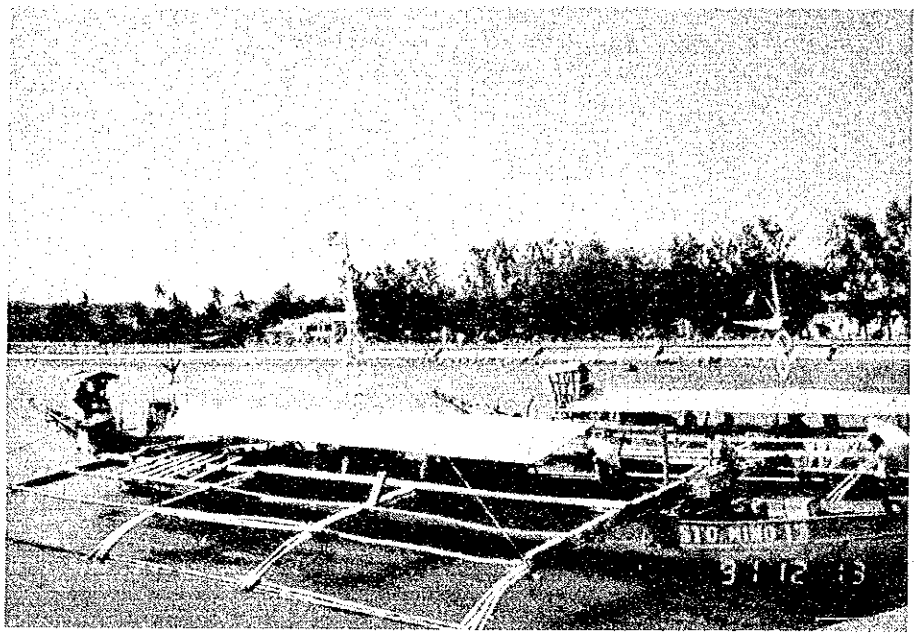

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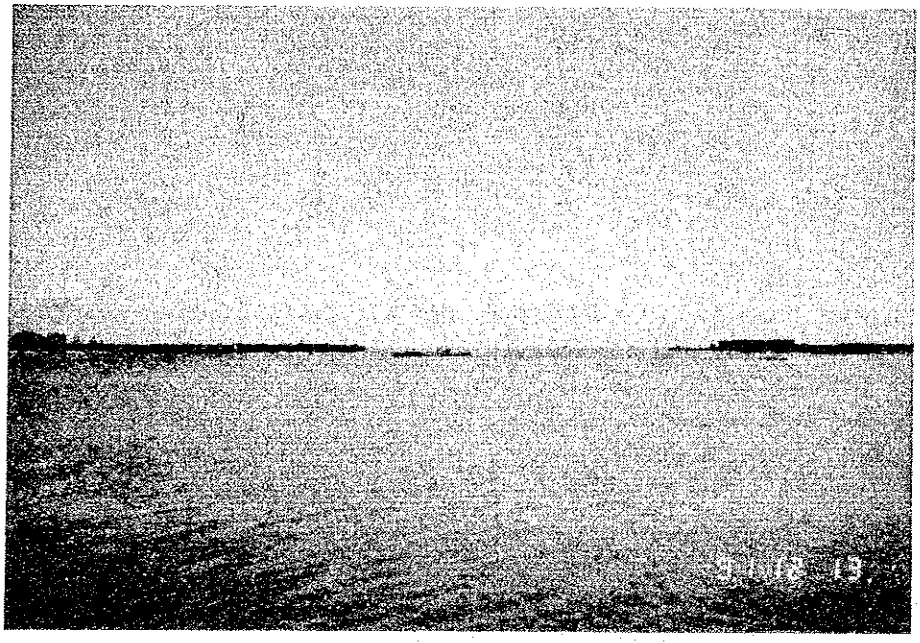

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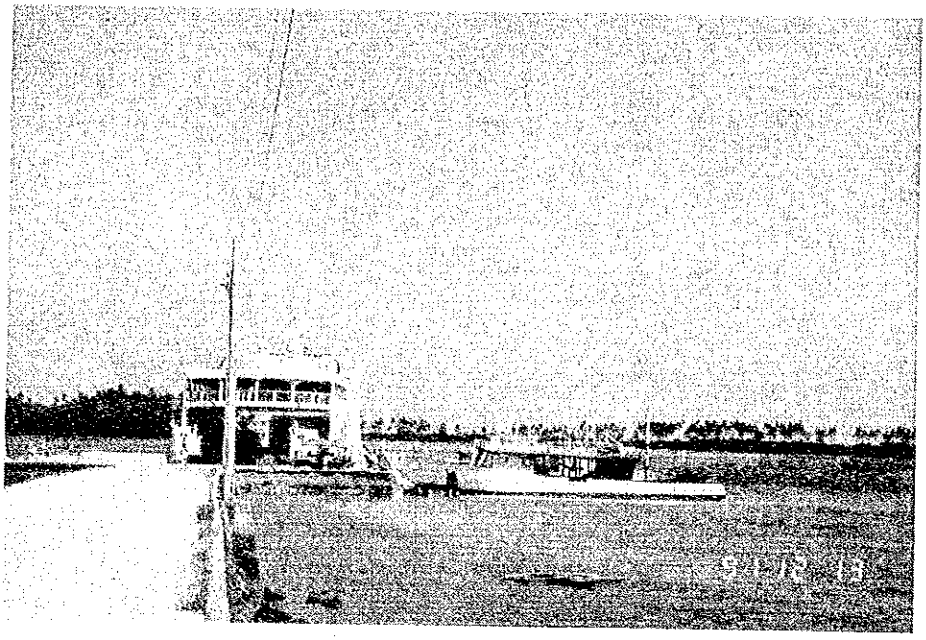


Picture 1.11

2. VESSEL INSPECTION SYSTEM UPGRADING PROJECT

2.1 Surroundings

1) Shipbreaking and shipbuilding

Worldwide demands to shipbreaking are raising. Shipbreaking business in the philippines seems to be feasible by a virtue of plenty and cheap labor force. Only one problem to be solved is the market of scrap iron,

If Philippine National Steel Corporation could utilize scrap iron to produce steel for vessel use with some subsidy from government, this local produced steel gives benefit to shipping/ shipbuilding industries. In addition of this direct impact to the industries increase of employment and improvement of trade balance has some meanings from the national economy point of view.

Ministry of Transport of Japan invited six (6) foreign governments to "International Symposium on Shipbreaking" on February 23-29, 1992 in order to discuss on the subject of "current state and prospect of the shipbreaking industry and problem". In the six invited foreign governments the Philippine Government was included(other five are People's Republic of China, Arab Republic of Egypt, Republic of Indonesia, Kingdom of Thailand and Socialist Republic of Viet Nam).

We expect and see Philippine government's response to the symposium.

2) Education system of shipbuilding technology

In June 1991 Namei Polytechnic Institute and Mariner Polytechnic College and Cebu Central College were listed up as education entities for naval architect and marine engineer. In December of the same year one of them, Namei Polytechnic Institute, was the only one educational body. The reasons of decrease were (1) small number of applicants and (2) old aged instructors.

3) Shipbuilding Technology Center

Necessity of the center is summarized as follows;

Instruments, apparatuses, fittings and equipments, and lifesaving appliances are requested in general to receive "type approval" in order to assure safety and reliability. But there is no institution in charge of type approval test in Philippines.

Fundamental training to ship inspectors is required to

maintain fairness on ship inspection operation. But no training center is existing.

Education entities have few experiment facilities. Experiment facilities are necessary to educate shipbuilding engineers. Facilities of the center are applicable to that purpose.

Conclusion is that a shipbuilding technology center must be established with test facilities for "type approval", study rooms, experiment rooms, models for educational use and experiment tanks. Further expansion of the center in future is anticipated.

2.2 Ship Inspection System

Optimal ship inspection system is investigated together with Philippine counterparts. Recommended is as follows:

1) Head Office

Location: Manila

Works:
Approval of plan of new/conversion ships;
- Purposes
  - to ensure safety in engineering point of view
- Category of checks
  - Safety
  - Strength
  - Costs
- Method of checks/evaluation
  - Drawing scale
  - Scantling calculation
  - Stability calculation
  - Loadline calculation
  - Speed/power calculation
  - Electrical calculation
- Distribution of plans for checking in staff
  - Times
  - Number sheet
  - Complete/incomplete
- Period of checking
  - Minimum 25-28 days
  - Maximum 30-35 days

Issue of License/Certificate
- Category of the issuance of license/certificate
  - Shipyard
  - Vessel
- Factor of issuance of license/certificate
  - Shipyard
    - Shipyard land title

Shipyard MARINA approval
Shipyard inspection
Vessel
New vessel/local construction
Vessel/importation
Chartered vessel

Registration of ship
New vessel/local construction
Compliance of all necessary requirements of new vessel prior to registration
Compliance of all necessary requirements prior to start of construction
Vessel/importation
Compliance of all necessary surveys/inspections prior to registration
Compliance of all necessary surveys/inspections in verification prior to registration for new delivery
Chartered vessel
Compliance of all necessary surveys/inspections prior to registration
Compliance of all necessary surveys/inspections in verification prior to registration for new delivery
Pre-requirements for registration
Limitation period for new existing vessel
Screening documents prior to registration
Registration list documents
Submission of all kinds of necessary registration requirements

Amendments of rules and regulations
Amendments/review of merchant marine rules and regulations
Amendments of MARINA rules and circular policy
Schedule of committee members meeting

Technical control on shipbuilding/repairing
Shipyard project study
Ship/vessel project study
Shipbuilding/shiprepairing research for development of the industry
Implementation of policies, rules and regulations on the maximum and/or minimum requirements of shipbuilding and shiprepairing

Correspondence to international conventions
SOLAS, MARPOL, STCW etc.
Classification society

Preparation and maintenance of inspection manuals
New shipyard/existing shipyard
Inspection of new shipyard approval

Inspection of shipyard renewal approval
Local shipbuilding/shiprepairing
Keel laying inspection for new vessel
Periodical survey/inspection of construction vessel
Launching survey/inspection
Periodical survey/inspection for conversion and repaired vessel

Personnels:

Lawyer	2- 3 persons
Naval architect and marine engineer	8-12 persons
Mechanical engineer	4- 8 persons
Industrial engineer	2- 6 persons
Electrical engineer	2- 6 persons
Assistants	6-10 persons

2) Regional office

Location:
Batangas, Legaspi, Cebu, Iloilo, Tacloban, Cagayan de Oro, Zamboanga, Davao and Cotabato

Works:
Survey/inspection to ensure compliance of approved new/conversion ship plans
Preliminary survey
Periodical survey/inspection
Launching survey/inspection
Sea trials as observed
Supervising of inclining experiment to ensure compliance of stability criteria
Verification of loadline mark
Tonnage measurement

Annual survey/inspection of existing vessel
Dry docking survey
Annual inspection to ensure compliance of PMMRR

Mandatory inspection of vessel as requirements in the issuance of "Certificate of Inspection" such as conditions of hull, machinery, equipments, etc., manning requirements and ship documents.

Survey/inspection to determine the complete specification data prior to approval and to issuance of necessary documents for use in operation of vessel
Survey/inspection for verification the condition of vessel

Unscheduled material readiness inspection (MRI) of vessel to ensure maintenance of seaworthiness at any time.

Survey/inspection of hull thickness gauging with

ultrasonic instrument
Survey/inspection of machinery and communication equipments
Confirmation of upkeep of SOLAS standard

Personnel:

Naval architect and marine engineer	4-8 persons
Mechanical engineer and electrical engineer	2-6 persons
Assistants	4-8 persons

(Note) Number of personnel shall be flexible to the nature of regional office. In concrete regional offices such as Legaspi, Tacloban, Cagayan de Oro, Zamboanga, Davao and Cotabato need small number of personnel to be assigned. Against these Manila and Malabon-Navotas need large number of personnel.

3) Cost

Details are not clear because budget of MARINA is not open to the study mission. Rough estimation of costs has been done in the section 2.4 of Sector Report.

2.3 Environments surrounding the Ship Inspection System proposed

1) Transfer of ship inspection system from PCG to MARINA

Executive orders 125/125A declare the transfer of ship inspection works from PCG to MARINA, but this transfer does not realize at this moment (February 1992). PCG is preparing the draft of act to transfer PCG from under control of Navy to of DOTC. This act is considered to be submitted to the Parliament after election of President/Vice President and Parliament members.

Before the end of 1992 some changes on present ship inspection system are expected. These changes may impact to the proposed ship inspection system, especially organization, assignment of personnel and location of regional offices.

2) Resource of ship inspection engineer

Shipbuilding engineers working in MARINA and engineers presently engaged in ship inspection works in PCG become major human resource of the proposed new entity. Some shortage of engineers may be covered by recruiting from the industry.

Matters to be afraid is that difference of technical level in the engineer group, which might be large because of

composition of the group, becomes cause of unfairness of inspection. Inspection results must never differ by inspector, that is the fairness of inspection and that is the base of confidence to the inspection system. The most important matter is to maintain fairness of inspection.

To sustain reasonable technical standard is highly required to all of inspectors without exception. Field training in advanced countries in shipbuilding technology field is necessary for inspectors who have completed basic training course in the Philippines.

3) PMMRR

Amendment of PMMRR to fit to SOLAS '74 is on the way by the agency in charge. Amendment is scheduled to be completed within 1992.

Structural standards for wooden hull vessel and for FRP vessel are not established. The agency in charge is working to gather references of USA, Norway and Japan. In addition works to establish structural standards for aluminum alloy vessel are required.

4) Classification

MARINA advised to ship owners that vessels above 500 GRT have to be classified to one of the internationally recognized Classification Society and ship owners follow this advice.

Vessels smaller than 500 GRT are advised (as an option) to be classified to Philippine Register of Shipping (PRS), This classification is also on going but PRS has no rules and regulation for classification. These "classified policies" are useful for to lessen sea accidents in some extents and therefore to lessen rate of ship insurance also in some extents, but these effects are limited. Classification policy is not the solution of our subject that "approved over-capacity of passengers and accommodation of that capacity hurt the safety of passenger".

The concept of Class is not covering all aspect of the vessel's safety and seaworthiness. The Class is only concerned with the structural strength of the vessel, and the reliability of the equipment necessary for safe operation of the vessel. All other items normally related to as safety measures are not a part of the classification concept.

The Philippine government is responsible to ensure safety voyage of interisland service vessel through setting standard of passenger capacity and accommodation, and of life saving facilities. Reason of existence of PMMRR is for

the government to utilize it for that purpose.

5) Importation

Strict ship inspection requires more repair works of vessels in items, in scale and consequently in period, which results in lower rate at work of vessels and higher repair costs.

In changing words strict ship inspection forces shipowners/ operators low profitability and interisland shipping business results in declining.

To sustain interisland shipping under control of strict inspection system (1) duty and tax exemption of materials, machineries and spare parts for vessel use and (2) simplification of import procedure of them are necessary.

(1) Duty and tax exemption

a) Philippine Interisland Shipping Development Act (PISDA)

The salient provisions of this act are summarized as follows:

- A state policy to encourage the healthy and safe development of the domestic shipping industry
- Ready for availability of foreign exchange to qualified Filipino shipowners and operators importing vessels and spare parts, or both, including cost of importation from their port of origin
- Approval by MARINA, within 30 days, of all applications for importation of ships, spare parts, containers, and ancillary cargo-handling equipments, subject to proper documentation
- Exemption of beneficiaries of the act from payment of import duties and taxes and value-added tax for 10 years from the date of approval

For the application of this act the following conditions are required

- The age of a vessel shall not be more than 12 years for a passenger ship and 15 years for a cargo ship when it enters Philippine waters
- Vessels shall be classed by an internationally recognized classification society, and the vessels shall be maintained in class for the duration of their domestic operations
- MARINA certifies that the imported spare parts are not

locally produced in sufficient quantity and acceptable quality

- An imported vessel may be resold only to another qualified Filipino investor approved by MARINA.

b) Financial Policy

Quoted is said as financial policy.

"Foreign exchange will be made readily available but in the Philippine economy there are many demands on available foreign exchange; ships and spare parts, containers, and ancillary cargo gear will undoubtedly have to compete with other priorities for the available currency. The need exists for a supply of foreign exchange in the region of about US$ 50 million initially, at a low rate of interest (5 percent), and with an extended payback period (20 years). Depending on the type and size of ship most in need of replacement, this wood allow for the acquisition of 5 to 10 good secondhand vessels."

c) Comments

The above policies must be strong incentives for replacement of old interisland vessels to shipowners / operators. In turn following issues exist.

Safety of shipping is kept with periodical maintenance. Necessary materials/spare parts to maintain a ship are listed by shipyard but not by shipowners/operators. PISDA gives, however, incentives for importation of them to shipowners/operators but not to shipyard. It means delay of arrival of materials/ spare parts because acquisition/import procedures will start after the shipyard check the ship and list up necessary materials/spare parts.

Limited number of vessels can apply these benefits. When most of the interisland fleet could not receive any benefits from PISDA, this policy does not make any for encouraging the healthy and safe development of the domestic shipping industry.

PISDA is the policy to encourage importation of secondhand vessels and includes fear to disturb healthy development of domestic shipbuilding industry.

(2) Simplification of import procedures

We proposed simplification of import procedures. The paper issued by CISO, although which is not directly related with import procedures, shows unnecessary complication of government procedure.

The paper said; "Malacanang has ordered the immediate reduction of documentary clearance requirements for interisland vessels. The directive was made through Executive Order 493 entitled "Removing red tape and reducing clearance requirements for interisland vessels", which was issued December 3, 1991. The E.O., which takes effect immediately, states that the function of eight (8) government agencies requiring various clearances for every arrival or departure of a domestic vessel, will be limited to a single agency involved in port operations. And the Coasting and Passenger Manifest required for all domestic vessels shall be reduced to three (3) copies, instead of seven (7) and shall henceforth be submitted to the PPA.

(Note): Clearances for the departure and arrival of interisland vessels have to be secured from eight (8) government entities namely;

Bureau of Customs
Philippine Coast Guard
Bureau of Posts
National Quarantine Office
Bureau of Plant Industry
Bureau of Animal Industry
National Telecommunication Commission
Philippine Port Authority"

It is natural that such a complicated but meaningless procedure as quoted above made domestic shipping operation sustain inefficient. CISO paper also stated that "As a consequence, costs rise needlessly while graft and corruption is fostered".

Therefore, the process to simplify importation procedure might not be easy.

2.4 Steps to Construct the Ship Inspection System

1) Establishment of Ship Inspection Organization

The Ship Inspection Organization is to be established in MARINA. Functions of this organization shall inherit functions of ship inspection groups in PCG at present (as application of E.O. 125/ 125-A).

This organization is headed by the Principal Ship Inspector, equally ranked with Vice Administrator of MARINA.

Profile of the proposed organization is summarized as follows.

Head Office

Principal Ship Inspector
Administration Office
Registration and Tonnage Measurement Office
Rules and Regulation Section
Ship Hull Inspection Section
Ship Engine Inspection Section
Ship Apparatus Inspection Section

Regional Office(s)
Senior Ship Inspector
Administration Office
Tonnage Measurement Section
Ship Hull Inspection Section
Ship Engine Inspection Section
Ship Apparatus Inspection Section

2) Training of Ship Inspectors(ref.Improvement Plan 2.4.1 in Sector Report)

Human resources of the organization are mainly composed of engineers in MARINA and of ship inspectors presently belonging to PCG. Some number of shortage are recruited in public.

Training system as follows is necessary to maintain a sound technical level of inspectors.

(1) Fundamental Training

For establishment of reliable ship inspection system, the most important thing is that no personal difference in ship inspectors does exist on decision of whether the inspected ship is good to pass the inspection or not.

All inspectors must be trained on fundamental shipbuilding/ shiprepairing technology.

Authority on an individual inspection case is given definitely to an inspector in charge. The costs of construction or repair actually depends on the decision of the inspector. In order to prevent graft caused by the abuse of this authority perpetual efforts of moral education is quite important.

(2) Advanced Training

Cases of new shipbuilding are scarce and shiprepairing works are limited in ordinal type of vessels in Philippine. In order to acquire sufficient technical knowledge training in advanced countries of shipbuilding industry is strongly recommended for graduates of fundamental training course.

3) Ship Inspection

(1) PMMRR

The standing operation manual for ship inspection is PMMRR. However, structural standards of wooden hull vessels (including motor banca), FRP hull and aluminum alloy hull are not established yet. These structural standard must be established in PMMRR as soon as possible.

(2) Inspection

a) Extension of time

Periodical maintenance of a vessel needs 20-30 days in general. But it often takes 2-3 months in Philippine due to long waiting period for supply of necessary equipments, repair materials and/ or spare parts from abroad in addition of shortage of engineers at a shipyard.

Execution of strict ship inspection without changes of the said situation forces lower profitability to a shipping industry due to longer time of maintenance. Only the way to avoid such a problem under strict execution of ship inspection is to give an extension period for maintenance. Operation of the ship in an extension period must be allowed under an appropriate control.

"Extension of time" is the stopgap tactics. It is needless to say that reduction of and exemption of import taxes, simplification of import procedures and in addition incentives to domestic production of materials and spare parts are strategic policy to strengthen the interisland shipping industry.

b) Division of responsibility

Interisland service vessels are going to be classified by an international classification society. No duplication or loophole between ship inspection done by the government and by the classification societies is required. Division of responsibility between both entities shall be clarified in advance.

Vessels classified as a passenger ship, a passenger/cargo ship and a passenger/ferry ship shall be inspected by the government from life safe point of view.

4) Integrated Shipping/Shipbuilding Policy

Shipping is vital to the Philippines composed of more than 7000 islands. Without development of shipping industry and of shipbuilding/shiprepairing industry it is difficult to consider development of philippine economy. However, shipping industry is sustained with over aged vessels and

shipbuilding industry, to make matters wrong, is monotonously declining.

The said condition gives us anxious fear that strict execution of ship inspection, which is our proposal, may cause more dullness to shipping industry.

The Philippine government enacted PISDA to stimulate activity of shipping industry but, as mentioned before, PISDA is not sufficient countermeasure to the said situation.

The Philippine government has history of failure of "10 year shipping and shipbuilding program", which was chaired by the Board of Investment. That 10 year program was executed from middle '70s till middle '80s to develop shipping/ shipbuilding industries themselves and to develop shipping safety. Unfortunately evaluation of this program is negative in general. De facto, when the program was completed, shipping industry had still served mostly with superannuated vessels and shipbuilding industry was struck out, though which was partly because of worldwide recession.

The situation at present is similar to middle '70s. Important work at this moment is (1) to analyze "10 year shipping and shipbuilding program", (2) to list up faults of that program and (3) to find out the way to success. Without this effort ship inspection system can not work healthy.

We strongly recommend the execution of this study for the establishment of integrated policy for development of shipping/ shipbuilding industry based on the results of the study.

2.5 Evaluation

1) Relationship between maritime accident and seaworthiness

An analysis of recent maritime accidents in Chapter 4 of Main Report repeat in brief as follows;

- Accidents occurred most frequently during typhoon season
- Maritime casualties involved small wooden vessels to a great deal. Small craft accounted for more than half of the total reported mishaps.
- "Aground", "collision" and "caught fire" were generally caused by human error.
- Against these hardships "drifted", "capsized" and

"sunk" were regarded as casualties caused by seaworthiness.

Around 50% of accidents are of the "drifted", "capsized" and "sunk" type. This fact points out that the lack of seaworthiness is liable to meet with a hard casualty.

2) Estimated damage due to lack of seaworthiness in 1990

Despite of the complicated mechanism which ends in a maritime accident, the typical distress due to lack of seaworthiness can be simplified as follows;

- Those to be occurred on calm sea
- Those to be occurred with the figures of capsize, sunk and drifting

The same method in Chapter 7.3 of Main Report is applied to the estimation of the related damage of those accidents in 1990. As a result, the amount of damage is valued at 708.1 million pesos with the following items.

- Loss of hull value	87 vessels	P567.2 mil.
- Loss of cargo	14,804 tons	P109.9 mil.
- Loss of human lives	88 person	P 31.0 mil.

Eventually the accidents caused by the lack of seaworthiness accounts for 20% of the whole ones in number and 30% in value. Therefore the upgrading of ship stability will contribute to prevention of casualties considerably.

3) Operating Conditions

Operating reports of 171 interisland liners submitted to MARINA in 1990 indicates the following characteristics;

(Profile of Interisland Liners)

Average GRT	6,061
Average DWT	8,906
Average Year Built	1970 (newest in 1989, oldest in 1944
Average Days in Commission	224 days in 1989
Average Miles Run	31,697 in 1989
Daily Operating Cost	P93,439
Daily Running Cost	P60,181
Yearly Cost of Drydock, Repair and Maintenance	P7.6 million

4) Identified problems

Average days in commission which is a index of working ration was 224 days in 1989. It was considered to be low

compared with the operation condition of Japanese fleet. Because Japanese fleet usually work almost through the year and in case of Intermediate Survey every two years and Special Survey every four years, they separate around 350 days in a year. The following reasons would be supposes in relation to the operating conditions of interisland shipping in the Philippines;

- Average age of domestic fleet is nearly 20 years. These aged vessels result in low operation and high cost of drydocking, repair and maintenance.

- Unnecessary complication of import procedure delay the necessary equipments for ship repair. Consequently spare parts are always lacking while many vessel are waiting around a shipyard.

- Prohibitive costs of ships and high rate of import duties slap on second hand vessels and spare parts and remain domestic fleet obsolete.

- Operations of domestic shipping remain hampered by tremendous bureaucracy with unnecessary clearances and poor maritime infrastructures. These function to detain domestic shipping in low operation.

5) Conclusion

One of the immediate aims of the shipping industry must be the upgrading of all vessels belonging to the interisland shipping fleet to comply with the proposed inspection system. But the cost of equipping and reconditioning existing vessels and replacing obsolescent ships represents and additional burden on the ship operator, especially on the minor operator.

For that reason, it is afraid that enforcement of the proposed inspection enfeebles the viability of interisland shipping, while intensified inspection system will bring a great benefit from a socio-economic point of view.

Taking into account of these complex situations, this study recommend that the proposed inspection system should be implemented with other countermeasures to improve the operating conditions of interisland shipping such as simplification of import procedures and related clearances, incentives to taxation system and replacement of old vessel and development of shipbuilding/repair industry simultaneously.

2.6 Proposal for Next Step (Study of Development Policy of Interisland Shipping)

1) Outline of Study

As mentioned in the section 1.3, the prerequisite of execution of proposed ship inspection system is healthy development of shipping/shipbuilding industries. For that purpose PISDA is not sufficient measures.

Our proposal for the next step includes (1) to analyze and to inquire into the faults of "10 year shipping and shipbuilding program," (2) to analyze PISDA and to evaluate the impact of PISDA to the industries, and (3) to establish integrated policy for healthy development of the interisland shipping/shipbuilding industries.

2) Study Items

(1) Study of "10 year Shipping and Shipbuilding Program"

Purpose of the program
Contents of the program
Program period
Scale of financial investment (including loan)
Contents of government subsidy (scale of each loan, interest rate, return period, reduction of and exemption of taxes, etc.)
Results (including reasons of failure)

(2) Study of "Philippine Interisland Shipping Development Act" (PISDA)

Contents of the act
Contents of government subsidy (scale of each loan, interest rate, return period, reduction of and exemption of taxes, etc.)
Expected results (referring to lessons obtained from study item (1))

(3) Study of Development Program

When additional policy measures for development and modernization of interisland shipping/shipbuilding industries are considered to be necessary from the lessons of study items (1) and (2);

Policy measures for development and for modernization
Period of program
Types of vessels to be modernized (by route or by use)
Level of modernization of vessels by type
Concrete items of government subsidies (including subsidies to middle and small scale shipping

companies)
Concrete measures to encourage shipbuilding industry and related industries

Expected results

3) Key members of the study and study period

(1) Key members

Shipping Economist:
Financial analysis of vessel operation
Estimates of spread effects of shipping development
Shipbuilding Engineer:
Cost estimation of vessels required in Philippines by type by new construction/secondhand.
Shipping Policy Planner:
Survey/analysis of Philippine shipping policy
Establishment of development and modernization policy
Shipbuilding Policy Planner:
Survey/analysis of Philippine shipbuilding policy
Establishment of development and modernization policy
Coordinator:
Coordination of works of specialists

(2) Study Period

Twelve (12) months

3. AIDS TO NAVIGATION UPGRADING RELIABILITY PROJECT

3.1 Current Situation of Aids to Navigation

With respect to its 18,000 NM coastline, the Philippines has a total of 333 light stations, consisting of lighthouses and beacons.

In 333 of the existing lighthouses and light beacons, 54 have been out of service for a long period of time, and additionally 25 of the 54 lights suffer from serious damages such as collapse of housing towers.

It is reported that over 40 of the downed sites were fully recovered for proper performance in the past but it appears that most of them were only tentatively repaired with lower graded devices and have an ability less than what it should be.

Total number of buoys as reported by the PCG CG-10 are 40, broken down into 14 lighted and 26 unlighted.

As of August, 1991

Lighthouses and beacons	Operational	279
	Non-operational	54
	Total	333
Buoys	Lighted	14
	Un-lighted	26
	Total	40
	Grand Total	373

The visible ranges of lighthouses/beacons vary from over 20 miles in case of primary lighthouses to less than 20 miles for secondary ones and less than 10 miles for tertiary lightbeacons. Some lighthouses use large-scale rotary lighting devices installed between 1975 and 1977 when rehabilitation of the facilities was made by England. Energy is supplied by means of diesel engines, commercial electricity, battery and solar panels and some units that till make use of kerosene lamps.

Although, the position or location of navaids is suitable, the operation rate of existing navaids is low and luminous intensity are generally weak. The actual visible range of some lighthouses is insufficient and significant reduced in view of decreased luminosity.

PCG had five (5) buoy-tender ships that are utilized for maintenance and repair of lighthouse throughout the Philippines, and small ships such as motor banca for maintenance and checking, but there are no skilled

personnel/technician who can do the repairs and/or conduct preventive maintenance. Some lighthouses are maintained by lighthouse keepers who stay there for 2 week, while other go, alternately. 189 ATNs of a total of 333 are manned stations.

However, these manned stations do not function as reported. The main reason is the housing inadequacy of lighthouse keepers who live in old, dilapidated houses. Work assignment for lighthouse keepers is not also clearly defined. They are, de facto, to light on/off (in some stations it is done automatically), to operate a generator, to change batteries and to manage facilities.

Procurement of spare parts has been very slow. Delays in funding traveling expenses hinder the timely sending of maintenance teams.

The damages to lighthouse and lightbeacons investigated vary according to local condition and types of structured materials, and therefore, general solutions to the problem are difficult to apply.

3.2 Summary of Proposed Master Plan

1) Need Density Concept

The need density for navaid installations may not be defined in a general uniform term because of various conditions of waterways and traffic environment inherent to individual areas.

However, as a general index of availability of navaids establishments, number of navaid units per a hundred miles is applied, and the desirable target of index is in general set at 10-20 units.

The basic conditions applied in this case are generally such that lighted aids are established to cover the following:

- Cross bearing coverages up to 10 n.m. off coastlines
- Port entrance markings
- In-port waterways markings

It should be considered necessary ideally for the complex of Philippine waters, embracing a number of islands, to install more than the general need stated above.

However, the present level of lighted aid installations gives a considerably poor figure of only about 2 units per

100 n.m.

In order to meet the ever uprising maritime traffic in the Philippines, demands for navaids will no doubt substantially increase in the future.

2) Development Plan

The development plan was proposed in line with the policy below:

- Single bearing may be obtainable for coastal navigation majority of primary routes.
- Cross bearing may be obtainable at important turning points, narrow channels, etc.
- Accurate bearing may be obtainable at important turning points, narrow channels, etc.
- Dangers and hazards in and around the routes should be marked.
- Port entrances in-port waterways, etc. should be marked.
- A long range radio aids should be introduced.

The gradual and priority implementation should be planned according to the assessment basis for aids to navigation along the line above mentioned.

At the same time, the development of supporting systems for the effective operation and maintenance should be made to meet the development of navaids.

The outline of development plan was summarized as the following table shows, which are reasonable and recommendable.

(1) Visual aids

a. Lighthouse	22 units
b. Lightbeacon	
Large type	49 "
Medium type	73 "
Small type	101 "
c. Resilient light beacon	19 "
d. Lighted buoy	88 "

(2) Electronic aids

a. Loran C system	1 chain

b. Racon	20 stations
c. Local weather information broadcasting system	7 places

(3) Supporting system

a. Workshop/buoy base	3 places
b. Buoy/lighthouse tender	3 ships
c. Navaids monitoring and telecommunication network system	1 package
d. Training of personnel/ organization	1 package

3.3 Identified Problems and Issues

There would be no hope of the national progress in the marine nation, the Philippines, without prosperity of the marine industry. The provision of safety for the marine traffic however, is awfully undeveloped in comparison to the other nations. Status in progress of establishing aids to navigation, one of the most valuable factors in practicing the safety of marine traffic is, in the number of the established sites per the unit length of the coastline, approx.2 per 100 n.m. in the Philippines, which should be regarded as significantly poor, compared to 4.5 of Indonesia and 7 of Malaysia. These countries are steadily accomplishing their schedule of an achievement plan for establishing aids to navigation, and running ahead of the Philippines increasing the deviation.

There are not a less number of the visual aids which are out of service and/or under the nominal function so that require an urgent action to be repaired or improved.

Added up that the maintenance system to keep the function of aids to navigation is greatly insufficient, problems in this part of the public service in the Philippines have accordingly been piled up. The government of the Philippines has been making efforts to promote the situation in this field, which has not been able to reach a point to provide sufficient products, because there has been, in addition to a small amount of investment, a lack of a suitable development plan and a defined goals to be achieved in a long termed period.

In summary, the problems/issues are presented in the following paragraphs.

- Based on the proposed master plan, over 300 visual aids will be constructed according to implementation schedule.

- There are, a number of the existing lights need to be

rehabilitated and improved due to their poor light facilities, low luminous range, tear and wear of associated facilities, shortage of spare supplies and the like. The luminous range of a number of existing lighthouses and light beacons is insufficient.

- The monitoring of lights significantly improve the operational rehability of aids, and thus leads to safe navigation, but there is none.

- Lots of the large scale lighthouses were constructed in as early as about 100 years ago and individually have a unique appearance and a lighting equipment of various types. It is necessary to restore and to maintain by individual approach with taking account of historical value.

- The visual aids of comparatively small scale were built up recently and seem to closely standardized for buildings and devices in use. Systematic support should be required.

- Each of the manned lighthouses is nominally posted by 1 - 3 people but many of the lights are reportedly maintained by the local staff living in a village nearest to the light, because accommodation buildings at the site are badly deteriorated or damaged by age.

- Unmanned lighthouses are visited for maintenance by the HANC personnel once or twice in a year.

- The maintenance staff at HANC are well trained for their purposes. The lighthouse keepers are, however, not so good at technical services and regard monitoring of the light and keeping of the site area and the property as their major task.

- A 350-ton lighthouse tender carries out its duty as the only service vessel but is apparently deteriorated and has no capability to handle buoys.

- No organized system/structure exists to effectively monitor lights for operational situation. Only the monitor function alive is the human-being posted at manned sites. In addition, there is no way to make communication with PCG or St. from even the manned sites, which is referred as one of the causes to bring in delays in delivering necessary information to mariners.

- Considerably less number of stored spare parts, together with technical unfamiliality of the lighthouse keepers, has become one of the causes to prolong the repair time.

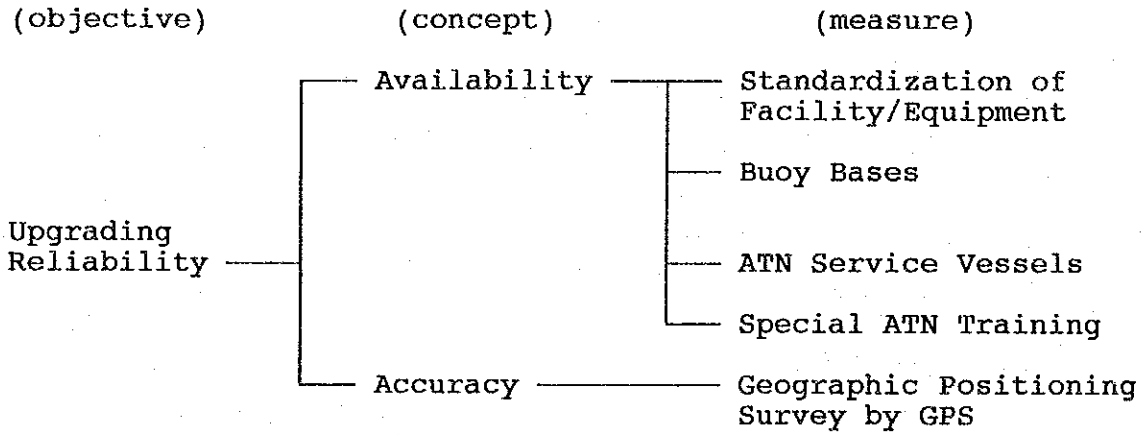
3.4 Proposed Measures for Upgrading Reliability

Based on abovementioned analysis, it is turned out that upgrading reliability of aids to navigation is important as well as these development in the Philippine. The concept of reliability can be divided into the following two phases;

1. availability - to operate without trouble

2. accuracy - to provide correct position

Both two make aids to navigation work fully. Accordingly, in this study five (5) measures are selected as follows;



This section will describe the examination and proposal of each measure.

3.4.1 Standardization of Facility/Equipment

(1) Classification of Visual Aids

The type and size of the visual aids are classified as follows;

Lighthouse,
Light Beacon L (P),
Light Beacon M (S),
Light Beacon S (T),
RLB, and
Buoy,

(2) Design Concept

In designing concept of buildings, either a steel reinforced concrete or a module type made up by materials of little weight such as FRP is taken up for the structure of lighthouses and light beacons, according to a limited

information on the local condition which lacks critical data such as of soil. For RLBs and buoys, one of the selected 2-3 types of materials is discussed, according to the depth of the site.
Equipment is assumed to have one unified instrumentation for each type and size, except power sources.

The power sources discussed here consist of the following primary power lines.

- "Commercial Power Line" + one "Emergency Engine-Generator".
- 2 or 3 "Engine-Generators".
- "Solar Batteries" (+ "Secondary Batteries").

(3) Design Principals

- To have a sufficient structural strength in order to withstand the frequent hits of typhoon.
- To properly function in higher ambient temperatures.
- To adopt lamps having a higher efficiency. This enables to save capacity of the power source.
- To focus on to facilitate maintenance of equipment but not to pursue development of a smaller sized one.
- To install a solar battery power system as many as possible.

The drawing of classified visual aids are illustrated in Annex 3.1.

3.4.2 Buoy Base

1) Maintenance of Buoy

Buoys which function to mark channels, route and navigational dangers, and their life time are affected by the local sea conditions installed, and accordingly their maintenance programme should take this into account.

The general maintenance programme to prolong the lifetime is that buoys need biannual services to maintain the performance standards, and within ports and harbours three to four years of maintenance interval may be reasonable.

Appropriate way of buoy maintenance is to deploy a package replacement system on a regular basis. A buoy body and its mooring equipment are all taken ashore for rust cleaning, painting, repairs and checks at the base so as to provide the adequate maintenance and repair, which were not possible to carry out at sea. It brings about prolongment of the life span and improvement of the operational performances, thus increasing navigation safety of ships.

Buoys removed for the maintenance services including lighting devices and mooring chains and sinkers are to be checked and repaired either at buoy bases or buoy open storages, and they will be reinstalled by buoy tenders in a form of the complete replacement at the respective positions on a scheduled basis.

The replacement cycle may vary according to the conditions under which buoys are sited and positioned. It may, however, be set at two years in principle. Under favourable conditions such as in calm waters and within bays and harbours, 3 - 4 years cycle may be reasonable, while under adverse environment like fact current waters, areas where introduce severe tear and wear of mooring chains and marine microorganism sticks on the buoy bodies, the cycle may need to be only one year. Development of this system will improve the reliability of aids to navigation and facilitate the effective maintenance.

2) Maintenance Procedure at Buoy Base

A complete package of buoy removed from sea will be thoroughly checked at a buoy base, and necessary repair work will be carried out. The process of buoy maintenance works at a base is shown in Figure 3.1.

(1) Buoy Body

Light and power devices and other parts should be dismantled from a buoy, and if necessary, the tower should also be removed for cleaning up.

Any damages, tear and wear and malfunction parts found after overall checkings shall be repaired together with rust clearing by sand blast and painting thereafter.

Careful painting should be carried out including antirust process according to the buoy painting procedures pre-established in terms of number of times and drying up period.

(2) Mooring

Any damages and torn and worn should be replaced through overall checking, and also necessary quantity of chains should be retained for immediate use.

(3) Equipment

Equipment for maintenance and repairs of buoys, chains are to be stored.

(4) Heavy Duty Machines

Truck cranes, fork lifts and such are to be used for carriage of heavy machines like sinkers.

(5) winches

Winches are to be used for stretching chains out for their checking at the open storage.

(6) Jetty for Buoy Base

3) Buoy Base Facilities

(1) Buoy open storage

Adequate open spaces are required both for buoy bodies, chains, sinkers and such, and for warehouse and repairing spaces.

Minimum of approximately 1,200 m^2 space will be desirable for this purpose, where the service capability of about ten (10) light buoys and ten (10) to twenty (20) small buoys will be stored on a continuous basis. The open storage should be near a jetty for the work efficiency.

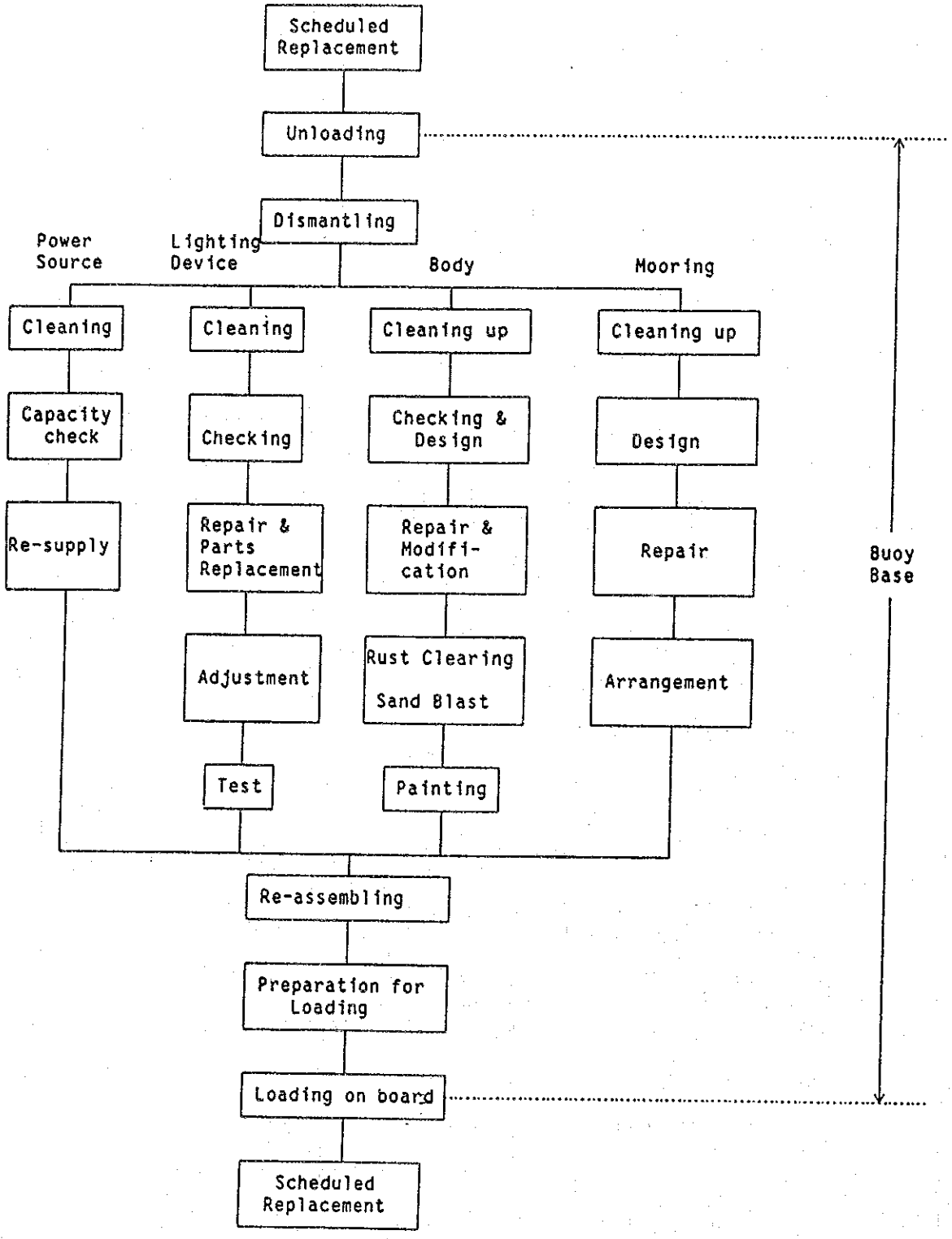
(i) Open storage for buoys

including (ii) - (iv) and (vi):

Approx. 500 - 3,000 m^2

Buoys serviced or to be serviced are to be stored.

Figure 3.1
Process of Buoy Maintenance Works



(ii) Open storage for chains: Approx. 135 m^2

Individual chains are to be stretched and stored.

(iii) Open storage for sinkers: Approx. 40 m^2

Sinkers are to be placed.

(iv) Open workshop: Approx. 110 m^2

Buoys unloaded from buoy tenders and those serviced and ready for re-installation are to be placed. The workshop is also used for repair and painting.

(v) Workshop storage: Approx. 400 - 1,000 m^2

The equipment and materials are to be housed, and indoor repair and maintenance are to be carried out. Painting works are also to be done during rainy weather.

(vi) Passage road

5-meter wide passage roads are to be available for maneuvering of vehicles, fork-lift, mobile crane, etc. within the facility area.

The site plans of typical examples for buoy base and buoy open storage are shown in Figure 3.2 and 3.3 respectively.

(2) Workshop

The workshop is one of the important establishments as a supporting facility for repair and maintenance of all kinds of equipment used for aids to navigation facilities. Heavy duty machines and equipment are inevitably required for the maintenance of buoys, and are to be installed at the workshops of buoy base and buoy open storages.

The workshops will have exclusive space sections as given below, in which work benches are to be fitted:

i) Storage room; 20 - 40 m^2

ii) Work room; 6 - 8 m^2

iii) Lighting device test and adjustment room; 9 - 16 m^2

iv) Battery charge room; 15 - 25 m^2

The workshop installation require the following:

- machine tools
- woodwork machine
- cutting and welding machine
- compressor and pump
- hand tools
- bench tools
- testing and measuring equipment
- electric maintenance equipment
- handling equipment
- generator set
- buoy positioning electronic equipment

(3) Spares

Spares of buoy body and other materials are to be kept at the buoy base and each open storage in order to carry out smooth replacement works. These spares will facilitate immediate recovery of buoy troubles and accidents like collisions, drifting away, light failures and forth.

The necessary spares comprise:

- Light buoy
- Small Buoy
- Lantern
- Flasher
- Batteries
- Gas Cylinder
- Chain for L.B.
- Chain fir U.L.B.
- Sinker

Figure 3.2
Site Plan for Buoy Base
(for 25 - 30 spare buoys)

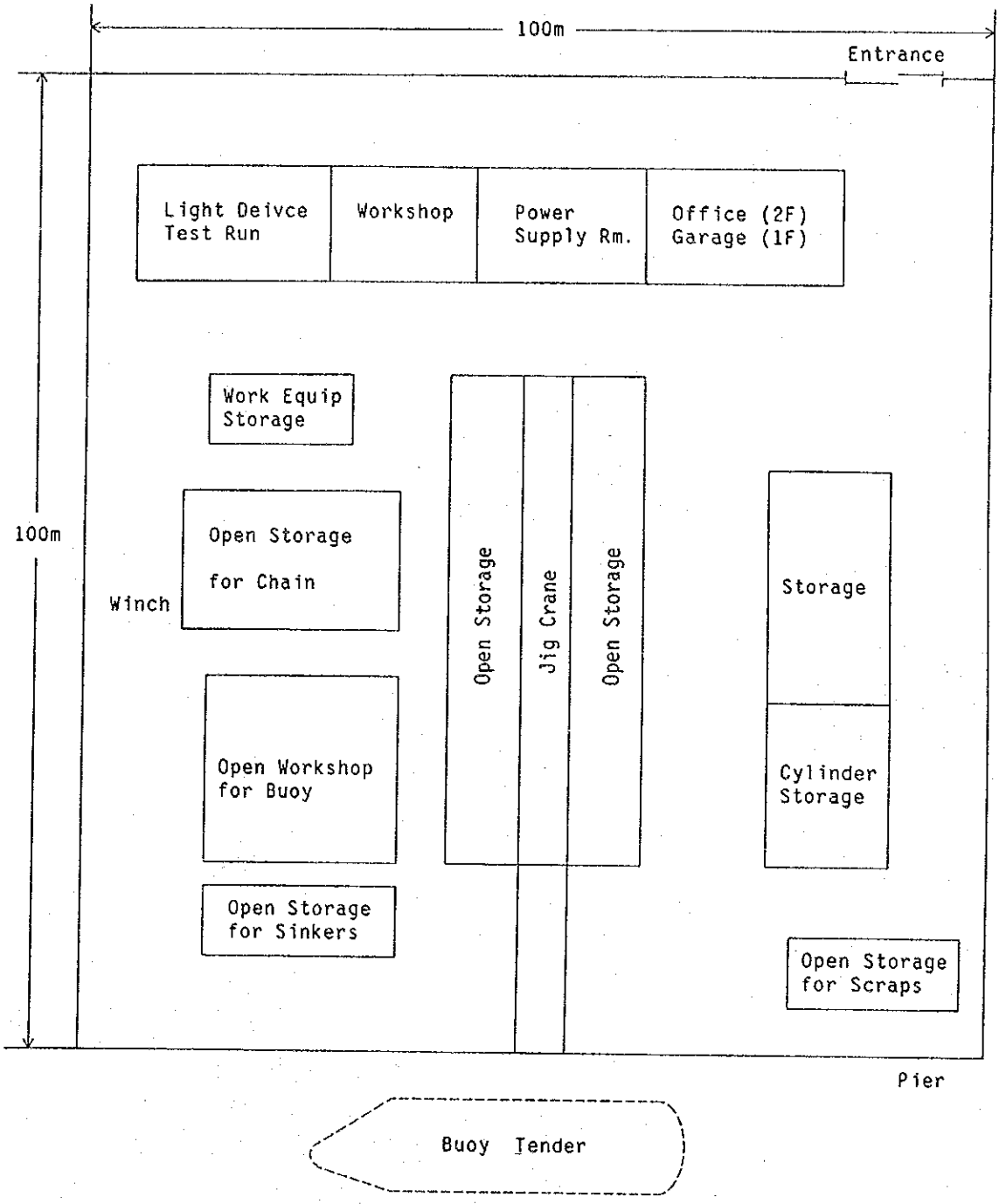
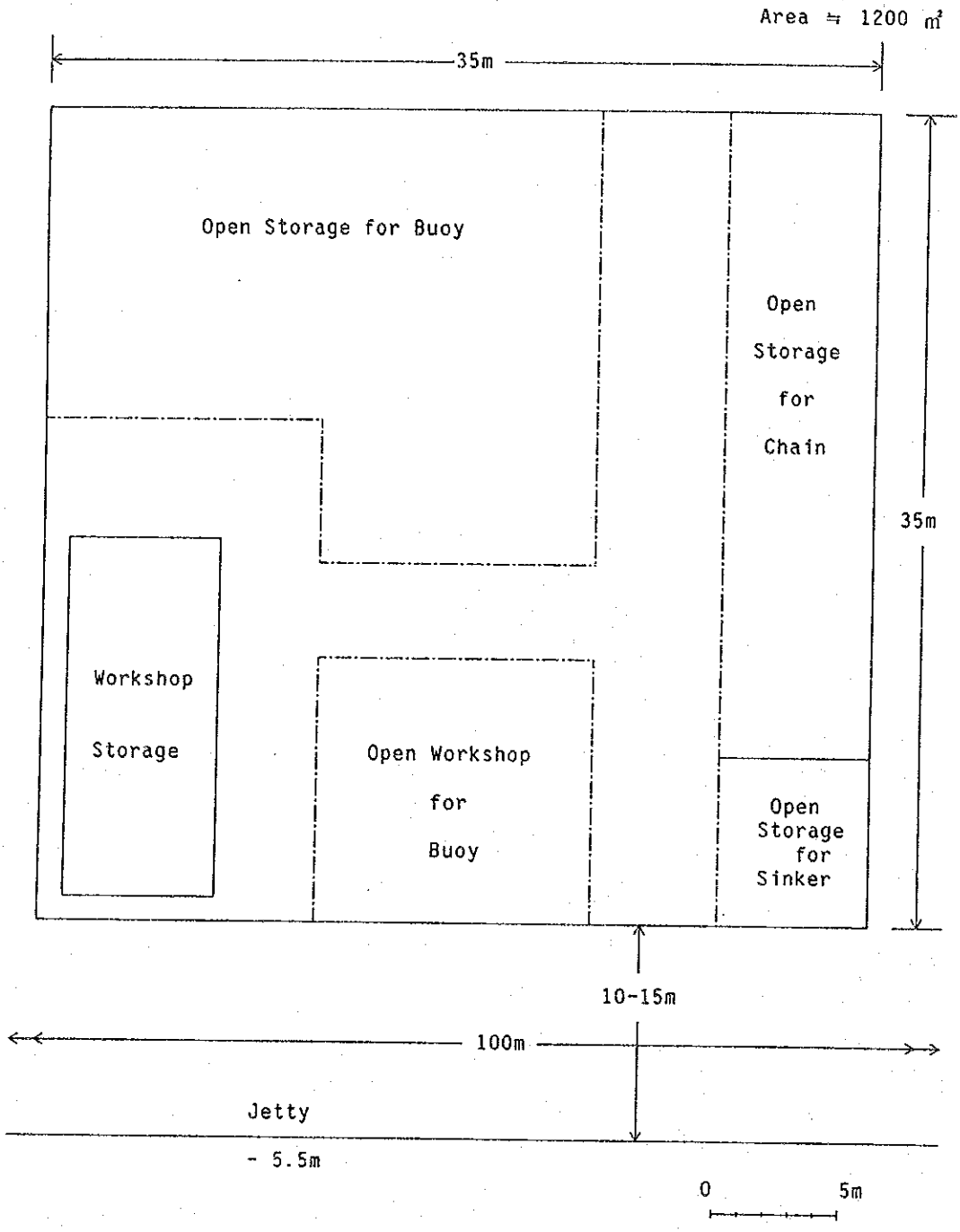


Figure 3.3
Example of Buoy Open Storage
- Site Plan -



3.4.3 ATN Service Vessels

There are presently only three buoy tenders in service for the maintenance and repair of lights throughout the country, and also some other small ships are in service such as motor banca for simple maintenance and checking.

The number of ATN service vessels required will be decided taking into account not only the maintenance policy but also the calculation result of work load. The calculation of work load of ATN service vessels involves a number of complex factors such as number and types of navaids, their locations, maintenance intervals and so forth.

1) Type of ATN Service Vessels

Different types for ATN service vessels are required for efficient execution of the maintenance services.

(1) Buoy tender

Installation and replacement of buoys. Maintenance of lighted beacons, RLB's lighted buoys and radar beacons.

(2) Supply Vessel

Shift of lighthouse keepers, supply of goods to lighthouses, supply of gas cylinders, batteries, etc.

(3) Aids Tender

Assisting buoy tender and supply vessel in performing maintenance of aids to navigation which are situated close to the base.

(4) Inspection boat

Inspection of visual aids to navigation and repair of minor damages.

(5) Survey vessel

Measurement of the light illuminating power. Evaluation and tests of radar beacons. Engineering survey for construction/installation of aids to navigation. Survey of sea banks, sea lanes where the depth is still in doubt, in connection with the planning of installing aids to navigation.

(6) Survey

To perform navigational survey works in limited coastal area and assist survey vessel.

2) Calculation of Work Load

The work load of a buoy tender may be calculated according to the following;

$$L = L1 + L2 + L3 + L4 + L5$$

where,

L : the work load of a buoy tender
L1 : the work load for maintenance of light buoys
L2 : the work load for maintenance of lightbeacon
L3 : the work load for maintenance of R.L.B.
L4 : the work load for maintenance of small buoys
L5 : the work load for maintenance of day marks

and, the above elements are calculated as given below;

(a) Maintenance of Lighted Buoys

$$L1 = \frac{1}{2} \frac{(A)\text{units}}{6} \times \frac{\text{distance} \times 2 \text{ times}}{10 \text{ knots} \times 24 \text{ hours}}$$

$$+ \frac{(A)\text{units}}{6} \times 5 \text{ day} + \frac{(A)\text{units}}{3}$$

(b) Maintenance of light beacon and R.L.B.

L2 = 4 times/year x 2 1/2 days/unit x (A') units x 46%

(c) Overhaul of R.L.B.

L3 = 1/2 times/year x 30 days/unit x (A") units

(d) Maintenance of small buoys

L4 = 2 times/year x 1 day/unit x (A"') units x 35%

(e) Maintenance of day marks

L5 = 2 times/year x 1 1/2 days/unit x (A"") units x 30%

Notes: A, A', A", A"' and A"" are the number of aids to be serviced.

The work loads of aids tender, supply vessel, inspection boat and survey vessel may also be calculated in the similar way.

3) Plan for ATN Vessel

The number of ATN vessels to be required should be worked out taking into account such factors as the maintenance policy, the number of aids units to be covered together with the work load calculation.

The correct foreseeable future needs contemplated to cope with the service requirements should be to re-build the three tenders now in service, i.e. AE46, AE59, and AE79.

In planning their re-building, the operational performance should be up-dated to meet the current requirement.

3.4.4 Special ATN Training

The reliable operation of aids to navigation is a kingpin to secure the safety of navigation, as the development of maritime transportation progresses. Presently, there is a lack of suitably trained personnel in the aids to navigation services of the Philippines to establish and carry out necessary maintenance. As a consequence, it has led to inefficient and unreliable operation of aids to navigation. Especially, at the technical level of personnel who are directly involved in the first line maintenance tasks.

The more senior positions within the aids to navigation services are in general filled by personnel already qualified, and accordingly their training should be confined to the specialized tasks that they must undertake in wider scope of responsibility.

In planning the training programme there are a number of basic questions that have to be addressed from the outset of:

a. the place of training; overseas or local

b. the basic qualifications needed in first recruitment

c. the detailed job descriptions including assessment of ATN personnel

d. the types of equipment

Proper training of ATN personnel is time consuming and expensive but never wasted. It is ideal to establish the training facilities to be exclusively used for training of ATN personnel. However, in view of the present situations, in which there have been no such training establishments in the Philippines, a realistic approach is to make the plan a outlined below:

(1) Overseas Special ATN training course

The overseas special ATN training is to be carried out for the senior staff to confine the specialized tasks of aids to navigation.

Period of course :	three months
Curriculum :	see curriculum (1)
Instructors:	maritime safety and ATN experts
Place of training:	overseas training facilities/institute

(2) Domestic special ATN training course

The domestic special ATN training course is to be carried out primarily for the technician level personnel of first recruitment.

Period of course :	two months
Curriculum :	see curriculum (2)
Instructors:	Foreign...ATN expert from overseas
	Local.....ATN experts who received the overseas special ATN training
Place of training:	existing maritime training facilities

(3) ATN Re-training course

The ATN re-training is a refresher or up dating course to train already experienced personnel on the front line in order for them to update new technology and equipment. This course may be arranged upon necessity in a form of factory training at the time of new procurement.

Curriculum (1) for Overseas Special ATN Training

(1) Service background and motivation

- International standardization of aids to navigation systems
- Overall organization
- Special task
- Cooperation between the organizations

(2) Maritime Safety

- International conventions and laws
- Prevention of marine accidents
- Pollution

- Oceanography

(3) Organization

- International organization
- Establishing operation and maintenance procedures
- Establishing operation and maintenance programme
- Organizing staff resources
- Budgetary planning and control
- Future planning
- Recruitment and training

(4) Administration Tasks

- Maintenance plan and execution
- Procurement plan
- Data and records publications
- Budgetary procedure

(5) Navigational Warnings

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

(6) Aids to Navigation Ships

Curriculum (2) for
Domestic special ATN Training

(1) Maritime Safety
(2) Organization
(3) Administration
(4) Marine Aids to Navigation

- Basic theory
- use of equipment and devices
- Safety
- Routing maintenance
- Fault finding
- Work at see
- Practical applications of study
- Advanced fault finding

3.4.5 Geographical Survey of Aids to Navigation

(1) Current Situation

The positions of aids to navigation are announced to mariners usually in the form of a publication "List of Lights" together with other characteristics of the aid such as the nature of light or on the nautical charts by using identification codes.

Almost all the charts are made up with old information acquired in the early days of well backed into the past. It is recognizable that lots of the charts do not meet the current situation of aids to navigation. It is reported that even not a few published positions of the aids are inaccurate.

Traditional geographical surveys employ such a method to determine triangular points with a means of an optical tools such as transit, or to obtain positions with a celestial measurement by sextant in case of remote islands where any connection from the main land is not available. These methods are essentially associated with a large scale sub-work for setting up complementary triangular points, cutting down lots of trees to get a clear range in sight or building up a watch tower to keep good visibility.

(2) Acceleration of Positioning by GPS

The GPS (Global Positioning System) drew our attention to be the alternative surveying method as it is used in some geographical surveys these days. Practicability and validity of the system in fixing/checking the points of aids to navigation were discussed.

The buildings of aids to navigation are generally located at a rural, remote site such as the head of a cape, which may cause troubles to shipping of the receiving equipment, availability of the electric power source, etc. Our discussions on this matter brought us a prospect that it should enable us to make position-fixing much more easily than the traditional way and to obtain better results.

It should be noted that;

- the GPS uses WGS-84 as the geodetic datum so that the positions obtained by GPS must be converted to the ones of the Luzon-datum, and

- the newly measured positions will require a study of an approach which enables them to be coordinated with the ones obtained through the traditional techniques.

(3) Preliminary Assessment

For preparation of this report, some of the existing ATN site positions were checked through the GPS by obtaining GPS fixes and comparing them to the published ones. The results show GPS can provide almost perfectly satisfied outputs, indicating that the difference in the comparison of the 2 types of data ranges within 30 m.

Regarding the positions of aids to navigation on remote islands, however, the survey work conducted in the days of initial construction of the aids should be restricted to a considerable extent in tools, method, etc. Thus, the positions of these sites require to be corrected by using modern technologies. It is expected that the positions of the sites, either new or existing, are obtained, checked or corrected through the validated GPS or other recent techniques at the opportunity of initial construction, rehabilitation, etc.

3.5. Evaluation

1) Analysis of Availability

(1) Definition

The availability is defined as follows:

Availability = MTBF / (MTBF + MTTR)
where, MTBF = Mean Time Between Failure(an averaged period of time which elapsed from the time a failure recovered till the time a failure occurred again.)

MTTR = Mean Time to Repair (an averaged period of time which elapsed from the time a failure occurred till the time the failure recovered.)
= ("Total Operation time" - MTTR) / "Total Operation Time"

IALA, firstly in the history of aids to navigation, presented the current status and the future target of the availability of aids to navigation at the 12th IALA conference in 1990, approving criteria defined in an IALA publication "NAVGUIDE", which reads as the table below shows.

		Current Status	Future Target
Major Lighthouses, etc.	(Category 1)	99.8% and more	99.8%
General Light Beacon	(Category 2)	99% and more	99 %
Buoy, etc.	(Category 3)	97 to 99.7%	97 %

(2) Availability of Aids to Navigation in the Philippines

Operational data of aids to navigation are extremely scarce in the Philippines. This fact disables a quantitative presentation of the availability. An assumption, however, provides us a total availability in order of 80% (82-85%), including the sites which are out of service for a long period.

(3) Improvement of Availability

Improvement of availability, is one of the urgent subjects to be taken into account in the Philippines. To upgrade the availability, efforts must be put on to make MTBF be longer and MTTR be shorter.

MTBF becomes longer when the rate of failure occurrence decreases by practice;

a) to increase the frequency and to upgrade the level of checking/testing at the field, and

b) to make the failure rate of components/devices lower.

MTTR becomes shorter by;

c) shortening the access time to aids to navigation, and

d) lessening the time required for repair work.

Another factor to be accounted in improvement of the availability is time elapsed from the moment a failure occurred till the time the maintenance personnel could detect the occurrence. Thus, it is also necessary for the improvement;

e) to make the occurrence of failures recognized in a shorter of time.

(4) Practical Approaches

In management of aids to navigation, each practice of a) to e) is achievable by the following arrangement.

For a);

- to give a good mobility to the maintenance personnel by providing servicing vessels and/or landcraft, and
- to increase the number of the operation personnel.

For b);

- to improve and standardize equipment, buildings, etc.

- to install solar batteries as the primary power source, and
- to construct workshops, buoy bases, etc.

For c);

- to give a good and speedy mobility, and
- to construct piers, access roads, etc.

For d);

- to store sufficient spare parts,
- to upgrade technical skills of the maintenance personnel (through trainings), and
- (aspects for b) above)

For e);

- to development a monitor system of aids to navigation, and
- to establish a communication data link,
- (Notice to Mariner may follow as a consequence.)

To take these practical approaches, buoy bases, service vessels and specialized personnel should be deployed with good coordination.

The standardization can provide the following merits;

- to facilitate the work of planning up to finishing processes of buildings at initial constructions and also at repairs in later, and

- to make the maintenance personnel be more familiar with the equipment. this leads to an expectation that the repair time may be shortened.

- to have test equipment and tools be usable at every site as a common support device.

Then, the development of aids to navigation with a certain standard can be considered to improve these availability. The commonness and compatibility for spare parts should be sought in line with this stadardization.

The four (4) proposed measures will be expected to improve the availability of aids to navigation from the existing poor conditions to the future target in "NAVGUIDE".

2) Analysis of Accuracy

Information to the mariner is important because they

anticipates that the aids to navigation on a route will be functioning in accordance with the advertised characteristics laid down in nautical documents and on charts. But current situation is insufficient. Inappropriate list of lights, actually not published officially, and old-fashioned nautical charts are the serious problems which confront maritime transportation in the Philippines.

GPS is a position-fixing system which will be used for general navigation on land, sea and air. The preliminary assessment in this study indicates that GPS is practicable and valid to fix the positions of aids to navigation rather than conventional methods. Taking account of cost and term, GPS should be introduced to fulfill requirements about the accurate information of aids to navigation from the mariner.

3) Conclusion

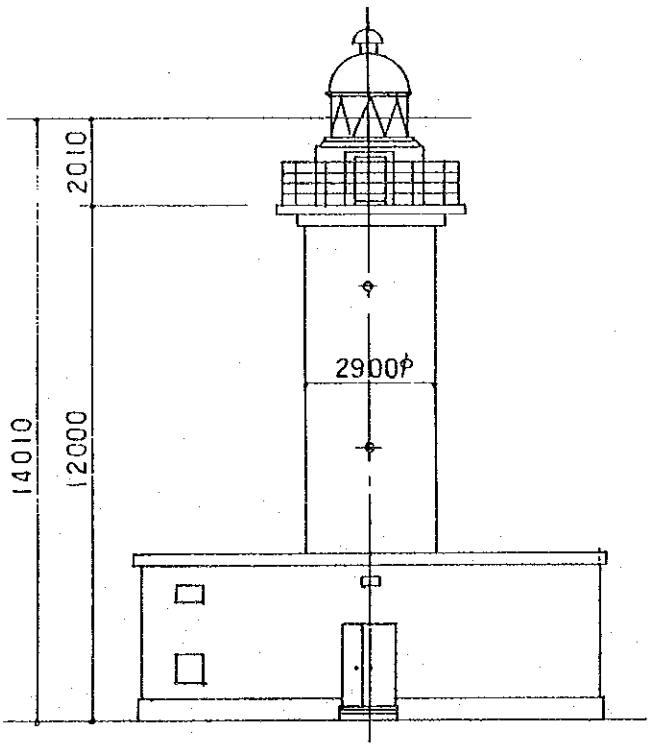
AS already noted, it is obvious that the five (5) proposed measures will contribute to upgrading reliability of aids to navigation to great extent. The four (4) proposed measures related to availability, standardization of facility/equipment, buoy base, service vessel and special training are described rich in substance in this study. Regarding to the accurate information, GPS is recommended to use for the completion of position data based on the supplemental survey for testing its capability.

With the complete implementation of the proposed master plan, however, a lot of operation and maintenance work will produce in line with development of aids to navigation. This will be liable to reduce in reliability of existing and new aids to navigation due to the limitation of budget, personnel and facilities. Therefore the proposed measures should be implemented in view of cost-effectiveness, time saving and the responsibility to the mariners.

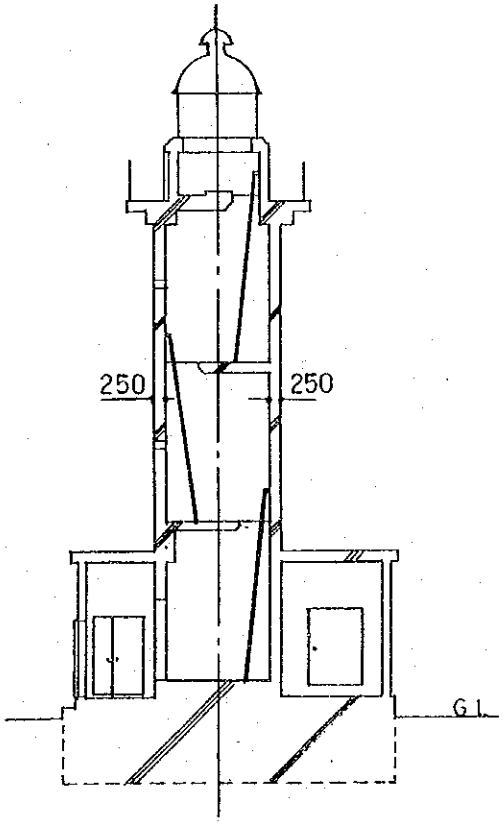
Annex 3.1
Drawings of Proposed Standardization of Visual Aids

1. Lighthouse

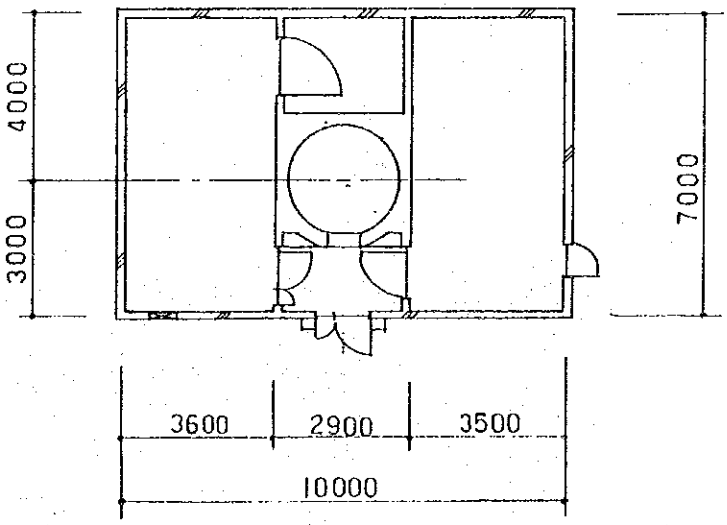
(front elevation)



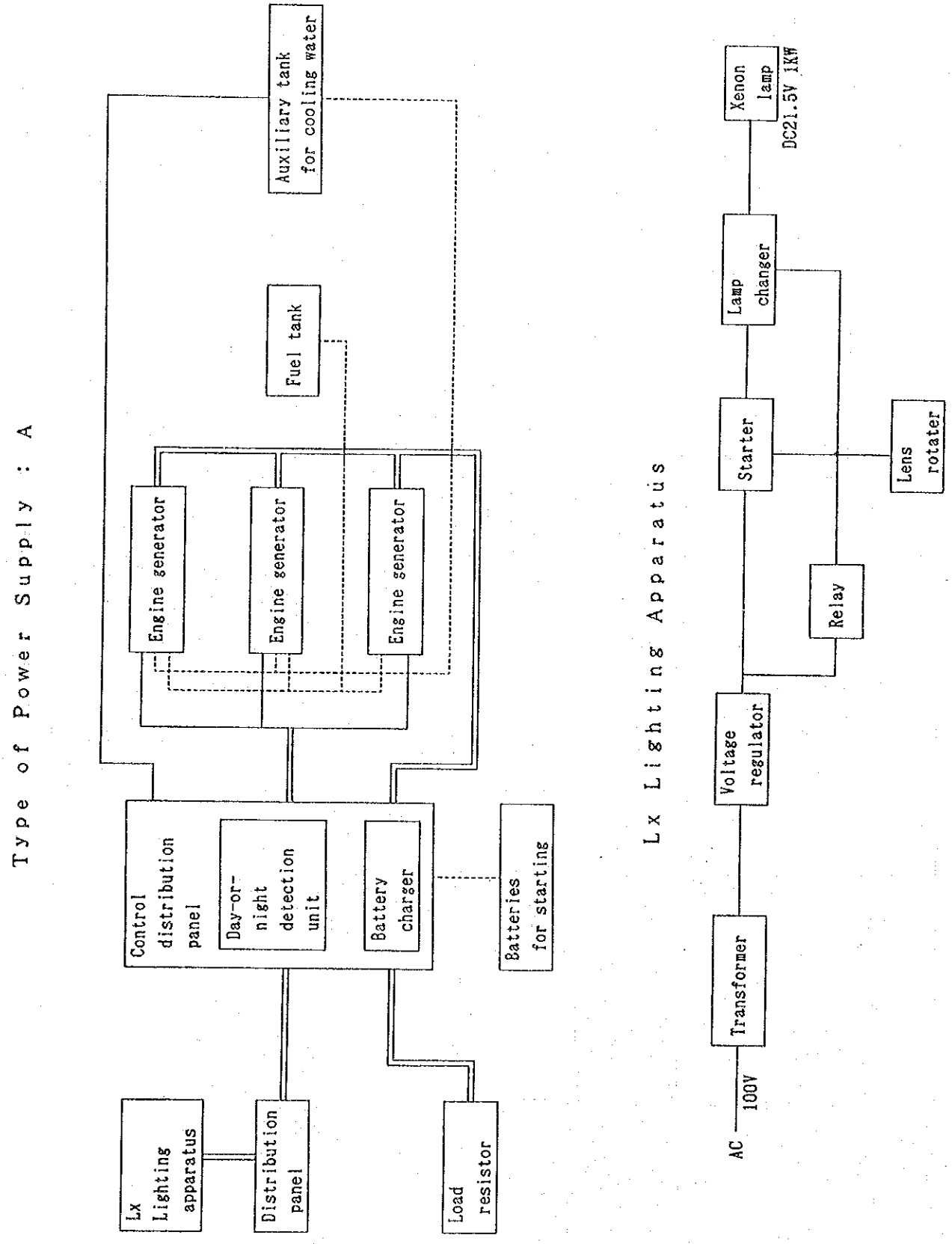
(half section)



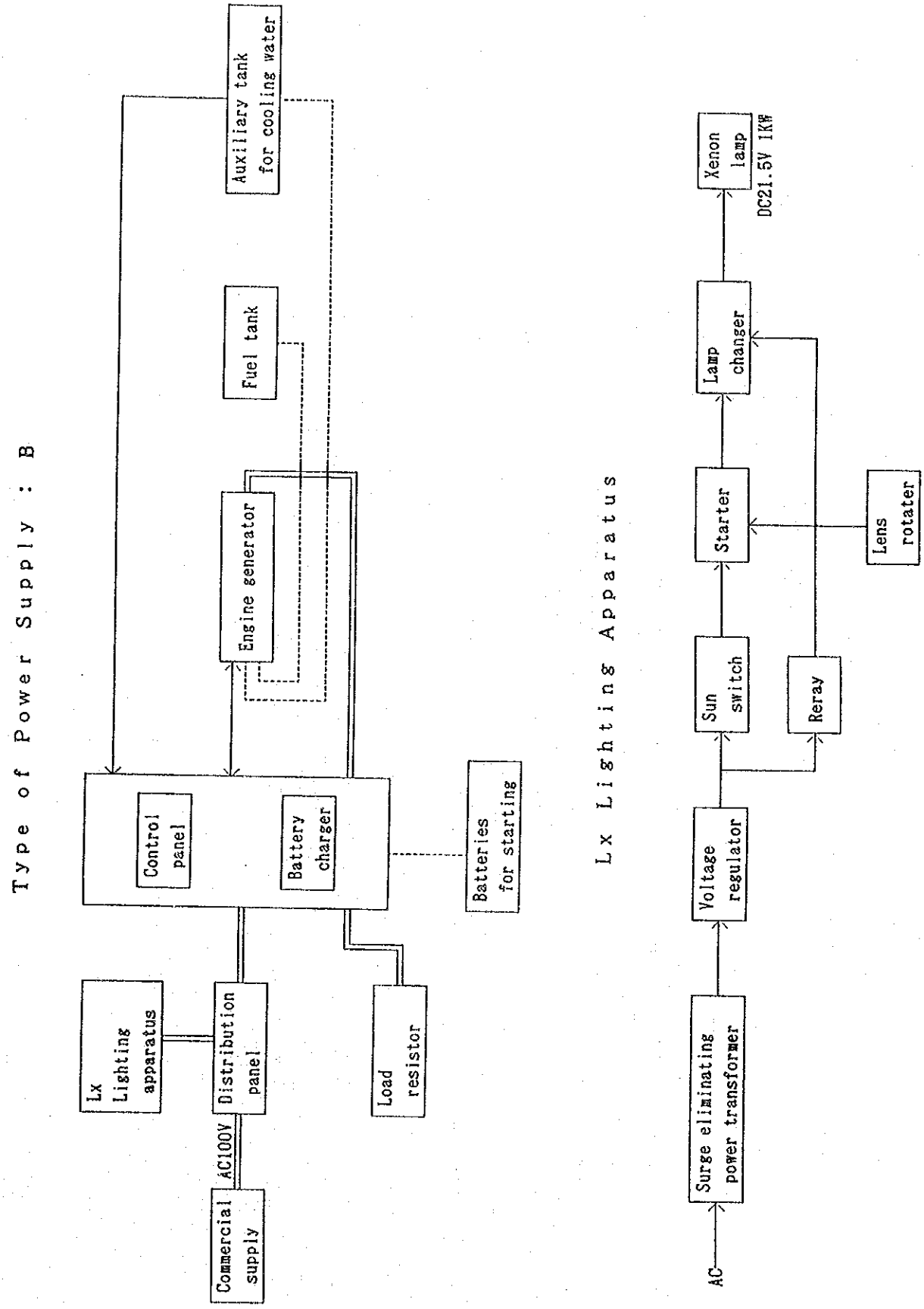
(top view)



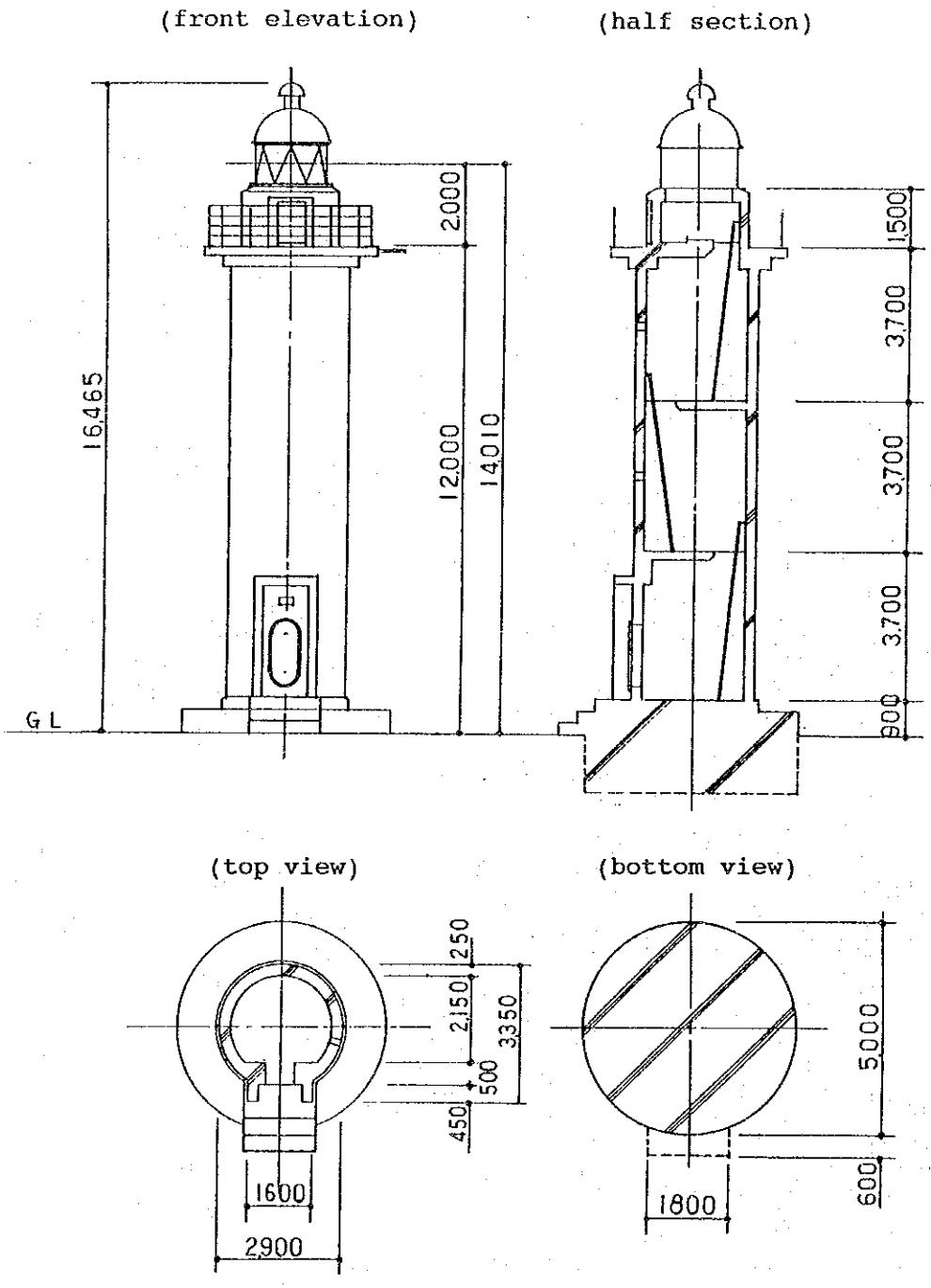
(block diagram of apparatus - case A)



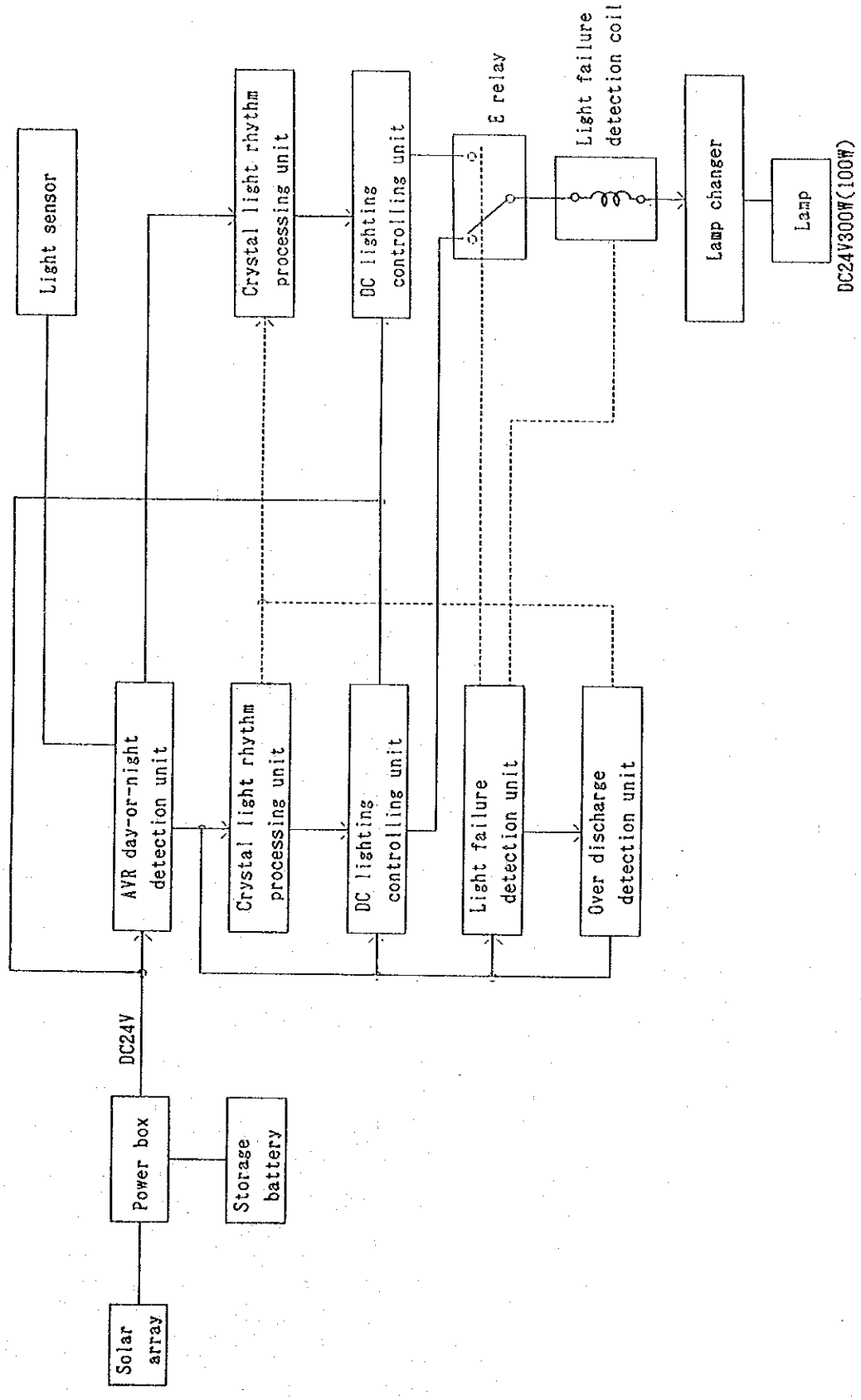
(block diagram of apparatus - case B)



2. Lightbeacon (L)

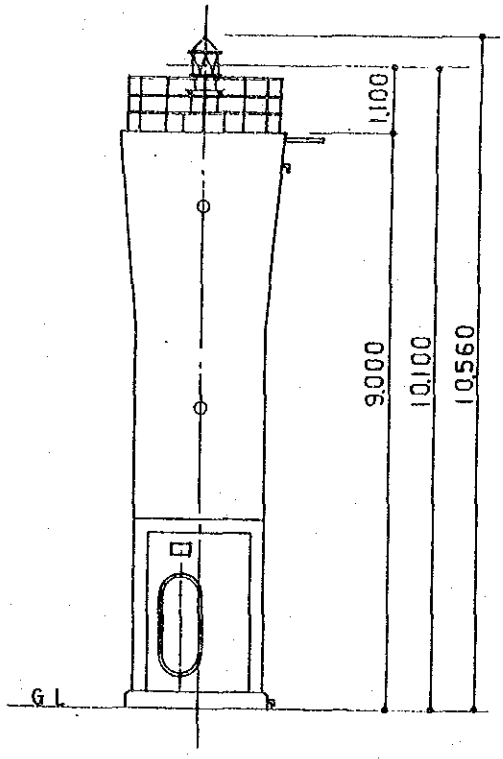


(block diagram of apparatus)

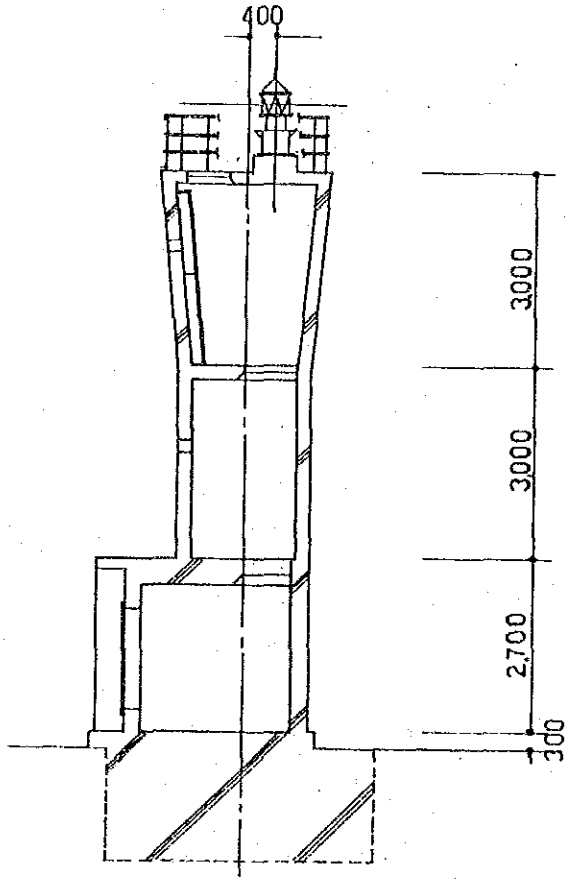


3. Lightbeacon (M)

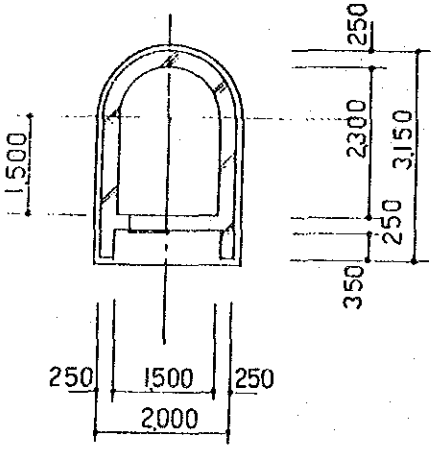
(front elevation)



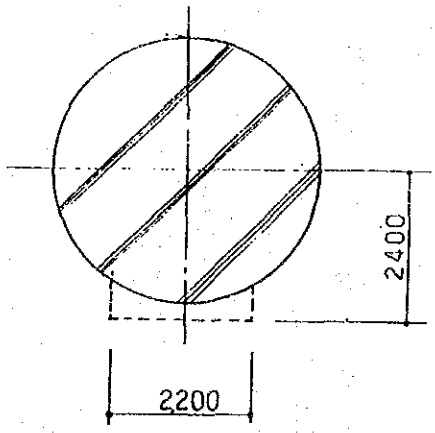
(half section)



(top view)

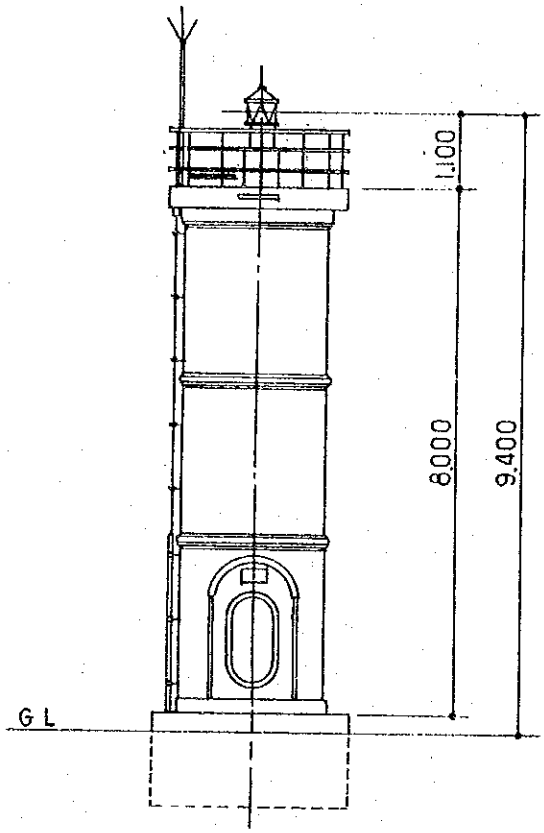


(bottom view)

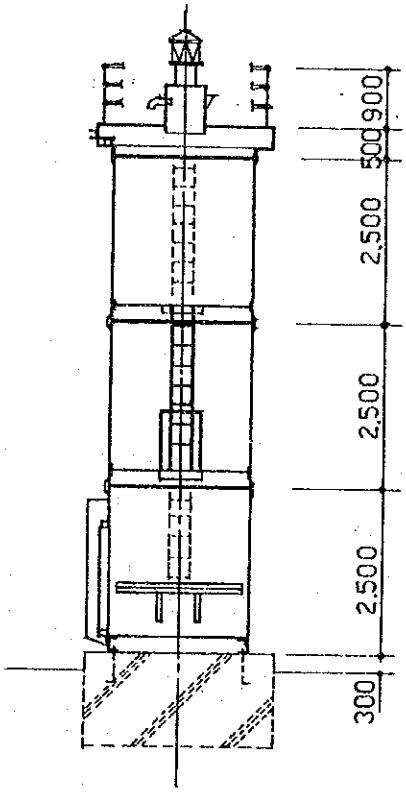


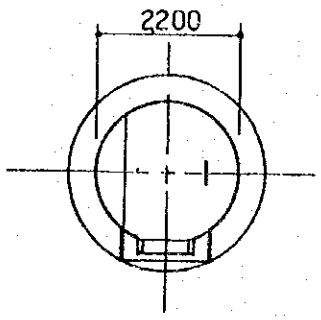
4. Lightbeacon (M)

(front elevation)

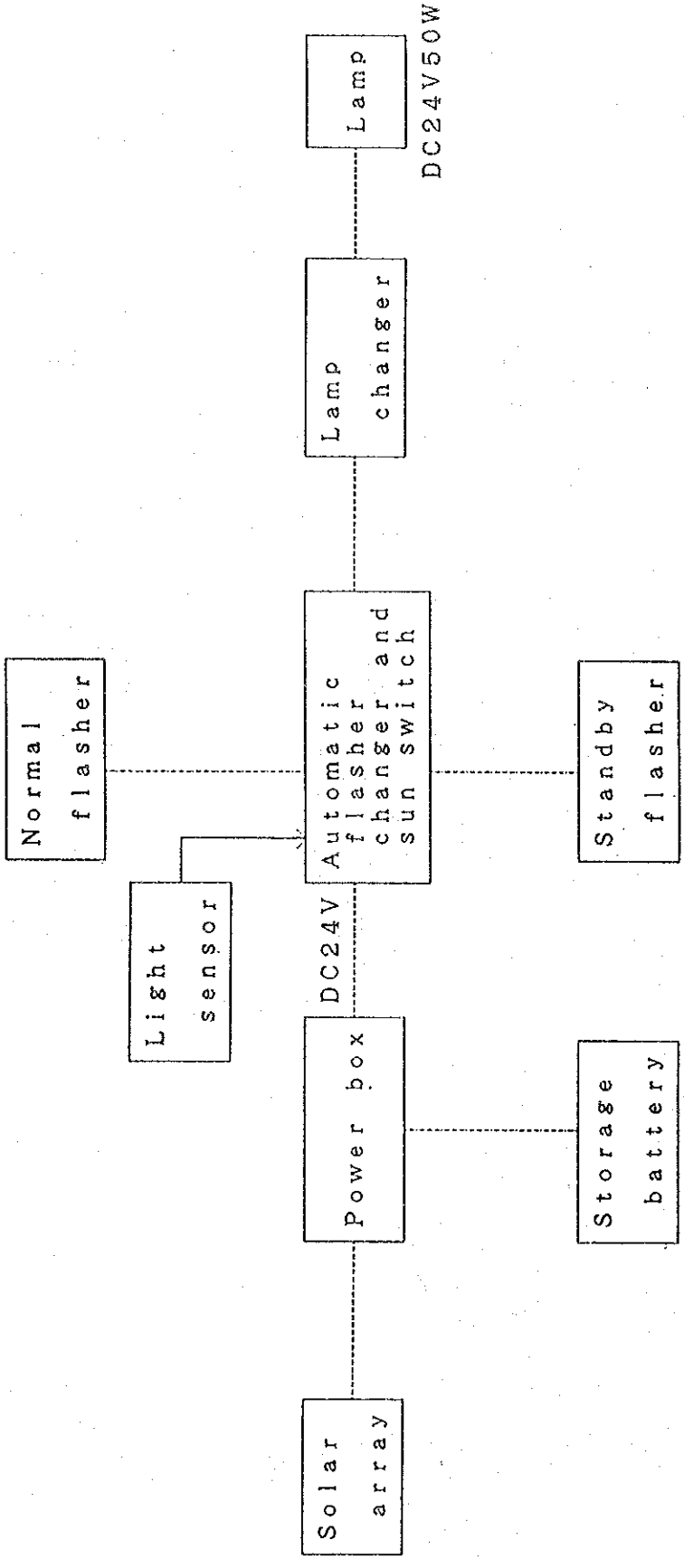


(half section)



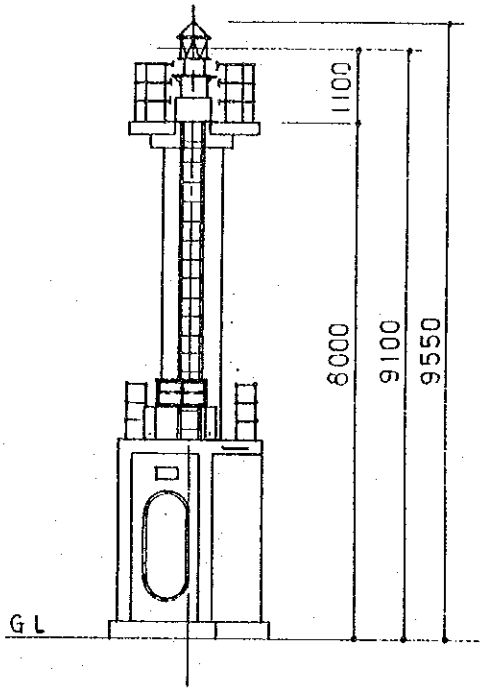


(block diagram of apparatus)

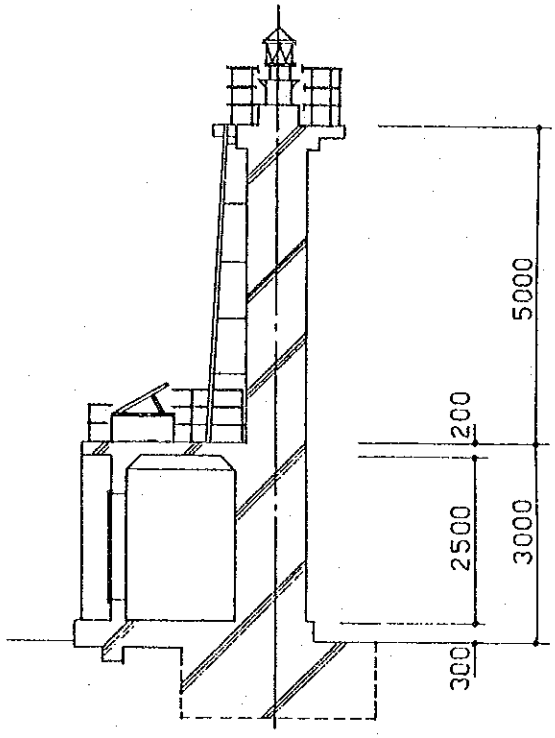


5. Lightbeacon (S)

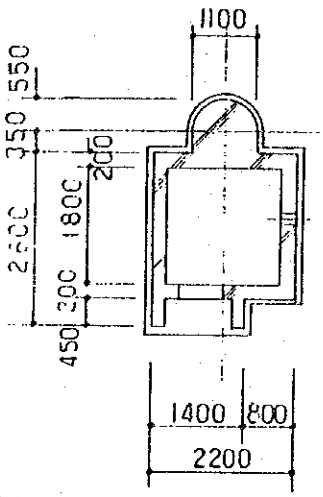
(front elevation)



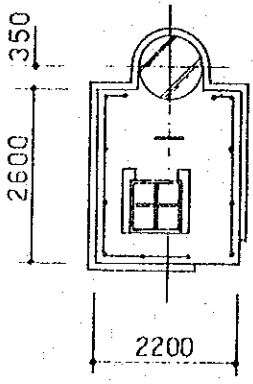
(half section)



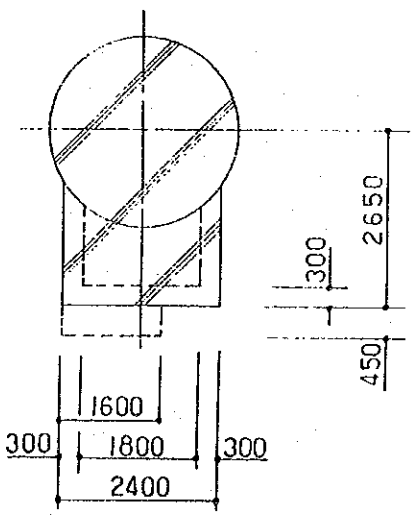
(bottom view)



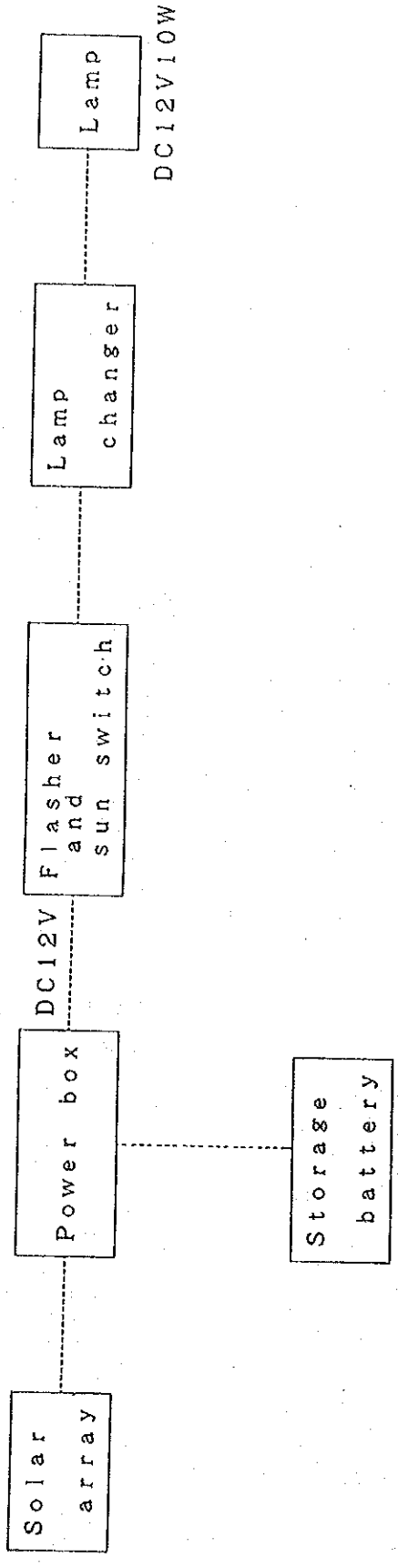
(top view)



(horizontal section)

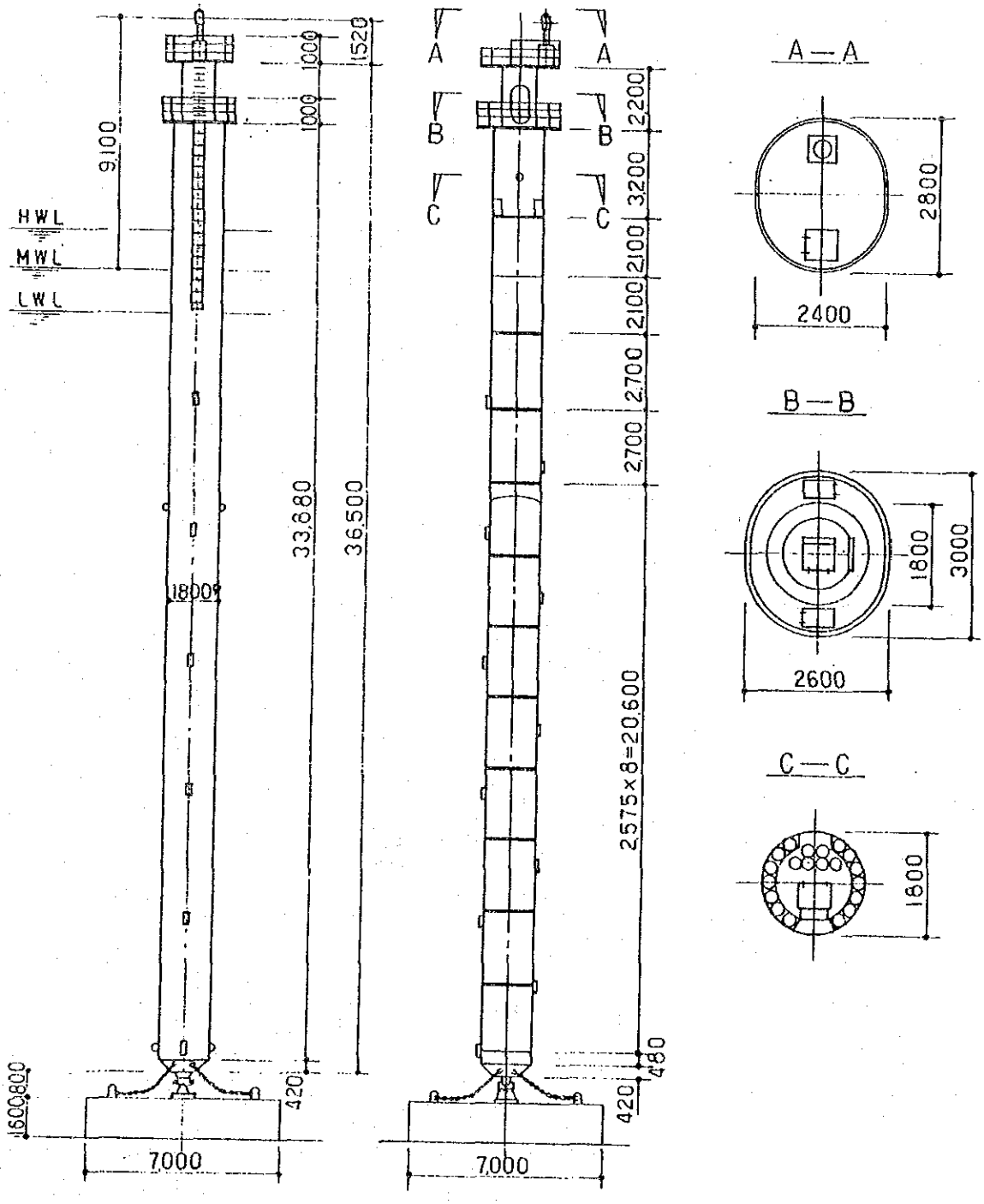


(block diagram of apparatus)

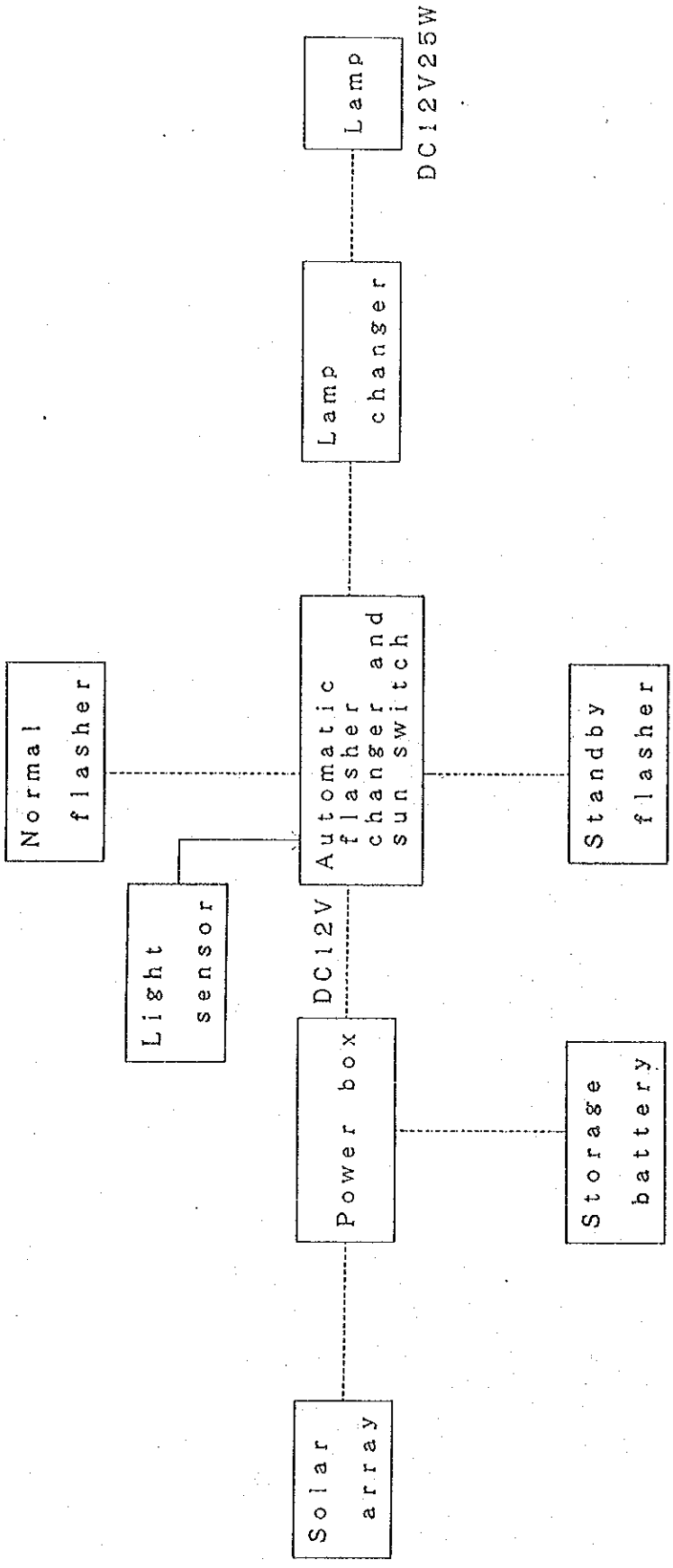


6. Regiliant Lightbeacon

(front elevation) (half section) (cutting plane)

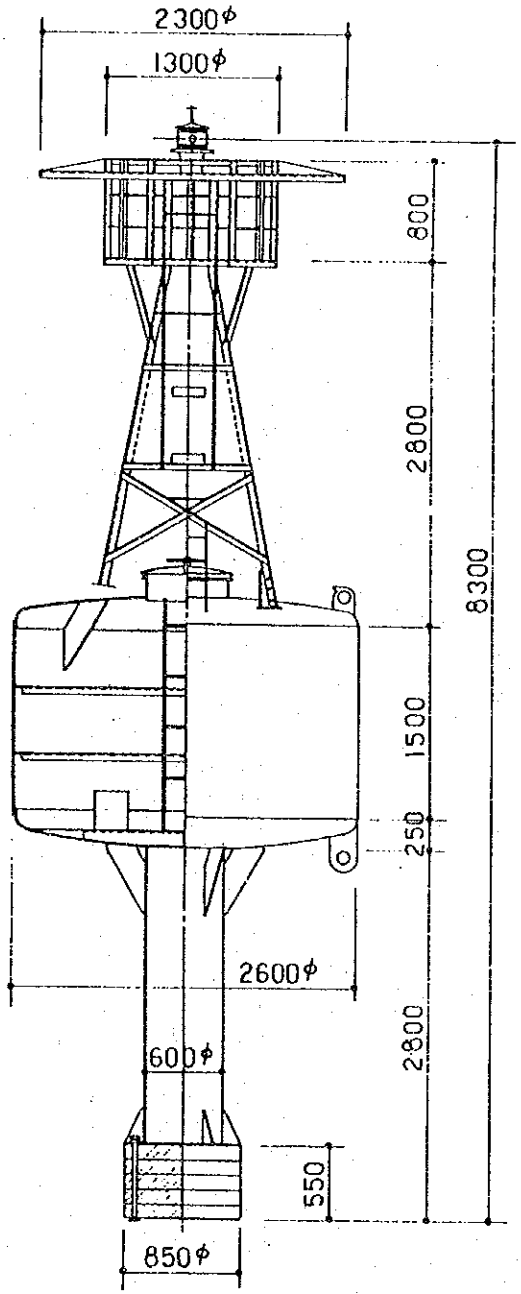


(block diagram of apparatus)

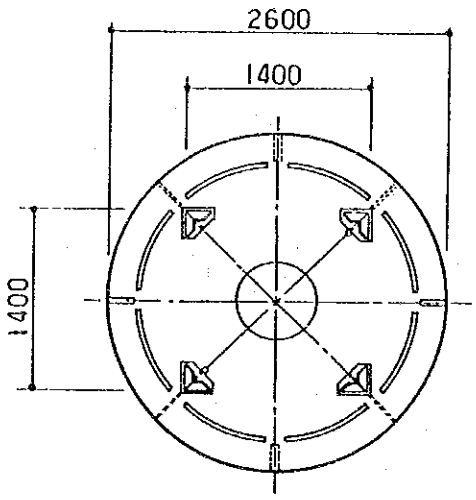


7. Buoy alternative 1

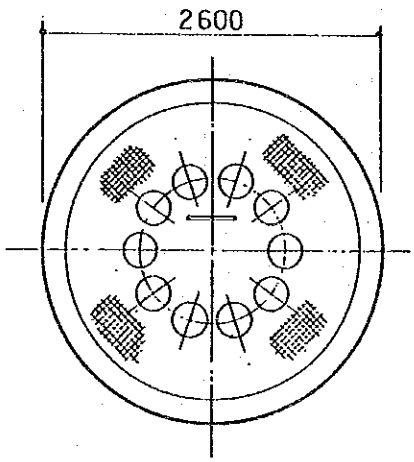
(front elevation)



(top view)

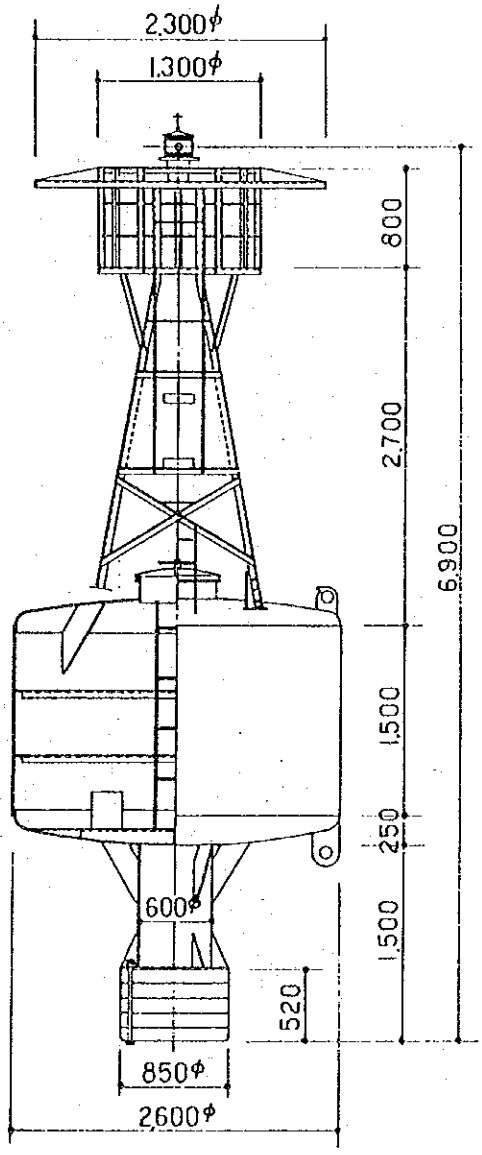


(bottom view)

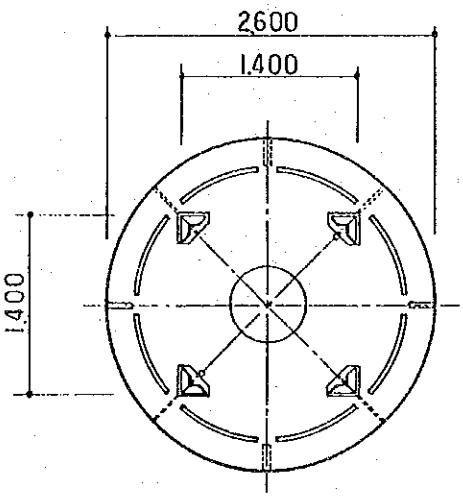


8. Buoy alternative 2

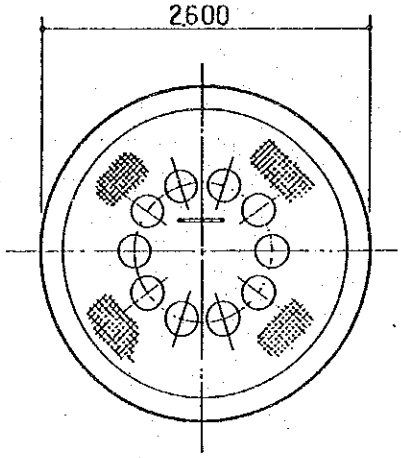
(front elevation)



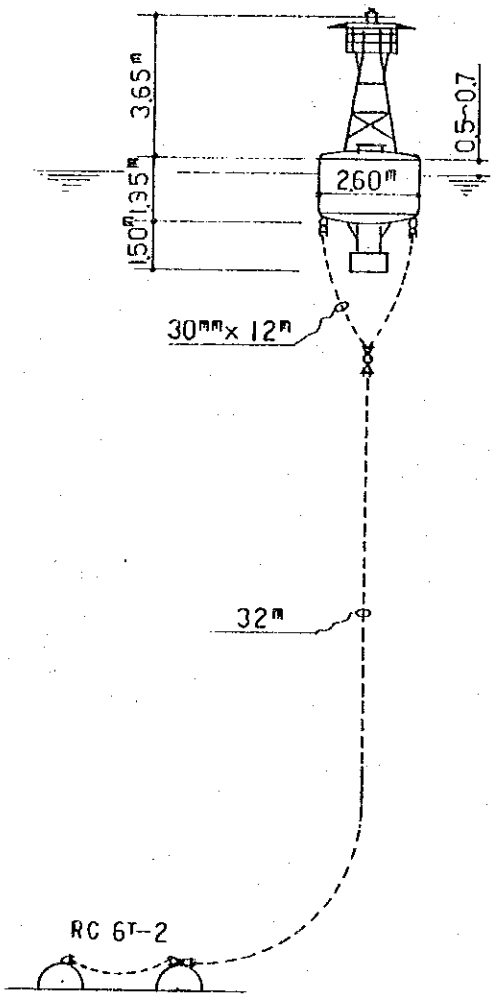
(top view)



(bottom view)



(perspective - alternative 1)



(perspective - alternative 2)