 72 light beacons and 400 lighted buoys which are already installed to cover these sea lanes. Among these, around 53 light beacons and 318 light buoys are under the VMS administration, while the rest of the light beacons and light buoys are outside the control of VMS. Several water channels are not well lighted at night for navigation. To

improve this situation, a rapid development program for light beacons and light buoys must be implemented.

(a) Light Beacon

1) Study of An Optimum System

In order to standardize the specifications for light beacons it is important that there be guidelines and standards in installing these facilities at the port entrances, and these include:

- Light range shall be approximately 13 n.m.
- Height of light apparatus shall be approximately 20 m above the sea level and the height of the tower shall conform with the topography of the specific site.
- Effective light intensity shall be approximately 9,000 c.d.
- Power supply shall be made from solar batteries.

On the other hand, standards for small-size beacons installed at entrances serving as leading light for water channels, hidden rocks and reefs, dangerous water lanes and breakwaters shall be as follows:

- Light range shall be up to 10 n.m..
- Height of lighting apparatus shall be approximately 8 m above sea level and height of light towers should conform with the topography of the particular site.
- Effective light intensity shall be approximately 2,000 cd.
- For power supply, solar cell with battery shall be used.

2) Development Plan

As of March 1996, the number of existing light beacons installed in various areas of Vietnam is presented in the table below which indicate both the number of light beacons that require rehabilitation and new construction.

Table 4.7

NUMBER OF EXISTING, REHABILITATION AND CONSTRUCTION REQUIRED

Name of Place	Existing Number of Stations	Rehabili-tation (for Year 2000)
CUA ONG (CAM PHA port. TU LONG) channel	* 14	* 1
HON BAI (HALONG bay, HON GAI port)	3	* 1
HAI PHONG (BACK DONG river and channel)	17	
CUA LO/BEN THUY	3	1
DANANG	6	1
QUI NHON and NHA TRANG	2	1
SAI GON	20	5
DINH AN	2	
DIEN CONG	* 2	
OHA RUNG	* 1	
KY HA	* 1	
Total	72	10

* Ave. outside the control of VMS.

There will be 77 additional light beacons that are to be constructed by the year 2000 and to be managed by VMS.

(c) Light Buoy

1) Study of an Optimum System

Light buoys are used as beacons to indicate the lanes in approaching ports and the narrow waterways of rivers, water channels, etc. The development program is intended to install these buoys to aid vessel navigation at night.

Furthermore, with the construction of waterways along with the development of ports and harbours, the allocation of light buoys must be studied.

The lighting apparatus of light buoys shall consists of several lamps of 12V/10W and powered by solar cell batteries. The light range shall be approximately 4 n.m.. Refer to Table 4.8.

Table 4.8
BUOY BODIESSTANDARDIZED IN VIETNAM

Parts / Materials	Type I Ø2M00	Type II Ø2M40	Type II Ø2M40
Overall height	5.5m	5.7m	6.0m
Focal plan heught	4.5m	4.7m	5.0m
Float dimension	2.0m dia.	2.4m dia.	2.88m dia.
Total weight	3.7ton	5.27ton	9.4ton
Buoyancy	4.6ton	4.7ton	11.8ton
Max. Current velocity	3.8ton	3.8ton	3.8ton
Max. Wind velocity	53.0m/s	53.0m/s	53.0m/s
Wave height	3.0m	3.0m	3.0m
Mooring Chain	30.0mm dia.	34.0mm dia.	34.0mm dia.
Bridge Chain	34.0mm dia.	38.0mm dia.	38.0mm dia.
Sinker	Concrete 4ton	Concrete 6ton	Concrete 6ton
Shackle	42.0mm dia.	45.0mm dia.	45.0mm dia.
Swivel	45.0mm dia.	48.0mm dia.	48.0mm dia.

2) Development Plan

There should at least be one buoy per one n.m. In the case of water channels of sea-cum riverways, the buoys shall be installed on both sides of the channels to show the center of the navigation lane. At the critical turning points, smaller size buoys shall be installed.

As a result, the total number of buoys to be installed at narrow channels such as rivers will calculated by the following equation:

$$2(L + T)$$

where, L: length of channel (n.m.)
T: number of turning point

The standard criteria of maintenance, such as surface preservation of steel materials and painting of buoys shall be improved.

In order to meet the requirements of regular and emergency replacement of buoys, the extra units shall be kept ready.

With respect to HONG GAI, HAI PHONG and SAI GON the number required is calculated by the above equation of N=2(L+T) since the length of their lanes are known clearly, while, with respect to other areas, the number required is estimated by simply multiplying the existing number by 1.5.
The number of buoys required will be reviewed according to the progress of reconstruction works.(Refer to Table 4.9).

Table 4.9

DEVELOPMENT PLAN OF ILLUMINATED BUOYS

Region	Name of place	Existing number of Buoys (a)	Number of requirement 2(L+T) (b)	New installation to be required (b) -(a)	Channel length No. of turning point. (estimated)
I	CUA ONG (CAM PHA port, TU LONG Channel)	* 17	25	8	
	HON BAI (HALONG BAY, HON GA Port)	26	42	16	16n.m., 5
	HAI PHONG (BACK DONG River and Channel)	42	54	12	20n.m., 7
II	CUA LO/ BEN THUY	8	12	4	
	DANANG	11	16	5	
III	QUI NHON/ NHA TRANG	17	25	8	
IV	HO CHI MINH	58	90	32	51n.m., 30
	DINH AN	14	21	7	
	DIEN CONG	* 9	13	4	
	PHA RUNG	* 31	46	15	
	KY HA	* 9	13	4	
	CUA HOI	23	34	11	
	CUA TIEU	14	21	7	
	THI VAI	23	34	11	
	THANH HOA	* 16	24	8	
		318	474	156	

* Outside the control of VMS.

4.1.3 Visual Aids for Sea-Cum-Riverways

The Aids to navigation such as light buoy should be planned according to related port development plan and requirement for transport network for Lach Giang estuary to Ha Noi. Nam Trieu estuary to Hai Hong. Dinh An estuary to Can Tho, Can Tho to Via Vam Nao pass (Cambodian border), Soai Rap estuary to HCM and HCM to Dong Nai.

The number of units for installation up to the year 2000 is estimated using the following method except for Hai Phong. Ho Chi Minh and Can Tho to Cambodian border route.

Both red colored buoys and green colored buoys are placed for every one nautical mile (nm) along the waterway route to delimit the navigation lane. Light beacons are also placed every 3 n.m. for same purpose.

Entrance channel of river mouth is delimited by placing 10 red colored buoys and 10 green colored buoys on both sides of the route.

Table 4.10
DEVELOPMENT PLAN OF VISUAL AIDS FOR SEA-CUM RIVERWAYS

River Route	Signal Type	Existing (a)	Number of Requirement (b)	New installation Required (b-a)	Channel Length (in nm)
Lach Giang estuary to Ha Noi	Beacon	* 58	25	25	76
	Buoy	* 283	172	172	
Nam Triew estuary to Hai Hong	Leading light	4	4	0	19
	Beacon	7	7	0	
	Buoy	42	58	16	
Dinh An estuary to Can Tho	Beacon	* 14	14	14	43
	Buoy		106	106	
Can Tho to Via Vam Nao pass (Cambodiam border)	Beacon	-	29	29	87
	Buoy	-	90	90	
Soai Rap estuary to Ho Chi Minh	Leading light	10	14	4	35
	Beacon	24	30	6	
	Buoy	58	90	32	
Ho Chi Minh to Dong Nai	Beacon	-	14	14	40
	Buoy	-	80	80	
Total	Leading light	14	18	4	300
	Beacon	31	119	88	
	Buoy	100	596	496	

4.1.4 Radio Aids to Navigation

Considering the present state of coastal vessels, there is a limited number of vessels which have radio aids to navigation on board which can be used effectively.

As a first step, therefore the plan is to have a radio system that will safeguard the safety of navigation without making any installation on-board the vessel. The second-step is to use a simple system which can be operated with simple equipment on-board.

(a) Racon

This system is convenient because this can be operated without special devices on-board as long as the vessels are equipped with radars.

1) Study of Optimum System

The optimum system will be one that will utilize dual-use of X-band and S-band under frequency-Agile method which complies to both IALA and IMO's regulation.

2) Development Plan

The racon shall be installed at lighthouses and light beacons that are located in the lanes for approaching the main ports and water channels. The main ports include CUA ON/CAMPHA port, TU LONG channel, HON BAI (HALONG bay, HON GAI port), HAIPHONG (BACK DONG river and channel), CUALO/BEN THOY, DANANG, QUI NHON/NHA TRANG and SAIGON.M. The racons shall be installed at lighthouses within a visual range of 20 n.m. or more.

Table 4.11
DEVELOPMENT PLAN OF RACON SYSTEM

Region	Site	Development	
		Year 2000	Year 2010
I	VINH THUC		o
	CO TO		o
	SOI DEN		o
	HON DAU	o	
	LONG CHAU	o	
	BACH LONG VI	o	
	BA LAT		o
	QUAT LAM		o
	LACH TRO		o
	HON.M.E	o	
II	THUAN AN		o
	TIENSHA	o	
	LY SON		o
	BALANG AN		o
III	PHUOC MAI		o
	CUA LAO XANH	o	
	MUI CHUT		o
	HON LON	o	
	HON CHUT		o
	MUI DINH	o	
	PHU QUI	o	
	KE GA	o	
IV	VUNG TAU		o
	CAN GIOHA		o
	BA DONG		o
	DINH AN		o
	BAY CANH	o	
	HON KHOAI	o	
	THO CHU		o
	Total	12	17

(b) Development Plan

HAI PHONG channel and SAI GON channels shall be the priority location areas of light beacons due to the anticipated increase in vessel traffic and congestion at these ports in the future . They will be given high priority in the implementation plan.

(b) DGPS (Differential Global Positioning System)

The DGPS system which utilizes Medium-Wave Radio Beacon (MWRB) is operating in 21 countries including the U.S., Canada and Europe, as of March 1996. It is widely used as a system to install light buoys in narrow waterways and for oceanographic surveys, among others.

One of the DGPS systems which utilizes In.m.ar-sat communication system is being used worldwide for civil use. One of these reference stations is located in Ho Chi Minh City as Sky-Fix system.

GPS is widely accepted, and user devices have become available at low cost. Under these circumstances, the U.S. Government made it clear on 29th March 1996 to continue GPS operation for civil purposes.

This system is convenient to use in Vietnam since the country has many river ports. However, GPS is operated by the U.S. Government (Air Force) and it is possible that its operations might be interrupted whenever the U.S. Government considers it necessary for its national interest.

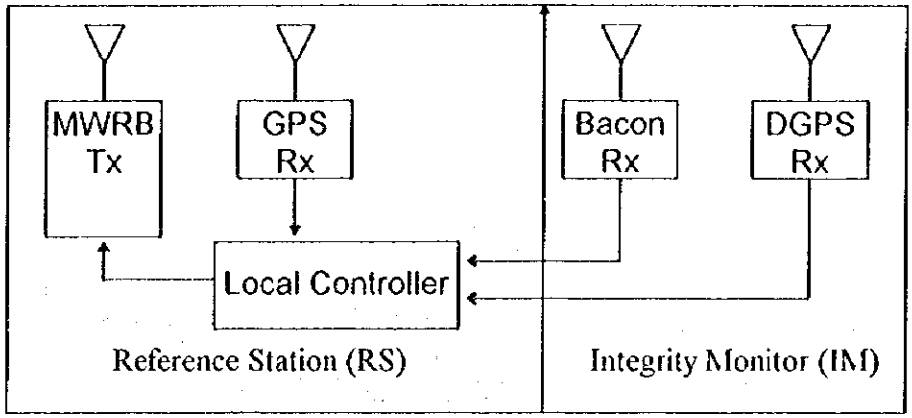
The expected positioning accuracy is less than 10 m $\pm$ (2RMS) when it is made within the range of correction signal of up to 100 n.m. in radius from MWRB station. This system is under construction in Japan at present.

1) Study of Optimum System

This system transmits GPS which is the reference data via the existing MWRB radio. The user can then correct the position data of his GPS receiver as received by the beacon receiver, and this enhances the accuracy of the position data of GPS.

Since there are no existing MWRB stations in Vietnam, it is necessary to install Maritime Radio Transmitter Station with frequency band of 285 to 325Khz, as recommended by IALA on the basis of ITU-R832 (Refer to attached sheet).

Figure 4.2
RECOMMENDED SYSTEM DIAGRAM OF DGPS REFERENCE STATION



2) Development Plan

The new station shall be installed within the location of HON DAW and VUNG TAU lighthouses. This makes it possible to use DGPS within the sea lane of HAI PHONG channel and SAI GONG channel. The new MWRB stations to be constructed will provide non-directional reference signal (Refer to Figure 4.3)

(d) Loran-C System

With the development of DGPS system, an independent radio aids to navigation is necessary and which is not influenced by the national interests of other countries. It should be an independent system of Navaids, that is effective and economical .

The development of Loran-C system is already in progress in the form of international cooperation of the North-West Pacific under the name of FERNS (Far East Radio Navigation Service) which is participated by Japan , Korea, Russia, China and U.S. The coverage of these chains reach as far as 20° latitude which is the southern edge of South Sea Chain of China. If a link can be made between FERNS and the potential Vietnam chain, it becomes possible to cover all the coastal areas of western Pacific by Vietnam chain Loran-C, (A brochure of International cooperation chain is attached as Appendix).

The basic plan for this Vietnam chain was first studied in "PRESENT STATUS AND DEVELOP DEVELOPMENT AND IMPROVEMENT PLAN" prepared by VINAMARINE February, 1994.

The coverage is shown in Figure 4.4.

Figure 4.3

DGPS COVERAGE PLAN IN VIETNAM

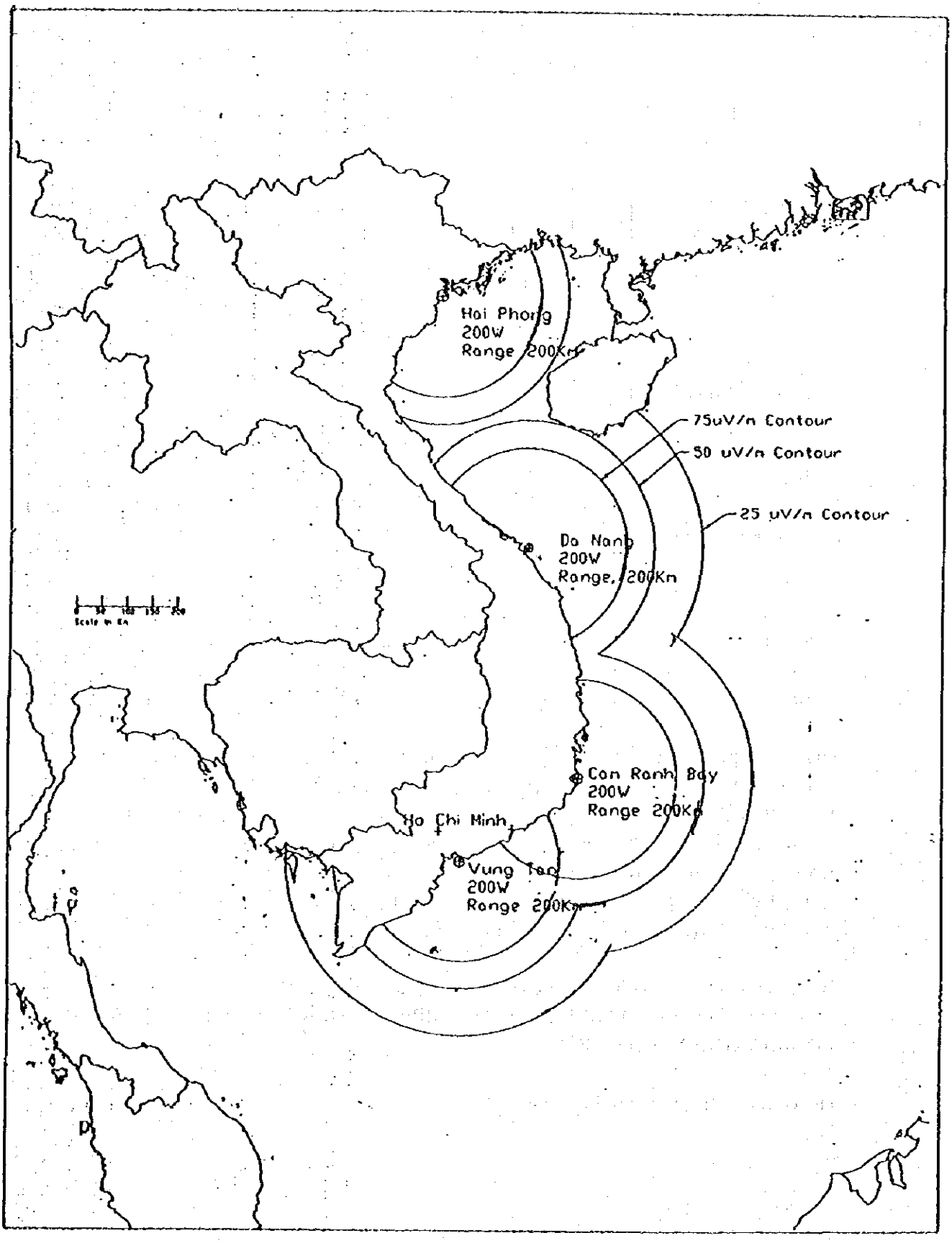
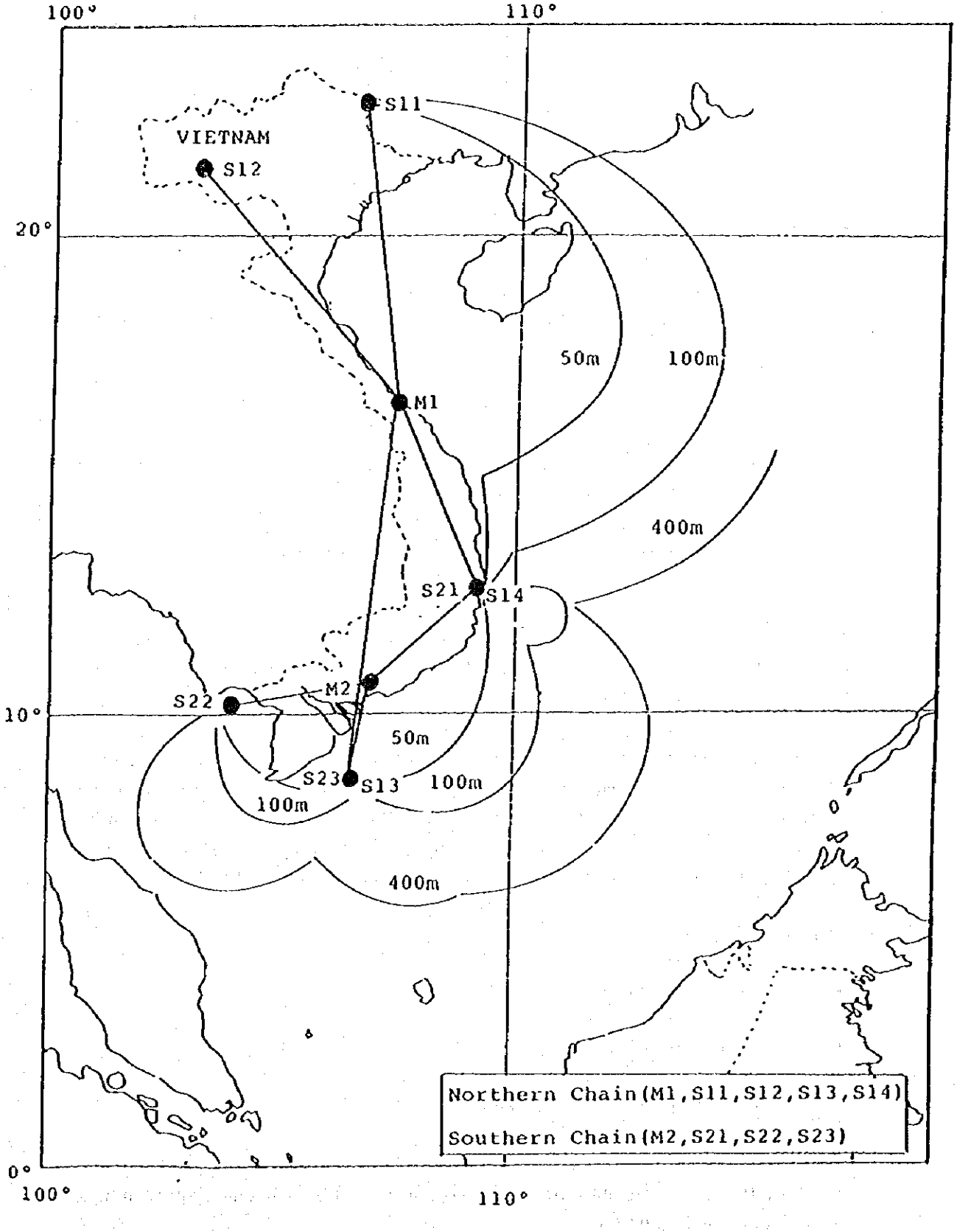


Figure 4.4

PLANNED SITES OF LORAN-C STATION AND THEIR COVERAGE



(e) VTS (Vessel Traffic Service)

This is an effective system to monitor vessel movement in ports and waterways that are presently experiencing increasing vessel traffic and congestion. The system was recommended in Resolution A578 (14) of IMO dated 20th November, 1985.

The main functions of the system are as follows.

- Data Collection;
- Data Evaluation;
- Information Service;
- Navigational Assistance Service;
- Traffic Organization Service; and
- Support of Allied Activities: such as pilotage, pollution control, port-service and SAR action.

The basic equipments required are as follows:

- Communication facilities: such as VHF radio equipment to use the appropriate frequencies including international distress, safety and calling frequency.
- Surveillance radar and other equipment: such as T.V camera.
- Monitor and Control facilities with micro-wave network for radar picture and control use.

The plan for the VTS was first studied in "PRESENT STATUS AND DEVELOPMENT AND IMPROVEMENT PLAN" prepared by VINAMARINE, February 1994.

According to latest information from VISHPEL (Vietnam Ship Communication and Electronic), there are two implementation programs for VTS . The first program will be located at Sai Gon river and to be undertaken as Phase I. The system will be completed by Year 1997 with the support of the Canadian Government. Phase II will be located at Hai Phong port to Hong Gai port, and will be completed by year 1999.

4.2 Support Facilities

The main support facilities are as follows.

- Supporting vessels;
- Communication facilities;
- Quays and Mooring facilities; and
- Workshop and Factory

Most of the above facilities that are existing are outmoded and require immediate rehabilitation and upgrading.

(a) Support Vessels

The existing number of support vessels at present include one buoy tender of 400 tons and nine boats of 50 tons for the purpose of inspection and maintenance. The actual maintenance of buoys is undertaken by a 50-ton vessel.

It is recommended that a support vessel be constructed as shown in Table 4.12.

Table 4.12
CONSTRUCTION PLAN OF SUPPORTING VESSELS

Type of Vessel	Year of Construction	Region					Recommended-tonnage
		I	II	III	IV		
Multi-purpose (buoy tender, supply and rescue)	Up to 2000				1	1	500 ton
	2010	1				1	* 75 ton
Small ship (Inspection, patrol, maintenance and rescue)	2000	3	1		3	8	
	2010	1		1	1	3	

* Refer to attached brochure which are standarized to use patrol for ATN at JMSA recently.

(b) Communication Facility

There are no existing general public telecommunication facilities within the existing lighthouses and they have to rely only on radio communications. At present, the main existing lighthouses are equipped with HF SSB Transceiver 100W. However, not all lighthouses will be equipped with such communication equipment even in the year 2000 for security reasons.

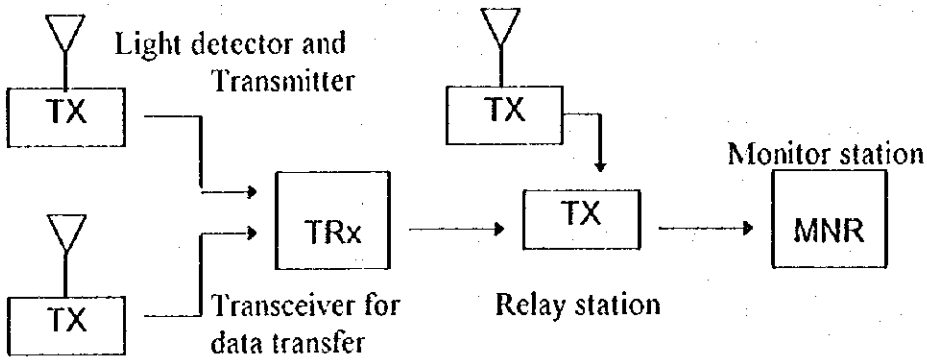
The key station is the Coastal Radio Station of VMS (VISPHEL at present). A regular communication system shall be established to make communication with supporting vessels.

(c) Light Monitoring System

Along with installation of unmanned light beacons, a plan will be made to introduce light monitoring system for the light beacons by using radio network as soon as possible.

1) Study of Optimum system

The standard composition of light monitoring system is as follows.



The TRx station is installed at site where good condition is available for radio transmission. This station receives data from multiple TX stations and transmit them to RL station which can also receive direct signal from TX station without going through Trx station. The frequency used are from 55 Mhz, with the signal transmitted at 100 baud of FSK.

One system is able to monitor as many as 50 units of light beacons and more than 8 items of monitoring data are also available. The principal monitoring items include light-out, of normal light bulb. The power supply of equipment of light monitoring system shall be made independent to that of the light beacon and light buoy.

(d) Quays and Mooring Facility

There is a buoy base in VUNG TAU, and vessels of 500 to which 600 tons can come along side the pier. However, the lighthouse-related facilities that were constructed in the 1960s did not consider the need for support facilities. Therefore, these support facilities shall be provided when rehabilitation and installation work of lighthouses are undertaken in the future.

(e) Workshop and Facility

There is one workshop for each Region, one factory in Hai Phong and one in Ho Chi Minh. All these are equipped with obsolete equipment and have no sufficient facilities.

A rehabilitation program of these workshops and factories together with the construction of Navaids will be undertaken. However in the case of factories, since they produce a variety of products other than ATN-related equipment, the plan therefore will be limited to the rehabilitation of workshops, while the rehabilitation of factories will be separately undertaken.

The main facilities are as follows:

- Iron work machine;
- Wood work machine;
- Cutting and welding machine;
- Compressor and pump;
- Hand tools;
- Bench tools;
- Transportation equipment;
- Generator set;
- Test and measuring instrument;
- Maintenance instrument; and
- Buoy positioning system;

4.3 Education and Practical Training

Based on the modernization of aids to navigation, it is necessary to provide the personnel engaged in maritime safety with opportunities and institutions to get the much needed education and training for their duties. There are existing educational organizations, Maritime Technical Training Schools (MTTS) in Hai Phong and Ho Chi Minh which provide the curriculum designed for lighthouse keepers.

In addition to MTTS, there are higher educational institutions in both Hai Phong and Ho Chi Minh which is the Vietnam Maritime University (VIMARU). The deck department and the electricity department of these institutes have relevant curriculum subjects such as Marine Aids to Navigation and Marine Radio Equipment.

However, since none of these educational institutions are solely concentrated on maritime safety duties, it can be expected that their graduates may not turn out to be capable of leading maritime safety organizations. Therefore, it is recommended that there's a need to establish new educational institutions whose main purpose is to recruit VMS personnel.

In order to materialize these objectives, it is necessary to prepare a training course for the instructors to improve their technical expertise. It is further recommended that " Special Overseas ATN Training" for them and "Special Domestic ATN tarining" for them and "Special Domestic ATN Training" for trainors of practical activities is to be undertaken.

In addition, a foreign expert can be appointed as an adviser and be based in Hai Phong to provide assistance, advice and instruction in the development of Navaids and who will take the responsibility of preparing the modernization program.

Table 4.13
SPECIAL OVERSEAS ATN TRAINING

	Special Overseas ATN Training
1.	Number of trainees Ten(10) persons from VMS
2.	Number of course One (1)
3.	Period of course Three (3) month
4.	Number of coordinator Three (3) coordinators, (1) month
5.	Foreign instructors Maritime safety and ATN experts with training coordinator
6.	Curriculum for the course See attached Table A.

Table A Curriculum for the Special Overseas ATN Training

1) Service background and motivation
- International standardization of aids to navigation system
- Overall organization
- Special tasks
- Cooperation between the organizations

2) Maritime safety
- International conventions and laws
- Prevention of maritime accident
- Pollution
- Oceanography

3) Organization
- International organizations
- Establishing operation and maintenance procedures
- Establishing operation and maintenance program
- Organization staff resources
- Budgetary planning and control
- Future planning
- Recruitment and training

4) Administration tasks
- Maintenance plan and execution
- Procurement plan
- Data and records publications
- Budgetary procedures

5) Navigational warnings
   - Notification of casualties
   - General notice to mariners
   - Navigational warnings
   - Casualty records

6) Aids to Ship Navigation

Table 4.14
SPECIAL DOMESTIC ATN TRAINING

Special Domestic ATN Training	
1.	Number of trainees Thirty (30) persons from each regional VMS
2	Number of courses One (1)
3.	Period of course Two (2) month
4.	Foreign instructors Two (2) ATN experts with one (1) training coordinator from overseas and one (1) interpreter from overseas
5.	Vietnamese instructors ATN experts from VIRAMINE (VMS)
6.	Curriculum for the course See attached Table B.

Table B Curriculum for the Special Domestic ATN Training

1) Maritime safety

2) Organization

3) Administration

4) Maritime Aids to Navigation

- Basic theory
- Use of equipment and devices
- Safety
- Routine maintenance
- Fault finding
- Work at sea
- Practical applications of study
- Basic theory and rule of wiring work for electric power line
- Advanced fault finding and repair

Chapter 5. Cost Estimation

In this section, the cost has been estimated on the condition that the Vietnamese Government would tap ODA fund to implement the proposed projects. It is therefore the cost is divided into foreign currency and local one.

5.1 Projects up to the Year 2000

(1) Visual Aids

Improvement	Type of Equipment (Tower height)	Number of Require-ment	Foreign Currency (US$) Price per Set	Foreign Currency (US$) Amount	Foreign Currency (US$) Price per Set	Foreign Currency (US$) Amount
[Lighthouse]						
Rehabilitation		24		3,656,760		0
	I (30m)	6	148,036	888,216		0
	II (20m)	4	153,808	615,232		0
	III (10m)	11	153,808	1,691,888		0
	IV (10m)	3	153,808	461,424		0
Re-Construction		11		1,837,562		1,771,000
	I (30m)	1	299,482	299,482	280,000	280,000
	III (10m)	1	153,808	153,808	149,100	149,100
	IV (10m)	9	153,808	1,384,272	149,100	1,341,900
New Installation		26		3,999,008		3,977,500
	II (20m)	1	153,808	153,808	250,000	250,000
	III (10m)	5	153,808	769,040	149,100	745,500
	IV (10m)	20	153,808	3,076,160	149,100	2,982,000
Sub Total		61	-	9,493,330	-	5,748,500
[Light Beacon]						
Rehabilitation	10m Height	10	108,120	1,081,200		0
New Installation						
Managed by VMS	10m Height	77	108,120	8,325,240	149,100	11,480,700
Sub Total		87	-	9,406,440	-	11,480,700
[Lighted Buoy]						
Managed by VMS Type III		156	27,260	4,252,560		0
Sub Total		156	-	4,252,560	-	0

Total: US$ 40,381,530

Daily average sunshine duration (hour) = 5.7 hours per day
No-sunshine days per month = 11 days
Source: Meteorological Data Hanoi, 1996
Monthly Average Sunshine Duration (hour) for Recent 20 Years

(2) Radar Beacon (RACON)

Improvement	Type of Equipment	Number of Requirement	Foreign Currency (US$) Price/Set	Foreign Currency (US$) Amount	Local Currency Price/Set	Local Currency Amount
(Racon)	X-band and S-band	12	40,000	480,000		
New Installation	Frequency-Agile					
		12		480,000		Unknown

(3) Workshop Facility

Type of Equipment	Number of Requirement	Foreign Currency (US$)		Local Currency	
		Price/Set	Amount	Price/Set	Amount
1. Iron work machine	4	221,000	884,000		
2. Wood work machine	4	15,000	60,000		
3. Cutting and welding machine	4	20,000	80,000		
4. Compressors and Pump	4	9,000	36,000		
5. Hand tools	4	2,000	8,000		
6. Bench tools	4	12,000	48,000		
7. Transportation equipment	4	362,000	1,448,000		
8. Generator set	4	40,000	160,000		
9. Test and measuring instrument	4	49,000	116,000		
10. Maintenance instrument	4	23,000	92,000		
			2,932,000		Unknown

(4) Supporting Vessel

Type of Vessel	Number of Vessel Required	Foreign Currency (US$)		Local Currency	
		Price/Set	Amount	Price/Set	Amount
Multi-purpose (buoy tender, supply and rescue) 400t type	1	15,000,000	15,000,000		
Small ship (Inspection, patrol, maintenance and rescue) 80t type	8	8,000,000	24,000,000		
Small boat (Patrol, maintenance) 5t type	8	280,000	2,240,000		
			41,240,000		Unknown

5.2 Projects between 2001 and 2010

(1) Visual Aids

Type of Equipment	Number of Requirement	Foreign Currency (US$)		Local Currency (10^3 VND)	
		Price/Set	Amount	Price/Set	Amount
Lighthouse - New Installation					
I (30m)	0	148,036	2,368,576	250,000	4,000,000
II (20m)	16				
III (10m)	0				
IV (10m)	0				
Light Beacon - New Installation	82	58,225	4,776,910	48,100	11,480,700
Light Buoy - New Installation	448	27,260	12,212,480		0
Total	—	—	19,357,966	—	15,480,700

(2) Radar Beacon (RACON)

Type of Equipment	Number of Requirement	Foreign Currency (US$)		Local Currency	
		Price/Set	Amount	Price/Set	Amount
X-band and S-band, Frequency Adile	16	40,000	640,000		
			640,000		unknown

(3) Light Monitoring System

Light Monitoring System (Hai Phong and Ho Chi Minh channels) 2 Systems	Foreign Currency (US$)	Local Currency
A. Equipment	9,840,000	
1. Light monitoring system	5,059,000	
2. Workshop equipments (include equipment for measurements illuminating intensity of lamp)	4,789,000	
B. Freight and Insurance (2% of equipment cost)	197,000	
C. Installation	576,000	
D. Training	477,000	
1. Domestic training (one course for 20 persons/2 months)	175,000	
2. Overseas training (one course for 5 persons/3 months)	302,000	
E. Consultation Consultation cost should be quoted separately on request)	—	
F. Inland Transportation	0	—
	11,098,000	unknown

(4) Differential Global Positioning System (DGPS)

DGPS System (Hai Phong, Da Nang, Can Ranh Bay, Vung Tau) with Remote Control Station	Number of Station	Estimation Foreign Currency (US$)	
		Unit Price	Total Price
Reference station system	4	840,000	3,360,000
Remote control station system	4	289,000	1,156,000
Service test equipment	2 sets	52,000	104,000
System training	1 set	73,000	73,000
Grand Total			4,693,000

Above estimation is quoted for equipment only.

(5) Loran-C System

Item (Ref. Fig. 4-2) Planned Site of Loran-C Station	Estimation	
	Foreign Currency (US$)	Local Currency
A. Equipment	56,296,000	
1. Equipment for installation at station		
- Master station (M1)	7,994,000	
- Secondary station (S11)	7,546,000	
- Secondary station (S12)	7,546,000	
- Secondary station (S13-S23)	8,262,000	
- Master station	7,994,000	
- Secondary station (S22)	7,546,000	
- Secondary station (S14-S21)	8,262,000	
- Monitor stations (2 stations)	1,146,000	
2. Spares	8,182,000	
B. Freight and Insurance (2% of equipment cost)	1,289,000	
C. Installation	8,850,000	
D. Training	3,265,000	
1. Domestic training (one course for 20 persons/6 months)	855,000	
2. Overseas training (one course for 10 persons/12 months	2,410,000	
E. Consultation Consultation cost should be quoted separately on request)	—	
F. Inland Transportation	0	—
	77,882,000	unknown

(6) Supporting Vessel

Type of Vessel	Number of Vessel Required	Foreign Currency (US$)		Local Currency	
		Price/Set	Amount	Price/Set	Amount
Multi-purpose (buoy tender, supply and rescue) 400t type	1	15,000,000	15,000,000		
Small ship (Inspection, patrol, maintenance and rescue) 80t type	2	3,000,000	6,000,000		
Small boat (Patrol, maintenance) 5t type	8	280,000	2,240,000		
			23,240,000		Unknown

PART 1 AIDS TO NAVIGATION APPENDICES

1. DGPS/DGNSS
2. Meteorological Data
3. List of Ships (VMS)
4. Lighthouse Rehabilitation/Improvement Plant (1996-2000)
5. List of Newbuilding Lighthouses
6. List of Newbuilding Light Beacons

Appendix 1

DGPS/DGNSS

1. Movement of International Maritime Aids to Navigation Authorities: IMO & IALA

1.1 Movements Related to SOLAS Convention

The Radio Navigation Committee of AILA (International Association of Lighthouse Authorities) forwarded the report of the 4th session of the IMO (International Maritime Organization). The sub-committee on the Safety of Navigation recommended that the Operations Committee review the proposed SOLAS (International Convention for the Safety of Life at Sea) Chapter V on Aids to Navigation.

The studies have been made by the Committee on Regulation 13 "Establishment and Maintenance of Aids to Navigation to bring their views at the 5th session.

The studies were undertaken by the Committee on Regulation 25 "Shipborne Navigational Equipment". It should be noted that the compulsory carriage requirement for direction finder has been deleted. The issue is presently discussed at IMO.

1.2. Negative Feature of Independent Use of Radio Beacon

It has been recognized and agreed by the Radio Navigation Committee of IALA that many Maritime Radio beacons have already been discontinued, and it is likely that Maritime Radio beacon services will be discontinued by the year 2000.

It is, therefore, noted by the Radio Navigation Committee of IALA that the use of the band for Radio Beacon Direction Finding Transmissions will gradually diminish over the next few years, but will continue to be used for DGPS/DGNSS (Differential Global positioning System/Differential Global Navigation Satellite System) transmission only.

1.3. DGPS/DGNSS Using Radio Beacon

It is recognized world-wide that radio beacons are to be used continuously for transmission of Differential GPS/ Differential GNSS, though in most cases all Maritime Radio beacon services will be discontinued by the year 2000.

DGPS is a radio navigation service which improves further the accuracy and integrity of US Department of Defense's Navstar GPS satellite navigation service. GPS is a constellation of 24 satellites that provide range information via ultra high radio frequencies. Position on earth is computed measuring the distance from a group of GPS satellites. GPS alone provides accuracy in the order of 100 meters or less. Position

accuracy, however, can be further improved, by identifying errors in the satellite signals and then transmitting corrections to the users for each satellite in view. This is exactly the function of DGPS.

GNSS is the international version of GPS. European countries are currently undertaking a joint study on European contribution to the GNSS, while the first meeting of the Conference Group of the EU High Level Group on Global Navigation Satellite Systems was held in Brussels on 2 October, 1995.

2. Present Implementation Status of DGPS World-Wide

The present implementation status of DGPS in the world is as follows:

Operational status: 21 countries have already been operating and 7 countries have planned to install DGPS using their radio beacons and these are shown below;

AUSTRALIA	IRELAND
BELGIUM	JAPAN
CANADA	KOREA
DENMARK	NORWAY
ESTONIA	POLAND
FINLAND	RUSSIA
FRANCE	SPAIN
GERMANY	SWEDEN
HONGKONG	USA
ICELAND	

Planning stage: 7 countries have plans to install DGPS in the near future:

ENGLAND	SARAWAK
GREECE	THAILAND
INDIA	VENEZUELA
ITALY	

Further details are given in Table 1.A.1.

Table 1.A.1 IMPLEMENTATION STATUS OF DGPS WORLD-WIDE

NO.	NAME OF COUNTRY	IALA DATA /1993 *				1996	1997	1998	TOTAL
		>10N.M. OTHER	<10N.M.		DIRECTIONAL				
1	ALGERIL	7	2	-	3				
2	AUSTRALIA	-	-	-	-	3			3
3	BELGIUM	2	2	-	-	1			1
4	BERMUDA					1			1
5	BRAZIL	14	-	-	1				
6	CANADA	63	-	-	-	16	7		23
7	CHINA	17	-	-	-				
8	IVORY COAST	1	-	-	-				
9	CROATIA	3	-	-	-				
10	DENMARK	17	1	-	2	3			3
11	ECUADOR	3	-	-	-				
12	EGYPT	-	-	6	-				
13	ENGLAND	13	4	-	-				#
14	ESTONIA	-	-	-	-	1			1
15	FINLAND	3	-	-	3	5			5
16	FRANCE	31	1	-	7	6			6
17	GERMANY	8	4	-	-	2			2
18	GREECE	-	-	2	-				#
19	HONGKONG	-	-	-	-	1			1
20	ICELAND	12	-	-	4	6			6
21	INDIA	20	-	-	-				#
22	INDONESIA	18	-	-	-				
23	IRELAND	8	3	-	2	2			2
24	ITALY								#
25	JAPAN	18	-	-	-	2			2
26	KOREA	7	-	-	-	7			7
27	HOLLAND	-	-	6	1	2			2
28	NEW ZEALAND	2	-	-	-				
29	NORWAY	22	-	-	6	10	2		12
30	POLAND	7	-	-	5	2			2
31	RUSSIA	160	-	-	1	2	17	13	32
32	SARAWAK								#
33	SOUTH AFRICA	24	-	-	-				
34	SPAIN					17			17
35	SUSAN	1	-	-	-				
36	SWEDEN	-	-	-	-	7			7
37	THAILAND								#
38	USA	91	1	-	8	53			53
39	URUGUAY	5	-	-	-				
40	VENEZUELA								#

Notes: * IALA, The development of aids to navigation during the year 1993, Tables and statistics

** IALA LIST OF RADIONAVIGATION SERVICES, DGPS Reference and Transmitting Stations in the Maritime Radio navigation-Radio beacons-Band (283.5-315 kHz Region 1; 285-325 kHz Regions 2 and 3), Issue 4 - April 1996

Planned