water) free from chlorine, foreign matters, etc. in order to prevent corrosion or contamination. Drain water which may contain harmful contents must be treated by centralized drain disposal facilities. The rain water draining system should desirably have a capacity of handling a heavy rain which may possibly occur once per 100 years.

4. Laboratory facilities

a) Grounding

Each laboratory must have grounding lines of sufficient performances. In particular, electricity-related laboratories must have independent grounding lines, whose grounding resistance must desirably be less than 1 ohm.

b) Dust-proof structure

Laboratories handling the length, mass, etc. must be clean rooms of class 10000 or so. They should be so designed, when designing the building, that higher-level clean rooms or clean benches may be installed if necessary.

c) Hume hood

Laboratories which may produce inflammable or harmful gases must be provided with fume hood and exclusive ducts in order to exhaust such gases to outside, make them harmless or the like.

d) Shielded rooms

Laboratories which will be exposed to reduced external electromagnetic waves must be shielded rooms.

5. Supporting Facilities

a) Fire prevention

Fire retarding walls and fire retarding doors must be provided in each necessary area. Each laboratory must be provided with a fire alarm and an initial fire extinguishing facilities. It is recommended to provide the common-use areas with sprinklers. Laboratories, etc. which must be free from water must be provided with inactive gas fire extinguishing facilities.

b) Power failure and water failure

Even if there is a slim possibility of power failure or water failure, emergency power supplies and water reservoirs must be provided, taking account of the specialty of NML's operations.

c) Centralized control of facilities

A centralized monitor system and monitor center must be provided in order to monitor the conditions of the power supply systems, air conditioning systems, and other facilities running continuously for 24 hours.

d) Control of going in and out

Each necessary area must have an automatic locking door and ID card system for grasping and controlling going in and out.

e) Instrumentation

Instrumentation activity must be provided for maintenance and repair of facilities and equipment in NML. Several technical staffs must be allocated for this activity.

f) Workshop

Workshop must be provided for preparation of sample for R&D activities in each laboratory and simple repair of equipment.

6. Others

Some laboratories may have the special features shown below, which must be taken into consideration at the stage of building design.

a) Special room height (ceiling height) and special load resistance of the floor

b) Cranes, hoists and other transportation facilities

c) Foundations and experiment bases independent from the floor pits and building structures

Taking account of metrology laboratories in overseas countries, we decided that these laboratories should be arranged like an island in the center of the building in order to avoid direct sunlight and should be enclosed by technical staff offices, conference room, library, and so forth. Some laboratories are located in a separate building since they produce vibrations or heavy objects are handled in them or they require special structures.

Fig. 7-2 shows the NML layout based on this plan. Table 7-1 shows the conditions of the laboratories, equipment and facility expenses, etc. The layout of each laboratory is described in the following section.

The construction cost of these buildings is approx. one billion yen as we refer to the costs of equivalent facilities in Japan.

4) Equipment plan

The equipment plan is described in details in the following section according to the laboratories. The basic principle of making the equipment plan is as shown below.

a) The target accuracies of the national standards should be specified in classes, and equipment and instruments suitable to these classes should be selected.

b) Equipment and instruments should be systematized for promoting common use. In order to establish a systematic standards, it is necessary to combine a number of equipment and instruments systematically. Thus, the equipment and instruments must have well-balanced performances and specifications and output data must be used commonly to process and control data in a centralized manner.

c) The equipment layout plan must be made according to the modules suitable to the laboratories. Sufficient work spaces must be secured. The equipment, racks, etc. should not cover 30% or more of each laboratory area, in principle.

The following shows the equipment plan and its cost of each laboratory decided in the above-shown principle. (The values shown below indicate the purchase

costs in Japan. Note that they are shown for reference only.) The total costs amount to approx. 1.577 billion yen.

Length standards laboratory	Approx. 287 million yen
Mass standards laboratory	Approx. 150 million yen
Volume and flow standards laboratory	Approx. 220 million yen
Force and pressure standards laboratory	Approx. 320 million yen
Temperature standards laboratory	Approx. 110 million yen
Electrical standards laboratory	Approx. 520 million yen
DC voltage	(Approx. 30 million yen)
Resistance	(Approx. 40 million yen)
LC	(Approx. 50 million yen)
AC voltage	(Approx. 35 million yen)
Electric power and energy	(Approx. 50 million yen)
High voltage	(Approx. 30 million yen)
Time and frequency	(Approx. 25 million yen)
High-frequency and microwaves	(Approx. 80 million yen)
Acoustics and vibrations	(Approx. 60 million yen)
Photometry	(Approx. 100 million yen)
Magnetic	(Approx. 20 million yen)
Total	Approx. 1607 million yen

Note: Figures in parentheses mean breakdown of those of "Electrical standards laboratory".

5) Conditions of location

We hear that the NML will possibly be located in any of the following four places.

a) Kulim Hi-Tech Park
b) Technology Park, Kuala Lumpur
c) Near the Sepang New Airport which will be constructed in the future
d) On the current SIRIM site or adjacent to it

We examined the sites shown above (except for the Sepang New Airport which is not expected so much) and collected data. Table 7-2 compares the characteristics of these locations from an engineering standpoint with consideration of the above-shown conditions.

As described below, the NML will require more than 100 employees at least in the future. Thus, we should take account of the employment problem as one of the important factors when deciding the NML site. Most of the employees of the current SIRIM Measurement Centre may move to the new NML. Thus, we should take account of the intentions and wishes of these employees carefully.

6) Management plan

Maintenance, researches and development of the metrological standards are quite public. It takes a huge amount of money to manage these activities. It is difficult to show in a concrete form how much costs are returned. It is also difficult to obtain profits since this operation has less direct beneficiaries. However, it is clear that the results of the laboratories are widely fed back to the people of the nation and serve as great bases of industry and economy. Therefore, many nations established metrology laboratories for maintaining the metrological standards and normally manage them using national budgets.

We made the expansion plan on the assumption that the Government will manage the NML using the national budget in Malaysia.

7) Staffing plan

We estimated the necessary number of technical staffs of each laboratory and determined the employee plan up to the year of 2000. Details of the necessary numbers of technical staffs of the laboratories are described in the following section. The table below shows the total number of technical staffs only. The first year is 1994.

	1994	1995	1996	1997	1998	1999	2000
Length standards laboratory	3	4	5	5	5	6	6
Mass standards laboratory	3	4	5	5	5	6	6
Volume and flow standards laboratory	3	3	4	6	7	9	10
Force and pressure standards laboratory	3	3	4	5	5	6	6
Temperature standards laboratory	4	4	4	5	5	6	6
Electrical standards laboratory	21	23	25	26	26	28	28
DC voltage / Resistance	(3)	(3)	(4)	(4)	(4)	(5)	(5)
LC / AC voltage	(3)	(3)	(4)	(4)	(4)	(5)	(5)
Electric power and energy / High voltage	(3)	(3)	(3)	(3)	(3)	(3)	(3)
Time and frequency	(1)	(1)	(1)	(1)	(1)	(1)	(1)
High-frequency and microwaves	(3)	(3)	(3)	(4)	(4)	(4)	(4)
Acoustics and vibrations	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Photometry	(4)	(4)	(4)	(4)	(4)	(4)	(4)
Magnetic	(2)	(4)	(4)	(4)	(4)	(4)	(4)
Total	37	41	47	52	53	61	62

Note: Numbers of technical staffs in parentheses mean those of "Electrical standards laboratory" in each parameter.

In general, a metrology R/D organization requires staffs of general affairs, financial affairs, planning, etc. and employees for miscellaneous jobs. Some laboratories require office workers for calibration services. Provided the same number of employees as the technical staffs are required, the whole NML will require approx. 80 employees at the beginning and approx. 130 employees in the year 2000.

Likewise, the NML requires a number of technical staffs. Even though the technical staffs of the current SIRIM Measurement Centre will move to the NML, the NCL described in section 7.2.2 below also requires a number of technical staffs. It is urgent to secure technical staffs. As described in Chapter 5 above, the SIRIM Measurement Centre is short in technical staffs even at present, and insufficient experiences lead to low calibration capability. Thus, we must say with special emphasis that it is urgent to secure experienced technical staffs and improve their engineering capabilities through proper training prior to the start of this plan.

8) Training plan

The NML handles the Malaysian national standards and aims to be an organization recognized internationally. Therefore, the NML should have higher technical levels than the current levels, including those of quantities which the NML will handle newly. In principle, NML's technical staffs should

be trained in overseas metrology laboratories for all quantities. As for the quantities which the SIRIM Measurement Centre handles now, the technical staffs should be mainly trained in the SIRIM Measurement Centre.

Training in overseas organizations should begin with operation of the equipment and instruments to be purchased. It may take 3 to 6 months, including theoretical education.

9) Implementation plan

This plan will begin with construction of the NML buildings and requires a total budget of approx. 2600 million yen (reference cost) for constructing the buildings and purchasing equipment. The Malaysian Government will require a period of preparing and handling the budget. We made the implementation plan as shown below on the assumption that this plan may be started in 1994.

1. Preparing the building construction plan and equipment plan
2. Employing technical staffs and carrying out preliminary training in the SIRIM Measurement Centre
3. Constructing the buildings
4. Purchasing and installing equipment
5. Implementing engineering training
6. Starting NML's research and development

Fig. 7-3 shows the flow of these works.

10) To be a membership of the Meter Convention

In relation with NML being internationally recognized metrology laboratory, it is highly recommendable that Malaysia will be a membership of the Meter Convention.

International comparison of measurement standards joined by each member country is one of the activities under the Meter Convention. As NML is planned to be a national metrology laboratory, when Malaysia be a member of the Meter Convention it is important and essential for NML to join international comparison with the purpose of this proposal.

7.2.2 Expansion Plan of National Calibration Laboratory (NCL)

7.2.2.1 Outline of plan

A metrological calibration service organization aims to offer accurate metrological standards to all industrial fields. It should be established and managed as the unified technical infrastructure of the industry. Thus, an organization handling the traceability of metrological standard and upstream parts should desirably be managed by the government. In fact, such organizations are managed by the government in many nations.

The organization called as the National Calibration Laboratory NCL in this report is an engineering organization which takes charge of the core of the traceability system applicable to a wide range of applications. It is a further development of the current SIRIM Measurement Centre and covers a wider range of operations. The NCL should offer a wide range of calibration services and fulfill the engineering needs of the industry in close cooperation with the NML, which maintains and controls the national standards. As an organization, it may be considered as one of the internal sections of the SIRIM like the NML.

The NCLs should be located near Kuala Lumpur, Penang, and Johor Baharu which are advanced industries in Malaysia. In the future, additional NCL will probably be established in Eastern Malaysia, which is not described in this report. In this report, NCLs located near Kuala Lumpur, Penang, Johor Baharu and in the Eastern Malaysia are referred to as NCL-SA, NCL-P, NCL-JB and NCL-EM.

1) Purpose of NCLs

The function and purpose of the NCLs are to offer calibration services for the measuring instruments whose traceability should be certified. At present, qualified auditors in the SIRIM Measurement Centre take part in the assessment works based on the SAMM Laboratory Accreditation System. However, such works are omitted from this report, since this plan covers metrology technologies only.

2) Types of applicable quantities

The NCLs offer calibration services. As described in section 7.2.1 above, the NML is to offer, for the time being, calibration services for the quantities which the SIRIM Measurement Centre does not handle now and the NML will handle

newly. The NCLs offer calibration services all over Malaysia. The NCL-SA near Kuala Lumpur, where the SIRIM Measurement Centre is located now, will play a major role. Therefore, the NCL-SA will cover all the quantities which the NML will handle, in principle. As for the fields which the NML will handle newly, the NCL-SA will offer services when calibration needs increases. Table 7-3 shows the measures handled by the NML and NCL.

The quantities which are to be handled by NCL-SA are as follows.

1. Length
2. Mass
3. Volume and flow
4. Force and pressure
5. Temperature
6. Electrical
   - DC current
   - Resistance
   - LC
   - AC
   - Electric power
   - Time and frequency

The NCL-P and NCL-JB will offer calibration services of only the basic quantities in much needs as follows. In the future, they will expand their operations according to the needs. The NCL-EM to be located in the Eastern Malaysia should begin its calibration services of the measures shown below.

1. Length
2. Mass
3. Force and pressure
4. Temperature
5. Electric measures
   - DC current
   - Resistance
   - LC
   - AC
   - Electric power
   - Time and frequency

3) Building plan

We assume that the current SIRIM Measurement Centre is enlarged and renovated for the NCL-SA. The problems of the current building are described in Chapter 4. Our plan assumes that it will be renovated as far as possible. Its points are as shown below.

- Both flanks of the current building must be extended to increase the floor area.
- A storage room of equipment and instruments requested to be calibrated must be provided.
- A space for making test pieces, etc. must be secured.
- Lifts for carrying equipment and instruments requested to be calibrated must be provided.
- Reception work must be done out in one place.

The area of the laboratories of the NCL-SA based on our plan is approx. 1300 m^2. The total floor area is approx. 3000 m^2. Fig. 7-4 shows the layout of the building. Details of the calibration laboratories are described in the following section. Table 7-4 shows the conditions of the laboratories. The current SIRIM Northern Branch Office is planned to be rebuilt into a new building, and accordingly the expansion plan of the NCL-P will be made in relation with it. In principle, the NCL-P will be constructed newly. The NCL-JB must be also built newly. The general requirements of these buildings must refer to the NML conditions described in 7.2.1 above. Table 7-5 shows the conditions of the laboratories.

The area of the laboratories of either the NCL-P or NCL-JB is approx. 450 m^2. Thus, the total floor area of either building will be approx. 1000 m^2.

4) Equipment plan

The NCL-SA will use most equipment and instruments currently used by the SIRIM Measurement Centre. As we researched the industrial needs as a part of this study, the equipment and instruments currently in use will meet most needs. Thus, the facilities and equipment plan of the NCL-SA is fulfilled by making use of the most equipment and instruments currently in use and by purchasing some new equipment and instruments. For the NCL-P and NCL-JB, most equipment and instruments will be purchased newly.

The equipment and instruments to be purchased should be adjusted with consideration of improvement of the calibration abilities of private accredited laboratories.

The following shows the equipment plans of the laboratories and their costs we estimated. (The costs are estimated in yen and shown for reference only.) The NCL-SA requires approx. 248 million yen, and either the NCL-P or NCL-JB requires approx. 170 million yen each, amounting to approx. 588 million yen.

1. Equipment costs of the NCL-SA

Length calibration laboratory	Diverting equipment currently in use
Mass calibration laboratory	Approx. 10 million yen
Volume and flow calibration laboratory	Approx. 8 million yen
Force and pressure calibration laboratory	Approx. 40 million yen
Temperature calibration laboratory	Diverting equipment currently in use
Electrical calibration laboratory	Approx. 190 million yen
DC voltage	(Approx. 40 million yen)
Resistance	(Approx. 40 million yen)
LC	(Approx. 30 million yen)
AC voltage	(Approx. 50 million yen)
Electric power and energy	(Approx. 30 million yen)
Time and frequency	(Diverting equipment currently in use)
Total	Approx. 248 million yen

Note: Figures in parentheses mean breakdown of those of "Electrical calibration laboratory".

2. Equipment costs of the NCL-P and NCL-JP (per laboratory)

Length calibration laboratory	Approx. 50 million yen
Mass calibration laboratory	Approx. 50 million yen
Force and pressure calibration laboratory	Approx. 20 million yen
Temperature calibration laboratory	Approx. 5 million yen
Electrical calibration laboratory	Approx. 45 million yen
Total	Approx. 170 million yen

5) Staffing and training plans

The staffing plan of the NCL-SA assumes that the technical staffs of the Measurement Centre will move to the NCL-SA. However, if it is executed together with the NML plan described in 7.2.1 above, it is clear that the NCL will be short in technical staffs, since the NML is to take charge of research and development and requires technical staffs experienced in metrology and accordingly its staffing plan assumes that the technical staffs of the Measurement Centre will be transferred to the NML. Thus, we have to point out that it is urgent to make a careful plan to employ and train technical staffs before executing this plan.

We calculated the number of technical staffs for calibration services of each NCL's laboratory and made a staffing plan up to the year of 2000. Details of the necessary technical staffs for each calibration laboratory are described in the following section. The table below shows the employment plan outline. It assumes that the first year is 1994.

	1994	1995	1996	1997	1998	1999	2000
Length calibration laboratory	5	6	6	7	8	9	9
Mass calibration laboratory	6	6	6	8	8	8	8
Volume and flow calibration laboratory	6	6	8	8	8	10	10
Force and pressure calibration laboratory	6	6	6	7	7	8	8
Temperature calibration laboratory	4	4	6	7	7	7	7
Electrical calibration laboratory	17	25	28	29	32	34	37
DC voltage / resistance	(6)	(9)	(10)	(11)	(11)	(12)	(13)
LC / AC voltage	(5)	(8)	(9)	(9)	(10)	(11)	(12)
Electric power and energy	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Time and frequency	(4)	(6)	(7)	(7)	(9)	(9)	(10)
Total	44	53	60	66	70	76	79

Note: Numbers of technical staffs in parentheses mean those of "Electrical calibration laboratory" in each parameter.

Since the NCL offers calibration services, it requires general affairs, financial affairs, planning, public information and other staffs, and office workers of reception, safe keeping, issuing test report and so forth, in addition to technical staffs. Provided the number of such staffs and office workers is 1.5 times as

large as the number of technical staffs, the whole NCL requires approx. 100 employees at the beginning and approx. 200 employees in the year of 2000.

Since the NCL-P and NCL-JB are established newly, they require newly employed technical staffs. For these technical staffs, it is necessary to make a plan for employing, training and developing them before executing this plan.

6) Management plan

The NCL offers calibration services upon requests of the industry, etc. It is expected to gain some profits. We believe that calibration charges should be used to run the NCL for promoting nongovernmental management of such organization in Malaysia after the NCL begins its operations, though a huge amount of initial investment including constructing buildings, purchasing equipment and facilities, etc. should be born by the Government. Many overseas calibration organizations have self-supporting accounting systems, though calibration services are highly public business operations. The Governments give restricted subsidies. Thus, the calibration charges should be determined with consideration of the management conditions of the laboratories.

7) Implementation plan

We think that the NCL-SA should be established first and, after education and training of technical staffs make progress to some extent in the NCL-SA, the NCL-P and NCL-JB should be established. Therefore, the implementation plan will take the following steps.

Step 1: Establishment of the NCL-SA

1. Making a facilities and equipment plan and a renovation plan of the current SIRIM Measurement Centre
2. Employing and training technical staffs (Desk study and OJT by means of supporting practical operations)
3. Renovating the buildings and purchasing and installing facilities and equipment
4. Starting operations of the NCL-SA
5. Education and training of technical staffs including high level technique

Step 2: Establishment of the NCL-P

1. Making a facilities and equipment plan and a building plan
2. Employing and training technical staffs (in the SIRIM Measurement Centre or NCL-SA)
3. Constructing the buildings and purchasing and installing
4. Moving technical staffs to the NCL-P and employing additional technical staffs
5. Starting operations
6. Education and training (Educating and training the technical staffs already trained in 2. in higher level technique. Educating and training newly employed technical staffs from OJT practical training.)

Step 3: Establishment of the NCL-JB

Same as described in the NCL-P, in principle. Step 2 has a problem of securing the budget. If we do not take it into consideration, step 2 should desirably be started at 3 of step 1. Step 3 should also be started at 3 of step 1 in the earliest case, taking account of the calibration needs in Johor Baharu.

Fig. 7-5 shows the flow of these steps.

Table 7-1 Condition for NML Standard Laboratories

Laboratory	Floor Area (m^2)	Room Temperature and Humidity	Equipment Cost (1000 Yen)	Reinforcement of Floor	Location	Illuminance	Electromagnetic Schield	Cleanness	Anti-Vibration	Others
Length	216	20±0.5 ℃, 50% or less (Precision Measurement Laboratory)	287,000	Necessary	1 F	1000 lx	—	Necessary	Necessary	
		20±0.5 ℃, 60% or less (General Measurement Laboratory)								
Mass	144	23±0.5 ℃, 60% or less (Precision Balance Laboratory)	150,000	Necessary	1 F	1000 lx	—	Necessary	Necessary	
		23±0.5 ℃, 60% or less (General Measurement Laboratory)								
Force	216	23±2.0 ℃, 60% or less	320,000	Necessary	Separate	1000 lx	—	—	Necessary	
Pressure	144	23±2.0 ℃, 60% or less		—	1 F	1000 lx	—	—	Necessary	
Volume/Flow	216 (Gas)	20±0.5 ℃, 60% or less (Basic Verification System)	220,000	Necessary	Separate	1000 lx	—	—	—	
	144 (Liq.)	23±2.0 ℃, 60% or less (General Measurement Laboratory)								
Temperature	144	23±1.0 ℃, 55± 5% (Precision Measurement Laboratory)	110,000	—	1 F	1000 lx	100 μV/m	—	—	
		27±2.0 ℃, 60± 5% (General Measurement Laboratory)								
Electrical	624	23±2.0 ℃, 60% or less	520,000	—	2 F	1000 lx	100 μV/m	—	—	Earthing (1Ω)
RF	528	23±2.0 ℃, 60% or less		—	1 F	1000 lx	100 μV/m	—	—	
Anechoic Rm	360	20±2.0 ℃, 70% or less	included in Bldg.		Separate	500 lx	—	—	Necessary	

Table 7-2 Comparison Table of Location

Location	Land Area	Transportation	Access	Electricity	Noise & Vibra'n	Accommodation
Kulim High-Tech Park	◎	△	△	○	N/A(*)	N/A(*)
KL Technology Park	○	○	○	○	○	○
Near SIRIM	○	◎	◎	△	○	◎

Legend : ◎ Excellent
○ Good
△ Fair

Note : (*) The construction of 'Kulim High-Tech Park' was under way at the site, therefore, no survey was practicable on the study items.

Table 7-3 Allotment Plan of Calibration Works

QUANTITY	NML		NCL		
	R&D	CAL.	Shah Alam	Penang	Johor
Length	◎	△	○	○	○
Mass	◎		◎	○	○
Force	◎	△	○	△	△
Pressure	◎	△	○	△	△
Volume/Flow	◎	△	○		
Temperature	◎		◎	○	○
Electrical					
Voltage/Resistance	◎		◎	○	○
AC and LC	◎		◎	○	○
High Voltage	◎				
Power/Energy	◎		◎	○	○
Optical	◎	○			
Magnetic	◎	○			
Time/Frequency	◎	△	○	○	○
Acoustic	◎	○			
HF/Microwave	◎	○			

NML
- ◎ Research and Development of Standard
- ○ Calibration Works until Establishment of Standard
- △ Calibration Works (Partial)

NSL
- ◎ Calibration Works
- ○ Calibration Works (Partial)
- △ Calibration Works (Future)

Table 7-4 Conditions for NCL-SA Calibration Laboratories

Laboratory	Floor Area (m^2) (Expansion)	Room Temperature and Humidity	Equipment Cost (1000 Yen)	Reinforcement of Floor	Location	Illuminance	Electromagnetic Schield	Cleanness	Anti-Vibration	Others
Length	192 (+96)	20±1.0 ℃, 60% ± 5%	–	Necessary	1 F	1000 lx	–	Necessary	Necessary	
Mass	192 (+96)	23±0.5 ℃,60% or less (Precision Measurement Laboratory)	10,000	Necessary	1 F	1000 lx	–	Necessary	Necessary	
		23±1.0 ℃,60% or less (General Measurement Laboratory)								
Force/Pressure	144(±0)	23±2.0 ℃,60% or less	40,000	Necessary	2 F	1000 lx	–	–	–	
Volume/Flow	144(±0)	23±2.0 ℃,60% or less	8,000	Necessary	1 F	1000 lx	–	–	–	
Temperature	144(±0)	23±2.0 ℃, 55± 5%	–	–	1 F	1000 lx	100 μV/m	–	–	
Electrical	480(+192)	23±2.0 ℃,60% or less	190,000	–	2 F	1000 lx	100 μV/m	–	–	Earthing 1Ω

Table 7-5 Conditions for NCL-P and NCL-JB Calibration Laboratories

Laboratory	Floor Area (m^2)	Room Temperature and Humidity	Equipment Cost (1000 Yen)	Reinforcement of Floor	Location	Illuminance	Electromagnetic Schield	Cleanness	Anti-Vibration	Others
Length	96	20±1.0 ℃, 60% ± 5%	50,000	Necessary	1 F	1000 lx	–	Necessary	Necessary	
Mass	96	23±0.5 ℃,60% or less (Precision Measurement Laboratory)	50,000	Necessary	1 F	1000 lx	–	Necessary	Necessary	
		23±1.0 ℃,60% or less (General Measurement Laboratory)								
Force/Pressure	96	23±2.0 ℃,60% or less	20,000	Necessary	1 F	1000 lx	–	–	–	
Temperature	48	23±2.0 ℃, 55± 5%	5,000	–	1 F	1000 lx	100 μV/m	–	–	
Electrical	192	23±2.0 ℃,60% or less	45,000	–	1 F	1000 lx	100 μV/m	–	–	Earthing 1Ω

Note : 'Floor area' and 'Equipment Cost' show as each laboratory.

Fig. 7-1 Organization Chart of MNC

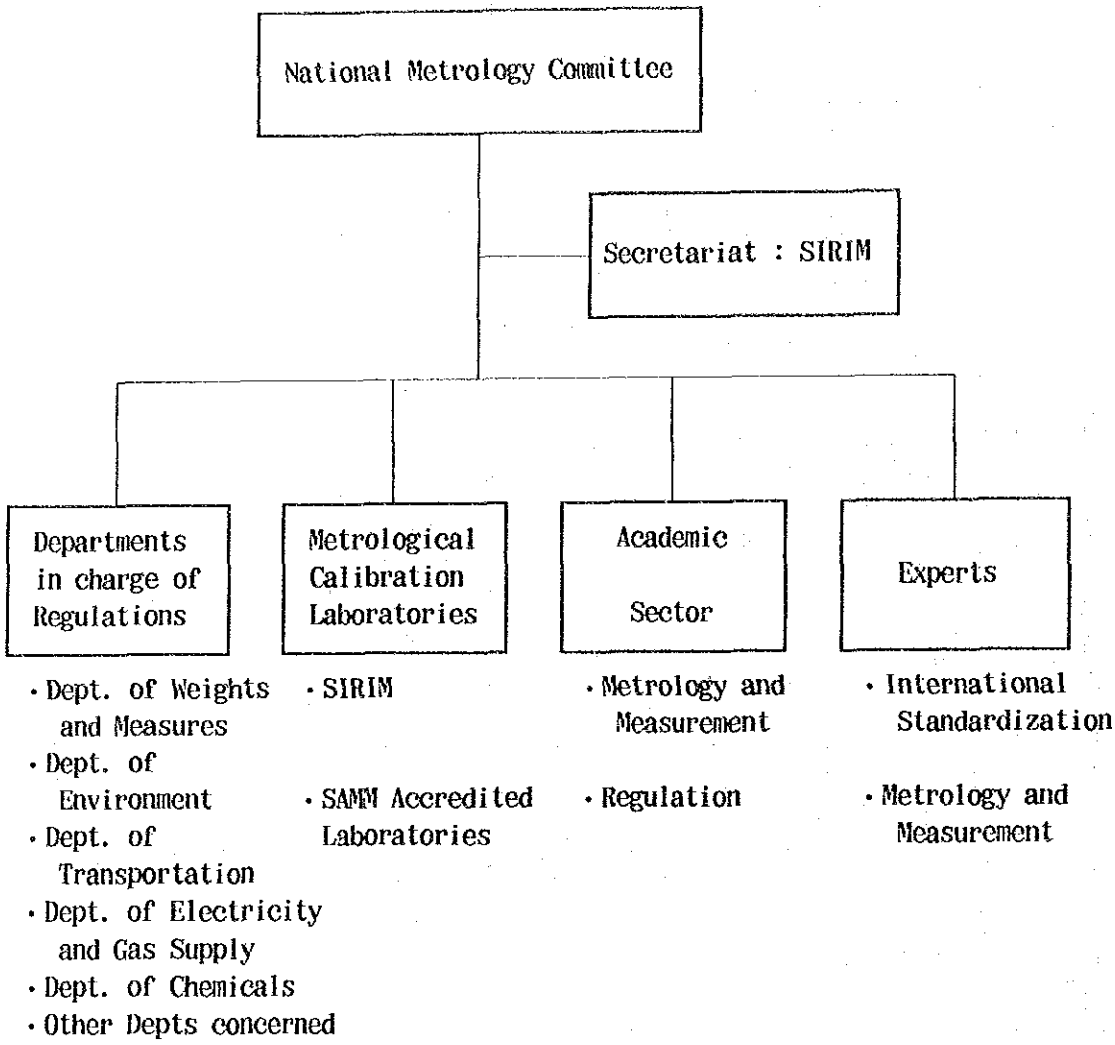
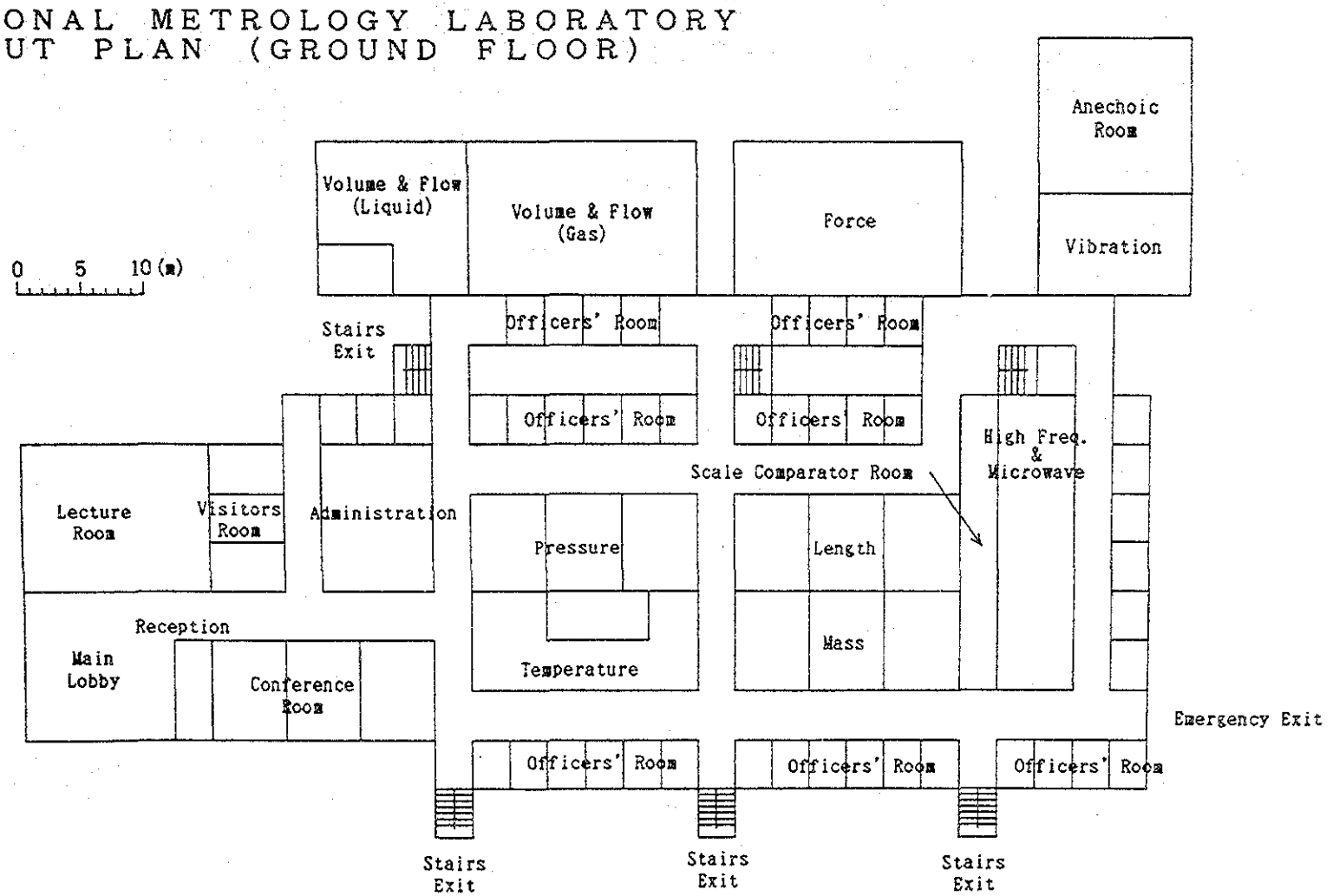


Fig. 7-2 Layout Plan of National Metrology Laboratory



NATIONAL METROLOGY LABORATORY
LAYOUT PLAN (FIRST FLOOR)

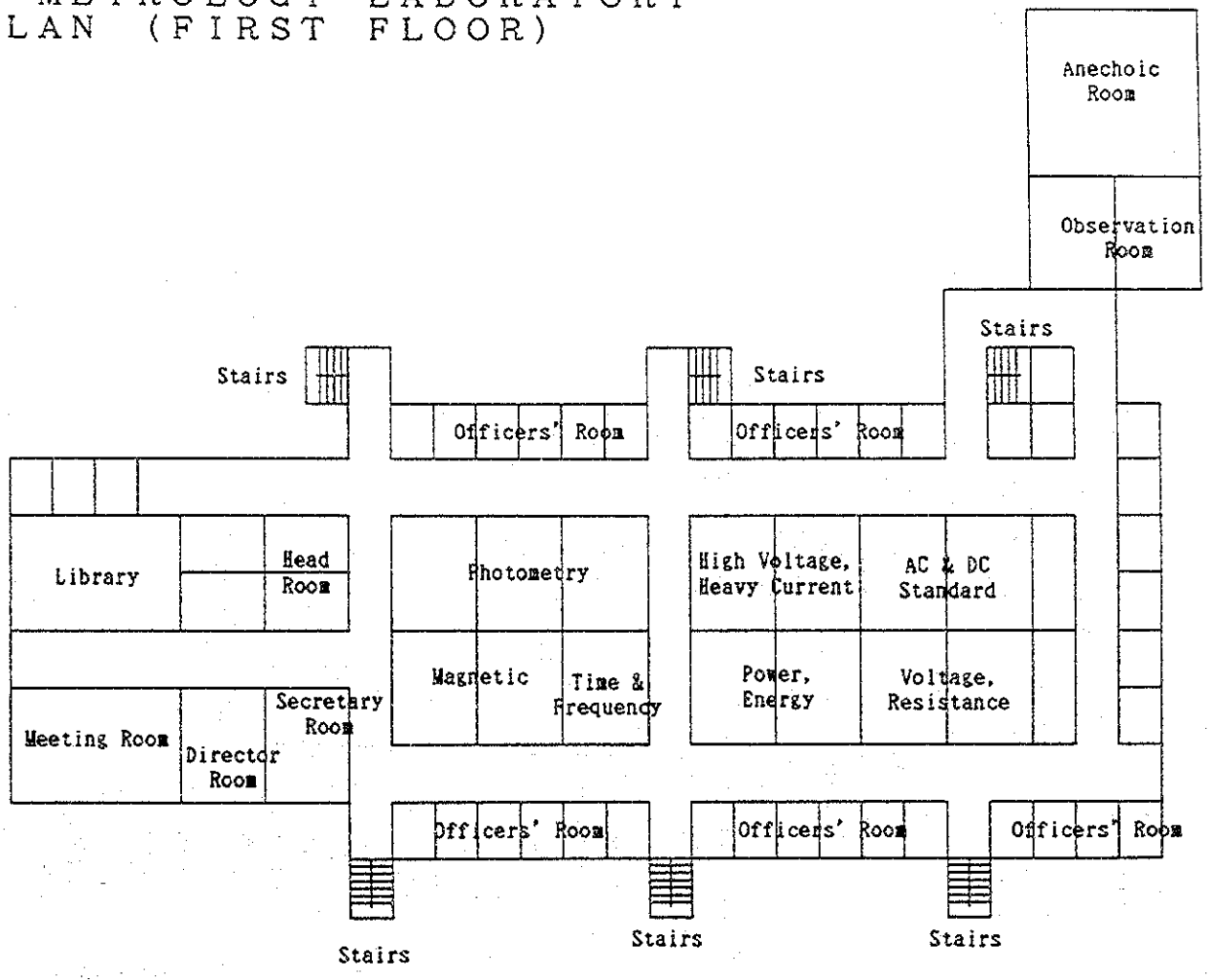


Fig.7-3 Implementation Plan

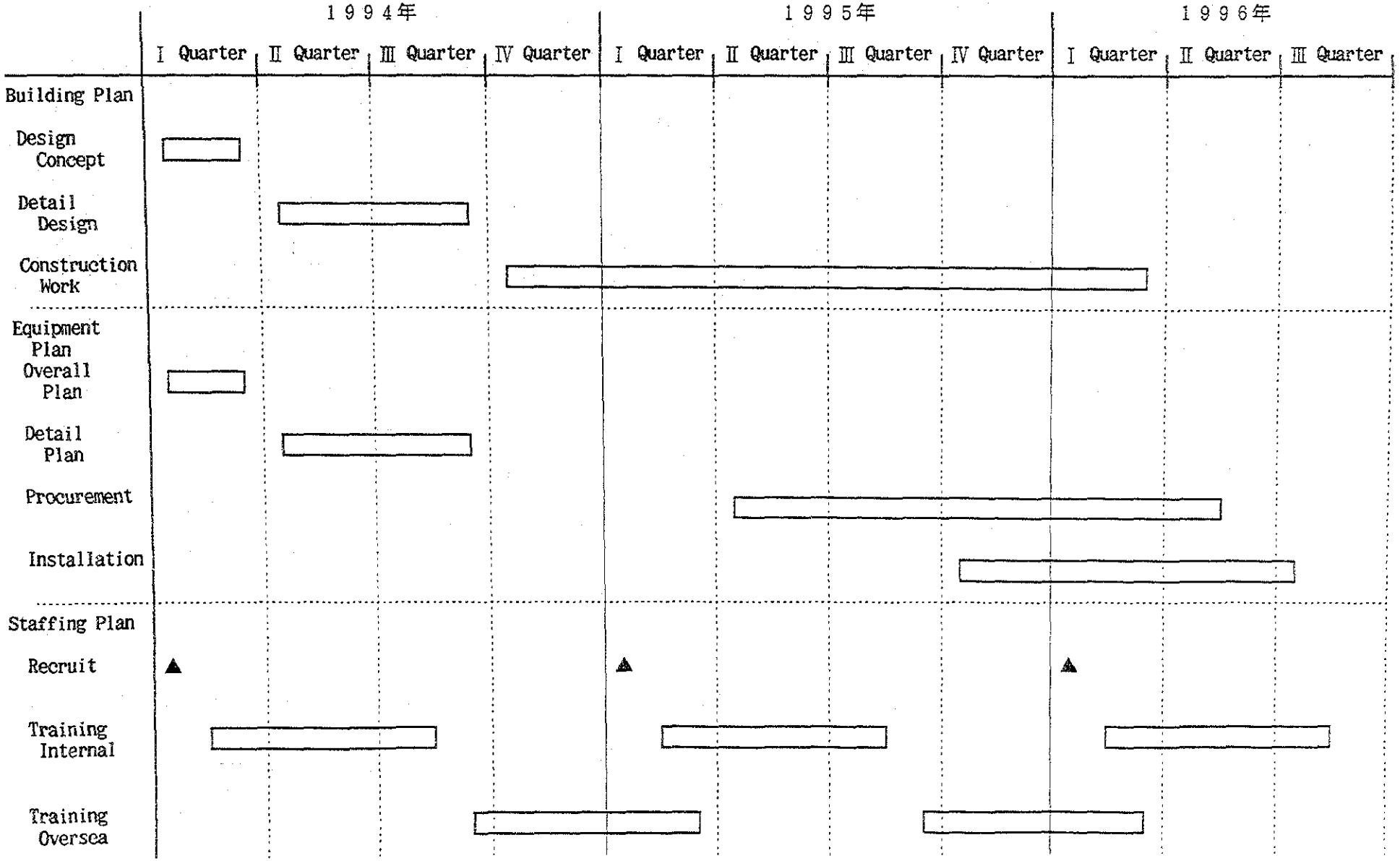
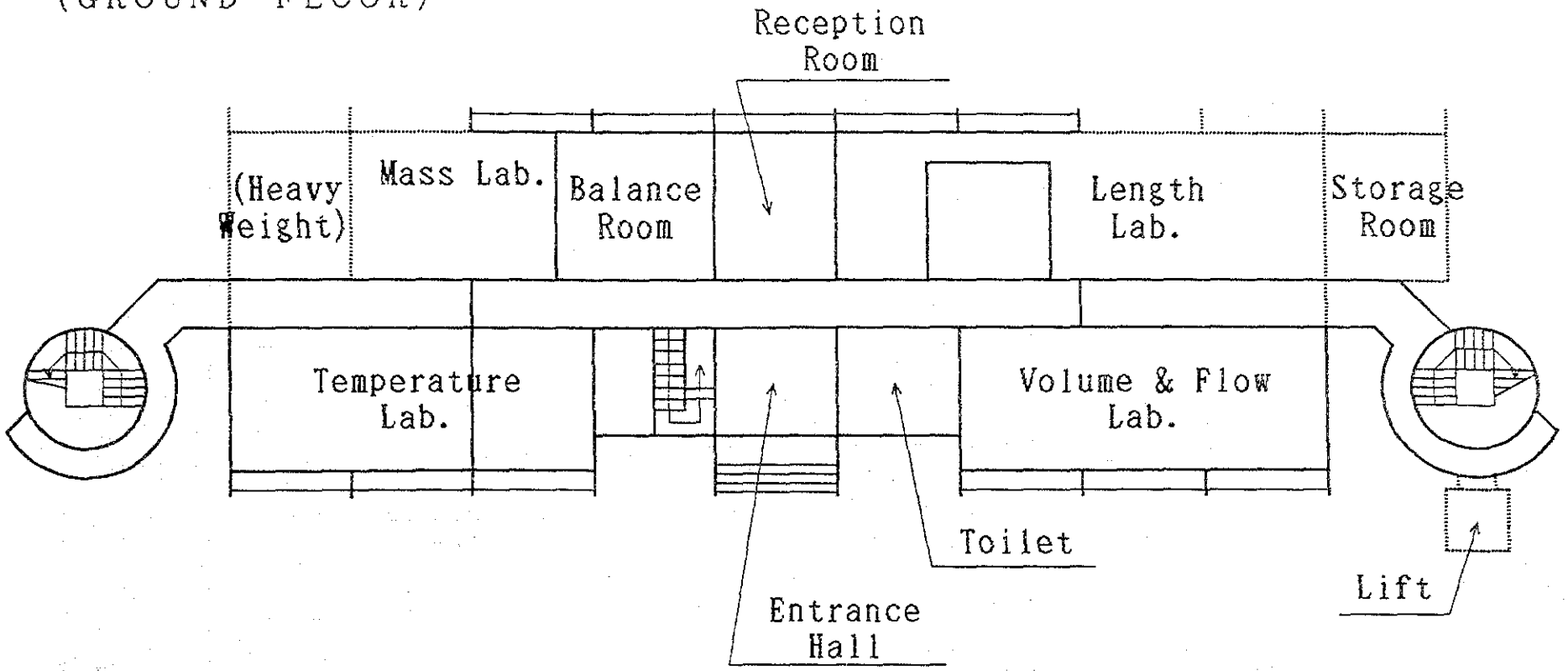
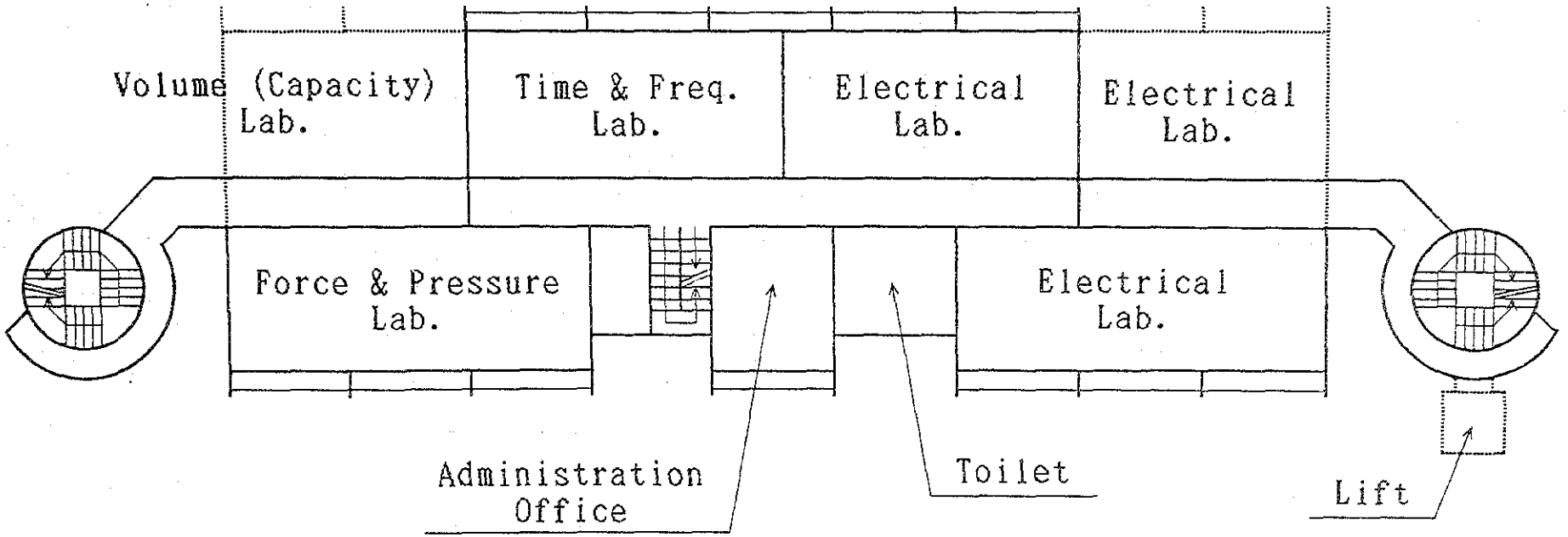


Fig. 7-4 Layout Plan of National Calibration Laboratory



SIRIM MEASUREMENT CENTRE LAYOUT - EXPANSION PLAN
(FIRST FLOOR)



SIRIM MEASUREMENT CENTRE LAYOUT - EXPANSION PLAN
(SECOND FLOOR)

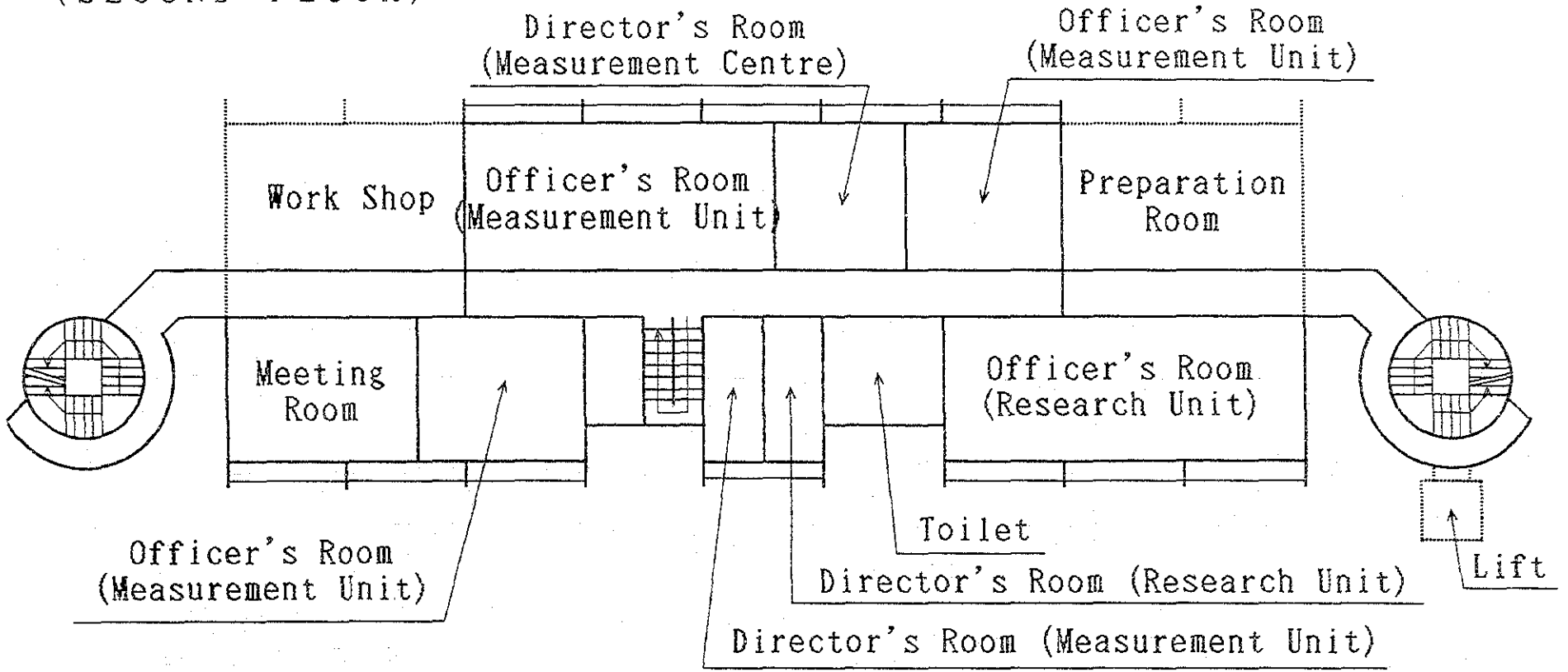
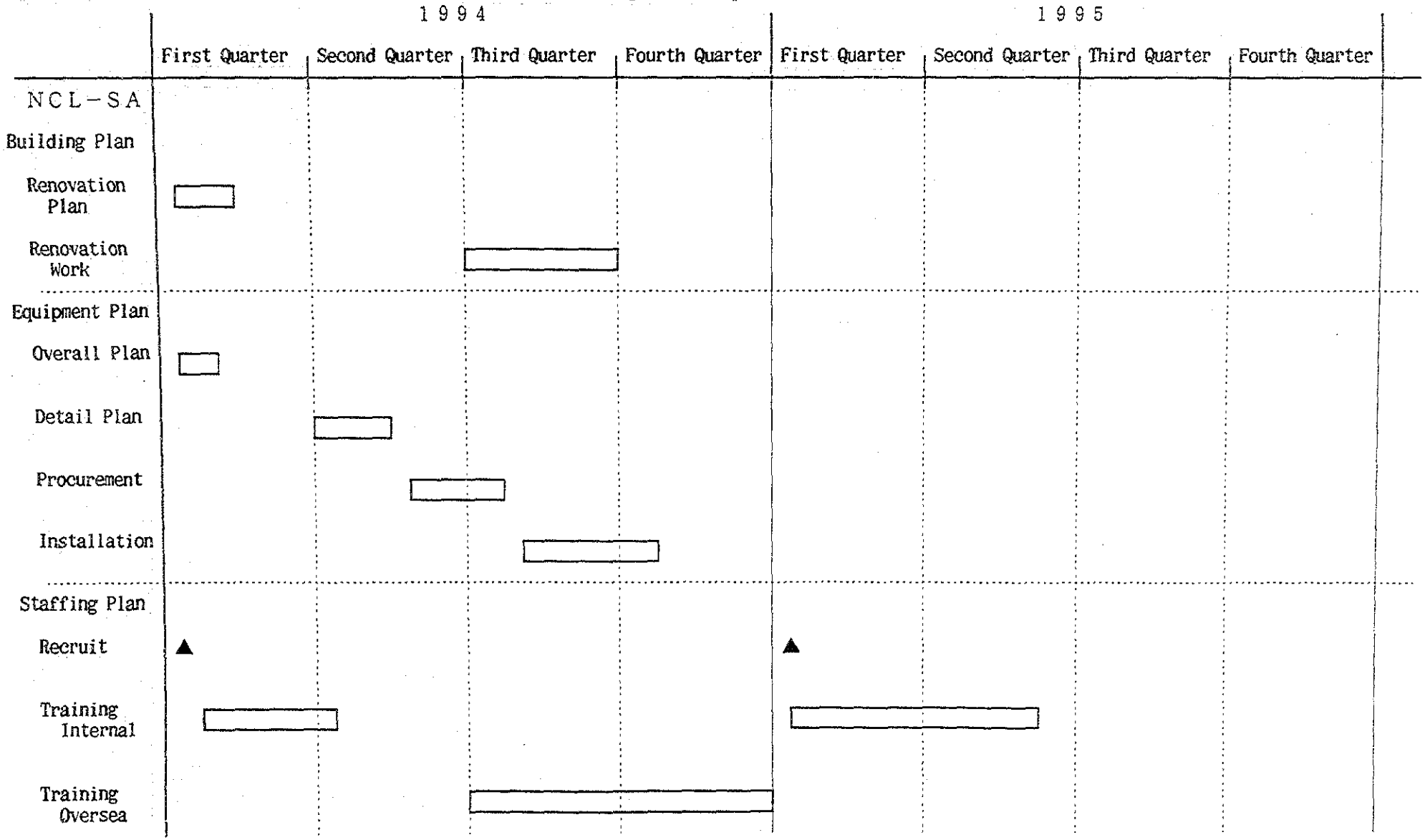
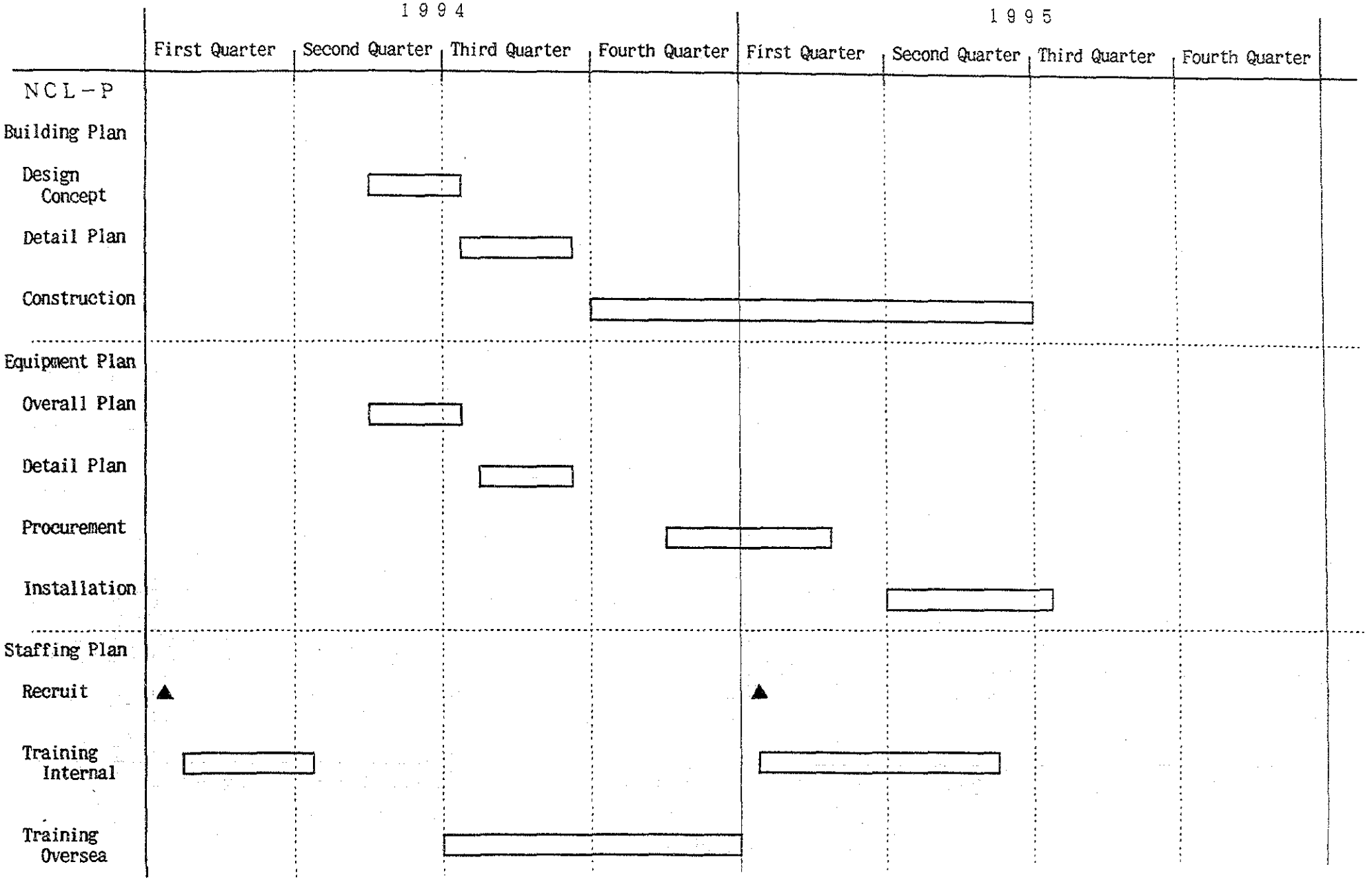
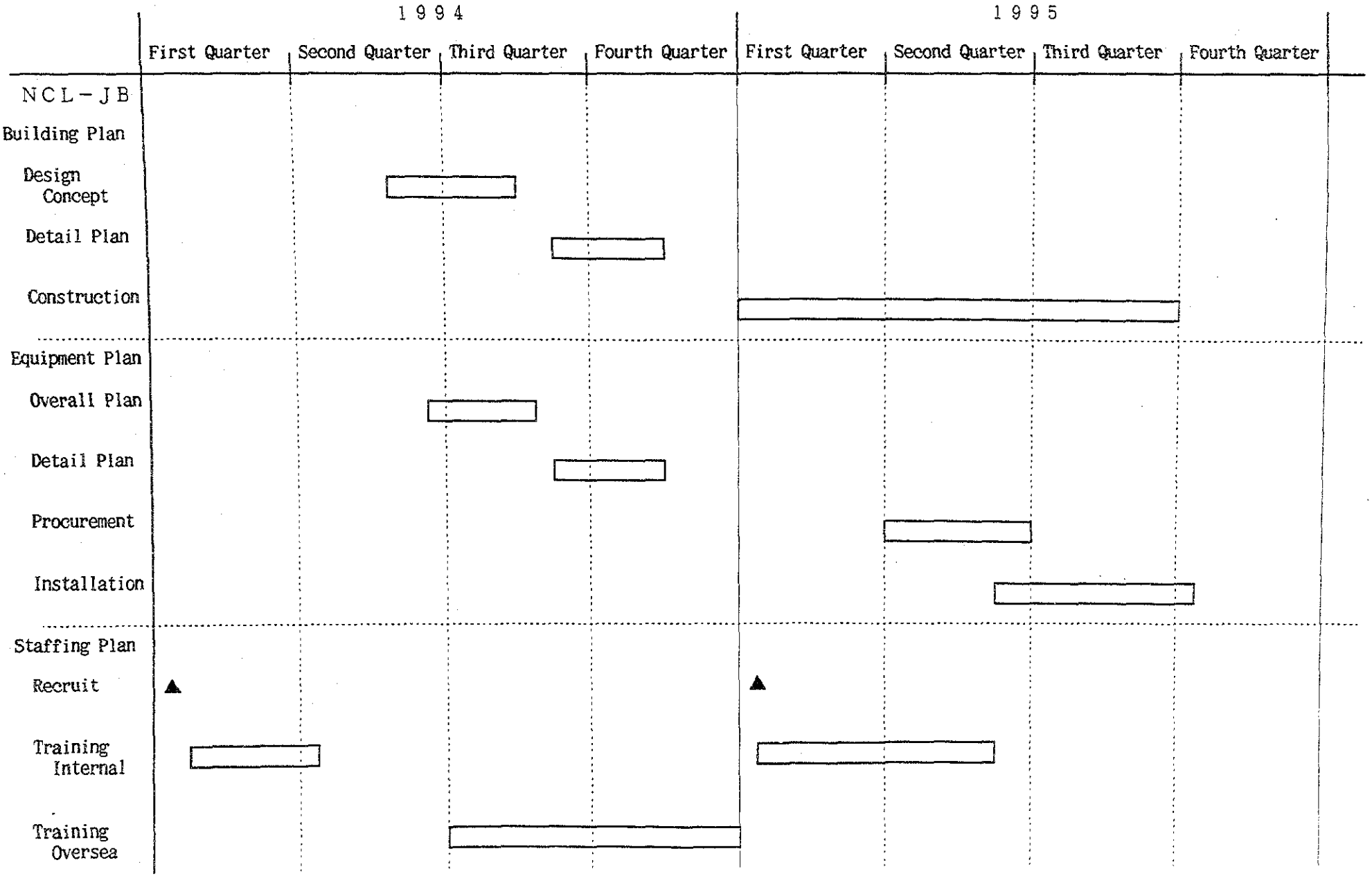


Fig. 7-5 Implementation Plan




1994
1995
First Quarter
Second Quarter
Third Quarter
Fourth Quarter
First Quarter
Second Quarter
Third Quarter
Fourth Quarter
NCL-P
Building Plan
Design Concept
Detail Plan
Construction
Equipment Plan
Overall Plan
Detail Plan
Procurement
Installation
Staffing Plan
Recruit
Training Internal
Training Oversea


1994
1995
First Quarter
Second Quarter
Third Quarter
Fourth Quarter
First Quarter
Second Quarter
Third Quarter
Fourth Quarter
NCL-JB
Building Plan
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Construction
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