CHAPTER 3 OUTLINE OF THE PROJECT

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3.1. Objectives

It is necessary to the future industrial development of Thailand to increase the competing power of products of the machinery, electrical, electronic and metalworking industries. To this end an upgrading of production technology in these sectors is required. A major barrier in achieving this objective is a shortage of engineers equipped with necessary capacities for carrying out independent research and development for the needed improvements. In order to train engineers in the field of precision engineering needed for future improvements, Thailand has drawn up the EIRD Expansion Project of the Faculty of Engineering of Chulalongkorn University. The aim of the Project is to provide the equipment necessary to the EIRD Expansion Project's implementation.

3.2 Study and Examination on the Request

3.2.1 Justification of the Project

The Project is in line with the Thai governmental policies. If EIRD functions are reinforced through the implementation of the Project, the following benefits are expected:

- reinforcement of the education of high level engineers required by industry
- strengthening of leading technology available to industry
- strengthening of higher technical education through a fuller activation of teaching staff capacities
- expansion of the scope of technical services offered to industry

In view of the above benefits, the plan is considered to directly contribute to the supporting and strengthening of the education of the human resources needed by the nation. It will also indirectly contribute to the nation's industrial development. The Project is therefore considered to meet the conditions for financial support of Japan in the form of a grant aid.

3.2.2 Operation and Maintenance Plan

The Project is closely related to the EIRD Expansion Project. There already exists a competent organization for implementing and managing the Project in the mechanical engineering, electrical engineering and metallurgical engineering departments. As these systems function adequately, no problems are anticipated concerning the operation of the Project.

3.2.3 Components of the Requested Equipment

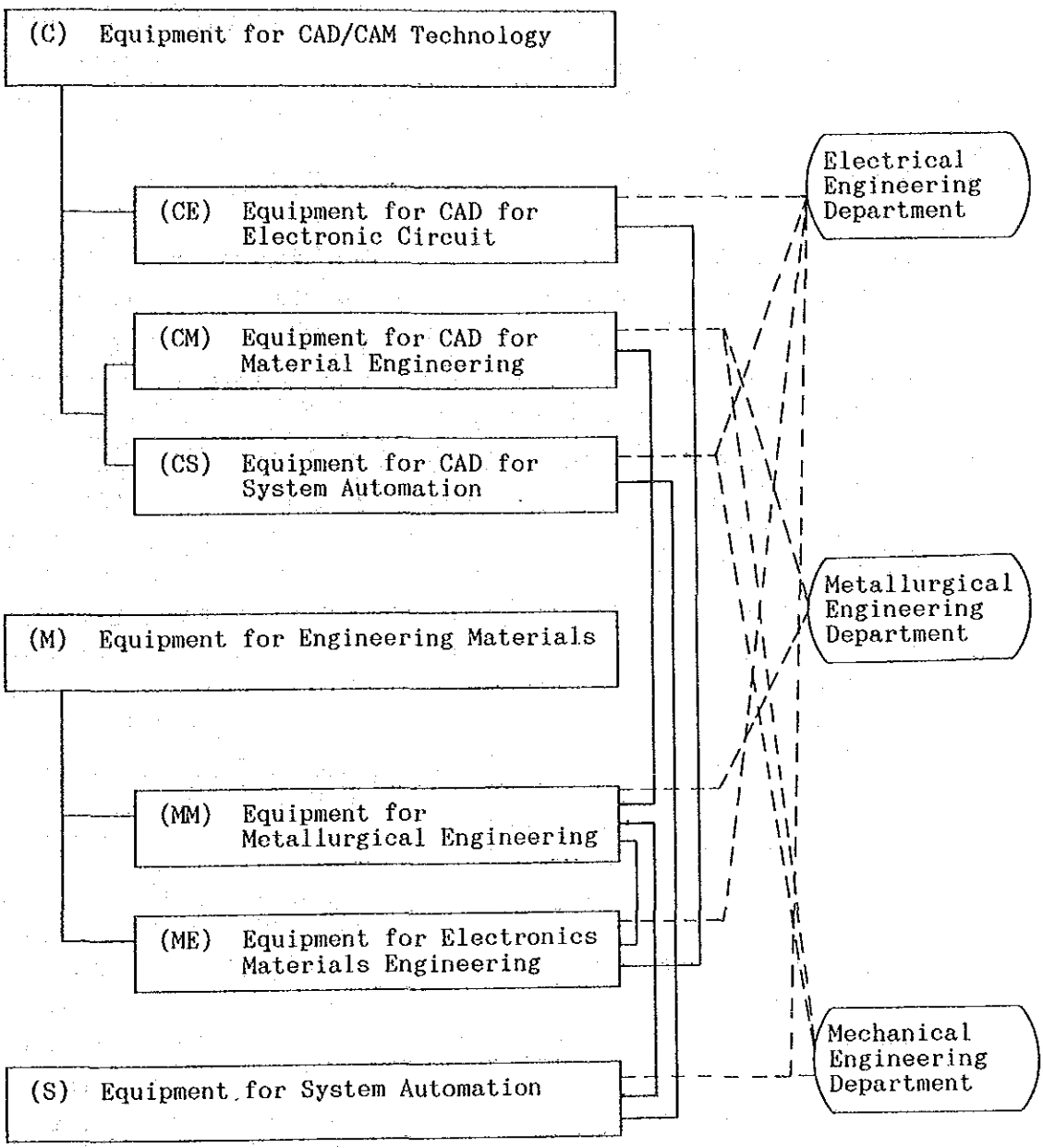
The Project consists of three principal components of CAM/CAD technology, engineering materials and system automation. These three areas are under the responsibility of the mechanical, electrical and metallurgical engineering departments. However research activities span across the various departmental divisions and so the same equipment can be used for more than two areas concurrently. The mutual relations between the three areas are shown in Figure 3.2.1.

For research and development in designing and manufacturing of metal molds, the equipment for system automation like a CNC machine tool will be used in addition to a CAD system and equipment for materials engineering.

For research and development in system automation, a CAD system for system automation, a CNC machine tool and robot need to be combined.

For research and development in a semiconductor device of electronics materials engineering, semiconductor manufacturing facilities as well as surface analyzer for characterization will be used.

Figure 3.2.1 Relation of Equipment for Expansion of EIRD



3.2.4 Outline of the Requested Equipment

(1) Background of the requested equipmemt

The list of the requested equipment which is confirmed by the Unviersity after the discussion between both party is shown as Table 3.2.1. Followings are the outline of these requested equipment.

1) Equipment for CAD/CAM technology

The introduction of a myriad variety of machinery and of production systems has been effected since the industrial revolution in efforts to rationalize production, but the advent of computer technology has resulted in a rapid increase in progress. Traditionally design work has been the domain of human intelligence and was considered beyond the scope of possible mechanization. However, if we divide design in patterned work and non patterned work, we can say that computers can handle aspects of patterned design work. CAD (Computer Aided Design) technology involves the reduction and simplification of designer's work through computerization of patterned design work. It also reduces the occurrence of human error and furthermore effects an activation of the calculating and memory resources of computers. Moreover, by aligning a numerical control device to a computer system, it is possible to realize an automation of the overall production system by linking the CAD to computer aided manufacturing (CAM) system.

In Thailand also there has been a natural development of industrialization which involves the advance form the stage of light industries to assembly industries for machinery and electrical sectors, and a growth in parts processing industries. This has been accompanied by an introduction of CAD and CAM technologies to the workshops and production sites. However, engineers with a mastery of CAD are still limited and their level of competence low so the employment of CAD is limited.

Table 3.2.1 List of the Requested Equipment

		Quantity	Priority
1. CAD/CAM Technology (C)			
C-1	Engineering Work Station (EWS) System for CAD	1 set	A
CE	CAD System for Electronics Circuit Design		
CM	CAD System for Engineering Material Design		
CS	CAD System for Automation and Precision		
2. Engineering Materials (M)			
	Metallurgical Engineering (MM)		
MM-1	Surface Analyzer (ESCA/AUGER)	1	A
MM-2	Instron Type Universal Tensile Tester	1	A
MM-3	100 ton Hydraulic Press	1	A
MM-4	Precision Surface and Profile Grinder	1	A
MM-5	Scanning Electron Microscope	1	B1
MM-6	CNC Wirecut EDM	1	B1
MM-7	CNC EDM (Engraving)	1	B1
	Electronics Materials Engineering (ME)		
ME-1	Molecular Beam Epitaxy (MBE) System	1	A
ME-2	Laser System for Material Processing and for Characterization	1 set	A
ME-3	Laser Measurement System for Displacement, Distance, Vibration, Angle and Smoothness	1	B1
ME-4	YAG Laser System for Material Processing	1	B2
ME-5	Lock in Amplifier (2 phases)	1	B2
ME-6	Box Car Integration	1	B2
ME-7	Multi-Channel Recorder	1	C
ME-8	Spectrum Analyzer	1	C
3. Automation and Precision (S)			
S-1	Cylindrical Coordinate Type Robot	1	A
S-2	Scara Type Robot	1	B1
S-3	Robot Vision System	1	B2
S-4	Precision Cartesian Coordinates Positioning Unit	1	B2
S-5	Portable Robot	1	B2
S-6	CNC Lathe Machine	1	A
S-7	CNC Machinery Center System with Programming Tool	1 set	A
S-8	CNC Milling Machine	1	B1
S-9	Grinding Machine	1	B1

Beginning with Chulalongkorn University, engineering faculties of the King Mongkut Institutes of Technologies, Ladkrabang and Thonburi all had computer centers. These institutes were carrying out education in computer use and were developing application technologies for computers including CAD. The computers of the Faculty of Engineering of Chulalongkorn University were largely introduced in 1986 and are mini-computer systems, with a current level equaling that of personal computer systems. They fall far below what is expected by the industrial sector for the development of CAD technology or in terms of guidance services. CAD is being actively furthered with the use of personal computer systems in the field of electric circuit design, but as there are limits to personal computer CAD the scope for application is restricted. Applications in the field of engineering materials are almost non existent because of the limits to computer capacities for simulations. Further, in the field of machine design some drawing up of blueprints with CAD and robot simulations by computer are carried out but levels remain low because of insufficient equipment. Basically despite the presence of a teaching staff excellently equipped for computer applications at present in the Faculty of Engineering of Chulalongkorn University, restrictions regarding the available equipment result in a limiting of achievements.

2) Equipment for material engineering

Materials engineering is basic technology to mechanical and electrical industries, and is relating technology to the functional materials such as semiconductors. In this sense they form the foundation of national industrial technology. Therefore materials engineering is essential to the future technological development of Thailand. There may be no company given present circumstances of the industrial sector of Thailand to develop material technology autonomously. They depend on the engineering faculties of the universities, beginning with Chulalongkorn University, to supply training of high level engineers who have development capacities in research and development for engineering materials. This situation of dependence is likely to continue for some time.

Chulalongkorn University possesses the sole department for metallurgical engineering among Thai universities and its excellent teaching staff carry out research and training. It also has the electrical department with the longest record for semiconductor research in the country in the field of electronics material engineering equipped with a semiconductor device laboratory, and continues its active research and diffusion of electronics materials technology.

3) Equipment for system automation

The automation of machine processing industries in Thailand is in the early phases of development in the sector of car parts manufacturing and relating metal mold production. Advanced companies are applying CAD/CAM equipment and CNC machine tools to realize production systems. Also, in assembly factories most operations rely on human manual operations and at present robots are rarely used. With the increase in labor costs and the need for standardized product quality, however, robots are expected to be more intensively utilized. The industrial sector needs to respond to these trends and organize automated systems. To this end, the industry needs more research and development in automation in universities given the limited number of own engineers and training of more engineers.

In the Faculty of Engineering of Chulalongkorn University efforts are being directed to upgrading technology for developing trial manufacture of various robots and for robotics. These efforts are focused in the robotics research laboratory of the mechanical engineering department. Also, to some extent automatic design is carried out in the computer center with the CAD as part of research in automation. However, as no educational equipment is installed for CNC machine tools or the highly precise robots, instruction in the applications technology of system automation is not possibly undertaken at present.

(2) *Selection of equipment*

The requested equipment is generally considered necessary to realize the aim of the EIRD Expansion Project for the training through research and development activities of engineers. The Project includes the equipment provision analyzed from the viewpoint of the Japanese government's grand aid. To do this, the following criteria were employed in establishing the policies of the equipment provision plan for the Project.

a) The equipment that is essential to the basic research of the concerned areas or equipment that is lacking at Chulalongkorn University is given priority.
b) The equipment that is closely connected with the industrial technology already introduced (or very likely to be introduced) in the Thai industrial sectors is given priority.
c) The equipment requiring high level skills and experience for operations and maintenance is chosen if Chulalongkorn University has a training program for operations and maintenance personnel, and if funds for maintenance are expected to be made available.

Selection of equipment in each of the individual sectors was carried out in line with the above principles.

1) CAD/CAM technology equipment

Engineering work station (EWS) system

The system consists of equipment for applying computer aided design technologies for engineering studies and for teaching computer aided design, and is used for CAD training for companies' engineers. The system is formed by three sub-systems, each of which is used for the following purposes:

- CAD system for electronic circuit design:
  used for design and analysis of analogue and digital circuits, a gate allay, a printed circuit board.
- CAD system for materials engineering:
  used for design, analysis and process programming of metal molds.
- CAD system for system automation:
  used for equipment parts design, stress analysis, NC machining programming and research in interface with machine tools and robots. A personal computer (32 bits) supplements EWS for rough design and data input. The existing personal computer (16 bits) cannot be used for CAD in combination with EWS.

2) Materials engineering equipment

- Metallic materials engineering equipment

Surface Analyzer (ESCA/AUGER)

This device is used for structural and physical analysis of minute parts. It is widely used in universities and research institutes and is essential for conducting analysis of materials in Japan. For the purpose of the research commissioned by the Thai government on metal plating and collusion of a food can, this equipment is indispensable. Since well-trained skills are needed for operation and maintenance of the equipment and a maintenance system needs to be established, we confirmed that Chulalongkorn University plans to train designated staff in Japan for these purposes. If the annual expenses for the operation and maintenance are expected to be met out of the research funds for the above-mentioned government-commissioned research, the equipment has been added to the provision plan.

Testing and Inspecting Equipment

Since evaluation of mechanical properties such as tensile strength, and stress-strain curve is essential to research and development of materials engineering, a universal tensile tester is needed. The Project does not provide a scanning electron microscope, because it will be purchased by the University with its own fund.

Metal Mold Processing Equipment

There are a large number of metal mold processing industries in Thailand. It is essential to raise the technical level of them and from this viewpoint the university considers research on metal mold important. Since their installation will contribute to upgrading the technical level of the Thai metal mold industry and to development of the industry generally we have selected a electron discharge machine (EDM) (engraving) and precision surface and profile grinder. The hydraulic press for testing of metal mold is excluded from the provision of the Project, because Thai made equipment is available to use.

- Electronics materials equipment

Molecular Beam Epistaxy (MBE)

A MBE is most frequently used worldwide recently for research and development equipment for semiconductor. The semiconductor device laboratory of Chulalongkorn University has promoted research and development in optoelectronic devices based on a belief that the optoelectronics industry has promising future. Since the laboratory plans to continue research and development in this field including the research in development of a laser diode commissioned by the Thai government. A MBE is judged necessary for production of compound semiconductor devices and other things for this purpose. Though the operation and maintenance of a MBE needs skills and experiences, the laboratory plans to train the staff to be exclusively assigned for this equipment in a research institute in Japan. The funds for maintenance are expected to be made available adequately because of the University research and development budgets and the Thai government budgets for the above research project.

Laser Application Development Equipment

Being facilities for research and development in electronics materials, and MBE is used for producing semiconductor devices and a laser processing system is for precision processing applying laser. Among university research and development in electronics materials, a compound semiconductor is more essential than laser application which is judged to have lower priority in the light of the current

Thai precision processing industry. The laser processing system, consequently, is excluded. A holography system is also excluded because its application is mainly a three-dimensional photography.

3) Systems automation equipment

Robot and CNC Machine Tool

The research and development of systems for CNC machine tools and robots contribute directly to the establishment of factory automation systems. They are therefore considered as beneficial to the quality of Thai products and to their increasing the international competing power. The Project provides a cylindrical coordinate type robot used for welding etc., a scara type robot used for assembly etc., a CNC lathe, a CNC machining center and a CNC milling machine used for computerized numerically controlled machining. A tool grinder is also needed for grinding cutters and tools for these machines. These equipment can be used for training engineers of the industry in automated technologies used in factories, and conducive directly to industrial development.

3.2.5 Basic policy in implementing the Project

Implementation of the Project has been evaluated in accordance with the above considerations of its benefit as well as the actual capacities of Thailand. Bearing them in mind, we find that the expected benefits from the Project meet the conditions of the Japanese grant aid and judge the provision of such aid reasonable. Therefore on the basis of a precondition of such grant aid from Japan and foregoing examination of the outline of the request, we recommend that the basic design be executed. Concerning details of requested equipment, however, we recommend that part of them be changed in line with the modifications outlined above.

3.3 Project Description

3.3.1 Executing Agency and Operational Structure

The Faculty of Engineering of Chulalongkorn University, the executing agency of the Project, has set up an 11 member Committee headed by the Dean of the Faculty of Engineering.

Members of the Executive Committee for the EIRD Expansion Project are;

Committee Chairman; Dean of the Faculty of Engineering
Vice Chairman ; Deputy Dean responsible for planning and Development of the Faculty
Committee members ; Deputy Dean responsible for research of the Faculty (EIRD Director)
4 staff members of the Electrical Engineering Department
4 staff members of the Mechanical Engineering Department
1 staff of member of the Metallurgy Engineering Department
1 administrative officer responsible for planning
Secretaries ; to be concurrently undertaken by 2 of the above committee members.

Indication of concurrent duties and task required by the Project and of approaches and dealings with related bodies are to be carried out by the Vice Chairman in close liaison with the Dean and EIRD Director.

Implementation of the Project is to take place under the guidance of the executing agency organized for this purpose consisting of the various steering committees dealing with individual areas and the administrative, accounting, training, installation and maintenance groups set up. (cf. Figure 3.3.1) Given the nature of EIRD it is expected that most of the members will continue their duties and posts in the Faculty of Engineering concurrently with the progress of the project.

3.3.2 Plan of Activities

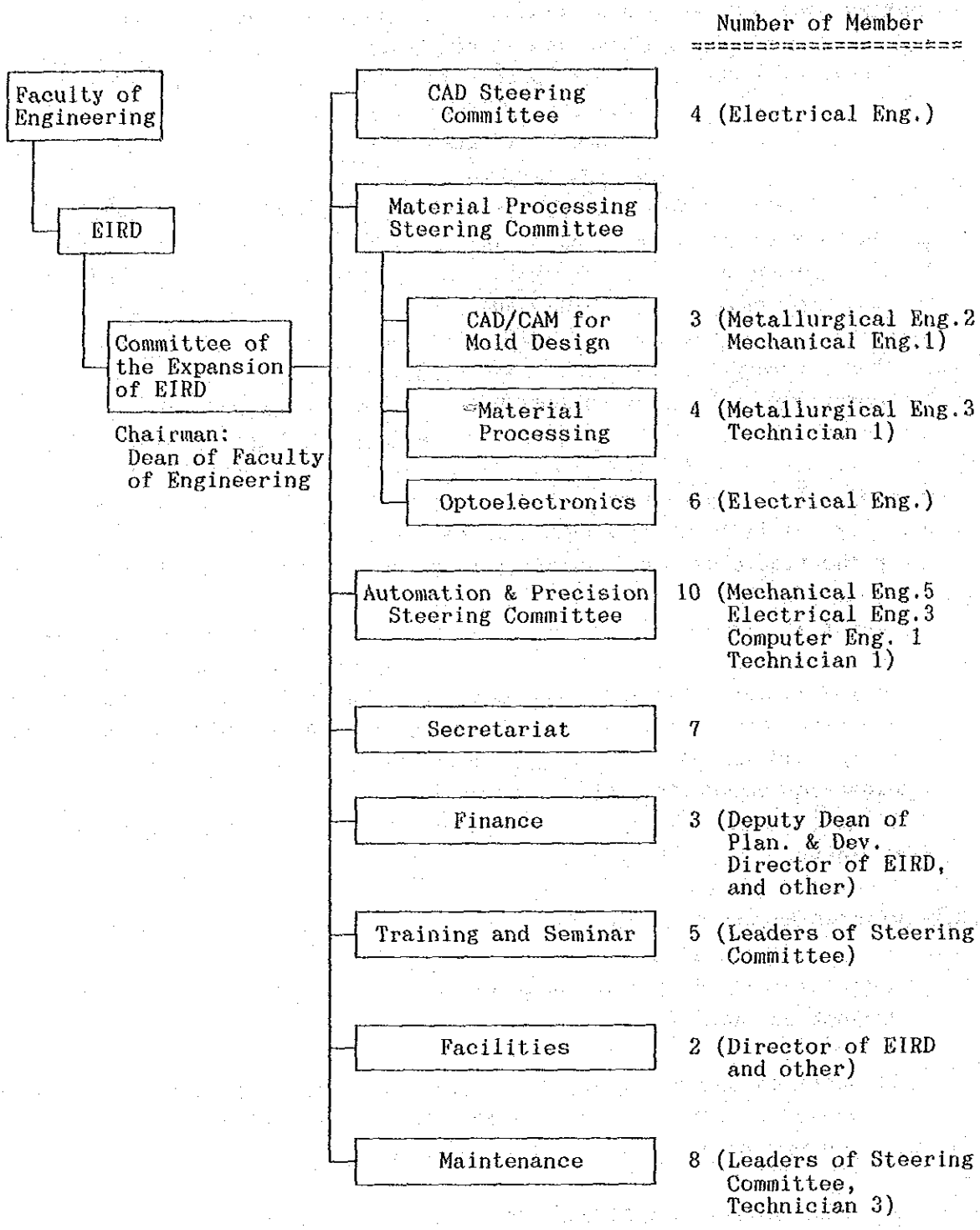
Activities which are planned in conjunction with the EIRD Expansion Project are as follows;

1) Research and development in application technology relating to the areas of CAD/CAM technology, materials engineering and system automation

2) Educational activities directed to the undergraduate students (graduation studies) and postgraduates in mechanical, electrical and metallurgy engineering departments

3) Education and training of engineers and technicians of public and private enterprise

Figure 3.3.1 Organization Chart for the Project for Expansion of EIRD



(1) Research and development activities

1) CAD/CAM technology

A. CAD for electronics circuit design

Analog circuit analysis, design and simulation
Digital circuit analysis, design and simulation
Logic verification and simulation
IC (Integrated circuit) and gate alley design
Printed circuit board design

B. CAD for metallurgical engineering

Fluid analysis of injection mold for plastics
Solidification studies of metals and alloys
CAD/CAM technology development for automation and optimation of metal forming
CAD/CAM technology development for mold and die design and manufacturing

C. CAD for automation and precision

CAD/CAM technology development for mechanical design and manufacturing
CAD application to programming for CNC machining
CAD/CAM application to flexible manufacturing system
Design, analysis and simulation for industrial robot

2) Engineering materials

A. Metallurgical engineering

Die and mold manufacturing
CNC machining technology : Theory and Practice
Press tools manufacturing : Theory and Practice
Corrosion studies of metals
Optimization of surface treatment
(ex. Electroplating Process)
Materials failure studies

B. Electronics materials engineering

Development and application of solar cells
Photovoltatic system design and application
Amorphus silicon physics and application
Semi-conductor sensor development and application
Optoelectronics device development and application
Laser technology development and application
Compound semi-conductor development

3) Automation and precision

Precision processing development
CNC machining and interfacing techniques
CNC machining system development
CNC control system development
Low cost automation
Robotics and factory automation
Industrial robot : Programming and Application

(2) Education activity

A. CAD/CAM technology

a. CAD for electronics circuit design
Undergraduate 30-40 students
Postgraduate 6-10 students
b. CAD for material engineering
Undergraduate 10-20 students
Postgraduate 6-10 students
c. CAD for system automation
Undergraduate 20-25 students
Postgraduate 6-10 students

B. Material engineering

a. Metallurgy engineering
Undergraduate 10-20 students
Postgraduate 6-10 students
b. Electronics material engineering
Undergraduate 20-25 students
Postgraduate 6-10 students

C. System automation

Undergraduate	20-25 students
Postgraduate	6-10 students

Present undergraduate course curricula for mechanical engineering, electrical engineering and metallurgical engineering departments are referred in Appendix-6.

(3) Training activities

As the EIRD is not a training institution, it has not undertaken any specific training activities as part of the regular curriculum. In line with the needs expressed by industry, however, training does take place. In connection with the Project the following training activities are scheduled to take place.

Training details	scheduled number of sessions	sessions per year
A. CAD for electric circuitry design		
Introductory ; theory/practice	30	4
Advanced ; theory/practice	30	2
B. CAD for PCB Design		
Introductory ; theory/practice	30	4
Advanced ; theory/practice	30	2
C. CAD for Metal Mold Design		
Introductory ; theory/practice	30	4
Applied ; theory/practice	30	2
D. CNC Processing Technology		
Introductory ; theory/practice	30	4
Applied ; theory/practice	30	2
E. Development of CNC Software		
Introductory ; theory/practice	30	4
Applied ; theory/practice	30	2

In addition, to the above seminars are scheduled to be held 5 times a year. Technical consultation and reception of engineers on a personal basis is to be undertaken.

3.3.3. Location and Condition of Project Site

(1) Location

1) Surface area of Chulalongkorn University

The University owns a huge site of approximately 1 million sq.m. (100 ha.), being a 1,000 metres on the east to west side and the same north to south. The part near to the campus is rented out to the private sector as a commercial site and rents acquiring are used towards the running costs of the University.

Figure 3.3.2 shows the map of Chulalongkorn University campus.

2) Surface area of the Faculty of Engineering

Located in the south-east section of Chulalongkorn University, the Faculty occupies 62,500 sq.m. (6.25 ha) in a block of land 250 m. wide from east to west and 250 m. long from north to south.

The map of the Faculty of Engineering is indicated in Figure 3.3.3.

(2) Buildings and facilities

The buildings scheduled for installation of the equipment for EIRD use are the EIRD building and Building 3.

Area of EIRD Buildings

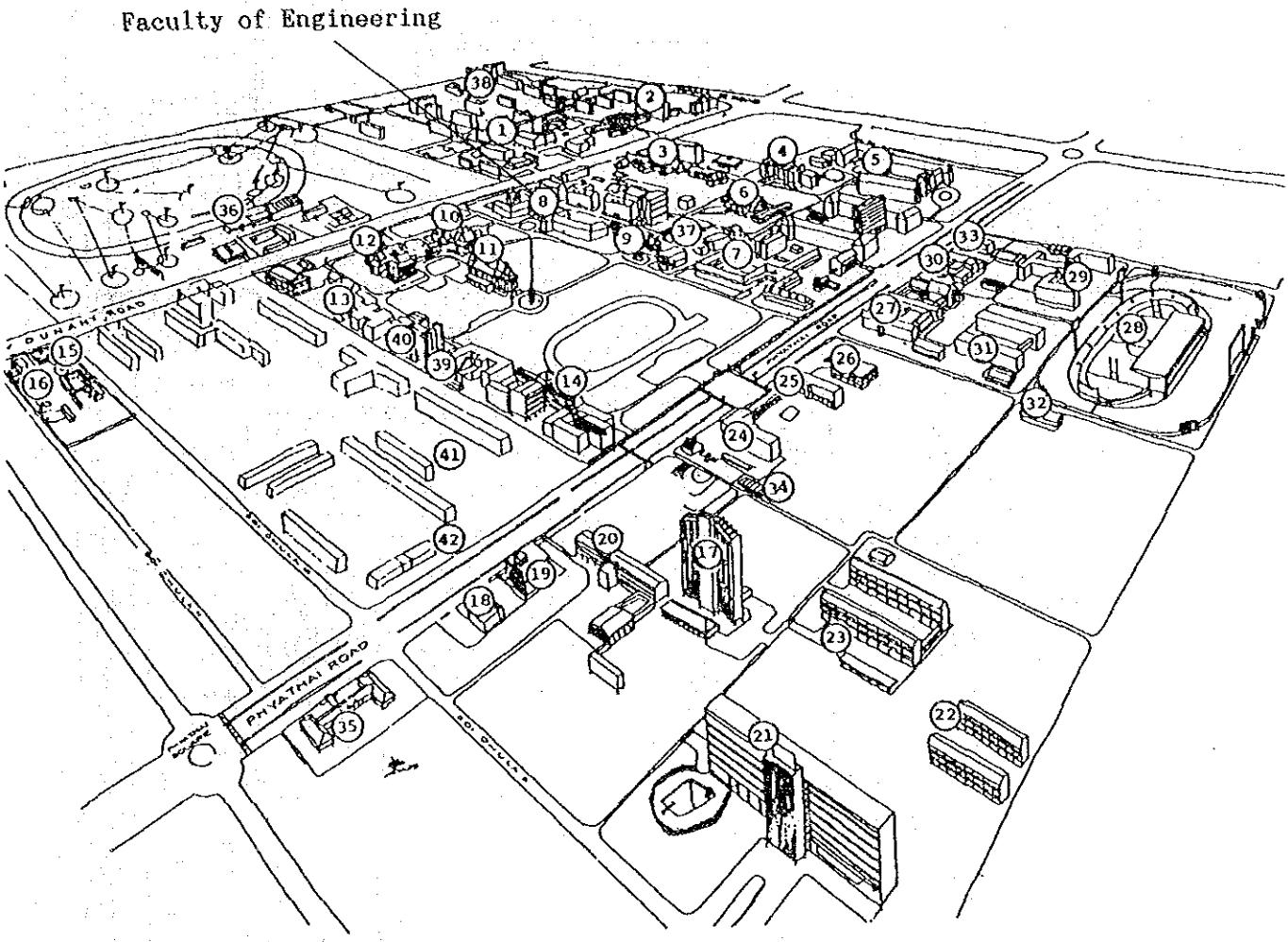
a. EIRD Building, 1st Floor	246 sq. m.
2nd Floor	246 sq. m.
3rd Floor	246 sq. m.
b. Building 3, 1st and 2nd Floor (Area of the EIRD space)	574 sq. m.
Total	1,312 sq. m.

1) EIRD Building

This is a three story building with ferro-concrete floors but the walls are of solid brick. There is a loading elevator installed in the center of the building serving first to third floor

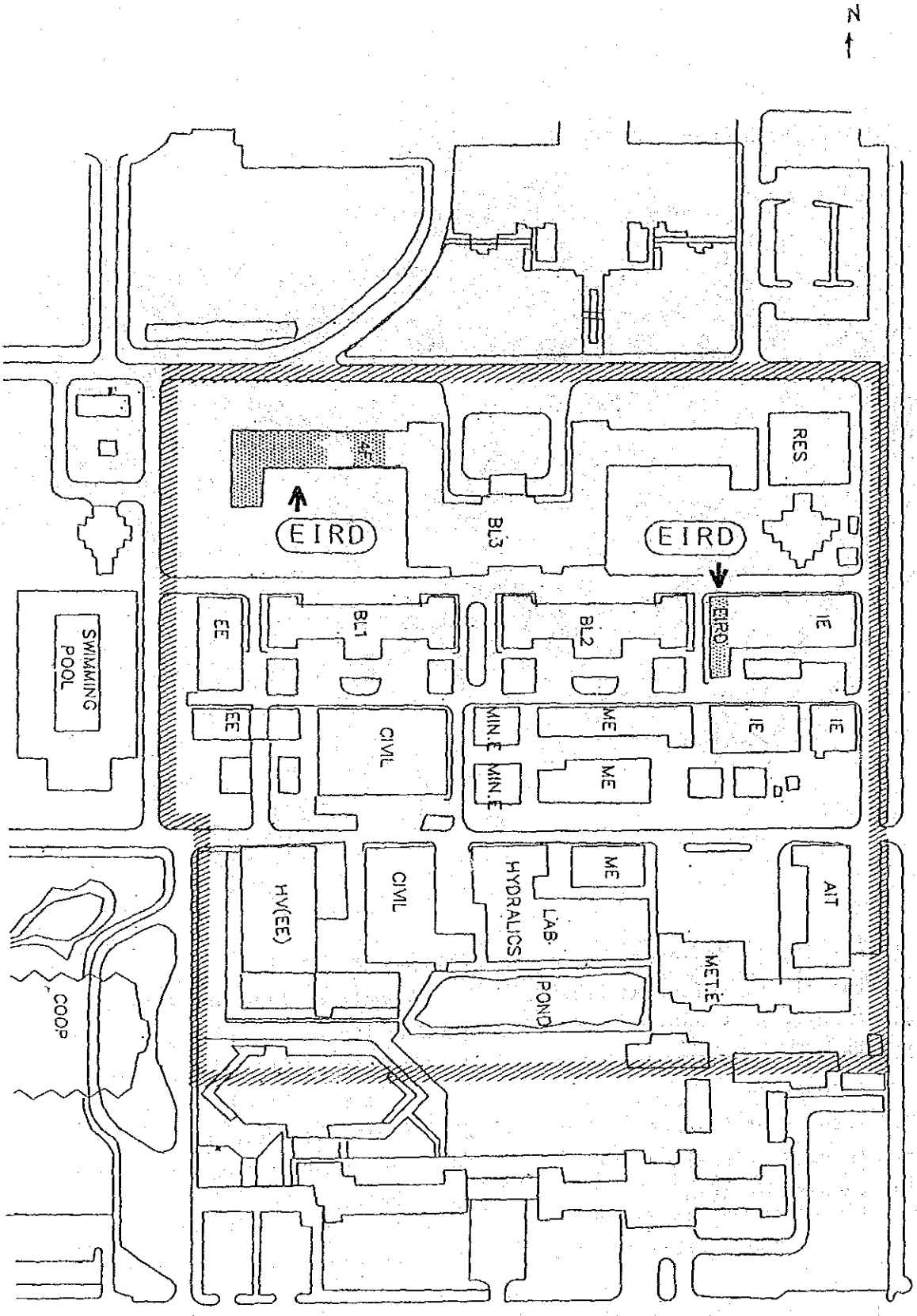
Details of room height (from the floor to ceiling), floor thickness

Figure 3.3.2 Map of Chulalongkorn University



1. Faculty of Medicine
3. Faculty of Political Science
4. Faculty of Economics
5. Faculty of Commerce and Accountancy
7. Faculty of Science
8. Faculty of Engineering
10. Faculty of Arts
13. Faculty of Pharmaceutical Science
    Faculty of Fine and Applied Arts
14. Faculty of Architecture
15. Faculty of Veterinary Science
16. Faculty of Dentistry
27. Faculty of Education
30. Faculty of Communication Arts
33. Faculty of Law

Figure 3.3.3 Map of Faculty of Engineering



designed maximum load, and wall thickness for each story are as shown in the following table

story	room height	floor thickness	max.designed load	wall thickness
3	3.5m	200 mm	400 kg/sq.m.	100mm
2	3.5m	200 mm	300 kg/sq.m.	100mm
1	4.5m	unknown	300 kg/sq.m.	100mm

At present, a boring machine, turning lathe, tool grinder, shaping and sealing lathe, sawing machine and other machine tools, work-benches and parts racks are installed on the first floor. However, these are all scheduled to be transferred to the workshop of the mechanical engineering department.

A plunger pump unit and an air compressor unit installed on the first floor to be remained. Designed working pressure of the air compressor unit is about 10 kg/cm^2.

The second floor is at present used for an administrative office and research laboratory. The third floor houses the administrative office and calorimeter laboratory (surface area of 42.4 sq. m.) and this latter is scheduled to be left as it is.

2) Building 3

At present, this is a three story building but work is in progress on the present roof area for the construction of a fourth story. First to third floors house the Faculty administration offices, classrooms, computer center, etc. The equipment is scheduled to be installed on the west side of the first and second floors. A part of existence computers will be moved up to second floor and class-rooms placed in and floor to forth floor now under construction. At the latest, the expansion work for the fourth floor is scheduled to be completed by the end of 1990 .

A triangular roof is now placed above the third floor roof of Building 3, and the support wall is to be raised from 1.7 m to 3.5 m height by the addition of a 1.8 m addition. The present triangular roof is to be raised to accordingly, and extension work is smoothly done so that the completion is expected by the end of 1990.

(3) Infrastructures

1) Bangkok Harbor

The equipment to be provided is unloaded at Bangkok Harbor. Bangkok Harbor is a harbor complex composed of Klong Teoi Port and small docking ports located along the side of Chao Phraya River. Klong Teoi Port is situated to the south west of Bangkok and is 7 km distance from Chulalongkorn University by road. Klong Teoi Port is placed under the authority of the Port Authority of Thgailand (PAT) and the capacity of unloading facilities presents no problems.

2) Roads

All roads leading to Chulalongkorn University from Klong Teoi Port are concrete surfaced. All roads inside the University campus are also concrete surfaced. There are no obstruction to the transport equipment. However, the recent rapid increase in the number of vehicles has resulted in traffic congestion and particular attention needs to be given to safety conditions during the transportation of equipment. As it is only 7 km away from Klong Teoi Port to Chulalongkorn University there is no danger of delays in transporting time due to traffic jams.

3) Water utilities

The water used in the Faculty of Enigneering of Chulalongkorn University is all drinking water, and industrial use water is no used. The Metropolitan Water Works Authority (MWWA) supplies water. Recently, a certain insufficiency in water supply has been noticeable and the water pressure in the intake piping is only 1.5 kg/cm^2. A 200 m^3 water tank has been installed since supplies are insufficient. This is filled at night and prepared to use as required. In daytime hours water is pumped up to the various floors of Building 3 (at present to third floor building, the fourth floor at completion being scheduled for the end of this current year of 1990).

As the volume of drinking water used in the EIRD building has been small a 1 inch branch pipe has been taken off the main intake pipe, and water is sent up to floors 2 and 3 after passing through a plunger pump and water pressure tank.

The water currently consumed is used mainly for the purposes of the flush toilet, toilet washing facilities, and air conditioning, and almost none is used for machinery.

The pressure of supplied drinking water is 1.5 kg/cm^2g and the temperature is 35 ^oC maximum and 15 ^oC minimum.

4) Electricity

There are several transformer sets in the Faculty of Engineering of Chulalongkorn University. The primary voltage is 12 KV and secondary voltage 380 V, they are three phase, four wire, 50 Hz transformers with a total volume of 3000 KW. Electricity is supplied by the Metropolitan Electricity Authority (M.E.A.).

Current details of the electricity used for machinery and lighting are as follows:

a. AC 380V plus or minus 3%, 3 phase, 50 Hz
b. AC 220V plus or minus 3%, single phase, 50 Hz

Electricity supplies are stable but power failures occur on average about once a year in the gale season. Power failure records are as follows:

1989 power failure 1, length of failure 2 hours
1988 power failure 1, length of failure 3 hours

3.3.4 Equipment Plan

Followings are the equipment selected for the Project.

(1) Equipment for CAD/CAM

Engineering workstations (EWS) system is to be installed for the technical development of electronics circuit design, engineering materials (mold design) and systems automation (CAD/CAM, Robotics) but also for the training of engineers in CAD technology. The hardware of the above systems is to be supplemented with the fundamental software for the above areas.

The system will consist of one unified computer system but will be composed of the three sub-systems, electronics circuit design CAD system, material engineering CAD system and system automation CAD system.

1) Hardware

The hardware of EWS system is composed of main apparatus (engineering workstations and personal computers) which is used for data input, calculation and graphic design, and the common used equipment such as a file server and output apparatus. Each individual workstation, file server and each output apparatus connected each other with local area network (LAN), and they organize the overall EWS system. Figure 3.3.4 shows the EWS system network. The personal computers are also connected to a file server and organize the network with the workstation. Also in anticipation of power failures the power source of the overall system should be supplied via source an uninterrupted power source device (UPS).

Main EWS apparatus	: computer, input device (mouse) and display
Common used apparatus	: file server (hard disk and magnet tape recorder), output apparatus (dot printer, plotter and laser printer)

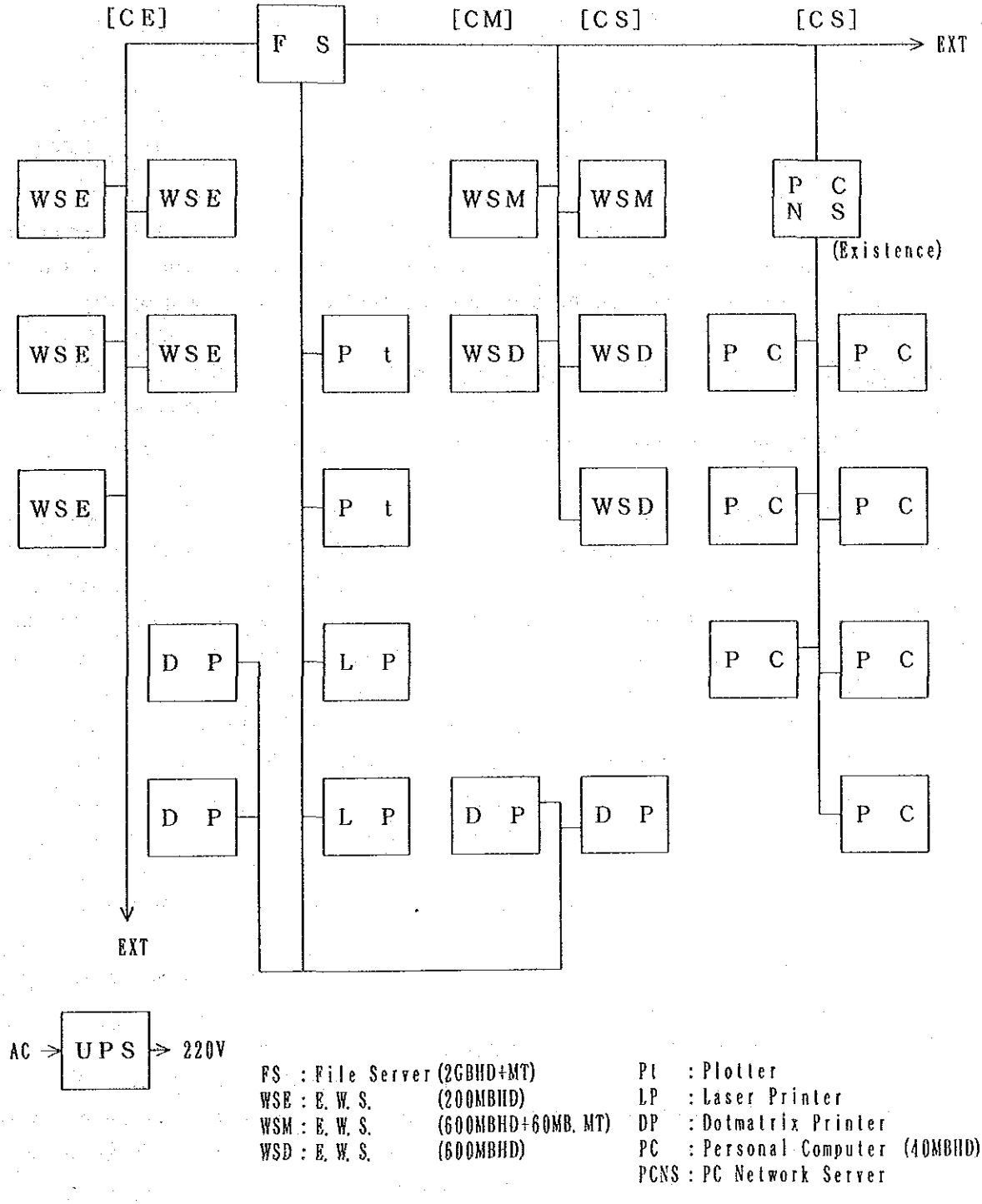
2) Software

In accordance with the aims for use of the three systems, the following software is to be provided. All software will be in English. The software will be preserved in the file server and it will be possible for any workstation to obtain access by employing the LAN system. To this end it will be necessary to equip each work station with software for operating the LAN.

(A) Electronics circuit design CAD system (CE)

a. Software for analogue circuit design
b. Software for digital circuit design
c. Software for gate array design
d. Software for printed circuit design

Figure 3.3.4 Network of EWS System



FS : File Server (2GBHD+MT)
WSE : E. W. S. (200MBHD)
WSM : E. W. S. (600MBHD+60MB. MT)
WSD : E. W. S. (600MBHD)

Pt : Plotter
LP : Laser Printer
DP : Dotmatrix Printer
PC : Personal Computer (40MBHD)
PCNS : PC Network Server

(B) Material engineering CAD system (CM)

a. Software for mechanical design
b. Software for NC programming and processing
c. Software for metal mold design

(C) System automation CAD system (CE)

a. Software for mechanical design
b. Software for NC programming and processing

The software for design of electric circuits (A) differs from that for engineering materials (B) and systems automation (C), but the latter two areas share the same contents in this respect.

(2) Equipment for materials engineering

1) Equipment for metallurgical engineering

The testing and inspection apparatus for materials necessary for the test of mechanical properties and for the element analysis and characterization of the surface, and metal mold processing equipment needed to the practical research and development in metal mold manufacturing are to be installed.

Testing and inspection apparatus
Surface analyzer - ESCA
- AUGER
Universal tensile tester (Instron type)

Equipment for processing of metal mold
Precision surface and profile grinder
CNC EDM (engraving)

2) Equipment for electronics materials engineering

The research equipment for the experiment of semiconducter devices necessary for the research and developemnt in electronics materials are to be installed.

Experiment equipment for semiconductor device
Modular beam epitaxy (MBE)

(3) Equipment for system automation

Various types of CNC machine tools and robots necessary for the technical development and training in automated processing and assembly and in mechatronics technology combined both mechanical and electronics technology are to be installed.

Robot
Cylindrical coordinate type robot
Scara type robot

CNC machine tool
CNC lathe
CNC machining center system
CNC milling machine
Tool grinding machine

3.3.5 Operation and maintenance plan

(1) Maintenance

The benefits of the Project will only be realized after transfer of equipment has taken place and the receiving country institutions begin operations with the provided equipment. The programs for the operation and maintenance of equipment will need to be supported by adequate funds as well as appropriate organizational and personnel frameworks. It will also be necessary for the Japanese suppliers to provide the manuals and operational guidelines for the operation and maintenance of equipment.

(2) Maintenance systems

The teaching staff of the concerned departments and technicians of the Faculty of Engineering of Chulalongkorn University will be placed in charge of the operation and maintenance of the equipment installed in the EIRD with the Project. The EIRD Expansion Project is planed to increase and train the teaching staff and technicians of each department directly concerned with the operation and maintenance of the equipment. These staff are equipped with the necessary levels of technical competence to handle the equipment to be provided by the Project but there is need proper instruction in the operation and maintenance of each equipment. At present, equipment of the same type

as that to be provided exists in Thailand, and after-sales service are being carried out by supplying manufacturers. However, the responsible staff handling each equipment should be appointed for day-to-day use to ensure its long useful life and maximum benefits out of it. To help the personnel in charge of equipment, it is therefore advisable that they receive instruction and guidance relating to the equipment for which they will be responsible for molecular beam epitaxy and surface analyzer (ESCA and AUGER). Especially it is indispensable to train personnel in charge in manufacturers or the institution where the equipment is installed in.

(3) Maintenance costs

The running and maintenance costs estimated for the equipment and materials to be provided in the Project are as follows:

1) Annual personnel costs

The equipment to be provided by the Project are to be run and maintained by the existing staff members of the Faculty of Engineering. The personnel expense of the Faculty of Engineering will be met by the University budget. It is difficult to determine the increase of personnel expense specialized for the EIRD Expansion Project. It is considered including in the overall University's personnel plan. The personnel for concerned sections of EIRD to the Project are 36 for direct engaged and 10 for indirect. The annual expense for them is estimated approximately 4.57 million Baht (refer to Appendix-7), and as most of personnel are existing the increase of the personnel expense will be small.

2) Maintenance costs

The costs directly related to the provision of equipment and materials for in the Project are as follows:

a)	electricity and water costs	190,000 Bahts
b)	chemical agents and consumables	780,000 Bahts
c)	maintenance costs for the equipment	3,450,000 Bahts
	TOTAL	4,420,000 Bahts

The additional costs for repairs of facilities, business trips, communications, etc. which,by their nature can not be identified to be attributable to the Project, will be covered by the general budget of the Faculty of Engineering.

3) Funds for the maintenance

On the basis of the past records described under 2.3 of Chapter 2, the total annual budget of the Faculty of Engineering is estimated at 80-85 million Bahts for each year after 1991 when the Project is to be implemented. The maintenance costs described above account for about 5 percent of the total budget. If the Project adds engineering equipment, more research and development projects exemplified below are expected to be commissioned by the government and other organizations and more training requests are expected to be received. Since the funds for these research and development are expected to be added to the ordinary Faculty budget, adequate maintenance and operations will be ensured from a viewpoint of availability of funds.

		(thousand Bahts)
Laser diode formation	1990-1991	4,488
Optoelectoronics device development	1990	1,000
Metal alloy plating process development	1991-1993	2,644
Corrosion of food can	1991-1993	2,388
Metal Mold design	1990-1993	3,000
Robotics research	yearly	475

3.4 Technical Cooperation

When actual supply takes place, the manufacturers will provide assistance and guidance in operating of the equipment on the site. In the case of special equipment manufacturer's training of University staff in Japan will be planned.

For the equipment described below, the programs of training in Japan and dispatching of experts need to be considered. If these programs are synchronized with the Project, the benefits of the provision of equipment will be greater and more firmly assured.

Surface Analyzer (ESCA and AUGER)

Training in ESCA and AUGER need to be added to planned for the Materials Science Cooperation Program in the context of the ongoing project type technical cooperation.
Dispatching Japanese experts for 3 or 4 weeks is desirable as well for teaching facility operations.

Molecular Beam Epitaxy (MBE)

Besides the already determined training program sponsored by the Japan Society for the Promotion of Science (JSPS), engineers' training in the manufacturer's plant is desirable.
Dispatching Japanese experts for 3 or 4 weeks is desirable as well for teaching facility operations.

System Automation and Mechanical CAD

Since technical cooperation in these fields are ongoing with the United Kingdom, the cooperation from Japan does not needed.

CHAPTER 4 BASIC DESIGN

CHAPTER 4 BASIC DESIGN

4.1 Design Policy

The following design policies were postulated and evaluated in connection with the equipment planning discussed in the foregoing 3.3.4. Equipment Plan.

(1) Realization of the aim of the Expansion Project

The final aims of the EIRD Expansion Project are (1) to make EIRD a superior research institute possessing technical competence in the fields of precision engineering, and (2) to make possible the training of engineers who possess the expertise for self-supported research and development activities required by the nation and industry. The equipment is designed to achieve these aims through the practical training programs.

(2) Compatibility with the research and training program

The aim of the Project is focused on the research and development of the teaching staff and students (undergraduates and postgraduates) of the mechanical engineering, electrical engineering and metallurgical engineering departments. It is also planned to contribute to the training of students and engineers from industry. It is therefore necessary to ensure that engineering equipment is suitable for the objectives of research and development.

(3) Scale and usefulness of the equipment

As the Project is to strengthen the technical capacities of EIRD, equipment must be chosen which is of a scale and level suitable for experimental and training purposes. The equipment will be installed for research and training in each field. Since the technical aspects of each research area will be involved and each equipment will also be possible to use for a different technical fields, general use equipment is to be selected.

(4) Ease of operation and maintenance of equipment

It is best to choose equipment for which a maintenance system and back up services can be easily provided in Thailand. It is also necessary to select equipment so as to keep operation maintenance expense which will arise after the installation of the equipment down to a minimum.

(5) Arrangement plan

The engineering equipment of the Project is to be installed on the first and second floors of Building 3 and the EIRD building of the Faculty of Engineering. Bearing in mind the layout plan, dimensions, weight, etc of the equipment, the minimum partitions necessary are to be constructed and equipment is assembled according to functional groups such as processing equipment, inspection and testing equipment and computer equipment.

4.2 Study and Examination on Design Criteria

4.2.1 Environmental Conditions

1) Temperature

Temperatures inside the buildings of Chulalongkorn University are indicated in the following table, and these figures have been used for the design and planning of equipment;

a. yearly average temperatures in rooms without air conditioning, max. 42 ^{o}C min. 15 ^{o}C

a' ditto relative humidity in these rooms, max.98% min.70%

b. yearly average temperatures in air conditioned rooms, max. 27 ^{o}C min. 20 ^{o}C

b' ditto relative humidity in these rooms, max.80% min.70%

2) Earthquakes and tremors

These did not occur on the record.

4.2.2 Buildings and Utilities

(1) Building

According to the plan of Chulalongkorn University, supplied equipment are scheduled to be installed on the first and second floors of Building 3 and first floor of EIRD building, and the third floor of EIRD building to be used for administrative offices. The remodeling of the rooms will be facilitated by the fact that room partitions use only wooden panels.

(2) Electric power supply

Since power failures do very rarely occur, it is necessary to have UPS (an uninterrupted power supply system).

For equipment which require a tolerance latitude of plus or minus 5%, it will be necessary to install an automatic voltage regulator.

Voltage is either of AC 380V three phase or of AC 220 single phase type. In cases where equipment on a different voltage is only obtainable, the supply of transformers will be necessary.

The 220 V single phase electric outlets and plugs used in Thailand are divided into 15 A, 10 A and 5 A types. It was decided to standardize the use of 15 Amp. outlets and plugs as far as possible, and to use the 10 A devices only where their use was the better choice.

(3) Gases

Urban gas is not provided for use. LPG is used for gas burners,etc. where gas is needed for combustion purposes. In the case of equipment to be provided, which requires utility gas, it is necessary to stipulate to be LPG.

Oxygen, nitrogen, hydrogen and argon gases which are needed for experiments or research will be able to supply from Thai Industrial Gas (TIG), and import will not be necessary. The supply of cylinders, equipment piping or hoses and attachment work will both need to be decided once the exact details of supply of gases is determined.

(4) National regulations and standards of Thailand

There are no national Thai regulations or standards concerning design, manufacture, installation, piping and operating of the equipment to be provided. Japanese regulations and standards are possible to use..

4.3 Basic plan

Equipment is design on the basis of the contents and policies described in the previous chapter and 4.1 design policy. In principle, the quantity of equipment is to be determined in line with the following considerations.

(1) Since the fundamental function of EIRD is research and development, the number of pieces of equipment is to be decided necessary to that end. Generally, it is desirable to keep the quantity of similar equipment to a minimum and to provide the various types of equipment possible rather than duplicating the same equipment. Therefore, with the exception of computer equipment, one piece or set of each equipment is to be provided.

(2) For the number of computer facilities, 5 sets EWS will be for electronic circuit designing, 2 sets for materials engineering and 2 sets for system automations, as well as 7 sets personal computers. Basic software for each function is to be provided in several sets and depending on the frequency of use one set of software for each special application is to be made available. Several sets of hardware are installed so that the various software can be used simultaneously, and represents the entire computer system and in order to function efficiently for its purpose of CAD

4.3.1 Equipment for CAD/CAM

The equipment for common use to each sub-system is put on the list of (1) Equipment for electronics circuit design CAD.

(1) Equipment for electronics circuit design CAD

No.	Equipment	Number	Reference
1) Hardware			
CE-1 (A1-1)	Engineering Work Stations (E type)	5 set	for graphic design, calculation, and input. 32 bit CPU Memory size: 200 MB disk, Display: 19" Color monitor, Input device, Mouse, 3.5" FDD, 1MB
CE-2 (A1-2)	File Server (Common use)	1 set	Server for softwares and communication of data to out put equipment 32 bit CPU Memory capacity 2GB disk 150 MB magnetic tape drive
CE-3 (A1-11)	LAN Equipment	6 set	to form network system among CE-1 and CE-2 with cable for LAN system
CE-4 (A1-10)	Plotter (Common Use)	2 set	Output equipment for drawing, A0 size
CE-5 (A1-13)	Laser Printer (Common Use)	2 set	Output equipment
CE-6 (A1-12)	Dot Matrix Printer (Common Use)	4 set	Output equipment 24 dot
CE-7 (A1-16)	Uninterrupted Power Supply System	1 set	Input: 3 phase 380V Output: 1 phase 220V Power Capacity: 20KVA Power Failure Backup: 15 minutes

No.	Equipment	Number	Reference
2) Software			
CE-11 (A1-3)	Software for LAN and BS	6 set	for network and basic operation
CE-12 (A1-5)	Software for Analogue Circuit Design	3 set	for analogue circuit design and analysis
CE-13 (A1-6)	Software for Digital Circuit Design	3 set	for digital circuit design and analysis
CE-14 (A1-6) (A1-7)	Software for Gate Array Design	1 set	for gate arrey design and logic design
CE-15 (A1-4)	Software for PC Board	1 set	for PC Board design, analysis and simulation

(2) Equipment for materials engineering CAD

No.	Equipment	Number	Reference
1) Hardware			
CM-1 (A1-1)	Engineering Workstation (D Type)	2 set	for graphic design, calculation and input, 32 bit CPU Memory size: 600 MB disc Display: 19" color monitor Input device: Mouse 3.5" FDD, 1MB
CM-2 (A1-1)	Magnetic Tape	1 set	for backup for served data 65 MB magnetic tape
CM-3 (A1-11)	LAN Equipment	2 set	to form network system same as CE-3

No.	Equipment	Number	Reference
2) Software			
CM-11 (A1-3)	Software for LAN and BS	2 set	for network and basic operation
CM-12 (A1-8)	Software for Mechanical Design	1 set	for metal mold design
CM-13 (A1-9)	Software for NC Programming and Processing	1 set	for programming of metal mold processing
CM-14 (A1-9)	Software for Metal Mold Design	1 set	for simulation in metal mold design

(3) Equipment for system automation CAD

No.	Equipment	Number	Reference
CS-1 (A1-1)	Engineering Workstation CD Type	3 set	for graphic design calculation and input 32 bit CPU Memory size: 600 MB disc Display: 19" Color monitor Input device: Mouse 3.5" FDD, 1MB
CS-2 (A1-1)	Magnetic Tape	1 set	for backup for served data 65 MB magnetic tape same as CE-3
CS-3 (A1-11)	LAN Equipment	3 set	to form network same as CE-3
CS-4 (A1-14)	Personal Computer	7 set	for rough design and data input 32 bit

note: Existing personal computer network server (equipment to connect with LAN system so that data of personal computer are commonly utilized on EWS) is moved to utilize.

No.	Equipment	Number	Reference
2) Software			
CS-11 (A1-3)	Software for LAN and BS	3 set	for network and basic operation
CS-12 (A1-8)	Software for Mechanical Design	2 set	for mechanical design and analysis
CS-13 (A1-8)	Software for NC programming and processing	2 set	for machine tool programing
CS-14 (A1-14)	Softwares for PC CAD	7 set	for rough design and data input by personal computer

4.3.2 Equipment for Materials Engineering

(1) Equipment for metallurgical engineering

No.	Equipment	Number	Reference
MM-1 (A-2) (1)	Surface Analyzer -ESCA	1 unit	for element analysis and characterization of surface of the micro part of various materials
(2)	-AUGER	1 unit	for element analysis of ultra micro part of material surface (mostly of metal)
MM-2 (A-3)	Universal Tensile Tester	1 unit	for test of mechanical strength of materials, Instron type Capacity: 10 ton
MM-4 (A-10)	Precision Surface and Profile Grinder	1 unit	for precise finishing of metal mold. Possible to shaped finishing by shaped grinding stone with NC tool
MM-7 (B1-6)	CNC EDM (Engraving)	1 unit	for practice of metal mold processing Table size: 800 x 550mm

(2) Equipment for electronics material engineering

No.	Equipment	Number	Reference
ME-1 (A-4)	Molecular Beam Epitaxy(MBE)	1 unit	for growing of ultra-thin film by molecular beam emission of raw materials of semi-conductor devices in ultra-high vacuum atmosphere. grouing room vacuum:less than 1×10^{-10} Torr Wafer size:1 inch ϕ

4.3.3 Equipment for system automation

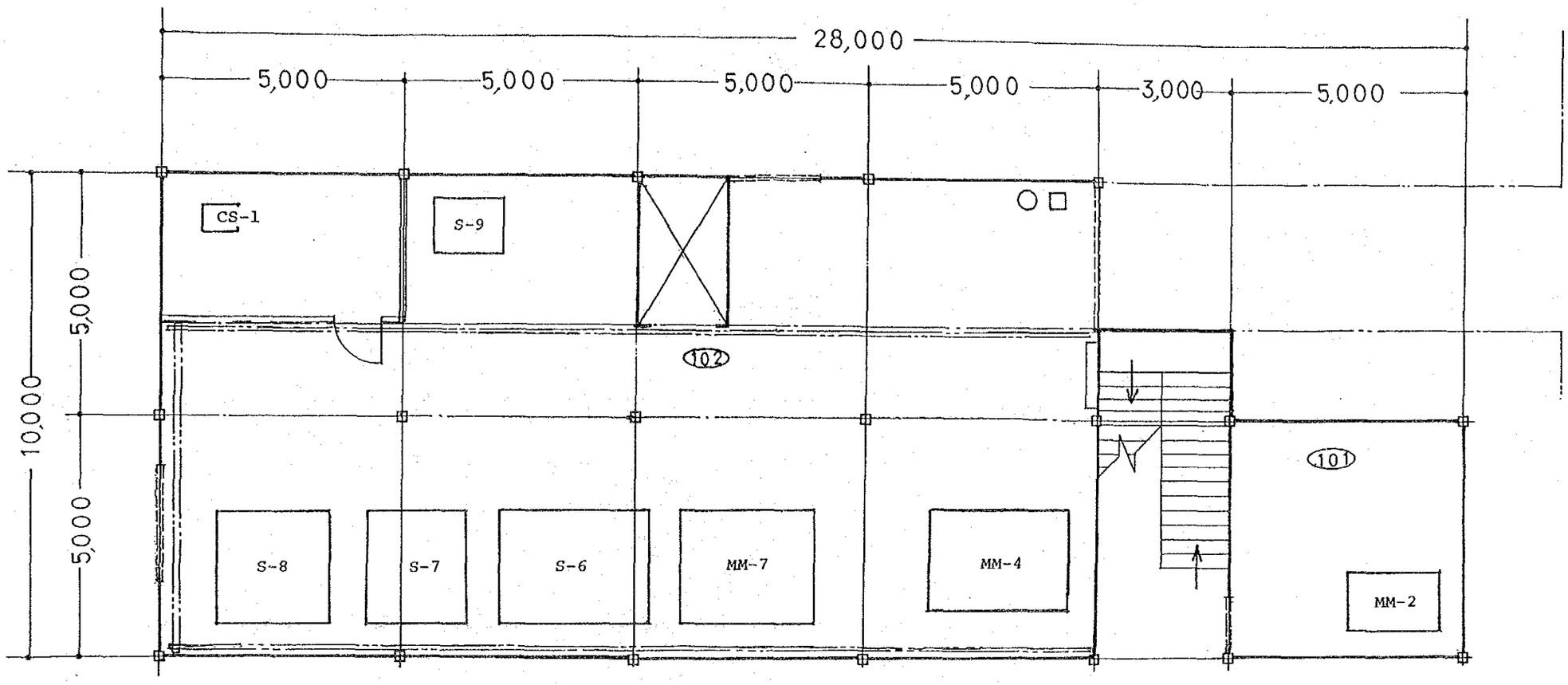
No.	Equipment	Number	Reference
S-1 (A-6)	Cylindrical Type Robot	1 unit	for practical experiment of robotics
S-2 (B1-4)	Scara Type Robot	1 unit	for practical experiment of assembly robot
S-6 (A-7)	CNC Lathe	1 unit	for application research and practical experiment of NC programing and CAD to CNC lathe Diameter 210mm, with tale stock
S-7 (A-8)	CNC Machining System (with NC Programming Tool)	1 set	for application research and practical experiment of NC programming and CAD to machining and metal mold processing, with 18 tools changer, tool holders, and champs
S-8 (B1-3)	CNC Milling Machine	1 unit	for application research and practical experiment of NC programming and CAd to NC million machine Table size: 1,050 x 400mm
S-9 (B1-7)	Tool Grinding Machine	1 unit	for grinding of cutters and tools for machine tools Tool size 250 x 700 mm

4.4 Arrangement Plan for Equipment

The following arrangement plan indicates the positioning of the major equipment to be provided.

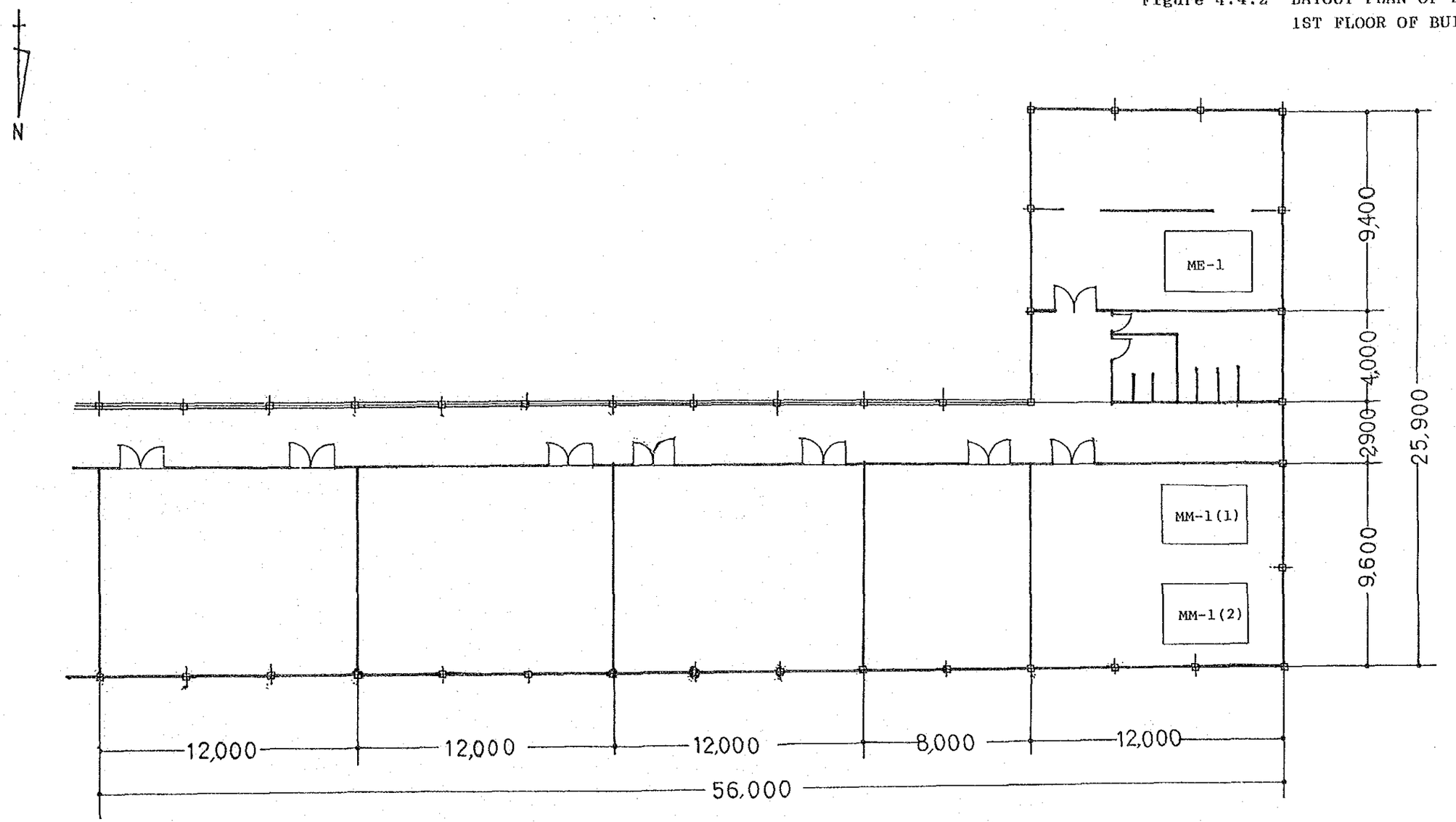
Figure 4.4.1 Layout Plan of Equipment in 1st Floor of EIRD Building
Figure 4.4.2 Layout Plan of Equipment in 1st Floor of Building 3
Figure 4.4.3 Layout Plan of Equipment in 2nd Floor of Building 3

Figure 4.4.1 LAYOUT PLAN OF EQUIPMENT, 1ST FLOOR OF EIRD



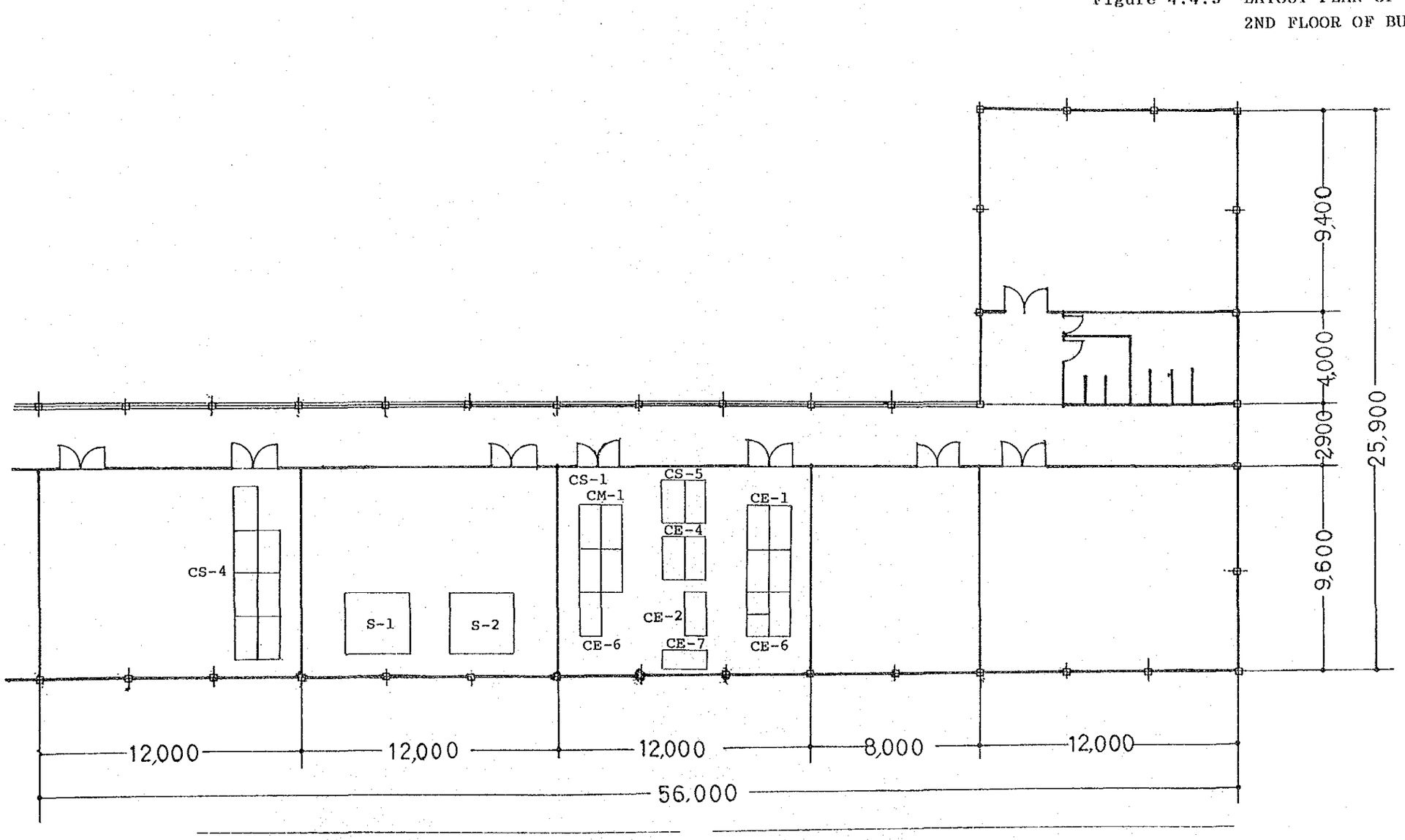
Equipment		Number	Equipment		Number
MM-2	Universal Tensile Tester	1	S-6	CNC Lathe	1
MM-4	Precision Surface and Profile Grinder	1	S-7	CNC Machining Center System	1
MM-7	CNC EDM (Engineering)	1	S-8	CNC Milling Machnine	1
			S-9	Tool Grinding Machine	1
			CS-1	Engineering Workstation	1

Figure 4.4.2 LAYOUT PLAN OF EQUIPMENT, 1ST FLOOR OF BUILDING 3



	Equipment	Number
MM-1(1)	Surface Aualyser ESCA	1
(2)	Surface Aualyser AUGER	1
ME-1	Molecular Beam Epitaxy (MBE)	1

Figure 4.4.3 LAYOUT PLAN OF EQUIPMENT,
2ND FLOOR OF BUILDING 3



Equipment		Number
CE-1	Engineering Workstation	5
CE-2	File Server	1
CE-4	Plotter	2
CE-5	Laser Printer	2
CE-6	Dot Matrix Printer	4
CE-7	UPS	1

Equipment		Number
CM-1	Engineering Workstation	2
CS-1	Engineering Workstation	2
CS-4	Personal Computer	7
S-1	Cylindrical Coordinate Type Robot	1
S-2	Scara Type Robot	1

4.5 Implementation Plan

4.5.1 Implementation Condition

The basic policy of the implementation works is to assure the installation work of the equipment on schedule.

The equipment scheduled for provision under the Project is considered to include items for which an export approval from the Japanese government will be required. Bearing this in mind sufficient time must be accorded for the approval application when scheduling the time required for carrying out the provision.

With regard to the installation of provided equipment on site and the dispatch of supervisory personnel it is necessary to avoid wasted time and schedule works for maximum efficiency. This needs to be borne in mind when scheduling for the dispatch of personnel.

4.5.2 Implementation System

The Faculty of Engineering of Chulalongkorn University takes responsibility for the implementation of the Project under the supervision of the Ministry of Universities Affairs. The Faculty is therefore responsible for administrative procedures involved in the contract with the consultant and contractors, for banking agreements, for equipment and facility plans, etc. The Department of Technical and Economic Cooperation (DTEC) will also participate in planning activities.

4.5.3 Supervising Plan

In accordance with the policy of the Japanese government for grant aid and the contract with the chosen consultant, it will be necessary for the consultant to organize a project progress team as an integrated part of its duties for the implementation planning and monitoring. This team will be responsible to ensure the implementation of the Project up to its completion. Its monitoring duties during installation will include confirmation of the equipment blueprints, monitoring during the factory completion tests, supervisory monitoring during the installation on site, and dispatch of competent experts for inspection at transfer. It must ensure the smooth progress of all installation works. It must also ensure that parts of the work undertaken by

Thai party are carried out without problems for the delivery of equipment and if delays should arise should notify the Thai party of necessary measures immediately, as part of its function to monitor the overall progress of the Project.

4.5.4 Scope of Work

(1) The works undertaken by Japanese party in the Project are;

1) provision of engineering equipment and materials
2) delivery overseas
3) transportation, installation and wiring on the site
4) test operations after installation
5) consulting works involved in the detailed planning (preparation of bid documents), and monitoring of installation

(2) The works undertaken by the Thai party are as follows;

In accordance with the principles of a Japanese grant aid, the Thai party is to prepare buildings, and works for provision of utilities for reception of the equipment. This will be necessary to ensure the realization of the upgrading of these capacities which is the aim of the Project.

1) Construction and preparatory works on buildings

The first and second floors of Building 3 is to be carried out for the installation of computers, robots, materials engineering and evaluating devices and MBE. In order to ensure that the rooms are clean finishing of walls, windows, doors and other fittings will be necessary. A space for changing outdoor shoes to indoor shoe wear and partitions will need to be laid out. As malfunctioning of equipment might arise, if room temperatures rise considerably above 40% temperature control will be needed.

Machine tools, metal processing machines and universal tensile tester will be installed in the first floor of EIRD. The universal tensile tester will require foundation works. It is necessary to achieve a good level of flatness finishing for the floors. Tight closing windows and other entry-exit points are desirable to ensure that dust and impurities can not enter.

2) Electrical Works

The scope of electrical works to be undertaken by the Thai party is for the works involved in wiring etc. from the room distributor box of each room to the local switches and sockets. Provision and wiring and connection works from local switches and sockets to equipment is to be carried out by the Japanese party. However, in cases where installation of local switches or of sockets is not carried out but wiring is done directly from equipment to the room distributors then all electrical work done from the distributor point is undertaken by the Japanese party.

3) Plumbing and waste water works

Plumbing and waste water works are the responsibility of the Thai party.

4) Displacement, transfer and reinstallation of existing equipment

5) Provision of desks, chairs and other office equipment in each room

6) Provision of electric power and other utilities required for the test running of equipment

7) Procedural duties and costs
costs involved in banking agreements
costs involved with tax procedures
speeding up of customs clearance and internal transportation

exemption procedures for the customs duties, Thai domestic taxes and other surcharges to be charged to the Japanese members concerned in the implementation of the Project in accordance with the conditions of the contractual agreement

ensure the convenience of the above Japanese members in connection with entry and stay in Thailand for the purposes of carrying out their project duties

posting of the staff needed for running and supervision of the Project

4.5.5 Implementation Schedule

The following steps shall be followed through in the implementation process of the project:

(1) Implementation design (Detailed design)

On the basis of the basic design study a decision of the details of equipment to be provided shall be made, preparation of tender documents carried out and approval of related institutions obtained. Two (2) months are required for the work.

(2) Implementation of equipment manufacture and works

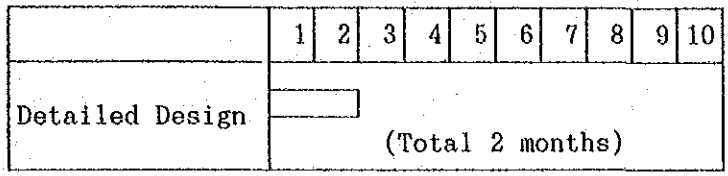
The companies taking orders are to prepare approval documents and complete drawings for manufacturing, to manufacture and ship equipment, and to delivery to Thailand. The companies taking orders are responsible for implementing all works involved on the site up to completion of trial runs. (i.e. unloading, internal transportation, and installation works)

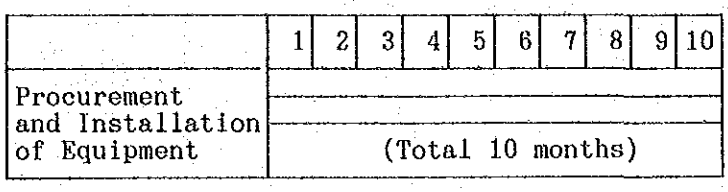
(3) Completion of works

Equipment will be test run monitored by members from EIRD of Chulalongkorn University, the consultant and other parties concerned after installation. Once it has been confirmed that the equipment matches the specifications, transfer to the Thai party will be completed. The Thai party will issue a certificate of completion of works to the company carrying out the order. If all works proceed smoothly the total period estimated for completion of works is 10 months after the supply contract.

The above implementation schedule is illustrated in Figure 4.5.1.

Figure 4.5.1 Implementation Schedule





4.5.6 Estimated Cost for Thai Side Work

The estimated cost of the works to be carried out by Thai side are of the order of approximately 7.05 million Bahts.

unit; million Bahts

	Extensions to Bldg.3	EIRD Bldg.	Total
1) Extension and Remodelling of Buildings, etc.	2.5	0.7	3.2
2) Utility Works	0.7	0.35	1.05
3) Equipment	0.7	0.7	1.4
4) Appliances/Accessories	0.35	0.35	0.7
5) Miscellaneous Works	0.35	0.35	0.7
Total	4.60	2.45	7.05

CHAPTER 5 PROJECT EVALUATION AND CONCLUSION

Chapter 5 PROJECT EVALUATION AND CONCLUSION

5.1 Evaluation of the Project

Thai government emphasize the role of the export orientated industries in the manufacturing sector as the central pillar of social and economic development, and the importance of nurturing the mechanical, electrical and electronics, and metalworking industries which form the technical basis of industry has been strengthened. For this purpose, important issue is the nurture and development of human resources especially in the field of science and engineering which are the groundwork for the promotion of science and technology.

The Project is for the EIRD Expansion Project which is planed by the Faculty of Engineering of Chulalongkorn University to provide the engineers in areas of precision engineering which form the basis for the production technology of mechanical , electrical and materials engineering needed for national development. Results to be achieved by the realization of the Project include the following.

(1) Reinforcement of training of engineers

In the industrial development of Thailand the training of engineers who can carry out self-supported research is of great importance. However, the self-training capability of engineers in industry is insufficient and there is a dependence on university graduates. The Faculty of Engineering of Chulalongkorn University desires to effect an upgrading of its educational and research programs in order to improve student levels. The implementation of the Project is to activate the research activities of Chulalongkorn University and to provide an education focusing on applied research through practical experimentation. The aim to train engineers and thereby to strengthen the training of human resources which will support the future industrial development of Thailand will be performed.

(2) Strengthening of role to lead advanced technology to industrial sector

The advanced companies of machinery, electrical/electronic and metalworking industries in Thailand are developing their technology by an introduction of equipment and technology improvements from abroad.

However, as they have limited capacity of engineers they depend on universities for the provision of the basic and applied technology needed for such improvements. The staff of Chulalongkorn University have quite adequate ability to guide and lead such technology, but the lack of equipment is unable to provide such research and development. Through the implementation of the Project future technical research to lead the future industry in Thailand will be made possible and so an invaluable contribution to industrial development be made.

(3) Promotion of advanced technical education

The implementation of the Project will enable staff who have been trained in foreign research institute to continue their research after their return to Thailand. This will encourage the research enthusiasm of younger research staff and is expected to upgrade the overall motivation for educational and training in the applied research sectors. It is expected that this will have positive results to the quality of the higher engineering education in Thailand.

(4) Reinforcement of technical services to industry

The links between industry and universities are strong in Thailand. Universities are often consulted in relation to industrial problems and are relied on for the training of engineers and technicians. Through the implementation of the Project it will be possible to carry out a wide range of technical services in the future.

(5) Evaluation of activity plan

The activities which EIRD schedules to undertake are as follows;

1) Research and development of application technology in the area of precision engineering highly demanded by the nation and industrial sector.

2) Education of undergraduate and postgraduate students in the form of practical training through research and development activities.

3) The education and training of engineers from industry.

These activities are judged to be in accordance with the intention of Thailand to upgrade the production technology of the nation and industrial sector.

(6) Evaluation of the management system

The Faculty of Engineering of Chulalongkorn University is the executing agency for the implementation of the Project. An executing organization is to be formed whose members will be responsible for the progress of the Project and is under the direct control of the Committee headed by the Dean of the Faculty of Engineering. This is currently engaged in the undertaking of the Project and its managerial system and capacities are positively evaluated.

(7) Evaluation of operation and maintenance aspects

The main implementing bodies of the EIRD Expansion Project are the departments of electrical, metallurgical and mechanical engineering. Each department has a certain amount of existing equipment and each has plans for expansion and training of teaching staff and technicians. It is judged that existing maintenance systems of each department are already sufficient for the equipment to be provided. It is believed that the smooth operation and maintenance for the equipment will be possible by choosing of manufacturers who can maintenance service for Thailand.

The EIRD Expansion Project has already been approved as part of the mid term plan of Chulalongkorn University and the budget for implementation work already earmarked in the budget of the University and the Faculty of Engineering. The annual running budget will be fixed annually, and it is very important to ensure the cost for operation and maintenance for the equipment to be provided.

5.2 Conclusions

Thailand is directing energies towards the training of engineers who will be needed to further and support the mechanical, electrical and electronics, and metalworking industry and promote the progress of science and technology. The EIRD Expansion Project of Chulalongkorn University has been drawn up to respond to and meet the above needs. By reinforcing the training program for engineers in the sectors of precision engineering of EIRD

through the Project, a considerable contribution to the industrialization and promotion of science and technology in Thailand is expected in result of the enriched personnel assets. Therefore, the grant aid from Japan for realizing the Project is deemed to be extremely worthwhile and meaningful.

However, in order to maximize the effect of the Project following tasks need to be undertaken by the Thailand party.

(1) Works to be undertaken by the Thai party

The Thailand is to be in charge of carrying out and ensuring the smooth completion of the extension and preparatory works for Building 3 and the EIRD Building of the Faculty of Engineering where the equipment is to be installed, the provision of furnishings and fixtures such as the desks, laboratory tables,etc. the interior finishing of walls, windows, etc.and the construction works for the provision of water and electricity. It is necessary to undertake any budgetary measures and implementation planning which may be required for the completion of the above works.

(2) Safety control in installation of equipment up to trial running

The works involved from the delivery, installation up to trial running of the equipment to be provided under the Project are to be carried out by the Japanese suppliers. It will be necessary to ensure that appropriate measures are taken with regard to unloading at Bangkok harbor, the transportation to the University campus, delivery to actual sites for installation , safety control of equipment and storage locations. It is also desirable that the Thailand party take prompt action for the customs clearance and unloading procedures for equipment and materials.

(3) Budgetary measures for the maintenance fees

The University and the Faculty of Engineering are to assure the funds for the operation and maintenance expenses required to achieve the aims of the Project. Efforts are to be directed to ensure that the Project runs according to the original plan.

(4) Personnel planning

In order to ensure the effective application and maintenance of the engineering equipment to be installed under the Project, it is necessary that the plans for personnel expansion of the EIRD, and in particular those for the recruiting and training of teaching staff and technicians, are realized without delays, in conjunction with the progress of the implementation of the Project. For special equipment not only will it be necessary for suppliers and manufacturers to provide guidance on operating at the time of installation, but in addition to the training in manufacturers factory must be supplied. The training must be carried out in accordance with the overall progress of the various sub programs and sub plans.

(5) Reserve for spare parts and consumables and their storage

It will be necessary to make sure that sufficient consideration is given to secure a provision of spare parts and consumables. As Chulalongkorn University already possesses a wide range of equipment and is familiar with issues involved, there is little concern that equipment will be left idle for want of stocks of spare parts or consumables. However, it is necessary to ensure that the specified quantity of parts and consumables for the equipment of the Project is normally stocked. This must be organized so that a prompt response is possible in the event of parts replacement, malfunctioning or breakdowns.

(6) Technical cooperation

If the Project is formed as a vehicle for the creation of technical exchanges and cooperation with Japanese institutes, then this would in turn contribute to the further success of the Project generally.

APPENDICES

APPENDIX-1 MINUTES OF DISCUSSIONS

1.1 Minutes of Discussions (April 25, 1990)

1.2 Minutes of Discussions (July 13, 1990)

1.1 Minutes of Discussions (April 25, 1990)

MINUTES OF DISCUSSIONS
ON
THE PROJECT FOR EXPANSION OF THE ENGINEERING INSTITUTE FOR RESEACH AND DEVELOPMENT
IN
CHULALONGKORN UNIVERSITY
IN
THE KINGDOM OF THAILAND

In response to the request of the Government of the Kingdom of Thailand, the Government of Japan decided to conduct a basic design study on the Project for Expansion of the Engineering Institute for Research and Development in Chulalongkorn University (hereinafter referred to as "the Project"), and entrusted the study to the Japan International Cooperation Agency (JICA). JICA sent to Thailand the study team headed by Dr.Shigeo OZONO, Professor, Department of Precision Machinery Engineering, Faculty of Engineering, the University of Tokyo, from April 16 to May 3, 1990.

The Team had a series of discussions on the Project with the officials concerned of the Government of the Kingdom of Thailand and conducted a field survey.

As a result of the study and discussions, both parties agreed to recommend to their respective Governments that the major points of understanding reached between them, attached herewith, should be examined towards the realization of the Projcet.

Bangkok, April 25, 1990

大園成夫

Prof. Shigeo Ozono
Leader
Basic Design Study Team
JICA

Assist. Prof. Dr. Tavee Lertpanyavit
Dean
Faculty of Engineering
Chulalongkorn University

ATTACHMENT

1. Project Title

The title of the Project is "the Project for Expansion of the Engineering Institute for Research and Development in Chulalongkorn University".

2. Objective

The objective of the Project is to provide necessary equipment for the expansion of the Engineering Institute for Reseach and Development (hereinafter referred to as "EIRD"), emphasizing the fields of CAD/CAM, engineering materials, and automation & precision.

3. Implementing Agency

The implementing agency for the Project is EIRD, Faculty of Engineering.

4. Project Site

The site of the Project is located at Faculty of Engineering, Chulalongkorn University, Bangkok, Thailand, as shown in ANNEX 1.

5. Construction Work

The construction work of the buildings for the Project should be completed by the University by the end of year 1990.

6. Summary of Requested Items for the Project

The summary of the requested equipment is shown in ANNEX 2 reflecting the priorities of the request.

大園成夫

7. Grant Aid Program

1) The Thai side has understood the system of Japan's Grant Aid Program and the principle for the use of Japanese consulting firm and contractor for the implementation of the Project.

2) The team will convey to the Government of Japan the desire of the Government of the Kingdom of Thailand that the former takes necessary measures to cooperate in implementing the Project and provides necessary equipment under the Japan's Grant Aid Program.

3) The Government of the Kingdom of Thailand will take the necessary measures as shown in ANNEX 3 on condition that the Grant Aid by the Government of Japan would be extended to the Project.

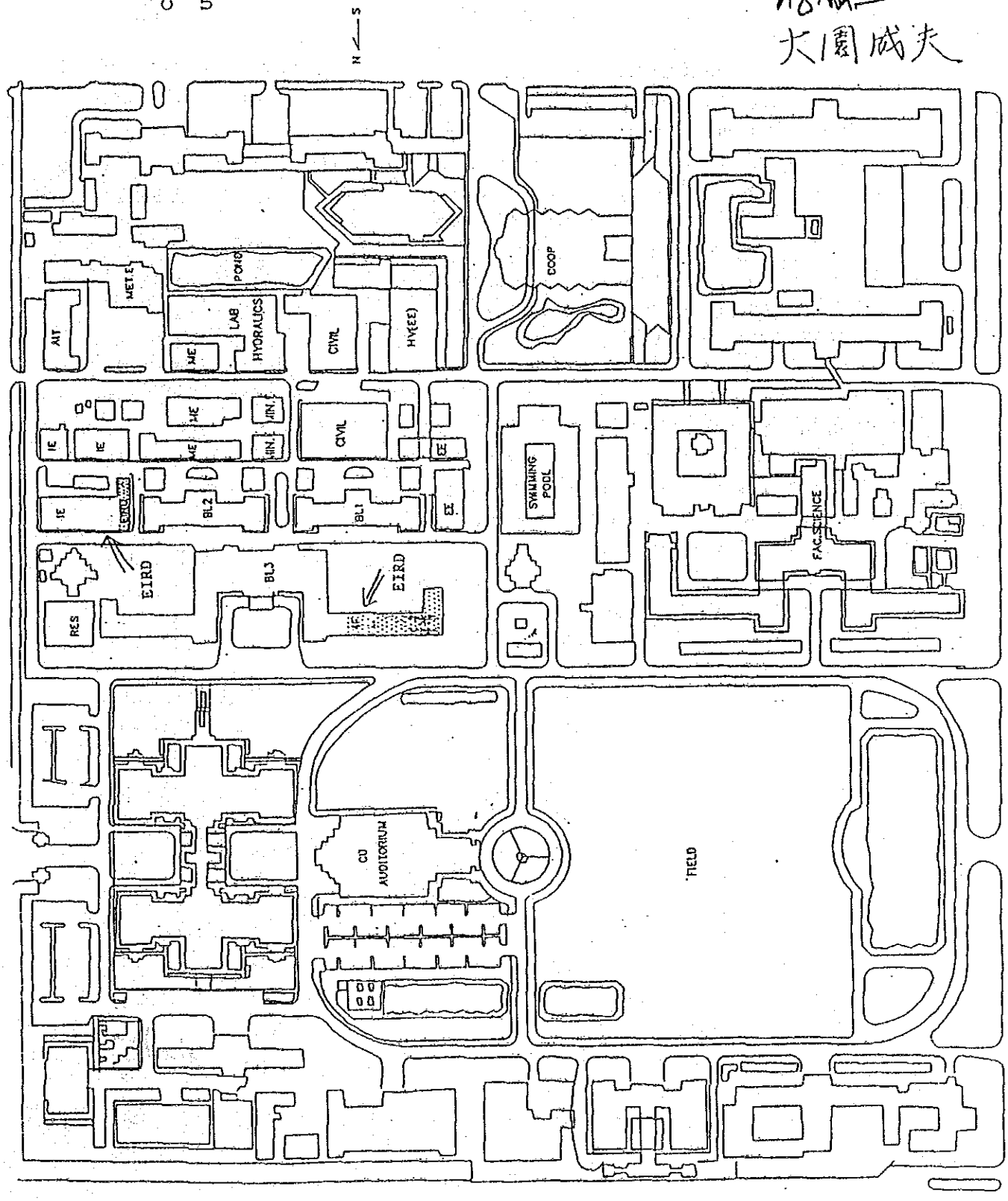
大園成夫

ANNEX 1

CHULALONGKORN

UNIVERSITY

大園成夫



ANNEX 2 Summary of requested items for the Project

The priority of the requested equipment is as follows:

Group A (The first priority)

items	Quantity
A-1. Engineering Work Station (EWS) for CAD	1 lot
A-2. Surface Analyser (ESCA/AUGER)	1
A-3. Instron Type Universal Tensile Tester	1
A-4. Molecular Beam Epitaxy (MBE) System	1 lot
A-5. Laser System for material processing and for characterization	1 lot
A-6. Cylindrical Coordinate Type Robot	1
A-7. CNC Lathe Machine	1
A-8. CNC Machining Center System with programming tool	1 lot
A-9. 100 Ton Hydrolic Press	1
A-10. Precision Surface and Profile Grinder	1

Group B (The second priority)

B-1-1. Scanning Electron Microscope	1
B-1-2. Laser Measurement System for displacement, distance, vibration, angle and smoothness	1
B-1-3. CNC Milling Machine	1
B-1-4. Scara Type Robot	1
B-1-5. CNC Wirecut EDM	1
B-1-6. CNC EDM (Engraving)	1
B-1-7. Grinding Machine	1

B-2-1. YAG Laser System for material Processing	1
B-2-2. Lock in Amplifier (2 phases)	1
B-2-3. Box Car Integrator	1
B-2-4. Robot Vision System	1
B-2-5. Precision Cartesian Coordinates Positioning Unit	1
B-2-6. Portable Robot	1

Group C (The Third Priority)

C-1. Multi-channel Recorder	1
C-2. Spectrum Analyser	1

大園成夫

ANNEX 3 Necessary measures to be taken by the Government of the Kingdom of Thailand

1. To provide data and information necessary for the implementation of the Project.

2. To complete the construction work of the buildings for the Project by the end of year 1990.

3. To provide facilities for distribution of electricity, water supply, telephone, drainage and other incidental works leading and up to the site.

4. To ensure prompt unloading, tax exemption, and customs clearance of the Project goods at the ports of disembarkation.

5. To accord Japanese nationals whose services may be required in connection with the supply of the products and the services under the verified contracts such facilities as may be necessary for their entry into the Kingdom of Thaialnd and stay therein for the performance of their work.

6. To exempt Japanese nationals from customs duties, internal taxes and other fiscal levies which may be imposed in the Kingdom of Thailand with respect to the supply of the products and services under the verified contracts.

7. To maintain and use properly and effectively the equipment provided under the Grant Aid.

8. To bear all the expenses other than those to be borne by the Grant Aid necessary for the execution of the Project.

大園成夫

1.2 Minutes of Discussions (July 13, 1990)

MINUTES OF DISCUSSIONS ON THE PROJECT FOR EXPANSION OF THE ENGINEERING INSTITUTE FOR RESEACH AND DEVELOPMENT IN CHULALONGKORN UNIVERSITY IN THE KINGDOM OF THAILAND

In response to a request from the Government of the Kingdom of Thailand, the Government of Japan decided to conduct a basic design study on the Project for Expansion of the Engineering Institute for Reseach and Development (hereinafter referred to as "the Project") and entrusted the study to the Japan International Cooperation Agency (hereinafter referred to as "JICA"). JICA sent to Thailand the study team headed by Dr.Shigeo Ozono, Professor, Department of Precision Machinery Engineering, Faculty of Engineering, Tokyo University, from April 16 to May 3, 1990.

As the result of the study, JICA prepared a Draft Final Report and dispatched a team headed by Dr.Takateru Umeda, Professor, Department of Metallurgy, Faculty of Engineering, Tokyo University, to explain and discuss it from July 8 to July 15, 1990.

Both parties had a series of discussions on the report and agreed to recommend to their respective Government that the major points of understanding reached between them, attached herewith, should be examined towards the realization of the Project,

Bangkok, July 13, 1990

梅田高照

Prof. Takateru Umeda
Team Leader,
Basic Design Study Team,
JICA

Assist. Prof. Tavee Lertpanyavit
Dean,
Faculty of Engineering,
Chulalongkorn University

ATTACHMENT

1. The Thai side agreed in principle on the basic design proposed in the Draft Report with a request to alter equipment plan slightly as shown in Annex.

2. The Final Report (10 copies in English) on the Project will be submitted to the Thai side by the end of September, 1990.

3. The Thai side understood the Japan's Grant Aid System and confirmed that the necessary measures will be taken by the Government of Thailand for the realization of the Project as shown in the ANNEX Ⅲ of "the Minutes of Discussions" signed on April 25, 1990, on the condition that the Grant Aid by the Government of Japan would be extended to the Project.

4. The Government of Thailand agreed that the necessary budget will be provided for the Project to ensure the effective operation and maintenance of the equipment provided under the Grant Aid by the Government of Japan.

5. The consultant will assist the Thai side in the following items, on condition that the Grant Aid by the Government of Japan would be extended to the Project:
   1) To supply the available technical data of all equipment provided under the Project to the Thai side for consideration before bidding;
   2) To prepare the specification of all equipment provided under the Grant Aid for the tender process and subject to the final acceptance by the Thai side;
   3) To proceed of the tender process; and
   4) To conduct other necessary activities for the implementation of the Project under the consultant contract.

6. The Thai side requests to the Japanese side for the future collaboration as a follow-up of the Project. The Japanese team promises to convey the request to the Government of Japan.

ANNEX Equipment plan (revised)

1. Equipment for CAD/CAM

Engineering workstation system (EWS)		1 set
1) CAD for electronics circuit design	EWS	5 sets
2) CAD for metal mold design	EWS	2 sets
3) CAD for system automation	EWS	3 sets

2. Equipment for materials engineering

Equipment for metallurgical engineering

1) Surface analyser	ESCA	1
	AUGER	1
2) Universal tensile tester		1
3) Precision surface and profile grinder		1
4) CNC EDM (engraving)		1

Equipment for electronics materials

1) Molecular beam epitaxy (MBE)	1

3. Equipment for system automation

1) Cylindrical coordinate type robot	1
2) Scara type robot	1
3) CNC lathe machine	1
4) CNC machining center system with NC programming tool	1
5) CNC milling machine	1

a. Deleted items from the draft report

Equipment for metallurgical engineering

1) Hydraulic press
2) Scanning electron microscope

Equipment for electronics materials

1) CO_2 laser system and laser power meter

b. Decrease number of equipment

Equipment for CAD/CAM

1) CAD for electronic circuit design : decrease 2 sets
2) CAD for metal mold design : decrease 2 sets
3) CAD for system automation : decrease 1 set

(CS-11 Software for mechanical design 2sets (decrease 1set) refer page 4-8)

梅田高照

c. Added item to the draft report

MM-1 Surface analyser	ESCA	1
	AUGER	1
ME-1 Molecular beam epitaxy (MBE)		1

梅田高照

APPENDIX-2 MEMBER LIST OF THE SURVEY TEAM

2.1 Basic Design Survey Team (March 16, 1990 - May 3, 1990)

Team Leader	: Dr. Shigeo OZONO Professor Dept. of Precision Machinery Engineering Faculty of Engineering The University of Tokyo
Engineering Equipment	: Dr. Takateru UMEDA Professor Dept. of Metallurgy Faculty of Engineering The University of Tokyo
Project Coordination	: Mr. Tetsuya SUZUKI First Project Management Division Grant Aid Project Management Department Japan International Cooperation Agency
Equipment Planning	: Mr. Kiko NAGASAWA UNICO International Corporation
Electronics Engineering	: Mr. Teruo KOBARI UNICO International Corporation
Automation and Materials Equipment	: Mr. Morihiko SUGIURA UNICO International Corporation
Layout Planning and Cost Estimation	: MR. Reiichi TOKORO UNICO International Corporation

2.2 Draft Report Explanation Team (July 8 - July 15, 1990)

Team Leader	:	Dr. Takateru UMEDA Professor Dept. of Metallurgy Faculty of Engineering The University of Tokyo
Project Coordination	:	Mr. Satoru WATANABE Second Basic Design Study Division Grant Aid Planning & Survey Department Japan International Cooperation Agency
Equipment Plannning	:	Mr. Kiko NAGASAWA UNICO International Corporation
Electronics Engineering	:	Mr. Teruo KOBARI UNICO International Corporation

APPENDIX-3 SURVEY SCHEDULE

3.1 Basic Design Survey Team

1. Apr 16 (Mon) Lv. Tokyo (JL717)
Ar. Bangkok (Mr. Suzuki, Mr. Nagasawa, Mr. Kobari, Mr. Sugiura)

2. Apr 17 (Tue) (Bangkok)
Courtesy Meeting with Permanent Secretary of Ministry of Univ. Affairs

Courtesy Meeting with Chief of Japan Sub-Division/DTEC (Dept. of Tech. & Economic Coop.)
; Explanation and Discussion on the Outline of the Survey

Courtesy Meeting at the Emb. of Japan and JICA Office
; Explanation and Discussion of the Survey Schedule and the Survey Outline

3. Apr 18 (Wed) Lv. Tokyo (JL717)
Ar. Bangkok (Dr. Ozono, Dr. Umeda)
Meeting at Chulalongkorn Univ.
; Explanation on the Inception Report and Questionnaires, Survey of the Present Condition of Faculty of Engg.

Meeting at King Mongkut's Institute of Technology, Ladkrabang
; Interviewing, Survey of the Present Condition of Faculty of Engg.

4. Apr 19 (Tue) (Chulalongkorn Univ./Bangkok)
Courtesy Call on the President of Chulalongkorn Univ.,
Survey of teh Presnet Condition of Faculty of Engg.
Survey of EIRD
Survey of STREC

5. Apr 20 (Fri) (Chulalongkorn Univ/Bangkok)
Interviewing on the Subject Plan
Discussion on the Contents of the Equipment

6. Apr 21 (Sat) (Bangkok)
Factory Visit and Interviewing at Ogihara (Thailand) Co., Ltd.
Factory Visit and Inverviewing at MINEBEA Thai Limited

7. Apr 22 (Sun) (Bangkok)
Team Meeting

8. Apr 23 (Mon) (Bangkok)
Discussion with The President of the Federal of Thai Industries (Siam Cement)
Factory Visit and Interviewing at Thai Engineering Products Co, Ltd.
Factory Visit and Interviewing at the Siam KUBOTA Diesel Co., Ltd

9. Apr 24 (Tue) (Bangkok)
Discussion on the Contents of Submitted Equipment List and Explannation on the Grant System with Chulalongkorn Univ. Staff
Intermedidate Meeting with JICA
Laboratoy Visit and Interviewing with MIDI

10. Apr 25 (Wed) (Bangkok)
Signing of the Minutes of Discussions between the Survey Team and Chulalongkorn Univ.
Report to the Embassy of Japan and JICA on the Minutes of Discussions
Meeting at King Mongkut's Institute of Technology, Thonburi
; Interviewing, Call on Faculty of Engg.

11. Apr 26 (Thu) Lv. Bangkok for Japan (TG640)
(Dr. Ozono, Dr. Umeda)
(Chulalongkorn Univ.)
; Survey of Research/Training items and equipment specifications. Survey of EIRD development plan

12. Apr 27 (Fri) (Bangkok)
Hearing and factory visit at;
National Semiconductor (Bangkok) Limited
MAGNUM Tooling System Co., Ltd.
C.M. Industry Co., Ltd.

13. Apr 28 (Sat) (Bangkok)
Data arrangement

14. Apr 29 (Sun) (Bangkok)
Team meeting, Data arrangement

15. Apr 30 (Mon) (Chulalongkorn Univ.)
; Survey of Research/Training items and equipment specifications, Survey of Building and Utility facilities

16. May 1 (Tue) (Chulolongkorn Univ.)
; Discussion on the general subjects of equipment plan, Survey of Research/Training items and equipment specifications

17. May 2 (Wed) (Chulalongkorn Univ.)
; Discussion on the layout plan of equipment with Dean, Faculty of Engg. Receipt of answers (for the questionnaires)

18. May 3 (Thu) Lv. Bangkok for Japan (CX700/CX508)
(Mr. Nagasawa, Mr. Kobari, Mr. Sugiura, Mr. Tokoro)

3.2 Draft Report Explanation Team

1. July 8 (Sun) Lv. Tokyo (TG641)
Ar. Bangkok (Dr. Umeda, Mr. Watanabe, Mr. Nagasawa, Mr. Kobari)

2. July 9 (Mon) (Bangkok)
Courtesy Meeting at the Embassy of Japan and JICA office
; Explanation and Discussion on the Basic Design Study, Schedule of the Study
Meeting at Chulalongkorn University
; Explanation on the Draft Final Report
Discussion on the Equipment Plan

3. July 10 (Tue) (Chulalongkorn Univ./Bangkok)
; Discussion and Clarification on Equipment Plan, Layout Plan and Technical Cooperation

4. July 11 (Wed) (Chulalongkorn Univ./Bangkok)
; Explanation on Implementation Plan (General Grant Aid System)
Discussion on Minutes of Discussions

5. July 12 (Thu) (Bangkok)
Courtesy Meeting with Permanent Secretary of Ministry of University Affairs
; Explanation on the Outline of the Basic Design Study

Courtesy Meeting with Chief of Japan Sub-Division/DTEC (Dept. of Technological and Economic Cooperation)
; Explanation on the Outline of the Basic Design Study
Meeting at JICA office
; Report to JICA on the Outline of the Discussions with Chulalongkorn University

6. July 13 (Fri) (Chulalongkorn Univ./Bangkok)
Signing of the Minutes of Discussions between the Survey Team and Chulalongkorn University

7. July 14 (Sat) Lv. Bangkok for Japan (TG640)
(Dr. Umeda, Mr. Watanabe)
(Bangkok)
Supplementary Survey, Data Arrangement

8. July 15 (Sun) Lv. Bangkok for Japan (TG640)
(Mr. Nagasawa, Mr. Kobari)

APPENDIX-4 MEMBER LIST OF CONCERNING PARTY IN RECEPIENT COUNTRY

1) DTEC (Department of Technical and Economic Cooperation)

Chief of Japan Sub-Division	Sutin Susila
Japan Sub-Division	Vudhisit Viryasiri
Japan Sub-Division	Peeraporn Soronpiboon

2) Ministry of University Affairs

Permanent Secretary	Prof. Dr. Wichit Srisa-an
Director of Foreign Relations Division	Dr. Vibool Phinit-Akson
Foreign Relations Division	Vendee Ketanitinaw

3) Chulalongkorn University

President	Prof. Dr. Charas Suwanveloa
Dean, Faculty of Engineering	Assoc. Prof. Dr. Tavee Lertpanyavit
Deputy Dean of Planning Development	Assoc. Prof. Phulpom Saengbaugpla
Deputy Dean of Research (Director of EIRD)	Assoc. Prof. Wongpun Lionpaseni
Head of Dept. of Electrical Engineering	Assoc. Prof. Dr. Narong Yoothonom
Head of Dept. of Mechanical Engineering	Prof. Dr. Variddhi Ungbhakorn
Head of Dept. of Metallurgical Engineering	Assoc. Prof. Dr. Paritud Bhandhubanyong
Head of Dept. of Computer Engineering	Assoc. Prof. Suyut Satayaprauob
Dept. of Electrical Engineering	Prof. Dr. Somsak Panyakeow
Dept. of Electrical Engineering	Assoc. Prof. Dr. Ekachai Lelarasmee
Dept. of Electrical Engineering	Assoc. Prof. Choompal Antarasena
Dept. of Electrical Engineering	Dr. Dusit Kruangam
Dept. of Mechanical Engineering	Assoc. Prof. Dr. Viboon Sangveraphensiri
Dept. of Mechanical Engineering	Assoc. Prof. Dr. Surin Phongsapamit
Dept. of Metallurgical Engineering	Assist . Prof. Dr. Wikrom Vajaragupta
Dept. of Metallurgical Engineering	Sumalee Vongchan
Director of Engineering Computer Center	Assoc. Prof. Dr. Suthan Vanichseni
Director of Chula Unisearch	
Director of Scientific and Technological Research Equipment Centre (STREC)	Virul Mangclaviraj
Assist. Director of Scientific and Technological Research Equipment Centre	Assist. Prof. Weerachoi Banchornclhevakul

4) KMITL (King Mongkut's Institute of Technology Ladkrabang)

President	Dr. Kosol Petchsuwcen
JICA Coordinator	Hideo Sakuraba
JICA Expert	Masabumi Kawamura
JICA Expert	Toshio Iijima

5) KMITT (King Mongkut's Institute of Technology Thonburi)

Dept. of Electrical Engineering, Faculty of Engineering	Ave Chaisawadi

6) MIDI (The Metal-Working and Machivery Industies Development Institute)

JICA Coordinater	Hidetaka Nishiwaki

7) Ogihara (Thailand) Co., LTD.

Managing Director	Tamotsu Yamada
Deputy Managing Director	Katsuhiro Imamura

8) MINEBEA Thai Limited

General Manager	Nobutoshi Yoihida
Adminictrative Manager	Kiyoshi Takasugi

9) The Federation of Thai Industries (Siam Cement)

President	Paron Israsena
Vice President (Siam Cement)	Chaisak Saeng-Xuto

10) Thai Engineering Products Co., LTD.

Managing Director	Alongkat Chutinan
Plant Engineer	Suporn Supornrungrasmee

11) The Siam KUBOTA Diesel Co., LTD.

Vice President Production	Hiroshi Maeda
General Technical Assistant	Kiyoji Kitano

12) National Semiconductor (Bangkok) Limited

Ceramic DIP Operating Manager	Komes Noppom
Human Resources Manager	K.A. Chang

13) MAGNUM Tooling Systems Co., LTD.

General Manager	Banpot Teerapakul

14) C.M. Industry Co., LTD.

Chief Executive Officer	Khemadhat Sukondhasingha

15) Embassy of Japan

First Secretary	Yoshihiko Kamo
Second Secretary	Koichi Noguchi

16)Japan International Cooperation Agency (Thailand Office)

President Representative	Nobuji Abe
Deputy Director	Keiichi Kato
	Tatsuo Suzuki
	Chisa Hara
	Makoto Asino

APPENDIX-5 Existing Equipment in the Faculty of Engineering
(Main Equipment in the Concerning Department)

1. CAD/CAM and Mechatronics	
(1) PRIME Mini Computer System 9750	Computer Centre
(2) SUN Workstation	- ditto -
(3) Personal Computer 386 and 286	- ditto -
(4) Robot	Dept. of Mech. Engg.
- Scara Type Robot (Original Made)	
- 3-axis Cylindrical Coordinate Type Robot (Original Made)	
(5) CNC Machine	Dept. of Mech. Engg.
- Vertical Milling Machine	
- Wire-cut Electric Discharge Machine (EDM)	
2. CAD for Electronic Design	
(1) SUN Workstation (same as (2) above)	Computer Centre
(2) IBM Personal Computer	Dept. of Electrical Engg.
80386	
80286	
8088	
Plotter	
3. Metallurgical Engineering Materials	Dept. of Metallurgical Engg.
(1) Casting Equipment	- ditto -
(2) Heat Treatment Testing Equipment	- ditto -
(3) Metal Structure Testing Equipment	- ditto -
(4) Electroplating Equipment	- ditto -
(5) Chemical Analysis Equipment	
4. Electronics Materials	
(1) LPE (Liquid Phase Epitaxy)	Dept. of Electrical Engg. (Semiconductor Devices Research Lab.)
Horizontal type	
Vertical type	
(2) Diffusion Furnace	- ditto -
(3) Electron Beam Evaporator	- ditto -
Vacuum Evaporator	
Mask Alignment Machine	
Deionized Water System	
(4) Scanning Electron Microscope	- ditto -
(5) Die Bonding Machine	- ditto -
Wire Bonding Machine	
(6) CO_2 Laser for Heat Annealing (Original Made)	- ditto -
YAG Laser for Heat Annealing	
Laser Holography (Original Made)	

APPENDIX-6 CURRICULUM OF THE THREE DEPARTMENTS (UNDERGRADUATE)

MECHANIAL ENGINEERING CURRICULUM

		Credits
1st Semester	General Courses for all of Engg. Dept.	18
2nd Semester	(omitted to refer)	20

	Course	Credits		Course	Credits
3rd Semester	Found Eng II	3	6th Semester	Humanities/Social Sciences	3
	Civilization	3		Elec Eng I	3
	Mech Drawing	2		Elec Eng Lab I	1
	Eng Mech I	3		Machine Design	3
	Eng Management	3		Advance Math	3
	Calculus III	3		Approved Elective	3
	Stat Phys Science	3			
		20			16
4th Semester	Man & Society or Science & Culture	3	7th Semester	Elec Eng II	3
	Eng Mech II	3		Elec Eng Lab II	1
	Mech of Mat I	3		Mech Eng Lab II	1
	Thermodynamics I	3		Refrigeration	3
	Calculus IV	3		Heat Transfer	3
	Dife Equations	3		Energy Mgt Bldg or Egy Mgt Industry	3
				Approved Elective	3
		18			17
5th Semester	Humanities/Social Sciences	3	8th Semester	Mech Eng Lab III	2
	Mech Eng Lab I	1		Air Conditioning	3
	Machine Design I	3		Inter Comb Engin	3
	Mech of Machine	4		Power Plant Eng	3
	Thermodynamics II	3		Mech Eng Project	3
	Fluid Mechanics I	3		Free Elective	3
		17			17

Total Credits for Graduation = 143

ELECTRICAL ENGINEERING CURRICULUM

		Credits
1st Semester	General Courses for all of Engg. Dept.	18
2nd Semester	(omitted to refer)	20

	Course	Credits		Course	Credits
3rd Semester	Found Eng II	3	6th Semester	Prop of Elec Eng Mat	3
	Society & Culture	3		Feed Cont Sys	3
	Circuit Theory I	3		Em Egy Conv Lab II	1
	Elect Circuit Lab or Microcomp Lab	1		Etron Circuits	3
	Emech Egy Conv I	3		Etron Cct Lab	1
	Eng Mech I	3		Princ of Comm	3
	Calculus III	3		Me Lab Non Me	1
		19			15
4th Semester	Human or Social Studies	3	7th Semester	Human or Social Studies	3
	Civilization	3		Feed Cont Sys lab	1
	Elect Eng Math	3		Elec Power Power Sys I	3
	Elect Circuit Lab or Microcomp Lab	1		Comm Eng Lab	1
	Basic Electronics	3		Option Core Courses	6
	Eng Mech II	3		Eng Management	3
	Stat Phys Science	3			
		19			18
5th Semester	Circuit Theory	3	8th Semester	Elec Project	3
	Elec Meas/Instru	3		Option Core Corses	3-0
	Electro Mag Fund	3		Option Approved Electives	6-9
	Emech Egy Conv III	3		Free Elective	3
	Em Egy Conv Lab I	1			
	Phys Electronics	3			
	Etron Dev Lab	1			
	Basic Thermo	3			
		20			15

Total Credits for Graduation = 143

METALLURGICAL ENGINEERING CURRICULUM

		Credits
1st Semester	General Courses for all of Engg. Dept.	18
2nd Semester	(omitted to refer)	20

	Course	Credits		Course	Credits
3rd Semester	Found Eng II	3	6th Semester	Humanities/Social Sciences	3
	Civilization	3		Basic Mech Eng	3
	Eng Mech I	3		Min Technology I	4
	Met Thermo	3		Chem Met II	3
	Phy Met I	3		Chem Met Lab	1
	Phy Met Lab I	1		Anal Chem	3
	Calculus III	3			
		19			17
4th Semester	Man and Society or Society & Culture	3	7th Semester	Eng Management	3
	Eng Mech II	3		Corrosion Met	3
	Mineralogy	3		Mech Met	3
	Pri Met Oper	3		Met Forming I	1
	Phy Met II	3		Refrac Mat	3
	Phy Met Lab II	1		Electives	3
	Stat Phys Sceince	3			
		19			17
5th Semester	Human or Social Studies	3	8th Semester	Met of Mtl Joining	3
	Elec Eng I	3		Met Forming II	2
	Elec Eng Lab I	1		Met Forming Lab	1
	Mech of Mat I	3		Met Eng Project	3
	Phy Met III	3		Electives	3
	Phy Met Lab III	1		Free Electives	3
	Chem Met I	3			
		17			15

Total Credits for Graduation = 143

APPENDIX-7 PERSONNEL EXPENDITURE FOR CONCERNED SECTION OF EIRD TO THE PROJECT

Direct Personnel	Number	Total Annual Salary (thousand Baht/year)
Professor	1	240
Associate Professor	10	1,800
Assistant Professor	13	1,560
Lecturer	2	168
Technical Staff and Worker	10	397
Sub-Total	36	4,164
Industrial Personnel		
Cheif-Officer	1	48
Assistant Officer	3	144
Clarical Staff	6	216
Sub-Total	10	408
Total	46	4,572