BASIC DESIGN STUDY REPORT
ON
THE PROJECT FOR UPDATING TRAINING EQUIPMENT
FOR
NAUTICAL AND MARINE ENGINEERING EDUCATION
IN INDIA

MARCH 1992

JAPAN INTERNATIONAL COOPERATION AGENCY

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PREFACE

In response to a request from the Government of India, the Government of Japan decided to conduct a basic design study on the Project for Updating Training Equipment for Nautical and Marine Engineering Education in India and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to India a study team headed by Prof. Takashi Nakamura, Engineering Department, Marine Technical College, the Ministry of Transport from October 31 to November 19, 1991.

The team held discussions with the officials concerned of the Government of India, and conducted a field study at the study area. After the team returned to Japan, further studies were made. Then, a mission was sent to India in order to discuss a draft report and the present report was prepared.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

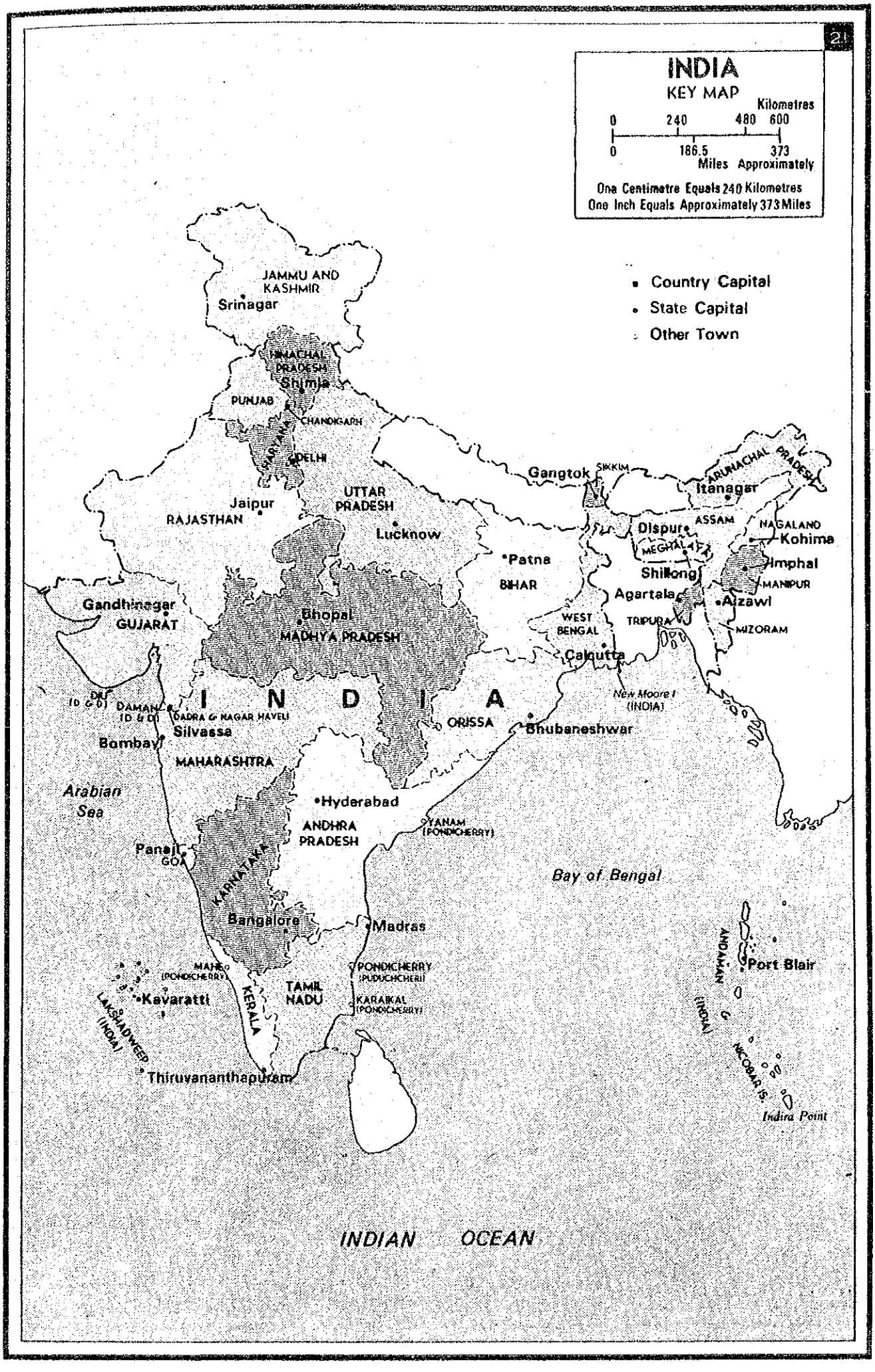
I wish to express my sincere appreciation to the officials concerned of the Government of India for their close cooperation extended to the teams.

March 1992

Kensuke Yanagiya

President

Japan International Cooperation Agency


2.I
INDIA
KEY MAP
Kilometres
0 240 480 600
0 186.5 373
Miles Approximately
One Centimetre Equals 240 Kilometres
One Inch Equals Approximately 373 Miles
Country Capital
State Capital
Other Town
JAMMU AND KASHMIR
Srinagar
HIMACHAL PRADESH
Shimla
PUNJAB
CHANDIGARH
HARYANA
DELHI
Jaipur
RAJASTHAN
UTTAR PRADESH
Lucknow
Gangtok
SIKKIM
ARUNACHAL PRADESH
Itanagar
Dispur
ASSAM
NAGALAND
Kohima
MEGHALAYA
Shillong
Imphal
MANIPUR
Agartala
Aizawl
TRIPURA
MIZORAM
Patna
BIHAR
WEST BENGAL
Calcutta
Gandhinagar
GUJARAT
Bhopal
MADHYA PRADESH
INDIA
DAMAN (D & D)
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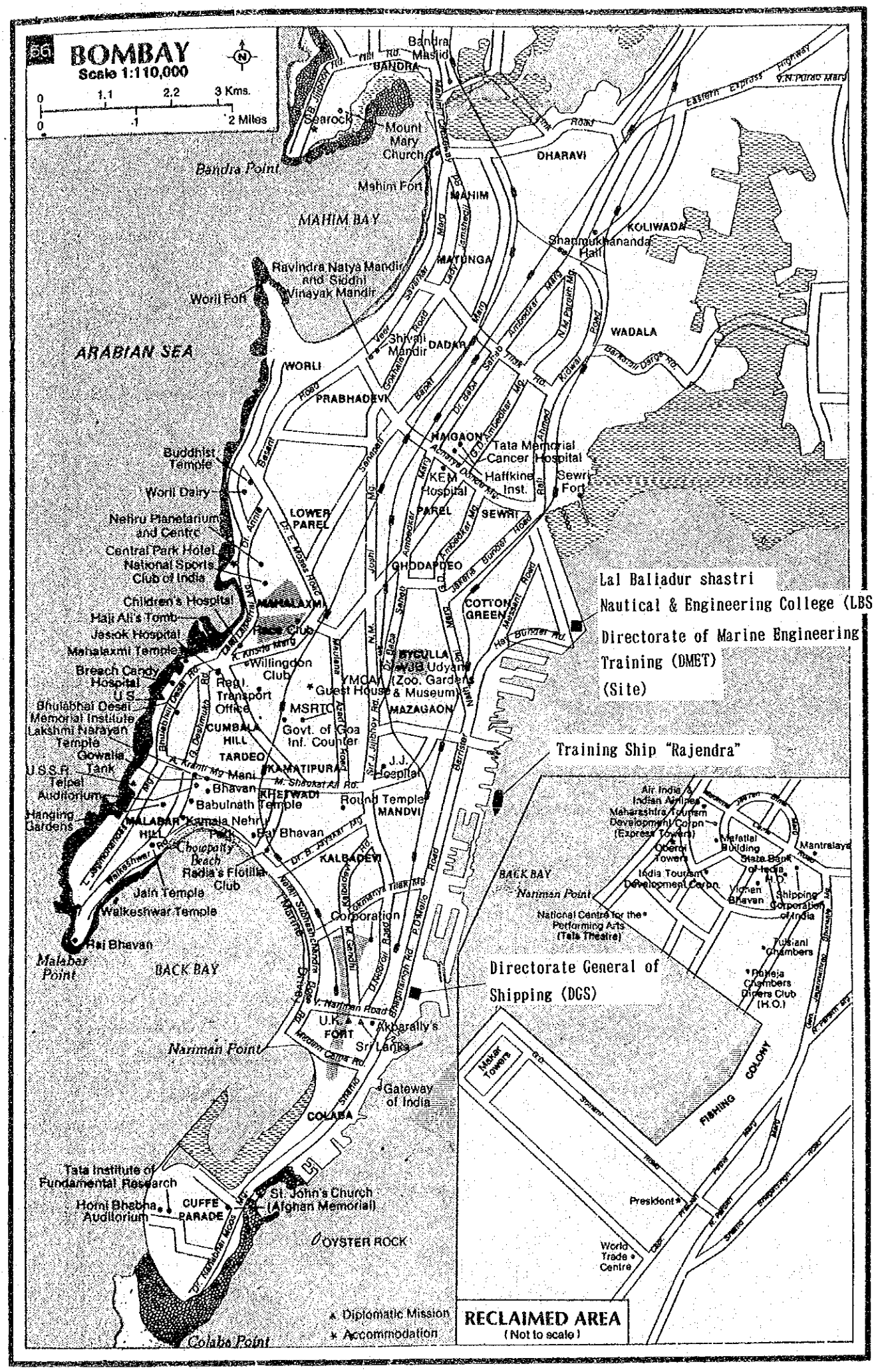
DADRA & NAGAR HAVELI
Silvassa
Bombay
MAHARASHTRA
ORISSA
Bhubaneshwar
New Moore I (INDIA)
Arabian Sea
Hyderabad
ANDHRA PRADESH
YANAM (PONDICHERRY)
Panaji
GOA
KARNATAKA
Bay of Bengal
Bangalore
Madras
MAHE (PONDICHERRY)
Kavaratti
LAKSHADWEEP (INDIA)
KERALA
TAMIL NADU
PONDICHERRY (PUDUCHCHERI)
KARAIKAL (PONDICHERRY)
Thiruvananthapuram
ANDAMAN & NICOBAR IS. (INDIA)
Port Blair
Indira Point
INDIAN OCEAN



Bombay City and Project Site

SUMMARY

SUMMARY

India is a country having a total land area of roughly 3.29 million km² (roughly 9 times that of Japan) consisting of the Subcontinent of India, which extends into the Indian Ocean from the Eurasian Continent, and the islands located in the Arabian Sea and the Bay of Bengal. Its population is approximately 810 million (as of 1989) composed of various races, languages, and religions.

As a serious problem in India, there is the high population growth rate of roughly 2% per annum, and the resultant increase in unemployed population. Therefore, in the 7th National Development Plan (1985 to 1990), emphasis has been placed on more appropriate utilization of the abundant human resources through improving their capabilities.

The economic growth rate of India has been slowly increasing since 1970, despite its industrial structure mainly composed of agriculture. In recent years, the industrial sector has begun to lead the economic growth due to the introduction of the economic liberalization policy. However, a deficit in the trade balance and difficulty in national finance are persistent.

The merchant fleet in the Indian shipping industry has been increasing, backed up by economic development, reaching to approximately 6.50 million gross tonnage in 1990.

However, the Indian Shipping industry is not yet capable enough for international competition, e.g. the loading ratio of Indian-flag ships for highly profitable cargoes in international cargo liner services, where a high efficiency is required, is as low as 16%, due to such problems as shortage of modernized ships, superannuation and low-efficiency of ships.

The ability and seamanship of Indian seamen have been recognized worldwide, so many of them have been on board foreign ships. Estimably an increasing number of Indian seamen are now on board foreign flag vessels, but the number can not be confirmed since seamen, other than those on board Indian ships, are not registered in India.

According to the data of the affiliated seamen's union under the Federation of International Transport Labor Unions, the number of Indian seamen is reported to be roughly 34,000, excluding the seamen on board foreign ships. The number of Indian seamen is almost equivalent to the number of Korean seamen following that of Japanese seamen, among Asian countries.

Such activities of Indian seamen are contributing not merely to the national shipping industry but also to the acquisition of foreign currencies by means of the seamen supply to foreign ships.

On the other hand, safe navigation and protection of the ocean environment corresponding to modernization of ships in recent years, have resulted in the necessity to upgrade the skills of ship officers in their ship operation. Furthermore, advanced shipping countries are in need of seamen, who are entitled to various competences required by the international conventions, to supplement the shortage of their own ship officers.

At present, among Indian seamen, the number of Indian ship officers who are ready to be on board is estimated to be roughly 15,000, of which about 9,000 are said to be on board foreign ships.

The Indian Government plans to generate at least 1,000 ship officers per year to secure the supply of ship officers in accordance with the demand and thereby to contribute to creating employment, which is a priority item in the National Development Plan.

Training of ship officers should be conducted not only to increase the number but also to satisfy the quality that is required by recent advanced and modernized ship equipment. Furthermore, such education and training have to meet the technical level required by the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978 (STCW) and the International Convention for the Prevention of Pollution from Ships.

The education of Indian ship officers is being conducted mainly in the following three education institutes which are under the Directorate General of Shipping (DGS) under the jurisdiction of the Ministry of Surface Transport.

The training institute for the nautical officer course is the Training Ship "Rajendra" ("T.S. Rajendra"), which having no propulsive engine, is being used as a floating school with classrooms and accommodation. However, the Indian Government plans to replace this educational institute with a mercantile marine academy that will be newly established on shore in 1992. The training institute for the engineering officer course is the Directorate of Marine Engineering Training (DMET) located in Calcutta and Bombay. The retraining institute for ship officers is the Lal Bahadur Shastri Nautical & Engineering College (LBS).

However, in these training institutes the training equipment and facilities are not renewed and their maintenance is unsatisfactory due to a continuous budget shortage.

The existing equipment are insufficient in quantity, many of them are outdated. There is no full-scale self-propelling training ship. Therefore, the education and training are mainly conducted by lectures in classrooms with no sufficient practical training. Consequently, the training that can match the requirements specified in the international conventions is not fully conducted.

To satisfactorily conduct the practical training it is desirable to utilize a training ship equipped with modern equipment. In this case, however, the burdens of maintenance and operating costs are heavy and also a large amount of investment is required.

Instead of having a real training ship, an effective alternative for practical training would be the introduction of simulators that can provide the training nearly equivalent to on board ship training and also require less maintenance cost compared to a ship.

From the above-mentioned background, the Indian Government has planned the introduction of such simulators to more effectively educate pre-sea

cadets for nautical and marine engineering officers, re-education of the qualified nautical and marine engineering officers and education for certification of various competences required by the STCW.

Then, the Indian Government has requested that the Japanese Government provide a grant aid for the training equipment required under this project.

The Japanese Government, in response to this request, has decided to conduct a basic design study and JICA sent a study team to India from October 31 to November 19, 1991. Furthermore, the study team was again sent to explain and confirm the contents of the draft final report to the officials concerned of the Indian Government and DGS from January 26 to February 4, 1992.
The outline of the study results is as follows:

(1) The executing organization, DGS, confirms the policy of actively dealing with training of seamen for upgrading the maneuvering techniques to operate modern ships and for satisfying the STCW Convention and the International Convention for the Prevention of Pollution from Ships and establishes the education and training programs for the above purposes.

(2) The education programs in T.S. Rajendra, DMET and LBS are mainly conducted by lectures in classrooms, since existing training equipment are extremely insufficient. Consequently, practical training being conducted using the present education curriculum is far from satisfactory. Therefore, it can be concluded that simulators which provide training equivalent to that of on board ship and require less maintenance cost compared to a ship are the adequate equipment for the intended practical training.

(3) The students are excellent in quality in T.S. "Rajendra" and DMET since they are selected from among applicants with high school careers at the entrance examination that has a very high competitive ratio. Therefore, an excellent education effect can be expected from the training utilizing the simulators.

(4) The building which has sufficient space to install the seamen training equipment has been prepared for this project. However, partial reinforcement will be required depending on the layout of the equipment.

Based on the above study results the contents and scale of the seamen training equipment required for effectively conducting the education and training of seamen satisfying the requirements specified in the STCW Convention and International Convention for the Prevention of Pollution from Ships have been planned.
The contents are as follows:

(1) Ship Maneuvering Simulator 1 set
The simulated bridge along with a simulated field of vision in front, should be installed. Under the conditions relevant to desired ship maneuvering and navigation watch which are set by the instructor, the nautical trainees are educated.

(2) Cargo Oil Handling Simulator 1 set
The mimic panel of the valve closing/opening device for an oil tanker shall be installed. Under the conditions relevant to cargo oil handling which are set by the instructor, the nautical and marine engineering trainees are educated.

(3) Engine Room Simulator 1 set
A graphic panel that simulates the engine room along with a main diesel engine shall be installed. Under the conditions relevant to operations in an engine room which are set by the instructor, the marine engineering trainees are educated.

The allotted responsibilities of this project are:
Japan: Manufacture, transportation to the site, installation, indoor wiring and piping, mechanical adjustment and test operations of the requested equipment

India :Installation of power source unit, lighting system for the requested equipment and furniture in classrooms.

This project will be executed in two phases. In the first phase the ship maneuvering simulator and in the second phase the cargo oil handling simulator and engine room simulator will be installed.

The required periods of work for 1st and 2nd phases respectively are: 2.5 months for detailed design and 12 months for manufacture, transportation and installation of the equipment.
The implementation cost for the project to be borne on the Indian side is estimated to be about 270,000 Rupees for the first phase and about 250,000 Rupees for the second phase respectively.

LBS is responsible for the post-delivery maintenance and management of the training equipment and the annual expenditure therefor is estimated to be 3.23 million rupees (approximately 17 million yen). This amount accounts for roughly 5.5% of the budget of DGS in 1990. However, since DGS recognizes the necessity to increase the number of ship officers and intends to implement it as a priority policy, there will be no problems for DGS in making budgeting arrangements for such maintenance and management costs.

As to the maintenance and management system, the following concrete measures are required after the planned increase in the workforce of LBS has been completed.

(1) Preparation of manufacture and maintenance manuals
(2) Appointment of personnel responsible for maintenance and management
(3) Acquisition of budget for maintenance and management
(4) Service training for the personnel required for maintenance and management
(5) Conclusion of contracts for maintenance, management and repair

In order to effectively use the training equipment included in this project, the functions of such equipment shall be fully studied. For such a purpose, technical training of the personnel in charge for an adequate period is desirable.

When this project is executed by Japan, the following beneficial effects can be expected.

(1) Training a larger number of Indian seamen to be qualified ship officers and a consequent increase in employment opportunities for them
(2) Upgrading the technical level of Indian seamen and a reduction in casualties and oil spill accidents
(3) Activation of other industries as a result of the development of the shipping industry in India

Considering the above, this project will be able to contribute to the achievement of the development plan that the Indian Government has established and therefore is deemed appropriate. Consequently, it is extremely significant that the grant aid be provided by Japan.

BASIC DESIGN STUDY REPORT ON THE PROJECT FOR UPDATING TRAINING EQUIPMENT FOR NAUTICAL AND MARINE ENGINEERING EDUCATION IN INDIA

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APPENDIX

Abbreviation

MOST	Ministry of Surface Transport
DGS	Director General of Shipping
DMET	Directorate of Marine Engineering Training
LBS	Lal Bahadur Shastri Nautical & Engineering College
SOLAS	International Convention for the Safety of Life at Sea
STCW	International Convention on Standard of Training , Certification and Watchkeeping for Seafarers

CHAPTER 1 INTRODUCTION

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India declares that the improvement in technology and the expansion of employment are items with overriding priority in her economical development plan. As a fundamental strategy to accomplish this policy, India intends to cultivate persons of talent and to qualitatively and quantitatively improve education in every industrial field. As a part of this policy, training of talents in the transportation sector is in the position of an important subject.

India has been developing as a base of international trade since time long past. The Indian Government has long been making efforts in keeping ports along the coast in good condition and in strengthening sea transportation for the acquisition of foreign currencies and the expansion of the national economy by the promotion of international trade.

Though India has 855 ships and about 34,000 seamen at present, it is essential to train ship officers and to improve technology for the further development of the shipping industry.

The training of pre-sea cadets and post-sea officers in India has mainly been executed by three maritime training institutes managed and controlled by the Directorate General of Shipping (abbreviation : DGS) which is under the supervision of the Ministry of Surface Transport (abbreviation : MOST). Two hundred nautical and engineering officers in total are trained by the training ship "Rajendra" and the Directorate of Marine Engineering Training (abbreviation : DMET) every year, and also eight thousand seamen in total are re-educated by the Lal Bahadur Shastri Nautical & Engineering College (abbreviation : LBS) each year.

The Indian Government has a plan to train 500 nautical officers and 500 marine engineering officers every year by expanding maritime training institutes in the future.

On the other hand, for the training of seamen, the International Maritime Organization (IMO) is asking maritime countries all over the world to upgrade the quality of their seamen through the "International Convention on Standards of Training, Certification and Watchkeeping for Seafarers,

1978" (hereinafter referred to as "STCW convention") aiming at the safety of life and property at sea and the protection of the marine environment.

However, maritime training institutes in India can not satisfy the above-mentioned standards because of the shortage of equipment necessary for training seamen, which gives rise to problems on the efficient training of seamen and the international employment opportunities of Indian seamen.

In view of such a situation, the Indian Government has planned to introduce various simulators for training seamen and requested the Japanese Government to provide a grant aid for the implementation of this project as an important step to qualitatively and quantitatively improve the education in these institutes.

In response to the request, the Japanese Government decided to conduct a basic design study. Accordingly, the Japan International Cooperation Agency (JICA) dispatched the "Basic Design Study Team", headed by Prof. Takashi Nakamura of the Engine Department, Marine Technical College of the Ministry of Transport, to India for 20 days from October 31 to November 19, 1991 with the objective of conducting the studies as required. The team had a series of discussions on the project with the concerned officials of the Indian Government and the training institutes, and also conducted a field survey, and data acquisition.

The Japan International Cooperation Agency also dispatched the "Draft Final Report Study Team" to India for the period from January 26 to February 4, 1992 to explain the report (draft) to the persons concerned in the Indian Government and to confirm its details.

The organization of the team, schedule of the field survey, visited places and persons, and minutes are listed in appendices at the end of this report. This report refers to the field survey, the results of the discussions held with concerned officials of the Indian Government and data and materials collected in India. The report also states the basic design, the implementation and operation & maintenance plans, and the project evaluation and final conclusion and recommendations.

CHAPTER 2 PROJECT BACKGROUND

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2-1 OUTLINE OF MERCHANT SHIPPING SECTOR

2-1-1 Present State of Merchant Shipping in India

The Indian merchant fleet has 415 ships aggregating about 5.94 million gross tons as of 1992.

Among them, ocean-going ships are 246 in number aggregating about 5.38 million gross tons that occupy about 91 percent of total tonnage, and supply vessels for oil rigs are 94 aggregating about 160,000 tons. On the other hand, the number of coastal ships is only 75 aggregating about 400,000 tons. Thus, the coastal shipping industry still remains small in scale though India has the long coastline and a good number of rivers and canals.

Among the ocean-going ships, trampers and bulk carriers amount to 114, about 2.43 million tons and tankers (including combination carriers.) 56, about 2.10 million tons. The gross tonnage of both categories of ships occupy about 84 percent of all ocean-going ships.

On the other hand, the fleet of modernized ships such as container ships, RO/RO ships, LPG/LNG tankers, etc., that can carry cargoes of higher freight rates are very small in scale. (See Table 2-1).

The composition of the merchant fleet by ship age is shown in table 2-2. As indicated by this table, the fleet is increasingly getting older so that this tendency may possibly give rise to a serious situation in future, i.e. in the ocean-going fleet tonnage, the percentage of ships of more than 10 years old is 54 and that of those of more than 16 years is 17.5, and in the coastal fleet tonnage, 36.4 per cent are ships of more than 10 years old and 20 percent are those of more than 16 years old.

Such composition of the Indian merchant fleet is giving an adverse effect on its competitiveness in hauling. The loading ratio of the Indian fleet in the period from 1989 to 1990 is as low as 35.8 percent, as shown in Table 2-3. Particularly, that for liner cargoes that can obtain higher

freight rates stands at only 16.5 percent. Such low loading ratios are causing the outflow of a good amount of foreign money as the freight earned by foreign ships.

The Indian shipping industry has been increasing its tonnage with the support of the government. However, the international competitiveness of the ocean-going fleet is getting lower and the competition of coastal ships against various land transportation means is getting keener because of the delays in the replacement of outdated or low-efficiency ships, simplification of procedures for second-hand ship deals, construction of ships with higher-earning capability, improvement of port facilities and simplification of cargo-handling procedures. The measures for coping with these problems will be the assignment for the time being.

Table 2-1 Tonnage of Indian Merchant Fleet by Ship Type
(As of 1 January, 1992)

Type of ship	Number of ships	Gross tonnage	Deadweight tonnage
(Ocean-going ship)			
Liner	63	713,769	1,002,031
Container ship	1	3,498	6,430
Small tramper, bulk carrier (dry cargo, bulk cargo)	114	2,434,267	4,101,353
Ore/oil carrier	8	488,030	889,024
Crude tanker	23	1,225,103	2,206,415
Product carrier	25	383,779	601,444
Acid carrier	4	64,039	89,070
Timber carrier	5	21,872	29,715
Passenger/cargo ship	1	8,279	8,820
LPG tanker	2	35,378	34,687
(Total)	246	5,378,014	8,968,989
(Coastal Ship)			
Dry cargo ship	33	24,772	45,271
Bulk carrier	10	127,008	198,139
Product carrier	15	134,699	216,951
Crude tanker	2	54,973	82,249
Timber carrier	1	4,356	6,579
Passenger/cargo ship	13	49,381	23,199
Ethylene gas carrier	1	2,577	1,060
(Total)	75	397,766	573,448
(Total of ocean-going and coastal ships)	321	5,775,780	9,543,437
(Supply vessel for off-shore oil rig)			
Supply vessel	63	68,193	75,854
Other service vessel	31	94,848	70,708
(Total)	94	163,041	146,562
(Grand total)	415	5,938,821	9,688,999

(Source: DGS Tonnage Statistics)

Table 2-2 Tonnage of Indian Merchant Fleet by Ship Age

(As of 1 January, 1992)

Ship age	Number of ships	Gross tonnage	Deadweight tonnage
1. Ocean-going ship			
Under 5 years	45	1,155,109	1,873,987
6 ～10 years	69	1,276,775	2,062,345
11～15 years	83	2,002,587	3,485,698
16～20 years	40	812,753	1,351,348
20 years and above	9	130,790	195,611
Total	246	5,378,014	8,968,989
1. Coastal Ship*1			
Under 5 years	53	181,611	210,475
6 ～10 years	51	173,030	240,685
11～15 years	17	92,864	155,656
16～20 years	23	88,381	131,299
20 years and above	25	24,921	53,895
Total	169	560,807	720,010
Grand total	415	5,938,821	9,688,999

(Source: DGS Tonnage Statistics)

Note) *1 : Supply vessels for off-shore oil rigs are included.

Table 2-3 Loading Ratio of Indian Fleet in Trade (1989-990)

Item	Loading volume of Indian ships (Unit: million tons) →	Loading volume of foreign ships (Unit: million tons)	Total volume (Unit: million tons)	Loading ratio of Indian ships (%)
Total volume				
Export	9.57	39.44	49.01	19.5
Import	28.69	29.11	57.75	48.6
Total	38.26	68.55	106.76	35.8
Volume of dry cargo				
Export	8.17	31.47	39.64	20.6
Import	6.54	13.12	19.66	33.3
Total	14.71	44.59	59.30	24.8
Volume of liquid cargo				
Export	0.12	2.29	2.41	5.2
Import	21.61	7.56	29.17	73.2
Total	21.73	9.85	31.58	67.8
Volume of liner cargo				
Export	1.27	5.68	6.95	18.8
Import	1.49	8.43	9.92	15.0
Total	2.49	14.11	16.88	16.4

(Source: DGS Tonnage Statistics)

2-1-2 Present State of Indian Seamen

The total number of Indian seamen is not accurately grasped, since they not only make up the crews of Indian ships. The state of the members of affiliated seamen unions in Asia under the Federation of International Labor Unions (the international workers' federation in which workers related to land and maritime transportation participate) is shown in Table 2-4.

As seen in this table, India is a country having the number of union

members which follows Japan and equals Korea. This number excludes seamen on board foreign vessels. Since Indian seamen are highly appreciated in terms of quality and skill, the number of Indian seamen on board foreign vessels is presumed to be considerably large.

Seamen are classified into two groups, one is ship's officers who can not serve on board unless they acquire seamen's competency certificates and the other is crews who do not require any qualification. The number of Indian qualified officers is estimated to be 7000 nautical officers and 8000 engineering officers, i.e. 15000 officers in total. Among them, it is said that 2400 nautical officers and 3200 engineering officers, i.e. 5600 officers in total, are on board Indian flag ships.

The supply and demand of Indian seamen is influenced by the market situation of the world shipping industry. Due to the worldwide depression in the shipping industry in the period from 1985 to 1988, some Indian seamen were dismissed and the number of young seamen who newly joined the shipping industry remarkably decreased.
Furthermore, seamen training institutes under the control of the Directorate General Shipping reduced the number of their incoming trainees to a considerable extent and some of these institutes were closed.

As a result, there have occurred in recent years problems of shortage and higher ages of seamen under the prosperous condition of the shipping industry. This condition is a factor impeding the development of the Indian shipping industry. On the other hand, the demand for seamen from foreign owners increases along with the shortage of manpower in advanced maritime countries.

Therefore, the training of seamen is an urgent necessity in India as one of the measures for the expansion of employment opportunities and for acquisition of foreign currencies.

So far, the Indian Government has placed more emphasis on the training of seamen for national flag ships, but is determined to plan the training, taking into account the supply of seamen to foreign flag ships, in the near future.

Table 2-4 Situation of Members of Seamen Unions In Asia

(As of the end of December 1989)

Country	Officer (Person)	Crew (Person)	Officer and crew (Person)	Total (Person)
India	6,150	28,136		34,286
Bangladesh			3,000	3,000
Hong Kong	2,658	5,761		8,419
Indonesia		17,610		17,610
Japan			65,000	65,000
Korea		34,900		34,900
Pakistan	1,001	15,621		16,622
Philippines			15,000	15,000
Singapore	3,307	2,314		5,621
Taiwan			27,706	27,706

Note: Members of unions affiliated with the Federation of International Transport Labor Unions

Source: Report on Activities of the Federation of International Transport Labor Unions(1990)

Though it is said that the salaries of qualified seamen are higher than those of other occupational categories, e.g. monthly salaries of 3,000 rupees for laborers and taxi drivers, the salaries in foreign shipping companies are higher than those in Indian shipping companies. Many ship

officers therefore want to get on board foreign ships if given such opportunities and so there is a short supply of ship officers to the national flag vessels.

Table 2-5 shows the comparison of salaries of qualified officers between Indian and foreign shipping companies.

Table 2-5 Salaries of Qualified Officers

(Unit: U.S.$)

Classification	Indian shipping companies	Foreign shipping companies
Masters/ Chief engineers	1,175	3,000
Chief officers/ First engineers	850	2,000
Third/Fourth officers having service experience of 3 years or more	705	1,600

(Source: DGS)

2-1-3 Present State of Officers Training in India

The training for ship officers in India began in 1927. Since then, after various changes, it is now being executed by three training institutes, namely, for nautical officers by the Training Ship 'RAJENDRA', for engineering officers by DMET and for retraining of ship officers by I.B.S., a college for ship officers, all controlled by the Directorate General of Shipping (DGS) under the supervision of the Ministry of Surface Transport.

According to the requirements for admission to officer training institutes in India, applicants must be men aged under 20 with school careers of 12 years (10 years in elementary and middle schools and 2 years in college), and they should have finished courses of mathematics, chemistry and physics.

Selection is made from a writing examination, interview and physical examination. Every year 80 applicants are selected as cadets of the nautical officer course to be trained on the floating school RAJENDRA, and 120 applicants as cadets of the engineering officers course at DMET, from among 20,000 applicants or so. The Indian shipping circles secure

competent young men in India through this method of selection.

Furthermore, in view of the ups and downs of the shipping industry, the Indian Government has established the following "Directly Entered Trainee Course" in which an additional number of trainees are trained on board ships in case demand for ship officers from shipping circles exceeds the prescribed number of trainees of RAJENDRA and DMET.

(1) Directly Entered Trainee Course for Nautical Officers
Trainees are selected from applicants of not more than 23 years of age with a bachelor of science and trained for three months before taking on board training. Then shipping companies directly employ them as cadets. After trained on board ships for three years, they acquire competences of nautical officers.

(2) Directly Entered Trainee Course for Engineering Officers
Trainees are selected from applicants with a bachelor of technical or mechanical engineering (who finished four-year education in technical universities after finishing ten-year education in schools and two-year education in colleges) and subjected to introductive training for twelve months. Then they are employed by shipping companies as primary engineers and enter into service on board.

In the following flowcharts, the courses from admission to the acquisition of competency certificates are shown for nautical and engineering officers respectively.

Nautical Officer Course

RAJENDRA (Training Vessel) Course

- School education for ten years
- Education in college for two years (the age of 20 years and under)
- Admission into the training vessel RAJENDRA

(Training on board for three years)

- Service on board as primary nautical officer

(Service on merchant vessels for a year)

- <Acquisition of 2nd nautical officer's competency certificate>

(Service on merchant vessels for 18 months)

- <Acquisition of 1st nautical officer's competency certificate>

(Service on merchant vessels for 18 months

- <Acquisition of master's competency certificate>

Directly Entered Trainee Course

- School education for ten years
- Education in college for two years
- Admission into universities of science and engineering

(Education for four years)

(Bachelors of science and engineering aged 23 and under)

- Training before training on board for three months

(Training on merchant vessels for three years)

- <Acquisition of 2nd nautical officer's competency certificate>

(Service on merchant vessels for 18 months)

- <Acquisition of 1st nautical officer's competency certificate>

(Service on merchant vessels for 18 months)

- <Acquisition of master's competency certificate>

Engineering Officer Course

DMET Course

- School education for ten years
- Education in college for two years (the age of 20 years and under)
- Admission into DMET

(Training for four year)

- Service on board as primary engineer

(Service on merchant vessels for six months)

- <Acquisition of 4th engineer's competency certificate>
  (Engineer on duty)

(Service on merchant vessels for 12 months)

- <Acquisition of 2nd engineer's competency certificate>
  (In charge of duty, maintenance and safety supervision)

(Service on merchant vessels for 18 months)

- <Acquisition of 1st engineer's competency certificate>

Directly Entered Trainee Course

- School education for ten years
- Education in college for two years
- Admission into universities of science and engineering

(Education for four years)

- Selection examination (Bachelors of science and engineering aged 23 and under)

(Training before service on board for a year)

- Service on board as primary engineer

(Service on merchant vessels for six months)

- <Acquisition of 4th engineer's competency certificate>
  (Engineer on duty)

(Service on merchant vessels for 12 months)

- <Acquisition of 2nd engineer's competency certificate>
  (In charge of duty, maintenance and safety supervision)

(Service on merchant vessels for 18 months)

- <Acquisition of 1st engineer's competency certificate>

2-1-4 Present State of Training Institutes for Ship's Officers in India

The Directorate General Shipping (DGS), the executing agency for this project, is an administrative agency under the Ministry of Surface Transport and responsible for the safe operation and promotion of the shipping and fishing industries of India. The education and training of seamen are also a part of DGS's responsibility.

The organization chart of the Training Branch of DGS is as shown below.

The Training Branch of DGS controls the college for ship's officers (Lal Bahadur Shastri Nautical & Engineering College) and training institutes for nautical and engineering officers.

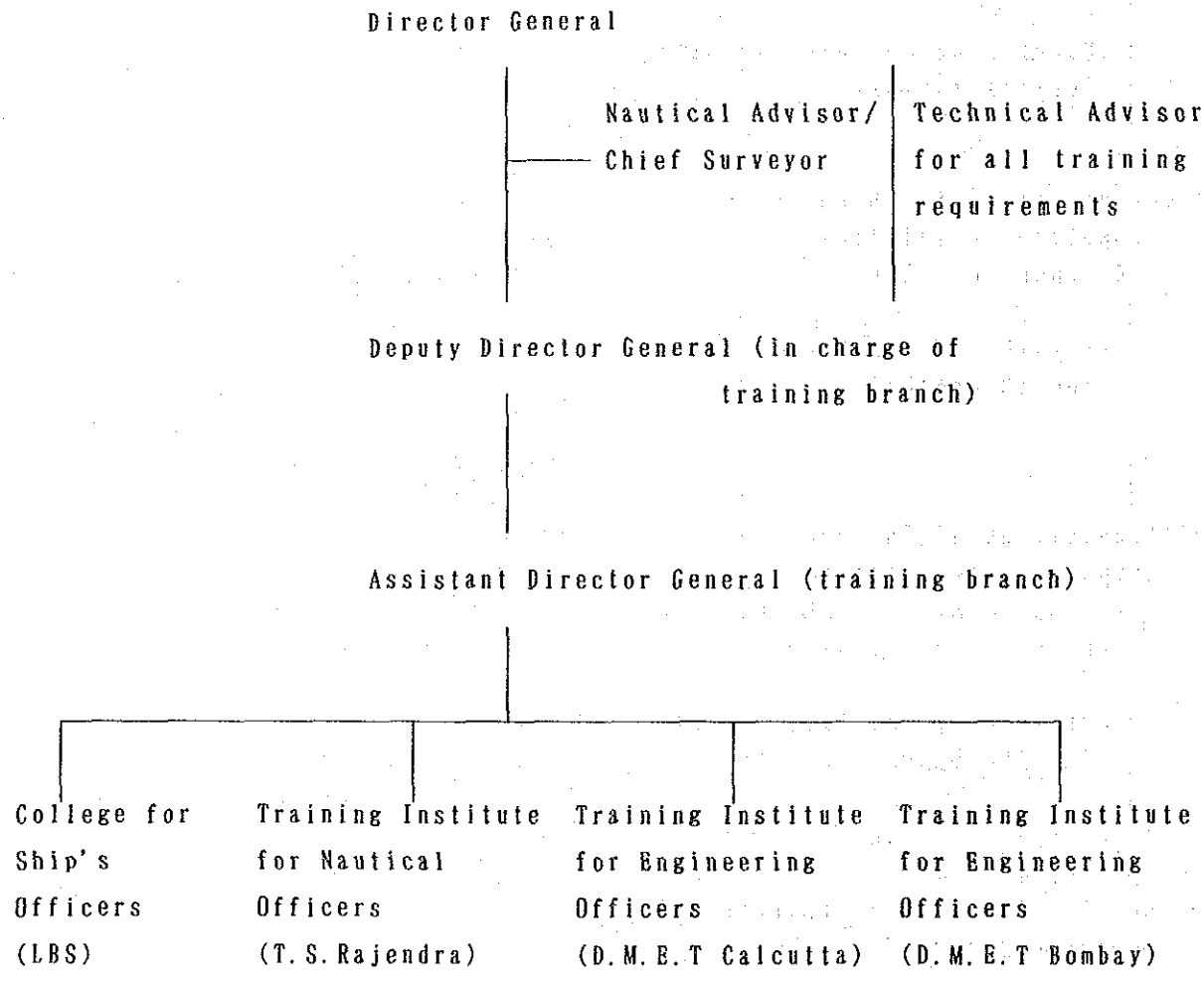

Fig. 2-1 Organization of Training Branch of DGS

(1) College for Ship's Officers (LBS)

LBS is a comprehensive college for the retraining of seamen, primarily upper-class seamen. It is the only institution in India that retrains nautical and engineering officers who have actual service experience and it sends out a total of 8,000 graduates in nautical and engineering courses every year.

When it was established in 1948, there were courses for taking examinations for the qualifications of both nautical and engineering officers. As the number of the trainees increased, LBS moved, in September, 1965, to the present school buildings located in Hay Bunder of Bombay. It faces the seashore, commanding the view of Bombay Port, having inland hills to the east, and covering an area of about 6.5 acres. In this college, there are provided boat-lowering facilities along the sea shore. Also available are facilities for the training for survival at sea. A real radar is set up in the school building, and trainees can take a radar observation course and an ARPA course which observe actual movement of ships coming into or going out of Bombay Port.

The six-storied main building of LBS accommodates lecture rooms and administrative offices. There are an auditorium, a reception room, bank tellers' windows, a post office and a dining hall on the first floor. The second floor accommodates a library, and the third, fourth and fifth floors contain lecture rooms. On the 6th floor, there are radars, ARPA, gyro compasses, direction finders, fathometers, and computers. There is another six-storied building nearby that is a dormitory accommodating about 100 trainees. Some rooms are single occupancy rooms, but others are shared by two or three persons. All rooms command the view of the ocean. In the campus, there are also two two-storied buildings having a classroom for the training of survival at sea and a classroom for the training of communication at sea, and one swimming pool that is used for the training of survival.

LBS offers three different courses as described below.

(A) Preparatory courses for taking examinations for the qualifications of nautical officers.

(B) Preparatory courses for taking examinations for the qualifications of engineering officers.

(C) Standard training courses based on STCW Convention, 1978 (Some of those courses are common to both nautical and engineering officers)

(A) Preparatory courses for taking examinations for the qualifications of nautical officers.

a. Extra Master Course

This course was established for the purpose of improving the knowledge level of instructors or examiners working at maritime institutes. Its curriculum includes maritime subjects which are not covered by the course for ocean navigating masters, and is very useful for the masters who are engaged in maritime jobs on land.

Extra master certificates are granted to masters who have distinguished knowledge out of ordinary masters. They used to study in the U. K. in the past in order to obtain such certificates.

This course consists of three terms, a period of 4 months each, and another term for preparing graduation theses.

b.	Course for Master of an Ocean-Going Ship	5 months
c.	Course for First Nautical Officer of an Ocean-Going ship	6 months
d.	Course for Second Nautical Officer of an Ocean-Going ship	5 months
e.	Course for Navigational Watch-keeping Officer	6 months
f.	Course for Master of a Coastal Ship	5 months
g.	Course for Nautical Officer of a Coastal Ship	5 months

(B) Preparatory courses for taking examinations for the qualifications of engineering officers.

a.	Course for Marine Engineering Officer Class I	4 months
b.	Course for Marine Engineering Officer Class II	4 months
c.	Course for Marine Engineering Officer Class III	2 months
d.	Course for Marine Engineering Officer Class IV	1 month

(C) Courses based on STCW Convention, 1978

a.	Professional in survival course	1 week
b.	Course for radar observation	2 weeks
c.	Course for ARPA	1 week
d.	Course for communication at sea	1 week
e.	Special course for safety of tanker (including inert gas and crude-washing apparatus)	2 weeks
f.	Course for safety of chemical tanker	1 week
g.	Course for safety of liquefied gas tanker	2 weeks
h.	Course for radar simulator and navigation simulator	1 week
i.	Course for first-aid treatment by masters	2 weeks
j.	Course for reconfirmation of qualifications of masters (Regulations of Indian Government require that masters at service on board take this course once every 5 years.)	

The aggregate number of trainees taking these courses of LBS is as many as 8,000 per year. There are about 80 instructors if full-time and part-time instructors are combined. It addition, about 80 persons are working at LBS, some for administration and others for maintenance. Figure 2-2 shows the organization of LBS and the number of personnel working at LBS.

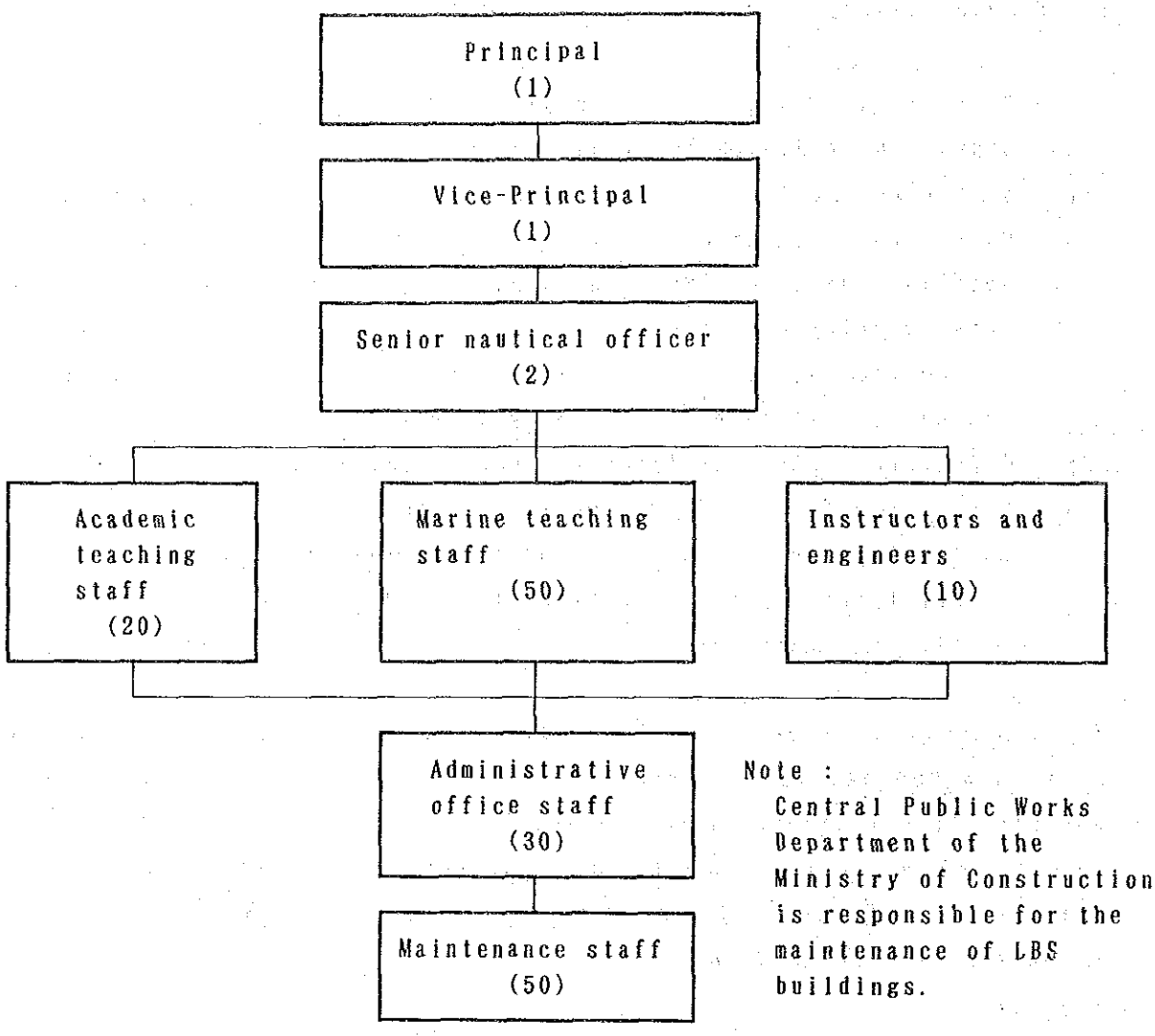

Fig. 2-2 LBS Organization Chart

The education curriculum, that is now in effect at LBS, is of a high-level of quality. However, it is mostly composed of class-room lectures, except for training with radar simulators and some electronic machines. Therefore, under the present circumstances, it cannot be said that the educational effects, as expected by LBS, are satisfactory.

(3) Training Institute for Engineering Officers (DMET)

DMET is an institute for the training of engineering officers, the principal institute was established in Calcutta in 1949 and the branch institute in Bombay in 1984.

In addition to lecture rooms, there are machine tool shops, power-

generating plants, machine shops and dormitories provided.

Four year training program is executed at DMET. Trainees, who have finished the entire curriculum, are given diplomas, which are equivalent to the Bachelor of Mechanical Engineering-degree. The trainees are required to reside in dormitories for a whole period of 4years, and thus receive 24 hours of education. The curriculum includes, in addition to academic or professional lectures given in lecture rooms, physical training, group sports, individual sports, swimming, drama performance, cultural activities, computer science, boat handling, etc.

Out of the 4 years, one and a half years are allotted to practical training as described below.

(a) 12 months for practical training in machining, lathe operation, welding, material tests, etc.

(b) Remaining 6 months for practical training in maintenance/servicing of machinery/equipment installed on board various ships staying in ports under direct instructions of chief engineers.

The curriculum for the 1st, 3rd and 4th years is executed at the principal institute in Calcutta, and that for the 2nd year (including practices at machine shops) is executed at the branch institute in Bombay.

Present prescribed number of trainees is 120 and it will be increased to about 200 in future.

(4) Training Institute for Nautical Officers (Training Ship Rajendra)

Training vessel Rajendra, not equipped with propulsion machinery from the beginning, is built as an institute for training nautical officers and is moored at a wharf of Bombay Port. This institute was built in 1972, and its age is around 20 years. But it is still being used as the only institute available in India for the training of nautical officers. Its principal dimensions are as follows.

Length b.p.p.	104.04 m
Breadth moulded	18.00 m
Depth moulded	8.30 m

Draft moulded	3.50 m
Gross tonnage	5,617.95 Tons
Accommodation	250 rooms for trainees
	20 rooms for apprentices
	150 rooms for officers/staffs

Trainees, who have finished three years of education/training in this institute, are given a Bachelor of Technology (Navigation Science) degree by Bombay University. It is compulsory for all trainees to reside on board during the whole period of 3 years to receive 24 hours of education. The curriculum is very extensive and includes, in addition to academic/professional lectures given in lecture rooms, physical training, group sports, individual sports, swimming, drama performance, cultural activities, computer science, boat handling, communication techniques, etc.

However in 1992 it is planned that this institute will be replaced by a mercantile marine academy to be newly established on land. The construction of the school buildings and facilities of the new academy is already in its final stage. It is planned that the number of trainees of the nautical course will be increased from about 80 to about 170 per year when the academy starts.

(5) Main existing training equipment available in LBS and DMET and RAJENDRA.

The items for training listed below are set up in each institute and are being fully utilized for training purposes.

(A) LBS

1.	Radar simulator	1 unit
2.	ARPA	1 unit
3.	Radar	2 units
4.	Fathometer	2 units
5.	Direction finder	3 units
6.	Gyro compass	3 units
7.	Facsimile	1 unit
8.	Life boat	3
9.	Life raft	2

10.	Ship model	many
11.	Engine model	many
12.	Personal computer	1 unit
13.	Audiovisual classroom	1
14.	Related book	5,000 books

(B) DMET (Bombay)

1.	Engine simulator (without computer, for primary education)	1 unit
2.	Refrigerating plant simulator	1 unit

(C) DMET (Calcutta)

1.	Engine simulator (simple type, each system is actuated by electromagnetic valves, hydraulic cylinders, etc.)	1 unit
2.	4-ram steering gear	1 set
3.	3-Cylinder engine	1 unit
4.	Air compressor	1 unit
5.	Medium-speed 2 stroke diesel engine	1 unit
6.	High-speed 4 stroke diesel engine	1 unit
7.	High pressure boiler	1 unit
8.	Coal burning boiler	1 unit
9.	Turbogenerator of 150 KVA	1 unit
10.	Steam reciprocating engine	1 unit
11.	Boiler for demonstration	1 unit
12.	Lathe	24 units
13.	Shaping machine	2 units
14.	Milling machine	1 unit
15.	Vice	75 units
16.	Purifier model	1 unit
17.	Related book	10,000 books

(D) T. S. RAJENDRA

1. Wheel house (including steering gear and nautical instruments)
2. Radar

3. Radio installation
4. Diesel generator

2-1-5 Budget of Training Institutes for Ship's Officers in India

Table 2-6 shows actual spendings for management in the Directorate General of Shipping which is the executing agency. According to this table, the scale of the expenditure is getting larger, though it varies more or less with fiscal years. The present situation of three institutes controlled by the Directorate General shipping does not show any difficulty due to a lack of funds and the number of trainees is in accordance with the training plan.

Table 2-6 Transition of Budgets for Management in Directorate General of Shipping

Fiscal year	Budget (1,000 Rupees)
1986～87	42,949
1987～88	49,378
1988～89	51,326
1989～90	55,373
1990～91	55,234

Though the budget for equipment costs varies with fiscal year as shown in Table 2-7, a necessary budget for the maintenance and equipment is ensured.

Table 2-7 Budget for Equipment costs in Directorate General Shipping

Fiscal year	Budget (1,000 Rupees)
1986～87	6,150
1987～88	22,025
1988～89	9,486
1989～90	8,211
1990～91	5,144

Note 1) The unspent amount of the annual budget, if any, can be brought over to the succeeding year.

2-2 OUTLINE OF RELATED PLANS

2-2-1 National Development Plan

The 1st five-year plan in India was established in 1951, and emphasis was placed on promotion of basic industries during the period from the 1st to the 3rd five-year plan (from fiscal 1951 to 1965). During the period from the 4th to the 6th five-year plans, planned targets and basic strategies were often retarded, amended and abolished due to the change of regime, war and a drought.

Under the 7th five-year plan, priority was given to creation of employment and improvement of productivity, based on the high rate of savings and the strengthened economic foundation achieved in the 6th plan (from fiscal 1980 to 1984). The 7th Five-year plan covered the period from fiscal 1985 to 1989. The 8th plan is now in preparation for the period from fiscal 1992 to 1996. Consequently, fiscal 1990 and 1991 are covered by the respective annual plans. The 8th plan will follow the basic policy of the 7th plan that has emphasized expansion of employment by maintaining continuous growth of the national economy.

Indian economy has long been heavily dependent on the agricultural sector and therefore easily influenced by a drought or others. In recent years, however, the industrial sector has begun to lead the growth of the national economy. For example, the economic growth attained in fiscal 1987, in spite of the sufferings by the drought, owed much to the growth made in the industrial sector.

The continuous financial deficit that the Indian Government is suffering not only constitutes the cause of inflation but also necessitates procurement of funds from foreign countries. Moreover, India has a continuous trade deficit that rapidly expanded in the 1980s, and the accumulated indebtedness reached a considerable amount. India has been positively taking a series of economic liberalization policies since 1980, aiming at the modernization of domestic industries and improvement of international competitiveness through such measures as relaxation of restrictions on imports, promotion of introduction of foreign funds and activation of industrial activities. It can be said that a high growth

rate shown by the mining and industrial sectors in recent years is attributable to the positive effect of such liberalization policies. Therefore, it is considered necessary that such economic liberalization policies be continued and strengthened to achieve the stable growth of the Indian economy in the long run.

1. Budget

1) National budget

The national budget of India for F.Y. 1989 is 748.2 billion Rupees in revenue and 821.6 billion Rupees in expenditure with a deficit of 73.4 billion Rupees. Table 2-8 shows the records of the national budget.

Table 2-8 Records of National Budget

Unit: Billion Rupees

	1987-88 actual budget	1988-89 reviewed budget	1989-90 budget
Revenue	592.5	678.4	748.2
Tax revenue		326.5	383.9
Non-tax revenue		97.7	135.1
Capital revenue		254.2	229.3
Expenditure	650.7	757.8	821.6
Non-planned expenditure		488.8	543.5
Planned expenditure		269.1	278.1
Balance	−58.2	−79.4	−73.4

Source: Budget at a Glance 1989-90, February 1989, Ministry of Finance

2) Budget for development plan

Aggregate investment made in the whole period of the 7th Plan amounts to 3,223.7 billion Rupees, of which public investment accounts for 1,542.2 billion Rupees. As for financial resources, an amount of 574.2 billion Rupees came from the government fund,

2,449.4 billion Rupees from private funds and 200 billion Rupees from foreign funds.

Sectorial breakdown of the aggregate outlay (1,800 billion Rupees) of the public sector is shown in the Table 2-9. Energy accounts for the largest portion at 30.5%. Next comes agriculture-related fields at 22.1% consisting of agriculture, rural development, special area programs and irrigation and flood control, followed by 12.8% in transportation in which shipping accounts for 3.6% (Corresponding to 0.5% in the aggregate outlay).

Table 2-9 Public Sector Aggregate Outlays under the 7th Development Plan

(Unit: 10 mil. rupees)

Heads of Development	Total	Centre	States	UTs
Agriculture	10,573.62 (5.87)	4,056.71 (4.25)	6,248.40 (7.74)	268.51 (7.13)
Rural Development	9,074.22 (5.04)	4,901.59 (5.13)	4,142.84 (5.13)	29.79 (0.79)
Special area programs	3,144.69 (1.75)	—	3,144.69 (3.90)	—
Irrigation and flood control	16,978.65 (9.43)	834.93 (0.87)	15,949.77 (19.77)	193.95 (5.15)
Energy	54,821.26 (30.45)	31,492.14 (32.96)	22,786.15 (28.24)	542.97 (14.41)
Industry and mining	22,460.83 (12.48)	18,552.97 (19.42)	3,785.88 (4.69)	121.98 (3.24)
Transport	22,971.02 (12.76)	16,459.37 (17.23)	5,772.50 (7.15)	739.15 (19.61)
Railways	12,334.55	12,334.30	0.25	—
Roads	5,200.04	1,019.75	3,666.98	513.31
Road transport	1,990.10	230.92	1,744.73	41.45
Ports and light-houses	1,260.42	1,134.79	97.31	28.32
Shipping	826.88	693.42	7.00	126.46
Inland water transport	225.73	155.00	67.20	3.53
Civil aviation	757.84	730.21	24.72	2.91
Tourism	326.16	138.68	164.31	23.17
Farakka barrage	49.30	49.30	—	—
Communication, information and broadcasting	6,472.46 (3.60)	6,365.82 (6.66)	99.33 (0.12)	7.31 (0.19)
Science and technology	2,466.00 (1.37)	2,303.43 (2.41)	157.28 (0.20)	5.29 (0.14)
Social service	29,350.46 (16.31)	10,350.90 (10.84)	17,182.88 (21.29)	1,816.68 (48.21)
Others	1,686.79 (0.94)	216.14 (0.23)	1,428.28 (1.77)	42.37 (1.13)
Grand Total	180,000.00	95,534.00	80,698.00	3,768.00

Notes: Figures in brackets are percentages of column totals.

2-2-2 Development Plan of Shipping Sector

According to the description concerning the shipping field under the 7th five year plan, the economic development in India largely depends upon whether effective and highly reliable transportation services are available or not, and it describes an analysis of the present state of the shipping industry (in 1984) as summarized under 2-1-1 and the targets under the 7th Plan, that are outlined as follows:

(1) It is necessary to increase modernized and efficient vessels in the national fleet such as container ships, specialized cargo carriers and oil drilling vessels, and to speed up the replacement of obsolete and inefficient vessels, in order to save foreign currencies by increasing the share in the export/import cargo transportation of the national-flag vessels.

(2) Merchant fleet will be reinforced so that the loading ratio of 100% in liquid cargoes 50% in dry bulk cargoes and 40% in liner cargoes can be accomplished.

(3) For the purpose of increasing productivity, communication, data processing and management systems will be improved, and infrastructure including ship-repairing facilities will be reinforced as well.

(4) Infrastructures and cargo handling operation in ports will be improved in order to realize a higher efficiency in port utilization and marine transportation.

(5) Supporting measures for replacement of obsolete and inefficient vessels and for modernization of the merchant fleet will be offered to the shipping industry.

(6) Formation of fund for purchasing appropriate vessels along with earnings from ship's sale and purchase will be made easier by simplifying the related procedures.

(7) The merchant fleet will be expanded to a total of 7.5 million gross tons by the end of the 7th five-year Plan. Further, in order to

promote the shipping industry, 6,930 million Rupees and 1,340 million Rupees will be allocated to the Shipping Development Fund and the accounts of the State Governments respectively.

2-2-3 Development Plan of Employment and Human Resources

(Only for Transportation Related Fields)

The following targets are described in the development plans for the employment and human resources and the labor policy under the 7th Plan.

(1) The average annual growth rate of employment in the transportation industry (excluding railway transportation) during the period from 1985 to 1989 is assumed to be 4.6% (against that in the whole national economy being 4%)

(2) Development of transportation industry must be accelerated in order to attain the production and employment targets in other fields.

(3) The population having a high academic career and engaged in economic activities is estimated to be 10.6 million as of 1990, but creation of further employment opportunities must be realized in view of the fact that the number of unemployed already reached 3.7 million as of 1985. The transportation industry is regarded as one of the fields, to the development of which priority should be given for such purpose.

2-3 BACKGROUND AND DETAILS OF REQUEST

2-3-1 Project Background

India is aiming to develop the national economy by making valid practical use of the abundant human resources, but on the other hand, there is the problem that there is a high population growth rate that causes ever-increasing unemployment.

Historically, the industrial structure in India has been heavily dependent on the low-productivity of agriculture. But in recent years, the industrial sector instead has begun to lead the growth of the national

economy. The Indian Government has been promoting an economic liberalization policy since 1980. It aims at modernizing its industry and strengthening its international competitiveness, through relaxation of import restrictions, acceleration of introduction of foreign capital and activation of industrial activities. It is expected that the problems of the trade balance and the foreign currency debt will be eased by more positive promotion of this policy.

Though the Indian merchant fleet has grown with the support of the government to be an influential one among developing countries, it has few modernized ships with high profitability and high technology, as well as, the problem of advanced aging and the lowered efficiency of ships. This situation causes inferior international competitiveness and an outflow of a large amount of foreign currency from this country.

Indian seamen are highly appreciated in quality and skill, and therefore many of them serve on board foreign ships. The number of Indian seamen follows Japan and equals Korea in Asia, and their services greatly contributes to not only the development of the national shipping industry but also the acquisition of foreign currencies.

However, the present situation includes the problems of shortage of ship officers and their aging on the one hand, and further that there is the requirement of upgrading their skill due to the regulations concerning safety of life and property at sea and protection of the marine environment made severer in compliance with modernization of ships in recent years on the other hand. Moreover, there is a strong demand from advanced countries for ship officers having various qualifications required by international conventions, to fill up the shortage in their own countries.

At present, the number of ship officers in India who are ready to serve on board is estimated at about 15,000 and it is presumed that about 9,000 among them are serving on foreign ships. The Indian government considers it necessary to educate/train at least 1,000 every year to be ship officers with sufficiently high skill, in order to satisfy these demands and to consequently create employment opportunities.

However, the existing training institutes for ship officers can not afford to prepare sufficient equipment for the required education nor have any full scale self-propelling training vessel due to insufficient funds. The education in these institutes has to be mainly based on lectures in classrooms with less practical training. Consequently, the present level of education is not fully satisfactory to meet the requirements of various international conventions. To cope with this situation, utilization of a training vessel installed with modern equipment would be an ideal. But, in view of the problem of budgeting of a large amount for its maintenance and operation, it is considered effective enough for training ship officers to introduce simulators which enable the instructors to do the operation training similar to those on board a real ship at a lower maintenance cost compared to a real ship.

Under such circumstances, the Indian Government has prepared a plan to have the training institutes under DGS educate pre-sea cadets for nautical and engineering officers and reeducate qualified nautical and engineering officers more effectively for the certification of various competences required by STCW convention. Then it has requested the Japanese Government to provide a grand aid to the preparation of the equipment necessary to realize the education and training under this plan.

2-3-2 Details of Request

The requested equipment for educating/training ship officers are a ship maneuvering simulator, a cargo oil handling simulator and an engine room simulator, with which appropriate pre-sea, post-sea and specialized training programs are made possible. Training items for each simulator and its function are as follows.

(1) Ship maneuvering simulator

1) Training item

Course keeping and changing, ship maneuvering to and from a port, Ship maneuvering in narrow channels, Ship maneuvering for access to anchorage areas or mooring buoys, Ship maneuvering in separated navigating channels, Speed control, Ship maneuvering for collision

avoidance, Navigation using ARPA, and Test for ship maneuverability.

2) Function

Selection of the type of an own ship from four kinds of models, Selection of the type of a target ship from three kinds of models and the type of a buoy from ten kinds of models, Establishment of a training area, Selection of training scenarios, Establishment of hydrographic conditions, Training monitoring, Play back, Analysis of training, ARPA function, Establishment of malfunction, visual range simulation functions (225° × 30°), Sound simulation functions, and Instructor's console functions.

(2) Cargo oil handling simulator

1) Training item

Understanding and operation of the control system for cargo oil handling, Cargo oil loading and unloading plan, and Avoidance of danger in case of an abnormal situation and/or accident.

2) Function

Cargo oil loading and unloading, Ballasting and deballasting, Tank cleaning (seawater washing and crude oil washing), Inert gas and tank vent control, Pump operation, Hull strength and stability calculation, and Instructor's console functions.

(3) Engine room simulator

1) Training item

Operation of main engine, Emergency operation of main engine, Operation of generator, Emergency operation of turbogenerator, Operation of steam generating plants, Operation of vital pumps, Operation of oil purifier, Operation of fresh water generator, Emergency operation of auxiliaries, Watching and data recording of main engine and auxiliaries, Treatment of engine room bilge, and

Remote and automatic control.

2) Function

Changeover of main engine control position (engine room, bridge and engine side), Start/stop/speed change of main engine and changeover of fuel oil from heavy fuel oil to diesel oil and vice versa, Strat/stop/speed change of turbogenerator and remote/automatic control of clutch between main engine and turbogenerator, Remote and automatic start/stop/speed control of diesel generator, Start/stop of auxiliary boiler, Start/stop of exhaust gas economizer, Start/stop of auxiliaries, Self check function, and Monitoring of running condition of main engine, auxiliaries and freezing containers.

CHAPTER 3 PROJECT CONTENTS

CHAPTER 3 PROJECT CONTENTS

3-1 PURPOSE

In India, the immediate necessity of educating seamen is to solve the shortage of qualified ship officers in her own shipping industry and to train ship officers so that they can acquire the sufficient knowledge on safe navigation techniques for recent modernized ships of high technology and on protection of the environment as well.

However, the education/training of the ship officers training institutes has to mainly depend on lectures in classrooms due to the shortage of teaching materials, along with very limited practical training using outdated teaching materials. Consequently, the results of the conducted education/training are not satisfactory. To cope with these problems, the Indian Government has established a plan to upgrade the teaching materials so that operational training similar to that on board a real ship can be realized.

The purpose of this project is to procure and install simulators necessary for executing the plan mentioned above.

3-2 STUDY ON CONTENTS OF REQUEST

3-2-1 Study on Propriety and Necessity of This Project

At present the training of ship officers, which the Indian Government considers to be urgent, centers on lectures in classrooms due to the obsolescence and shortage of effective teaching materials in the ship officer training institutes. Such education, that is mainly based on classrooms without sufficient practical training, can not properly train the seamen to be capable of performing safe voyage and environmental protection tasks required for modernized ships.
To solve such a problem, the best way would be to train ship officers on board a training ship installed with modernized equipment. However, this training would cause high maintenance and operating costs.

Taking these factors into account, introduction of various simulators is

considered most suitable for ship officers' training, because it will enable the instructors to do the training similar to on board training with lower maintenance and operating costs compared to on board training.

The pre-sea training and retraining of ship officers every year under this project, when realized, will contribute to the promotion of employment, and its effect will favorably influence the shipping industry in India and around the world. Safe voyage of ships that can be ensured by the training of ship officers will be conducive to protection of life and property and also to prevention of environmental pollution such as an oil spill caused by an accident or misoperation of ships.

3-2-2 Study on Execution and Management Plans

(1) Faculty and management of LBS

Among the present teachers of Lal Bahadur Shastri Nautical & Engineering College (LBS), the principal, vice-principal and senior nautical officers (deans) have "Extra master" or "Extra first class engineer" licenses. These are given to people who have passed qualifying examinations through experience as ship officers and teachers after having acquired the licenses of "Master" or "First class engineer". Though these licenses should have been previously acquired in the United Kingdom, the acquisition of "Master" license has become possible in India since four years ago, and the number of its successful applicants is now four or five per annum. Besides the above, professors have licenses of "Extra master", "Master", "Extra first class engineer" and "First class engineer", thus their levels are very high.

In LBS, full-time and part-time lecturers amount to about 80 and staff/members about 80 in total. In addition, LBS also has a plan to increase the personnel by seven for this project, of which three are for the ship maneuvering simulator, two for the cargo oil handling simulator and two for the engine room simulator. With regard to the recruitment of lecturers and school staffs there is the problem that the level of their salaries may be lower than that of private companies, but in case of the lecturers and staffs of LBS they are recognized in India as men of high social standing. Considering such

social position and the ties between teacher and student, the planned increase of seven personnel is deemed to be realized.

Training and guidance for the operation, maintenance and management of the training equipment are necessary at the beginning, since they are special machines. By doing the above, the training plan can be effectively executed.

From these circumstances, it is judged that the education of ship officers and the maintenance and management of the equipment by trained personnel can be effectively performed without any problem when this project is executed.

3-2-3 Study on Equipment Requested

The equipment requested consists of three sets, i.e. a ship maneuvering simulator, a cargo oil handling simulator and an engine room simulator. Since a large scale of favourable effects on training efficiency can be expected by introducing these machines, as mentioned in the section "3-2-1 Study on Propriety and Necessity of the Project", each machine has been throughly examined in detail. As a result, it has been concluded that the training program will become more substantial by adding the following items.

1) Ship maneuvering simulator

In the case of the simulator having only one training sea area on the visual screen, good results from the training can not be expected as trainees can easily remember the scenario. By increasing the training sea areas by three (actual sea areas), not only education for pre-sea cadets but also familiarized training and specialized training become possible, and excellent results can be expected.

2) Cargo oil handling simulator

Specifications requested are not shown in detail. However, the training of ship officers for tankers is required to meet not only STCW Convention but also International Convention for Prevention of

Oil Pollution, especially for India having a considerable amount of oil transportation. The systems shall be planned for the training capable of complying with these conventions in cargo oil handling. Items particularly such as trim, stability, segregated ballast, and the draught of tankers shall be incorporated into the cargo handling calculation program in order to judge such conditions.

3) Engine room simulator

Engine room plant where a uniflow type diesel engine having the world's largest share and being used mostly in India, as well is, installed as a main engine shall be simulated.

3-2-4 Study on Necessity of Technical Cooperation

Since a simulator is composed of many computers, a control device consisting of nautical instruments, a signal generator, a sound simulator, etc., technical expertise is necessary to handle a simulator. Furthermore, since a simulator is a precision machine, it is liable to be influenced by temperature, humidity and dust, and close attention is required to maintain it. In the actual education, the results of the education are determined by the method used to operate these simulators. When taking account of these facts, it has been considered that training at equipment manufacturers and marine training institutes in Japan is necessary in implementing future seamen training programs in India using the supplied equipment.

3-2-5 Basic Policy to Perform Project

It has been judged that it is proper to perform this project using the Japanese grant aid, from the facts that the feasibility and the effect of this project, as well as, the ability of the recipient country to perform this project have been confirmed by the study mentioned before and that the results of this project coincide with the purpose of the grant aid. Consequently, the outline of this project will be studied and the basic design conducted as follows, on the assumption that the Japanese grant aid will be used. However, concerning the details of this project, it is appropriate to partially modify the request, as mentioned in the section

3-2-3 "Study on Equipment Requested".

3-3 PROJECT OUTLINE

3-3-1 Executing Agency and Managing Organization

The executing agency for this project, is Directorate General of Shipping (DGS) and the actual management is entrusted to Lab Bahadur Shastri Nautical & Engineering College (LBS). The relation between DGS and LBS has been stated in 2-1-4 Present State of Training Institutes for Ship's officers in India. LBS is planning to add seven persons as its lecturers and staff for this project and its organization chart is shown in Fig. 3-1.

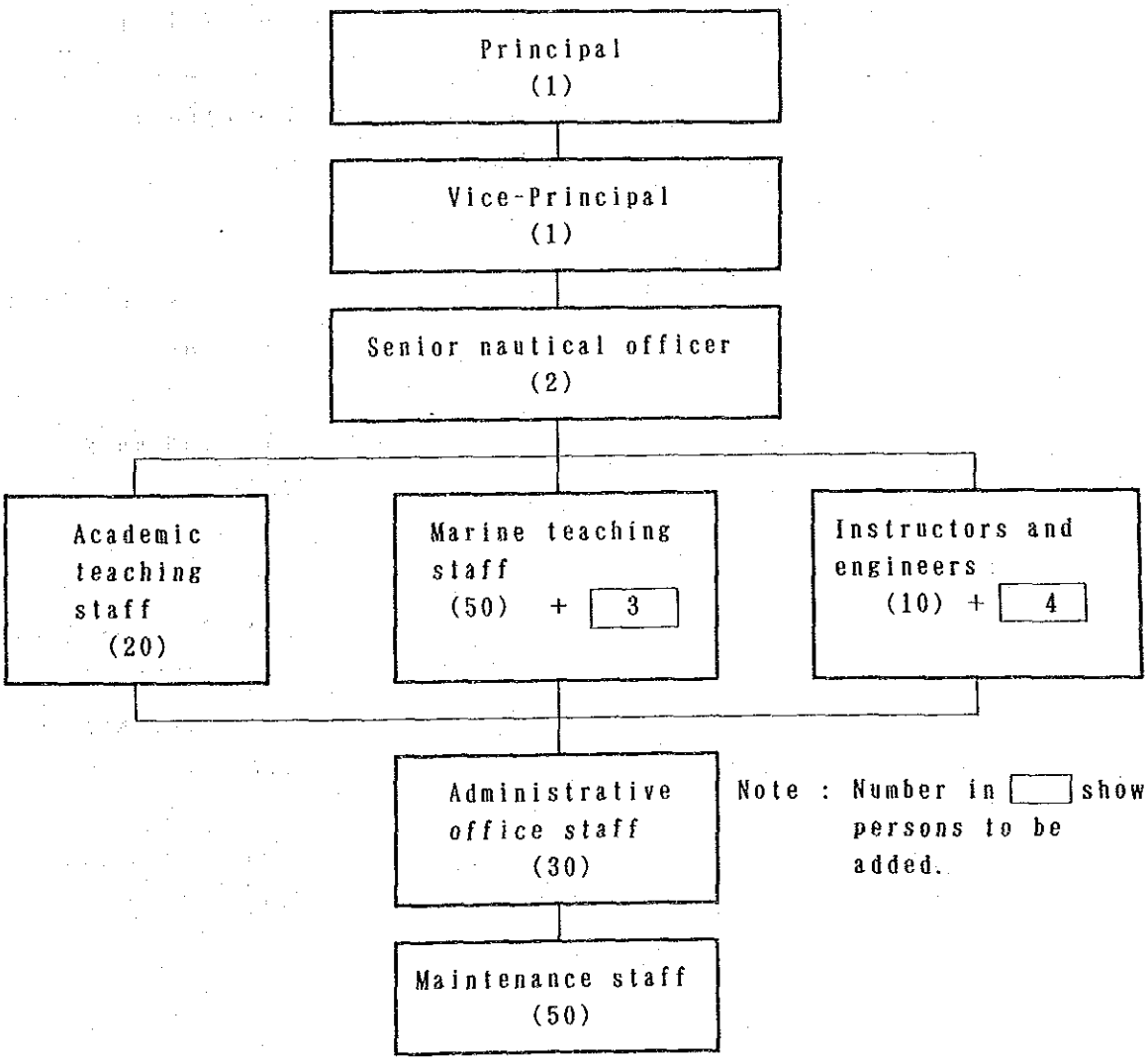

Fig. 3-1 LBS Organization Chart

3-3-2 Planned Education/Training Curriculum

The class curriculum for engineering and nautical trainees are shown in Appendices 5 and 6. However, additional training programs, as described below, are planned to be executed for trainees of the Nautical Officer Training Institute (T.S. Rajendra), Marine Engineer Training Institute (DMET) and Lab Bahadur Shastri Nautical & Engineering College (LBS) by using the training equipment to be amplified under LBS control.

(1) Ship maneuvering simulator

	Operation hours per year	Aggregated number of students	
a. Pre-sea cadets education	240 hours	500	T.S. Rajendra 80 (LBS 420)
b. Familializing training	1,320 hours	500	T.S. Rajendra 80 (LBS 420)
c. Specialized training	400 hours	100	(LBS only)
Total	1,960 hours	1,080	

(2) Cargo oil handling simulator

a. Familializing training	600 hours	300	T.S. Rajendra 80 DMET 120 LBS 100
b. Specialized training	1,400 hours	400	(LBS only)
Total	2,000 hours	700	

(3) Engine room simulator

a. Pre-sea cadets education	400 hours	200	T.S. Rajendra 80 (DMET 120)
b. Familializing trainin	1,400 hours	400	T.S. Rajendra 80 DMET 120 LBS 200
c. Specialized training	280 hours	70	(LBS only)
Total	2,080 hours	670	

3-3-3 Installation Site of Training Equipment and Environmental Conditions

(1) Natural condition of Bombay city

The annual average temperature in Bombay city is 24℃ to 30℃ and the average humidity is 67% to 83%. The annual rainfall reaches a considerable volume of about 2,000 mm, most of which almost concentrated in the rainy season from June to September. Especially, in July heavy rains exceeding 700 mm are usually observed. However, it is said that large-scale floods seldom hit this city, since drainage facilities are generally sufficiently provided. In the rainy season the city is often hit by strong winds and lightning. It is also said that this district is rarely visited by earthquakes.

Table 3-1 shows temperature, humidity and rainfall etc. for each month.

Table 3-1 Temperature, Humidity, Rainfall and Wind Velocity

(From 1931 to 1960)

	Temperature (℃)				Humidity (%)		Rainfall (mm)		Wind Velocity (knots)(3)	
	Average daily highest temp.	Average daily lowest temp.	Average monthly highest temp.	Average monthly lowest temp.	08:30	17:30	Average rainfall	No. of days with rain of 1 mm or more	08:30	17:30
January	29	19	33	16	71	63	2	0	3	7
February	29	20	34	17	72	62	1	0	3	7
March	31	23	35	20	72	63	0	0	3	8
April	32	25	35	22	73	66	3	0	3	8
May	33	27	35	25	73	68	16	1	3	8
June	32	26	34	23	80	78	520	15	6	7
July	30	25	32	23	85	85	709	23	8	8
August	29	25	31	23	85	84	439	19	7	8
September	30	25	32	23	85	80	297	13	4	6
October	32	25	35	22	80	74	88	4	4	6
November	32	23	35	21	73	67	21	1	4	5
December	31	21	34	18	70	64	2	0	4	6
Average	31	24	37(1)	15(2)	77	71			4	7

Notes: (1) Average highest temperature for each year.
(2) Average lowest temperature for each year.
(3) Based on data from 1952 to 1965.

Source: The Meteorological Agency in India

(2) Building

The equipment is expected to be installed in the school building of DMET (Bombay) on the campus of LBS.
The maneuvering simulator, cargo oil handling simulator and engine room simulator will be installed on 2nd (228 ㎡), 3rd (168㎡) and 6th floors (228㎡) respectively.

Though it is thought that room floors have sifficient strength judging from the constructional drawing of the building, it is necessary to reinforce some parts of the floors where concentrated loads are anticipated according to the arrangement of equipment.

It is necessary to change the windows of the building or to do away with them and make walls to keep the rooms airtight, since windows were not installed well and dust is being blown into the building.

It is also necessary to make entrances, which can be closed later, for carrying equipment into rooms, since present doors are too narrow for such a purpose.

Since this building is under the control of the Central Public Under taking Bureau, the implementing organization must get permission from the said bureau prior to the start of the construction work.

Fig.3-2 shows the arrangement of the campus.

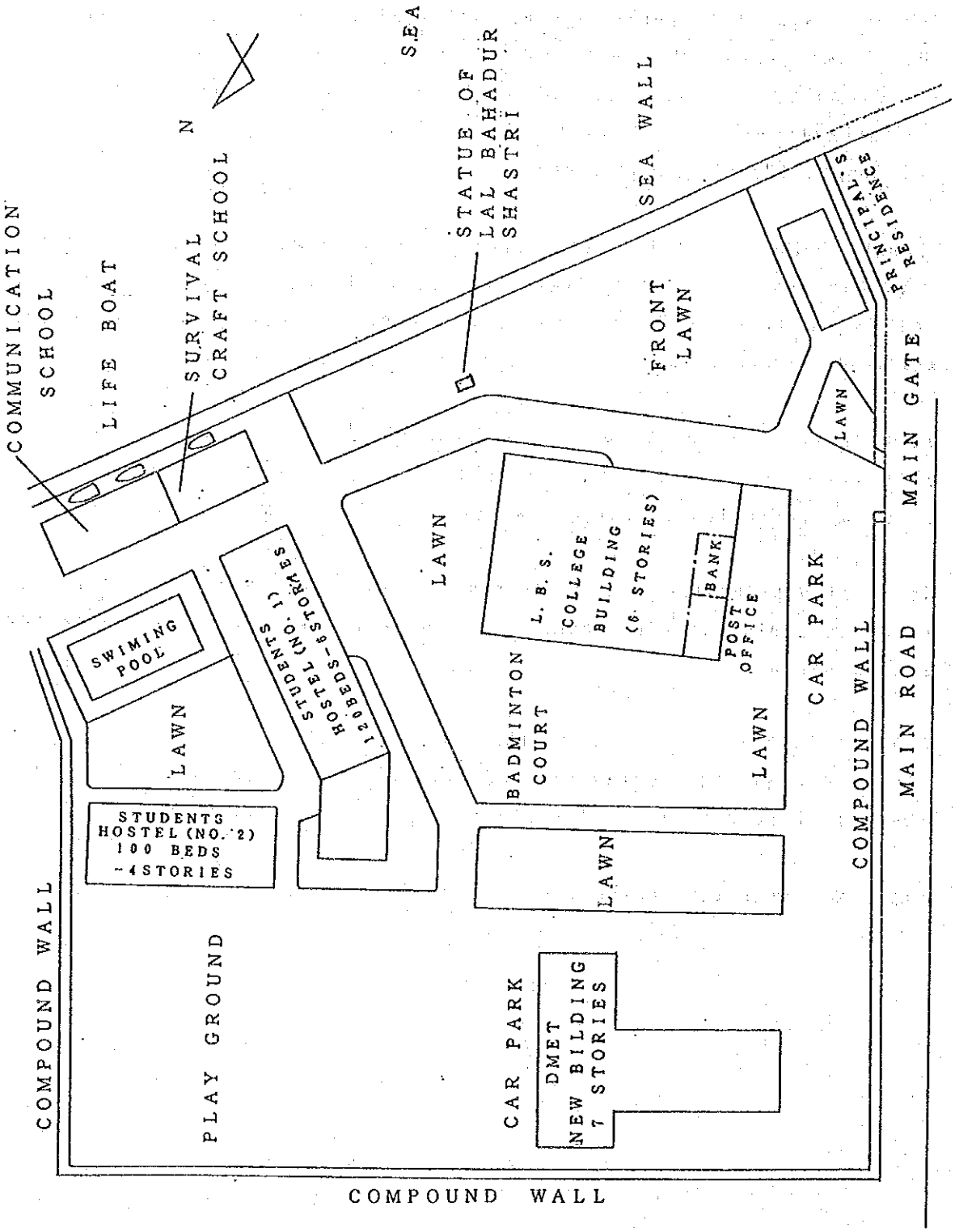

Fig. 3 – 2 Campus Layout

3-3-4 Seamen Training Equipment Outline

As for the equipment requested by India and supplied for this project, the contents and scope of the equipment will be planned as follows, so that the equipment can provide exceptional educational results through the execution of various education/training programs which Directorate General of Shipping (DGS) is now contemplating as described in Chapter 2.

(1) Ship Maneuvering Simulator

In view of the safety of human lives and properties at sea, as well as the protection of environment, it is strongly desired, in recent years, that the capacity of upper-class officers or watch officers, who operate and maneuver ships, should be further improved.
Especially captains or chief officers are internationally required to be capable of maneuvering ships under any conditions.
In such international circumstances, India has been trying to cope with the requirement by means of lectures in classrooms and training on board Indian-flagged merchant ships.
However, those efforts have not always proved so effective as expected. The use of a training ship would be most effective for students to learn ship-maneuvering techniques. But, the costs for building and maintaining such a real training ship would be enormous. Therefore, in order to solve this problem, and also to make training under various conditions which can hardly be experienced on board real ships, we plan to have one ship maneuvering simulator set. This simulator would be capable to retrain upper-class officers and also give students fundamental training on ship-maneuvering.
In this project, we plan to set up an imitation bridge, that is almost same as a bridge on a real ship, facing an imitation visual field as a front surfaces. Instructors would assume various conditions related to ship-maneuvering or watch, and have students cope with those conditions. Then instructors would appraise students' recorded actions and give adequate guidance/advice.
The simulator consists of three sections, namely, training section, instructor section, and control section. The training section has 225 degree vision screen, and also a ship-maneuvering console, etc., which are all the same as those installed on real ships. The

instructor section has devices by which they can set training conditions, and observe and record trainees' reactions.
The control section, being equipped with a system controller, performs controlling functions like conditions-setting or monitoring.
Three different sea areas are shown on the vision screen. Sea areas, which are considered to be most effective for training, are selected.
The number of ships or other objects, which can be shown on the screen, is about ten, which is in consideration of the actual situation of coastal navigation.

(2) Cargo Oil Handling Simulator

In view of protection of the environment at sea as well as on the coast, that is now strongly required, it is indispensable to improve the capability of the oil tanker crew in order to prevent pollution of sea and to secure the safety of tankers. The STCW Convention clearly stipulates qualifications which are necessary for the tanker crew. Furthermore, the criteria regarding oil quantity discharged from ships is specified in the International Convention For The Prevention of Pollution From Ships. It is mandatory to train tanker crew on techniques of cargo oil handling in order to meet these requirements. Under such circumstances, we plan to have one cargo oil handling simulator set for the purpose of training students with respect to cargo oil handling techniques.
They would be able to execute such training without any risk of accidents, such as explosion, pollution and contamination, by using this simulator.

In this plan, a mimic panel of the cargo oil valve operating apparatus is provided. Instructors can, with this device, set various conditions or create mimic accidents, and appraise trainees' reactions. Consequently, they can give adequate guidance or advice to trainees.
The simulator consists of training section, instructors section, and control section. The training section has a main console, a cargo loading calculator, and a mimic cargo-piping-system-indicating panel.
The instructors section has a device by which they can set various training conditions, create mimic accidents, and observe and record

trainees' reactions. The control section, equipped with a system controller, performs controlling functions like conditions-setting.

(3) Engine Room Simulator

Staff, who are in charge of watching the engine room area, are required to comprehensively understand the whole system of the main engine, related auxiliary machinery, and propulsion gear. They are required to master techniques for operating and watching all the machinery and equipment. To say it more concretely, they ate required to have capabilities to operate and watch the main engine and auxiliary machinery, to detect their defective parts, to determine the causes of malfunctions, to restore a defective machinery to normal conditions, or to take emergency counter-measures.
Therefore, engine room staff must undergo intensive education and training on the following items.

① Fundamental procedures for operation of the main engine and auxiliary machinery from the time of departure from a dry dock to normal navigation.
② Detection of various problems, indicated by mimic signals, determination of causes of malfunctions, actions for restoration or emergency counter-measures.

The use of a simulator is most efficient for repeated and effective training on these items.
This simulator allows trainees to witness mimic signals of engine operation modes and trouble occurrences, and records their reactions. Instructors judge the trainees' reactions, and consequently give adequate guidance and advice to trainees. This simulator imitates an engine control room of a real ship installed with a main diesel engine. It consists of a training section and an instructor's section. The training section has a control console with various gauges, a distributing board, and a graphic panel. The instructor's section has a console for instructors, and a computer attached to the console.
The graphic panel shows the system structure and the conditions of each machine. Instructors can set various operation modes for the

engine and create malfunctions or abnormal conditions by inputting training programs by using the condition-setting board. Trainees practice operating the handles or switches of the control console, the distributing board, and the graphic panel.

3-3-5 Maintenance Program

The effect of the project implementation is not achieved by a mere provision of equipment but requires recipient organ's endeavoring efforts to their proper handling and maintenance. In this sense, proper preparation and efforts for the operation and maintenance of the equipment are required. LBS has a new manning plan to add 3 persons as instructors and 4 persons as staffs and assistants. Though it can be judged that they can afford to operate and maintain the equipment in terms of manpower, the instructors should be well trained in the field of operation and maintenance under the proper training program.
It is suggested that the following items should be carried out so as to maintain the equipment in good condition for a long time :

(1) Preparation of operation and maintenance manuals

Instructional manuals for operation and maintenance of the equipment should be prepared by the equipment maker so that they can be easily understood by the instructors of LBS. These manuals should be controlled by LBS.

(2) LBS has to appoint official(s) responsible for maintenance and control of equipment ; the followings are considered necessary for them :

(a) Check list should be prepared in accordance with the maintenance manual and periodical checking against failure or trouble with their rectifications be recorded in a similar manner as done in the Deck and Engine "Log Book".

(b) Referring to the above, the appropriate quantity of spare parts and consumables should be fixed and stowed in the appropriate store under the proper store control. As to vital spare parts, supplementary procedures must be taken immediately after their

consumption.

(3) Budgeting for maintenance

The budget for the maintenance of the equipment, as well as, for the replenishment of its spare parts should be secured.
Refer to (5) below.

(4) Timing of training for the maintenance personnel

The training in Japan of the maintenance personnel for the purpose as described in 3-3-6 is preferably done during the equipment's manufacturing stage, inclusive of final trial test. Also, since the local setting and adjustment of the equipment at LBS is very useful for having, assistant maintenance staff trained by the maintenance personnel who have had the training in Japan, these assistants should have been selected prior to such an opportunity.

(5) Maintenance costs for equipment

Annual maintenance and operational costs are estimated roughly under the following conditions.

1) Equipment parts and consumables are purchased in Japan.
2) Operation hours are to be a total 6,040 hours per year for three simulators as mentioned in 3-3-2 "Planned Education/Training Curriculum".
3) Assumed Japanese service engineer's cost for equipment is included.

a) Electric power expense

• Maneuvering simulator				
Room illumination	1.6 kW	× 1,960 Hr	=	3,136 kWh
Air conditioner	22 kW	× 1,960 Hr	=	43,120 kWh
Simulator	30 kW	× 1,960 Hr	=	58,800 kWh
• Cargo oil handling simulator				
Room illumination	1.4 kW	× 2,000 Hr	=	2,800 kWh
Air conditioner	17 kW	× 2,000 Hr	=	34,000 kWh
Simulator	15 kW	× 2,000 Hr	=	30,000 kWh

・Engine plant simulator

Room illumination	1.6 kW	× 2,080 Hr	=	3,328 kWh
Air conditioner	20 kW	× 2,080 Hr	=	41,600 kWh
Simulator	13 kW	× 2,080 Hr	=	27,040 kWh
Sum				243,824 kWh

Annual expense of electric power

243,824 kWh × 2 Rupees/kWh = 487,648 Rupees

b) Expense for water consumption

・Maneuvering simulator				
Air conditioner	3 m^3/day	× 245 days	=	735 m^3
・Cargo oil handling simulator				
Air conditioner	3 m^3/day	× 250 days	=	750 m^3
Water tank	3 m^3/week	× 50 weeks	=	150 m^3
・Engine plant simulator				
Air conditioner	3 m^3/day	× 260 days	=	780 m^3
Sum				2,415 m^3

Annual expense for water consumption

2,415 m^3 × 30 Rupees/m^3 = 72,450 Rupees

c) Expense of equipment parts

・Maneuvering simulator	900,000 Rupees
・Cargo oil handling simulator	375,000 Rupees
・Engine plant simulator	127,500 Rupees
Subtotal	1,402,500 Rupees

These parts are : Print circuit bases (P.C.B.), Braun tube for projector, parts for high voltage, etc.

Cost estimation of equipment parts is drawn from the actual data of existing training equipment and delivered one in the past in Japan.

d) Expense of consumables

・Maneuvering simulator	108,170 Rupees
・Cargo oil handling simulator	82,500 Rupees
・Engine plant simulator	56,860 Rupees

Subtotal	247,530 Rupees

These are : Ink ribbon for printers and pens and paper for plotters.

Detailed description of consumables is shown in Appendix-7.

e) Expense for Japanese service engineer's periodical inspection

Operation check for maneuvering and cargo oil handling simulators

2 engineers × 10 days × 26,000 Rupees = 520,000 Rupees

Operation check for engine plant simulator

1 engineer × 10 days × 26,000 Rupees = 260,000 Rupees

Air Fare 3 rounds ticket = 240,000 Rupees

Subtotal	1,020,000 Rupees
Total	3,230,128 Rupees

As above, the annual maintenance and operation costs aggregate roughly 3.23 million Rupees.

The periodical inspection would have to be done by the Japanese service engineers for sometime to come, but LBS's personnel should become capable enough to take charge of the job instead as soon as practicable.

Necessary period for periodical inspection service by Japanese engineers will depend upon the attained level of technical ability of LBS's personnel in charge of the equipment.

(6) Availability of Budget for Maintenance and Operation

The Directorate General of Shipping (DGS) controls the budget for maintenance and operation related to ship officers training, and the actual results are as described in 2-1-5. The aggregate maintenance cost of the equipment for this project is approx. 3.23 million Rupees as mentioned in 3-3-5 (5) above, corresponding to about 5.5% of the total budget of DGS in F.Y.1990. DGS consists of Headquarters, Seamen Education Institutes, Seamen Welfare Department, Seamen Employment Agency, Merchant Ships Department, Ship Inspection Department, Sailing Ships Department and Merchant Ships Office. In these, the operational cost of the three ship officers training

institutes corresponds to about 65% of the total operational cost of DGS thus occupying a major portion among the organizations controlled by DGS.
Furthermore, DGS fully recognizes the necessity of increasing ship officers, giving it a top priority to educate and train ship officers for such purpose. Since DGS intends to arrange the budget to cover the maintenance cost required after executing this project, there seems to be in particular no problem.

When the project is executed, the cost for the acquisition of the equipment will have to be included in their budget for facilities in the form of a Counterpart Fund.

3-3-6 Technical Cooperation

DGS has made a request for Japan's technical cooperation. Taking into account the effective utilization of the training equipment, training for maintenance personnel, operation instructors and instructors in charge of curriculum preparation is deemed necessary. In particular, the staffs for maintenance and management should be desirably trained in Japan, considering the importance of such jobs.

(1) Training on equipment maintenance

-No. of trainees : 3 (2 nautical and 1 engineering ; all to be LBS or DMET instructors)
-Period : Around 3 months
-Training place : At equipment manufacturers and maritime technology training institutes in Japan.

CHAPTER 4 BASIC DESIGN

CHAPTER 4 BASIC DESIGN

4-1 BASIC DESIGN POLICY

As a result of studying the contents of this project, the basic design policy of the training equipment has been determined so that the education using them can achieve the results as desired by the Indian Goverment.
Consideration has been given to the following points based on the local conditions in India.

4-1-1 Compatibility with Intended Seamen Training

The specifications of the equipment should be so designed that the pre-sea, post-sea and specialized training programs can easily be established according to scenarios selected by the instructors and the results of the training can be evaluated.

4-1-2 Adaptability to the Operating/Maintenance Capability of Executing Agency

The equipment should offer easy handling and maintenance in view of the level of the instructors and operating/maintenance staffs and the maintenance capability for precision machines in India. Also an appropriate quantity of spare parts should be secured to prevent the occurrence of non-operation of the equipment caused by the unavailability of spare parts. The electric power consumption of the equipment should be made as low as possible.

4-1-3 Execution Period

This project should be executed in two phases. The ship maneuvering simulator is to be supplied in the first phase, the cargo oil handling simulator and the engine room simulator are to be supplied in the second phase.
Since the project in each stage is executed on the single-year-basis budget under the Japanese grant aid scheme, the equipment should be designed so as not to cause any time loss in the course of their

manufacture, and the software should be produced so that the final debugging can be completed in Japan.

4-2 DESIGN STUDY

The following conditions are to be considered for designing of the equipment :

4-2-1 Natural Conditions

In Bombay city, the average temperature is 24℃ to 30℃, but sometimes over 40℃ in the day time. The average humidity is 67% to 83%, but over 90% in the rainy season. Amount of rainfall is about 2000 mm per year. Strong winds and thunderbolts may occasionally occur in the rainy season.

The following considerations are for such natural conditions

(1) Design conditions are set up as follows :

Ambient temperature	45℃
Ambient humidity	95%
Room temperature in air-conditioning	30℃
Room humidity	80%

(2) Air tight walls around the equipment room and equipment covers should be provided in order to prevent any influence by winds with sand dust and any damage caused by rats.

(3) As to a thunderbolt consideration should be given to installation of lightning conductor and power facility.

4-2-2 Location of Equipment

The equipment should be arranged in the DMET school building so as not to generate a concentrated load because the floor strength is 250kg/m² to 300 kg/m².

If necessary, the floor should be reinforced in part.

Since voltage fluctuation is large, a constant-voltage regulator should be provided.

4-3 BASIC PLAN

4-3-1 Equipment Planning

The specifications of the educational equipment are determined according to the above-mentioned design condition. Their outline specifications, and the quantity and principal particulars of the equipment components are described as below.

The equipment planned in this project are as follows :

(1) Ship maneuvering simulator	1 set
(2) Cargo oil handling simulator	1 set
(3) Engine room simulator	1 set

(1) Ship maneuvering simulator

1) Outline

The purpose of the ship maneuvering simulator is to provide trainees with repeated training exercises in schoolrooms on land.

To achieve effective training effect, the simulator is provided with a mock bridge equipped with simulated visual and sound systems, which give a maneuvering environment in which the trainees feel as if they were actually on board a ship. The bridge is equipped with typical navigation equipment and bridge instrument. It can reproduce various movements of the own ship on real time base according to the operation by the trainees. Also it can simultaneously control the visual and sound systems so as to provide the consequent change of simulated visual range and sound, thus giving to the trainees a realistic simulation of ship's navigation.

From the training with this simulator, various results can be expected such as reduction of training hours, compared to on board training, and repeated training in various sea conditions and risks, recording and analysis of executed training for easy evaluation, etc.

2) Training programs

The following training will be made possible:

a) Course keeping
The simulator is made available for training to keep the own ship's course as planned under the set up condition in respect of relations between the own ship and others or buoys, wind, wave, current, etc.

b) course changing
The simulator is made available for course changing training that will be carried out under the most suitable training scenarios to be made out by setting up conditions as to target ships and buoys.

c) Ship maneuvering to and from a port
The simulator is made available for training to maneuver the ship for entering and departing from a port in accordance with selected training scenarios.

d) Ship maneuvering in narrow channels
Training of passing narrow channels can be carried out by setting up location of target ships and buoys closer to the own ship.

e) Ship maneuvering for access to anchorage or mooring buoy
Training of making the own ship access to a pilot launch, anchorage area and mooring buoy area can be done under appropriate setting up of buoys.

f) Ship maneuvering in separated navigating channels
This training can be carried out by setting up a separated navigating channel with buoys in a training scenario.

g) Speed control
The simulator is made available for training of speed control. The own ship speed is controlled by operating main engine controller in the mock bridge, according to the selected engine performances.

h) Ship maneuvering for collision avoidance

The training of collision avoidance is made available under the scenario to make the own ship come into collision with a target ship.

i) ARPA familiarization

Training of collision avoidance using the automatic radar plotting aid is made available.

j) Test for ship maneuverability

The simulator has a function that records tracks of the own ship and prints them out on paper.

Using this function, trainees can study ship maneuverability by way of doing turning test, z-test and spiral test.

3) Function

The functions of the simulator are summarized as follows:

a) Own ship models

The type of an own ship is to be selected from 7 kinds of models mentioned below:

6 models - Three kinds of single screw propulsion ships with full load condition and ballasted condition.

1 model - One kind of twin screw propulsion ship with operational draft condition

Every models are designed to have their own maneuvering characteristics for shallow water effect, bank effect and effect by tug boats.

b) Target ships and buoys

-Kinds of target ships

Kinds of target ship can be selected from 3 kinds of models.

Various ship's lights including restrictive conditions can be displayed on the target ships.

-Buoys

Buoys can be selected from 10 kinds of models such as baoy,

islands, etc.

c) Training area

Training areas are to be three.

d) Training scenarios

In training scenarios sea area zone, target ships, buoys, and hydrographic condition environment are set up, and the instructor selects them according to training themes. Furthermore new training scenarios can be prepared by arranging buoys, target ships, etc.

e) Hydrographic conditions

Wind speed, wind direction, wave height, wave direction, sea current speed and sea current direction can be set up.

f) Training monitoring

Training state can be monitored by the monitor attached to the instructor's console.

g) Play back

All the ship maneuvering data of conducted training are recorded and reproduced. Play back has functions of real time and quick traverse (4 times).

h) Analysis of training

Information and data for training conducted are printed out and its results will be easily analyzed.

i) Automatic radar plotting aid (ARPA) function

The automatic radar plotting aid is provided and used for training.

j) Malfunction

The simulation for training of the following abnormal situations is available by selection of the instructor.

-Main engine failure

-Steering gear failure

k) Visual system

The system has a function to project the images of sea, sky, target ships, own ship, buoys, coastline, harbor, etc. on a large screen placed outside the mock bridge. Training under day-time, night-time and fog condition can be carried out. The screen has a angle of visibility of 225 deg. H × 30 deg. V.

l) Sound simulation functions

The system has a function to mimic the sound of main engine, whistle, environmental sound, etc. by use of speakers installed around the mock bridge.

m) Instructor's console functions

The instructor's console is provided with the following functions

-Control of simulation such as start, stop, pause, play back, etc.
-Selection of training scenario
-Setting-up of own ship, target ships, objects and hydrographic conditions
-Changes of training conditions during training
-Monitoring of training condition
-Printing out of analysis data of training
-Data transfer to magnetic tape

4) Equipment components list

a) Simulated bridge section

-Simulated bridge	1 set
-Steering stand	1
-Gyrorepeater	1
-Main engine control stand	1
-Nautical instrument panel	1 set
(Rudder angle indicator, Ship speed indicator, wind speed indicator, Wind direction indicator, Angular speed indicator and Propeller shaft revolution indicator)	
-Automatic radar plotting aid (ARPA)	1
-Relative motion display type radar	1
-Own ship's position indicator (latitude and longitude)	1

-Bathymetric indicator	1
-Inter-phone	1 set
-Electric clock	1
-Chart table	1
-Key for morse signal light	1
-Speaker system	1 set

b) Instructor section

-Instructor's console	1
-Video-printer	1
-Laser-printer	1

c) Simulated visual display section

-Screen	5
-Projector	5 set
-Image generator	5 channel

d) Computer section

-Host computer	1
-Nautical instrument controller	1
-Radar signal generator	1
-Acoustic equipment	1
-Stabilized power equipment	1

(2) Cargo Oil Handling Simulator

1) Outline

The cargo oil handling simulator is to be for the purpose of giving training to learn fundamental operation techniques and procedures for cargo oil handling and ship's safety, and also mastering the remote operation for cargo oil handling, opening/closing of valves, tank cleaning, ballasting and deballasting, etc., in the same way as on an actual ship.

To achieve this purpose, the simulator is equipped with a simulated piping system of oil tanker on a graphic panel, coupled with a control console capable of operating pumps and related valves. An instructor's console can make possible the input of intended exercise

conditions and monitoring of exercise progress.
Computer system is made available for calculation of change of tank level corresponding to the operation of pumps, valves, etc., change of operation situation of pumps according to the pump performances and for generation of various kinds of signals, warnings, etc.
This simulator can meet the requirements specified in 73-78 of International Convention for the Prevention of Pollution from Ships and also has a system capable of loading three kinds of cargo oils.

2) Training programs

By this simulator, the following trainings are made possible.

a) Training for understanding control system and mastering the fundamental operation of cargo oil and ballast water handling

b) Training for preparing cargo oil handling plan, keeping the ship's safety in relation to the load change in loading and unloading

c) Training in case of an abnormal situation and/or accident

3) Function

The fundamental functions of the simulator are as follows:

a) Training programs by this simulator
-Cargo oil loading
-Cargo oil discharging
-Ballasting
-Deballasting
-Cargo oil loading and daballasting
-Cargo oil discharging and ballasting
-Tank cleaning (sea water washing)
-Crude oil washing
-Inert gas and tank vent control
-Pump operation
-Hull strength and stability calculation

b) Simulated malfunctions and abnormalities

This simulator can generate the following abnormalities and failures made artificially.

-Cargo oil pump: shutdown, abnormal revolution, suction, discharge and lowering of oil pressure
-Stripping pump; shutdown
-Ballast pump; shutdown
-Piping system; failure of valve, lowering of liquid pressure inside pipe
-Inert gas system; shutdown, lowering of inert gas pressure
-Tank level gauge; abnormal rise, abnormality of sensor, etc.
-Ship's stress abnormal heel, trim, etc.

c) Instructor's console

The console is provided with function to set up the followings;

-Training modes (cargo oil loading, cargo oil discharging, ballasting)
-Training conditions (cargo oil specific gravity, sea water temperature, cargo oil flow-rate, etc.)
-Interruption and restart of training during training
-Abnormalities and failures
-Simulated speed (real time, quick traverse)
-Play back of training operation

4) Equipment components list

a) Cargo oil handling simulator

-Cargo oil control console (including detection and control units for contamination of oils)	1
-Inert gas control console	1
-Loading computer	1
-Mimic diagram display unit	1
-Pump stand	1
-Instructor console	1
-Simulating computer	1
-CVCF power unit	1

b) Practical training equipment

(i) Tank cleaning machine

-Single nozzle tank cleaning machine with control unit	1
-Twin nozzle tank cleaning machine	1

(ii) Valve control and level gauge indicator

-Air compressor	1
-Water tank	1
-Control panel	1
-Hydraulic power unit	1
-Solenoid valve unit	1
-Manual pump unit	1
-Sluice valve	1
-Butterfly valve	1

(iii) Piping diagram panel

-Self stripping system diagram panel	4

(3) Engine Room Simulator

1) *Outline*

The Engine Room simulator is to simulate the operation system of propulsion plant in Engine Room and Engine Control Room using the computer. The simulator consists of main diesel engine, steam generating plant, electric generators and associated auxiliaries. Trainees will acquire the knowledge of operating propulsion plant and learn necessary technique required for duty engineers.

Instructor is to operate instructor's console introduce ship operation modes, such as in-port, standby, maneuvering in harbor, ocean navigation, or initial conditions or faults of machinery, etc. Trainees will learn operation of propulsion plant by operating handles or switches on console and panels to deal with changing operation modes and/or in accordance with instructor's directions through instructor's console.

The simulator uses as a model an engine room of container ship installed with the uniflow type main diesel engine, and composed

of a graphic panel and a control console simulating the real engine room, an instructor's console for setting up simulating conditions and monitoring the training condition, dummy sound generator for giving field ambience, computers and peripheral equipment.

2) Training programs

The simulator is made available for training of the following operations.

a) Operation of main engine
Training of fundamental operation for warming-up, start, power change, stop, finished with engine etc. of main engine

b) Emergency operation of main engine
Training of emergency operation for main engine trouble while its running

c) Operation of electric generators
Training of fundamental operation for start/stop, charge-over, parallel running and load control of generators

d) Emergency operation of turbo-generator
Training of emergency operation for trouble of turbo-generator while its running

e) Operation of steam generating plants
Training of fundamental operation for start/stop and back-up operation of oil firing boiler

f) Operation of vital pumps
Training of operation for start/stop and change-over of vital pumps

g) Operation of oil purifier
Training of operation for start/stop of oil purifier

h) Operation of fresh water generator
Training of operation for start/stop of fresh water generator

i) Emergency operation of auxiliaries
Training of emergency operation for trouble of vital pumps, heat exchangers, tanks, strainers, etc. while their running

j) Watching and data recording of main engine and auxiliaries
Training of watching and data recording at normal and abnormal operation conditions

k) Treatment of engine room bilge
Training of fundamental operation for treatment of engine room bilge

l) Remote and automatic control
Knowledge acquisition of automation through automatic start/stop systems of auxiliaries and through study on various control system.

3) Function

Function of the simulator are as follows:

a) Basic function of the simulator
-Control position change-over of main engine
(Engine control room, Bridge, Local)
-Start/stop and speed change of main engine and also change-over of fuel oil from heavy fuel oil to diesel fuel oil and vice versa
-Start/stop and speed control of turbo-generator and remote and automatic control of on-off clutch between main engine power transmission and turbo generator
-Remote and automatic start/stop and speed control of diesel generator
-Start/stop of auxiliary boiler
-Start/stop of exhaust gas economizer
-Start/stop of auxiliaries