

CHAPTER 4 BASIC DESIGN

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4.1 Basic Design Policy

The contents and the scale of equipment, which are studied in Chapter 3, are optimized through sufficient adjustment on the equipment and its function in cooperation with NTI so that the system is designed as a total one, eliminating duplication with the existing equipment and forming a minimum scale of system enough to achieve training objectives, based on careful study on the contents of NTI's training.

(1) Switching and Traffic Department

Digital switching equipment should be selected because this is the type of equipment that will be introduced widely in Egypt in the future. Considering that the switching equipment is primarily for training use, the components such as subscriber circuits, trunk circuit packages and modules should be of the minimum scale, and also pseudo traffic generators, several testing consoles, and training-use simulation systems should be provided. As for signaling, No. 7 signaling should be selected in consideration of its having the functions of current-use signaling in Egypt and becoming the world standard in the future.

(2) Network Planning Department

To train network planning engineers and to give technical support to optimum network design are one of the important roles of NTI, but this department presently has no equipment for training and technical support use. Therefore, network design system and data collecting and processing equipment suitable for training use should be selected. For mass data processing, network parameter calculation, and NTI's development of simple network design programs, some on-line personal computers should be provided.

(3) Transmission Department

All requested analog transmission equipment should not be included, and only digital transmission equipment should compose a system. So far as the training objectives are achieved and transmission practices can be conducted, the equipment system configurations are designed simply and economically by means of reducing the number of PCM multiplexers, limiting supervisory equipment functions of optical fiber transmission systems, simplifying the fading test and minimizing measuring instruments.

(4) Electronics Department

The training objectives of this department are to teach the fundamentals of electronic circuits and microprocessors and their applications to telecommunication systems and computer systems. Therefore, equipment necessary to design electronic circuits and microprocessors and equipment for measuring operating characteristics should be selected.

(5) Computer and Systems Department

At present, principal Egyptian governmental organizations and private sectors are advancing their business computerization and introducing in-house data communication systems consisting of computer and telecommunications services. ARENTO's public packet switching services to commence in the near future accelerate these tendencies. Therefore, these organizations have requested NTI to train computer-related engineers to master telecommunications network application techniques and telecommunications-related engineers to master computer application techniques. In response to these requests and to contribute to sound development in these fields, NTI plans to expand the training courses in the Computer and Systems Department. Therefore, computer systems necessary to conduct these training courses effectively should be provided. Each computer terminal and the host computer should be connected through a Local-Area Network (LAN), with the host computer used commonly from each computer terminal.

(6) Administration and Support Department

For balanced trainee technique levels and supplementary materials for trainees' own learning, Computer-Assisted Learning (CAL) systems should be provided. CAL systems also should have functions for preparing teaching materials.

4.2 Equipment Plan

4.2.1 Equipment Selection Policy

This section outlines the policy for selecting equipment for each NTI department.

(1) Switching and Traffic Department

- 1) The switching system should be a digital switching system using a stored program control system currently being introduced in Egypt and which will become the standard switching system from now on.
- 2) The stage is the local switching stage which has the largest number of systems and technical employees in Egypt.
- 3) The selected system is a commercial switch having the same capability as the switch currently used in Egypt.
- 4) As a basic rule, considering their use for training and research, the number of mounted packages and modules should be the minimum number that can constitute a complete switching system. Necessary components can be added to the system according to training needs.

- 5) The software has function similar to those of the digital switches currently being introduced in Egypt.
- 6) The switching system can be connected with the transmission systems and has functions to enable connection with outside switching systems.
- 7) The switching system includes peripheral equipment and measuring instruments used for practical training.
- 8) An automatic voltage regulator is included, but an emergency-use generator is not included.
- 9) Air-conditioning equipment is not included.

(2) Network Planning Department

- 1) Data collection equipment, data processing equipment and a network design system are provided.
- 2) Data collection equipment corresponds to subscriber telephone lines, data transmission lines, and digital signaling lines.
- 3) Data processing equipment that can efficiently and correctly analyze huge volumes of collected data and make data files from the collected data is provided.
- 4) The network design system is a graphic workstation with the function of switching network design and transmission network design.

(3) Transmission Department

- 1) The selected equipment is limited to digital systems and satellite communications equipment in consideration of future telecommunications technical trends.
- 2) The microwave transmission systems are a 6 GHz long-haul trunk line system and an 11 GHz short-haul system to carry out propagation tests of different frequency radio waves and characteristic tests of different modulation systems. The digital modulation systems are an 8 PSK system and a 16 QAM system.
- 3) The optical fiber transmission system is a single-mode long-haul optical fiber transmission system because this system will replace the existing long-haul coaxial cable system (960 channels).
- 4) The capacity of the microwave and optical fiber transmission systems is 1,920 channels, being compatible with the existing analog system capacity (960 channels).
- 5) To conduct automatic and manual circuit switching training, supervisory equipment is selected.
- 6) Digital multiplexers are limited to the minimum scale that can carry out integrated transmission system tests connecting switching equipment and transmission lines.
- 7) To test the basic characteristics of the satellite communication system, a satellite TV receiving earth station system is provided.

- 8) To carry out equipment characteristic tests and integrated transmission tests, of the above transmission systems, the minimum number of necessary measuring instruments is provided.

(4) Electronics Department

- 1) Printed circuit board design aided equipment and fabrication equipment and measuring instruments are selected to carry out experimental laboratory work on electronic circuit techniques and measuring techniques.
- 2) As printed circuit board design aided equipment and fabrication equipment, simple equipment is selected because trainees will use it for electronic circuit designing and trial fabrication.
- 3) Circuit training kits can be used for training semiconductor elements, electronic circuits, modulation and demodulation circuits, pulse circuits, analog-digital conversion circuits, and microprocessor functions and operating characteristics.
- 4) As for measuring instruments, standard types are requested for training use, and the number is limited to the minimum necessary number based on the frequency of use.

(5) Computer and Systems Department

- 1) The requested system is a general-purpose on-line computer system having the following three major uses:
 - a) Use as a practice computer in the computer-related training courses.

- b) Use as a practical system development computer in the consultation and research activities.
 - c) Use as a shared computer by the other departments.
- 2) The center computer may be either a mainframe or a super-mini depending on the amount of processing work and the required performance. Computer selection should also be based on expandability, maintenance capability, availability of new technology on that type, cost, training facilities, and operation.
 - 3) In order to lower the costs of the computer systems, a simplex configuration should be chosen on the condition that sufficient maintenance be available in Egypt, and that training have first priority at times of heavy loads.
 - 4) To cope economically with wide training and research needs, from personal computers to on-line computer systems, terminal equipment should not be an exclusive-use type but rather a general-purpose type. Therefore personal computers have been selected for use as terminal equipment, and these can also be used as stand-alone personal computer systems.
 - 5) Graphic terminal equipment is selected because of the need for high-end graphics, advanced graphics training, and systems development.
 - 6) X.25 gateway equipment is provided for the training purpose for connecting NTI computer system to the public packet switching system.
 - 7) Simple graphics training will be possible by adding a graphic board to the on-line personal computers, in consideration of economic system design requirements.

8) For the connection between the center computer and the on-line personal computers, two typical connection methods have been studied. One is a conventional method with MODEMs and the other is a relatively new (Local Area Network) system without MODEMs. In the NTI on-line system, a LAN system is recommended based on the following:

- a) Efficient use of the center computer system
- b) Easy installation compared with a conventional method; simple connection method and low cost (MODEMs not required)
- c) Ease of future expansion of the number of terminals by NTI itself.

9) The minimum and necessary software is selected for the use of training, consultation and research work.

10) Uninterruptible power supply units are included in consideration of Egyptian power circumstances.

11) Air conditioning system is not included.

(6) Administration and Support Department

- 1) CAL (Computer Assisted Learning) systems are introduced because the knowledge and technical capabilities of all the training course participants should be equal in order to conduct training courses effectively.

- 2) CAL system teaching materials installed will be related to basic technology in digital technology fields. For other fields, a teaching material production system is introduced so that NTI instructors can develop their own teaching materials.
- 3) On-line personal computers are introduced for the use of NTI's administrative and analytic work, Information Center work, and library management work, which can all make use of the center computer.
- 4) Uninterruptible power supply units are included.

4.2.2 Contents of Equipment Selected

Selected equipment is shown in Table 4.1 "Equipment List". Required functions of the equipment are shown in Annex-5 and the relationship between training courses and equipment is shown in Annex-6 "NTI Training Courses and Necessary Equipment".

The content of equipment selection and reasons of deciding quantity is as follows.

(1) Switching and traffic department

- 1) Based on the item 4.2.1 "Equipment Selection Policy", one unit of stored program digital switching system is selected.
- 2) Five maintenance and administration terminals are selected, on account of the plan that each course will take on 20 trainees, so that one terminal can be assigned to each group of four trainees, at the maximum, for experimental laboratory work.
- 3) Several sets of fundamental measuring instruments are selected for experimental laboratory work, assigning one set to each of selected categories of equipment.
- 4) The capacity of the traffic generator is decided so that it can generate a sufficient amount of traffic to perform load tests of a switching system under minimum capacity, generating 30,000 calls/hour with 90 subscriber lines, 30 analog trunks and 30 digital transmission channels.
- 5) No.7 signal monitoring equipment, which can monitor both the common channel signals and the channel associated signals, is selected.

Table 4.1 EQUIPMENT LIST

I. Switching and Traffic Department

Equipment	Quantity
<p>1. Switching system</p> <p>Comprising;</p> <p>(1) Digital switching equipment and NTI local data</p> <p>(2) Maintenance and administration terminal</p> <p>(3) Power unit</p> <p>(4) Spare parts</p> <p>(5) Measuring equipment</p> <ul style="list-style-type: none"> • Digital multimeter • Frequency counter • Oscillator/Levelmeter • Logic analyzer • Auto TMS <p>(6) Maintenance tool</p> <p>(7) Installation material</p> <p>(8) Documentation</p>	<p>1 System</p> <p>5 Sets</p> <p>1 Sys.</p> <p>1 Lot</p> <p>1 Lot</p> <p>1 Set</p> <p>1 Set</p> <p>1 Set</p> <p>1 Set</p> <p>1 Set</p> <p>1 Lot</p> <p>1 Set</p> <p>1 Set</p>
<p>2. Traffic generator</p> <p>(1) Generator for subscriber line</p> <p>(2) Generator for analog trunk</p> <p>(3) Generator for digital transmission</p>	<p>3 Sets</p> <p>1 Set</p> <p>1 Set</p>
<p>3. No.7 signaling monitor</p>	<p>1 Set</p>
<p>4. Training simulator</p>	<p>1 Set</p>
<p>5. On-line personal computer (On-line PC)</p> <p>(1) On-line PC</p> <p>(2) Uninterruptible power supply unit (UPS)</p>	<p>1 Set</p> <p>1 Unit</p>

II. Network Planning Department

Equipment	Quantity
1. Traffic measuring equipment (1) Measuring equipment (2) Off-line personal computer (3) UPS	5 Sets 2 Sets 4 Units
2. Network designing system (1) Graphic workstation (2) Color graphic printer (3) UPS	1 Set 1 Set 1 Unit
3. Measuring equipment (1) Protocol analyzer (2) Data communication analyzer (3) Modem tester (4) Voice band analyzer (5) Digital transmission analyzer (6) Artificial telephone line	3 Sets 2 Sets 2 Sets 2 Sets 2 Sets 2 Sets
4. On-line PC (1) On-line PC (2) UPS for on-lin PC	8 Sets 4 Units

III. Transmission Department

Equipment	Quantity
<p>1. Digital 6GHz Radio System</p> <p>(1) Transmitter-Receiver</p> <p>(2) Transmitter-SD.Receiver</p> <p>(3) Modulator-Demodulator</p> <p>(4) Modulator & Frame</p> <p>(5) Branching Circuit</p> <p>(6) Fading Simulator</p> <p>(7) Alarm Distribution Board</p> <p>(8) Power Distribution Board</p> <p>(9) Supervisory & Control System</p> <p>(10) 6 GHz Parabolic Antenna</p> <p>(11) 6 GHz Parabolic Antenna</p> <p>(12) 6 GHz Waveguide</p> <p>(13) Antenna Mount Structure</p> <p>(14) Dehydrator</p> <p>(15) Tools & Fittings</p> <p>(16) Attenuator</p> <p>(17) Switch</p>	<p><u>2 Systems</u></p> <p>4 Sets</p> <p>1 Set</p> <p>4 Sets</p> <p>1 Set</p> <p>2 Sets</p> <p>2 Units</p> <p>2 Sets</p> <p>2 Sets</p> <p>1 Set</p> <p>2 Units</p> <p>1 Units</p> <p>200 m</p> <p>3 Sets</p> <p>2 Sets</p> <p>1 Lot</p> <p>2 Units</p> <p>2 Units</p>
<p>2. Digital 11GHz Radio System</p> <p>(1) Transmitter-Receiver</p> <p>(2) Transmitter-Modulator</p> <p>(3) Modulator-Demodulator</p> <p>(4) Power Distribution Board</p> <p>(5) 11 GHz Parabolic Antenna</p> <p>(6) 11 GHz Parabolic Antenna</p> <p>(7) 11 GHz Waveguide</p> <p>(8) Antenna Mount Structure</p>	<p><u>1 System</u></p> <p>2 Sets</p> <p>1 Set</p> <p>2 Sets</p> <p>2 Sets</p> <p>1 Unit</p> <p>1 Unit</p> <p>200 m</p> <p>2 Sets</p>

Equipment	Quantity
(9) Dehydrator	2 Sets
(10) Tools & Fittings	1 Lot
(11) Attenuator	2 Units
(12) Switch	2 Units
3. PCM Multiplex System	
(1) 2M PCM Multiplexer	2 Sets
(2) 8M PCM Multiplexer	2 Sets
(3) 34M PCM Multiplexer	2 Sets
(4) 140M PCM Multiplexer	1 Set
(5) DDF & VDE	2 Sets
4. 140M Fiber Optic Transmission System	<u>2 Systems</u>
(1) Line Terminating Equipment	4 Sets
(2) Repeater Equipment	2 Sets
(3) Supervisory & Controlling System	1 Set
(4) Line Switch	2 Sets
(5) Optical Fiber Cable	140 Km
(6) Optical Fiber Cable	2 Km
(7) Joint Box	1 Lot
(8) Attenuator	4 Sets
5. Satellite TV Receiver System	<u>1 System</u>
(1) Antenna System	1 Set
(2) Low Noise Converter	1 Set
(3) Satellite TV Receiver	1 Set
(4) TV Monitor	1 Set
6. Microwave Training Bench	4 Sets
7. System Display Board	2 Sets

Equipment	Quantity
8. On-line PC	
(1) On-line PC	2 Sets
(2) UPS for on-line PC	1 Unit
9. Power Supply System	5 sets
10. Solar Power System	1 Set
11. Spare Parts	1 Lot
12. Installation Materials	1 Lot
13. Documentation	1 Lot
14. Testing & Measuring Equipment	
14-1 For Radio and MUX System	
(1) Power Meter	4 sets
(2) Frequency counter	2 sets
(3) Digital Transmission Analyzer	2 sets
(4) Spectrum Analyzer	1 set
(5) Spectrum Analyzer	1 set
(6) Synchroscope	2 sets
(7) Synchroscope	2 sets
(8) Microwave System Analyzer	2 sets
(9) Microwave Frequency Converter	1 set
(10) Microwave Frequency Converter	1 set
(11) Vector Signal Generator	1 set
(12) Vector Modulation Analyzer	1 set
(13) Noise Test Set	1 set
(14) Jitter Generator	2 sets
(15) Error Rate Measuring Equipment	2 sets

Equipment	Quantity
(16) Tracking Generator	1 set
(17) Video Signal Generator	1 set
(18) Satellite TV Signal Transmitter	1 set
(19) Video Signal Analyzer	1 set
(20) TV Waveform Monitor	1 set
(21) Signal Generator	2 sets
(22) Chart Recorder	3 sets
14-2 For Optical Fiber Transmission System	
(1) Stabilized Light Source	2 sets
(2) Optical Power Meter	2 sets
(3) Optical Wavelength Meter	2 sets
(4) Optical White Light Source	1 set
(5) Optical Spectrum Analyzer	2 sets
(6) Optical Time Domain Reflectometer	2 sets
(7) Chromatic Dispersion Characteristics Measuring Equipment	1 set
(8) E/O Converter	1 set
(9) O/E Converter	1 set
(10) Optical Return Loss Measuring Set	1 set
(11) Optical Variable Attenuator	4 sets
(12) Optical Switch	4 sets
(13) Optical Coupler	4 sets
(14) Fiber Arc-Fusion Splicer	1 set
(15) Connectorization Kit	1 set

IV. Electronics Department

Equipment	Quantity
<p>1. Printed circuit fabrication equipment</p> <p>(1) Standard circuit board</p> <p>(2) Ultraviolet exposure unit</p> <p>(3) P.C.B. processing & wash tank</p> <p>(4) Precision mini drill</p> <p>(5) P.C.B. etching tank</p> <p>(6) P.C.B. cutter</p> <p>(7) Printed circuit work frame</p> <p>(8) Ultrasonic cleaning tank</p>	<p>100 Units</p> <p>2 sets</p> <p>2 sets</p> <p>2 sets</p> <p>2 sets</p> <p>2 sets</p> <p>2 sets</p> <p>2 sets</p> <p>2 sets</p>
<p>2. Training Kits for analog and digital circuit</p> <p>(1) Semiconductor element experimental equipment</p> <p>(2) Electronic circuit experimental equipment</p> <p>(3) MODEM circuit experimental equipment</p> <p>(4) Pulse circuit experimental equipment</p> <p>(5) Analog digital conversion experimental equipment</p> <p>(6) IC training equipment</p> <p>(7) 8-bit microprocessor training equipment</p> <p>(8) 16-bit microprocessor training equipment</p>	<p>2 sets</p> <p>2 sets</p> <p>2 sets</p> <p>2 sets</p> <p>2 sets</p> <p>2 sets</p> <p>5 sets</p> <p>5 sets</p>
<p>3. CAD system</p> <p>(1) PCB CAD software package</p> <p>(2) Personal computer</p> <p>(3) Graphic plotter</p> <p>(4) UPS for personal computer</p>	<p>2 sets</p> <p>2 sets</p> <p>2 sets</p> <p>1 set</p>

Equipment	Quantity
4. Measuring equipment	
(1) IC troubleshooting kit	2 sets
(2) EPROM programmer	2 sets
(3) Microprocessor system analyzer	2 sets
(4) Logic analyzer	2 sets
(5) Microprocessor based controller	4 sets
(6) Logic probe	15 sets
(7) Function generator	5 sets
(8) Digital multimeter	5 sets
(9) Frequency counter	5 sets
(10) Q meter	1 set
(11) Vector impedance meter	1 set
(12) Selective level meter/oscillator	1 set
(13) Cable fault locator	1 set
(14) Spectrum analyzer	1 set
(15) Artificial telephone line	1 set
(16) Frequency synthesizer	1 set
(17) Audio analyzer	1 set
(18) Dynamic signal analyzer	1 set
(19) Portable instrumentation tape recoder	1 set
(20) Band pass filter	1 set
(21) PCM generator/monitor/noise generator	1 set
(22) PCM transmission measuring set	1 set
5. On-line PC	
(1) On-line PC	1 set
(2) UPS for On-line PC	1 unit

V. Computer and Systems Department

Equipment	Quantity
<p>1. Center computer system comprising;</p> <p>(1) central processing unit</p> <p>(2) Console subsystem</p> <p>(3) Magnetic disk unit</p> <p>(4) Magnetic tape unit</p> <p>(5) Line printer</p> <p>(6) X-Y plotter</p> <p>(7) Graphic terminal</p> <p>(8) X.25 Gateway equipment</p> <p>(9) Operating system and utilities</p>	<p><u>1 system</u></p> <p>1 set</p> <p>1 set</p> <p>4 units</p> <p>2 units</p> <p>1 unit</p> <p>1 unit</p> <p>1 set</p> <p>1 unit</p> <p>1 set</p>
<p>2. On-line PC for training</p> <p>(1) On-line PC (Trainees)</p> <p>(2) On-line PC (Instructors)</p>	<p>20 sets</p> <p>1 set</p>
<p>3. On-line PC for staff</p> <p>(1) On-line PC (staff)</p> <p>(2) Page printer</p>	<p>4 sets</p> <p>1 unit</p>
<p>4. Local area network (LAN : 3 segments)</p>	<p>1 set</p>
<p>5. Uninterruptible power supply unit (UPS)</p> <p>(1) UPS for center computer</p> <p>(2) UPS for on-line PC</p>	<p>1 unit</p> <p>14 units</p>
<p>6. Spare parts</p>	<p>1 lot</p>
<p>7. Maintenance tools</p>	<p>1 lot</p>

Equipment	Quantity
8. Installation materials	1 lot
9. Documentation	1 lot
10. Articles for consumption	1 lot

VI. Administration and Support Department

Equipment	Quantity
1. CAL (Computer Aided Learning) System	
(1) CAL terminal	4 sets
(2) Teaching materials making system	1 set
(3) CAL teaching materials (for 9 courses)	9 sets
(4) UPS for CAL terminal	2 units
2. On-line PC	
(1) On-line PC	2 sets
(2) Uninterruptible power supply unit(UPS)	1 unit

(2) Network planning department

- 1) Five sets of traffic measuring instruments are selected so that the fundamental traffic data of working subscriber lines can be collected at five locations at least at a time.
- 2) One set of network design system is provided for use in the Telecommunications Diploma Course and practical network design project.
- 3) Two sets of measuring instruments are selected for each category, in principle, so that one set can be assigned to each of corresponding ends. However, protocol analyzers are assigned three sets to each using purposes.
- 4) Eight on-line personal computers are selected so that each group of three trainees can use one set for data processing. Four of the eight sets are equipped with a 20-megabyte hard disk each for relatively small amount of data processing, and the others with a 40-megabyte hard disk each.

(3) Transmission department

- 1) A set of 6 GHz radio equipment (1+1 systems) with 68 MB of capacity equivalent to 960 CH being popular in Egypt and with typical digital modulation (8 PSK) is selected as a long-haul microwave transmission system. In addition to the equipment, supervisory/control equipment necessary for operation and maintenance is also selected to enable experiment on automatic and manual switching of the radio equipment.

- 2) One system of 11 GHz radio equipment with 140 MB of capacity equivalent to 1920 CH and with 16 QAM digital modulation suitable for high capacity is selected for its popular functions.
- 3) A set of optical fiber transmission equipment (1+1 systems) with 140 MB of capacity and a supervisory/control equipment are selected as the capacity (1920 CH) has compatibility with the capacity (960 CH) of the existing coaxial cable for the long-haul system.
Hereupon the number of systems (1+1 systems) of the 6 GHz radio and the optical fiber equipment is the minimum for twenty trainees in a course.
- 4) A set of digital multiplexers (2 systems of 2 MB, 8MB, 34 MB MUXs and a 140 MB MUX) is selected to install at one side of terminal transmission equipment because of the economical design.
- 5) A set of simple satellite TV receiver system with the function of receiving the TV signal transmitted from the existing EUTELSAT is selected together with an antenna system in consideration of economy and training effect. The antenna has a diameter of 4.5 meters to keep minimum video quality necessary for training.
- 6) Four sets of microwave circuit training kits which are arranged and connected together on a table for measuring each circuit are selected so as to supply five trainees with a set.

- 7) For microwave propagation experiments, three antennas for 6 GHz and two antennas for 11 GHz are selected. The arrangement of the antenna systems is shown in Figure 4.2 and the antenna diameters are minimized for training experiment though an actual microwave line normally has a 4-meter antenna.
 - 8) A minimized number of testing and measuring instruments necessary for measurement of the equipment characteristics and the system quality in the transmission systems is selected in due consideration of the number of trainees, frequency of use and necessity of tests.
- (4) Electronics department
- 1) One set of CAD (Computer Assisted Design) system for print circuit board design is selected, which has functions of component parts allocation and automatic wiring by means of input data.
 - 2) Two sets of simple printed circuit board fabrication equipment for manual making are selected. As to circuit boards, two types are selected, that is, the standard and the sensitive.
 - 3) Several kinds of experimental equipment are selected to perform digital electronics, electronic circuit measurement, microprocessor technology courses and so on.
 - 4) The measuring instruments, used for the training courses on circuit and measurement technology, and its quantity are decided in consideration of the categories and quantity that NTI has.

(5) Computer and systems department

- 1) The central processing unit of the center computer has the performance to be able to handle smoothly the various transactions of training, research and NTI administration works from 40 terminals or more.
- 2) Main memory area consists of four parts: that is, (1) an area to run the operating system (OS), (2) that to control terminals, (3) that to run various programs, and (4) that to be used commonly as an working area for data files.

Since real time control to 40 terminals, real time running of various kinds of programs for training and research, and real time retrieval and processing of various big-scale data bases related to telecommunications are required, a main memory with a capacity of 32-megabyte is suitable for the NTI's computer system.
- 3) The capacity of magnetic disk units is more than 2.5 gigabytes (GB) in total for use in training, consultation and research work. The 2.5 gigabytes should be divided into about four drive units to ease maintenance and operation.
- 4) Two magnetic tape units are installed because of the need of tape to tape processing and automatic unit switching for file copying and backup.
- 5) For graphic training, one graphic terminal equipment capable of making high-density graphics is installed. One digitizer is installed for graphic data input and one X-Y plotter is installed for graphic data output.

- 6) For the use of mass data printing at training and research work, one line printer is installed.
- 7) One unit of X.25 gateway equipment is provided to connect NTI computer system to the public packet switching system in ARENTO.
- 8) Because training course participants are normally limited to 20 persons, with a maximum of 40, and the number of the courses is quite large, the training courses have to be conducted effectively, therefore 20 on-line personal computers are installed for use by trainees, and one more for instructors.

The on-line personal computer for instructors has one color printer with simple color graphics output capability so that simple graphics made by trainees can be printed.

- 9) For the staffs' use four sets of on-line personal computer are installed. One set is used for various training programs and production of teaching materials, two sets are used for consultation and research work, and one set is used for the departments' own work and NTI's data base accessing.

In order to output a relatively large amount of teaching materials production and program making, one page printer is selected.

- 10) The LAN (Local Area Network) system adopts the CSMA/CD method which will be introduced to Egypt widely. Three segments of the LAN system are installed in consideration of the number of terminals and conditions of the building.

(6) Administration and support department

- 1) The CAL system is installed mainly for the purpose of equalizing foreign trainees from the third countries. The average number of foreign trainees in one course is normally four, therefore four sets of CAL terminals are installed.
- 2) CAL teaching materials are selected to give basic knowledge to equalize trainees' level.
 - a) Outline of network design techniques
 - b) Outline of traffic theory
 - c) Basic techniques of digital switching
 - d) Optical fiber transmission basic techniques
 - e) Digital transmission techniques
 - f) Digital microwave transmission theory
 - g) Data transmission control procedure
 - h) Basic electronic circuits
 - i) Advanced electronic circuits
- 3) One set of CAL teaching materials production system is installed and has teaching materials graphics (Frame) production functions and learning order decision functions, and is operated on the CAL terminals.
- 4) Two sets of on-line personal computers are installed. One set is used for the NTI's administrative and analytic work. The other set is used for Information Center and library management work.

4.2.3 System Configuration

4.2.3.1 System Configuration of Switching and Transmission Equipment

The switching and the transmission equipment shall be interconnected, forming a total telecommunications network similar to working ones. Outgoing and incoming trunks of the switching equipment shall be connected to the transmission equipment through VDF or DDF, making a loop at an adequate point, then enabling experimental work on a total system, not on independent equipment. A trunking diagram of the switching equipment is shown in Figure 4.1, and transmission system configuration is shown in Figure 4.2.

(1) Switching system configuration

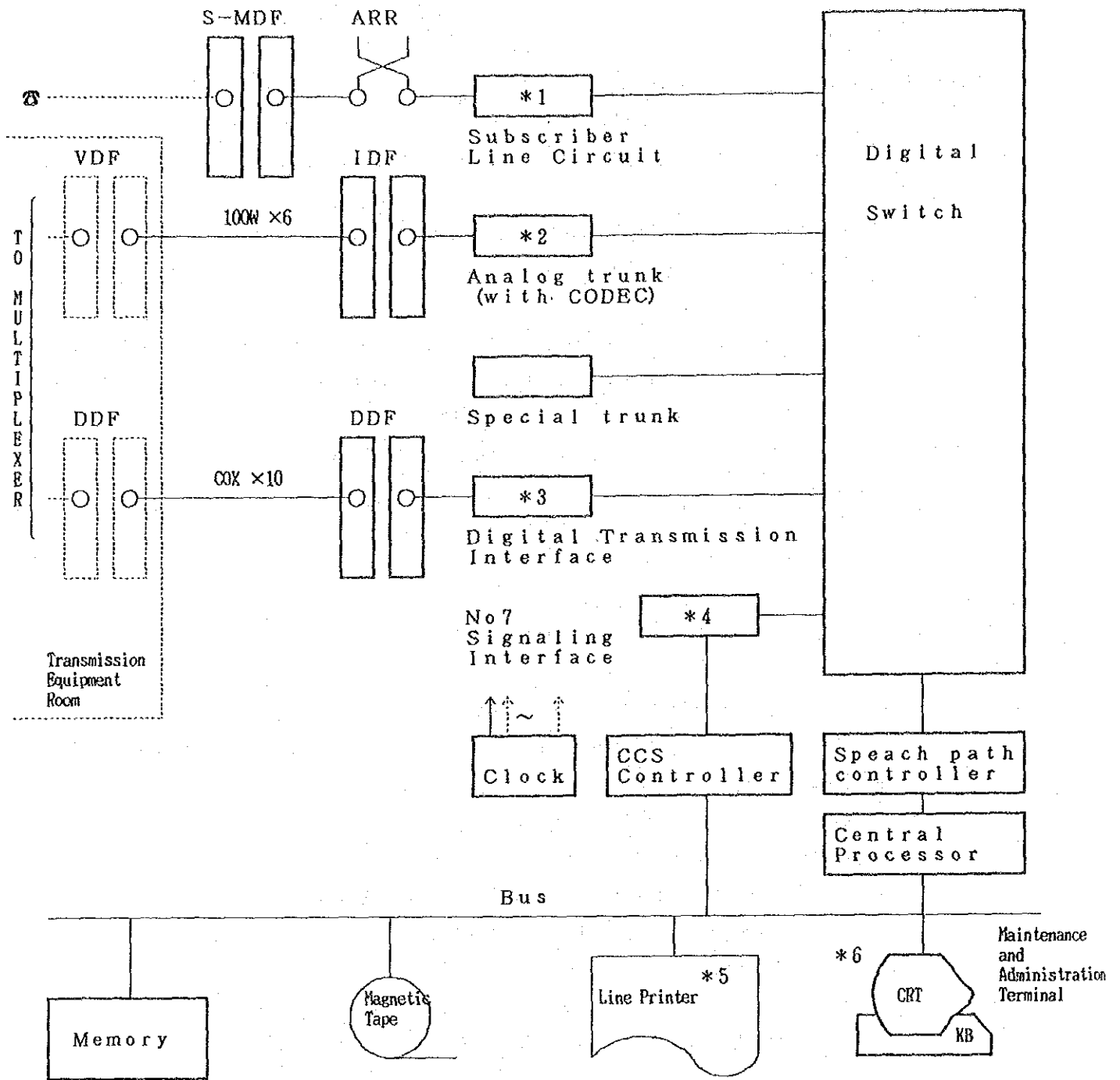
1) Interfacing to transmission equipment

Cables from VDF in the switching equipment room to VDF in the transmission equipment room shall be installed as part of the switching equipment.

Digital trunks shall be equipped with digital transmission interfaces of 2.048 Mb/s, while analog trunks shall be equipped with the function of CODEC and interconnected at voice level.

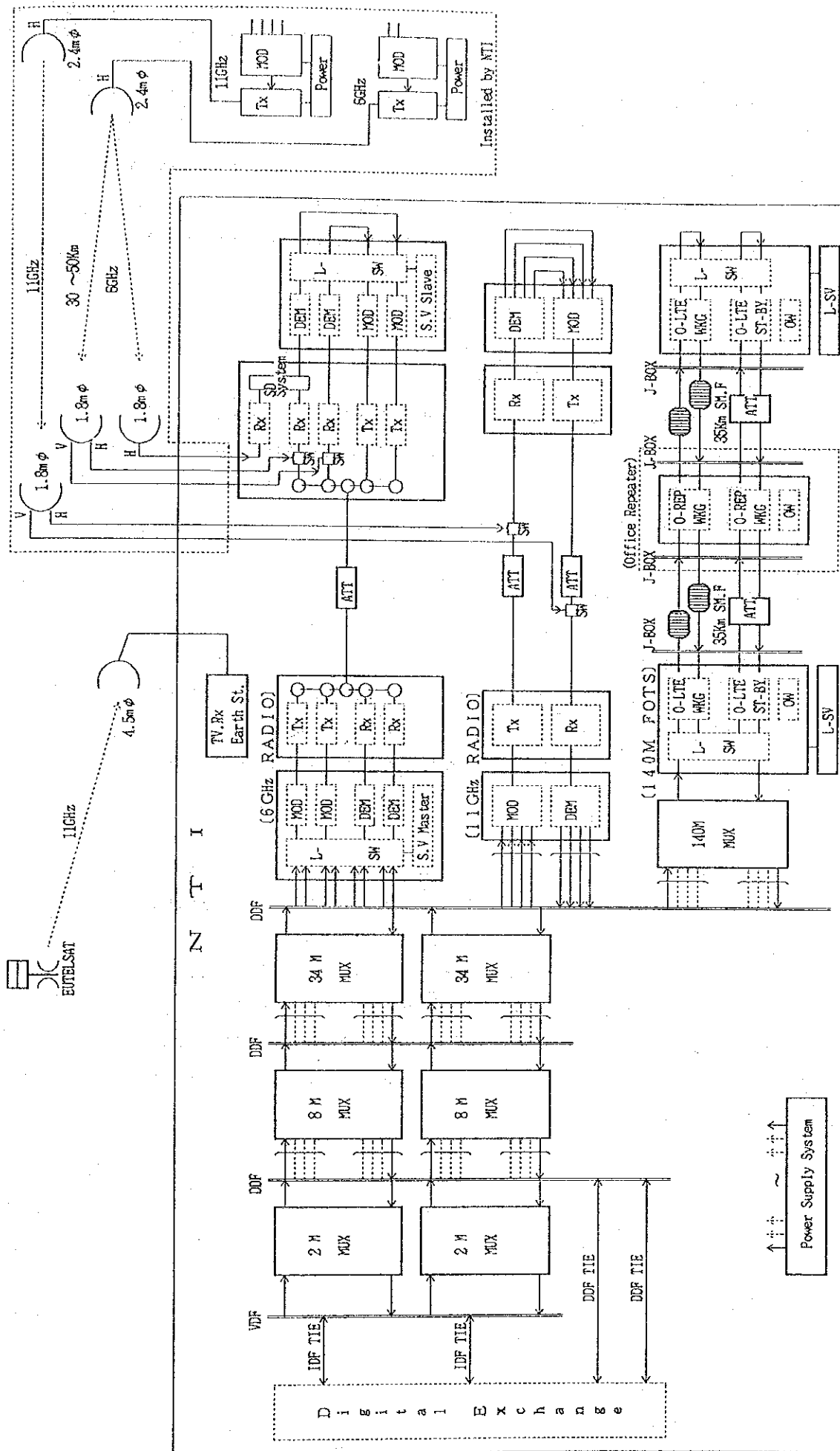
2) Interconnection to outside commercial facilities

Subscriber circuits, analog trunks and digital transmission interfaces shall be terminated at MDF, VDF and DDF, respectively. The interconnection to outside commercial switching systems may be realized through that VDF, or DDF in the transmission equipment room, by NTI, when necessary. The traffic generator can be connected to the switching system through those MDF, VDF and DDF.



Mark	Class	Q' ty	Mark	Class	Q' ty
*1	Individual	200 lines	*3	Digital Trans. Interface	5 IF
	Coin or PBX	40 "	*4	No7 CCS Interface	2 IF
*2	Loop/MFC	24 cct	*5	Line Printer	1 SET
	E&M/MFC	15 "	*6	M/A Terminal	5 SETS
	Other trunks	21 "			

Fig. 4.1 Trunking Diagram of Switching System



- 6GHz 68MB 8PSK 1+1 SYSTEM
- 11GHz 140MB 16QAM 1 SYSTEM
- 11GHz SATELLITE RECEIVER
- 140MB FOTS 1+1 SYSTEM

Fig. 4.2 Transmission System Configuration

3) Maintenance and administration terminals

Terminals for performing supervision, control and tests of the switching system shall be provided. Making use of the switching system software, traffic measurement, equipment diagnosis and data change can be performed by the terminals.

4) Network synchronization clock

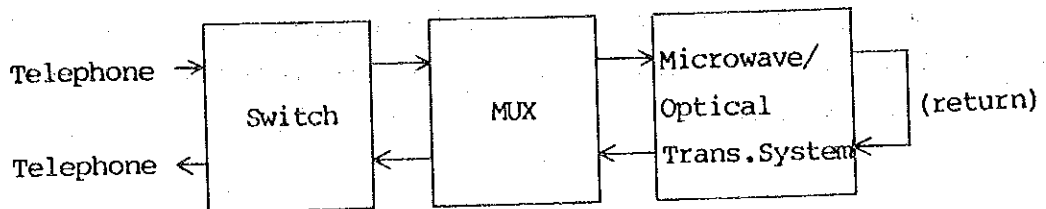
Network synchronization clock pulses shall be supplied from an internal clock of the switching system. They can be taken out of a digital transmission interface through digital transmission lines from other exchanges.

(2) Configuration of transmission system

1) A transmission system has functions that signals sent from a switch are multiplexed and transmitted far away through a microwave system or a cable/optical fiber system. Accordingly the transmission system containing above functions is provided in the Project.

2) In the configuration, the transmission system is composed of 6 GHz microwave systems (1+1 sys) having two corresponding terminal stations, an 11 GHz microwave system (1 sys) having two corresponding terminal stations, and optical fiber transmission systems (1+1 sys) having two corresponding terminal stations and one repeater station. Multiplexers are connected to the station on one side of each system through a signal distribution board (DDF).

- 3) Power attenuators are used in place of antennas between the microwave equipment as an in-building training system. In the optical transmission systems, one system has actual optical fiber lines and another has optical attenuators instead of optical fibers for economical reason.
- 4) On the occasion of training concerning an overall telecommunication system, trainees will comprehend that signals sent from the switch go forward to the end terminal equipment (right side in the configuration) and then turn back to the switch as shown below:



- 5) A system concept of microwave antennas for microwave propagation experiment is presented in Figure 4.2. A building for experiment on transmission antennas and transmitters will be selected from among the ARENTO or governmental buildings 30 to 50 Km away from the NTI building.

The microwave receivers of the radio equipment provided for NTI are used as the receivers of this experiment for economy.

4.2.3.2 On-line Computer System Configuration

NTI's computer system is a general-purpose system functioning as: 1) a computer training/practice machine, 2) a practical systems development machine and 3) a machine for common use on all department's terminals. In order to realize this system, all terminals (on-line personal computer : 39 sets, graphic terminal : 1 set) must be connected to the center computer on-line, and be able to use the center computer via time sharing. Therefore the system configuration shown in Figure 4.3 is selected.

(1) A LAN system with 10 M bps data transmission speed connects all terminals and the center computer. The LAN system is installed in a total of three segments (one segment has a 500 m coaxial cable at the longest). This segmentation is done to balance the load from all terminals to the center computer, and for floor layout purposes.

(2) A console system connected to the center computer carries out operation, supervision, and maintenance of the system.

(3) Magnetic disk units connected to the center computer can file various data and software in data base format which can be used commonly for training, consultation, research and for NTI's administration work etc.

(4) An on-line personal computer has a 20 MB hard disk for trainees use and a 40 MB hard disk for instructors and staff use, and can be used as a stand-alone computer. These also have simple graphics functions.

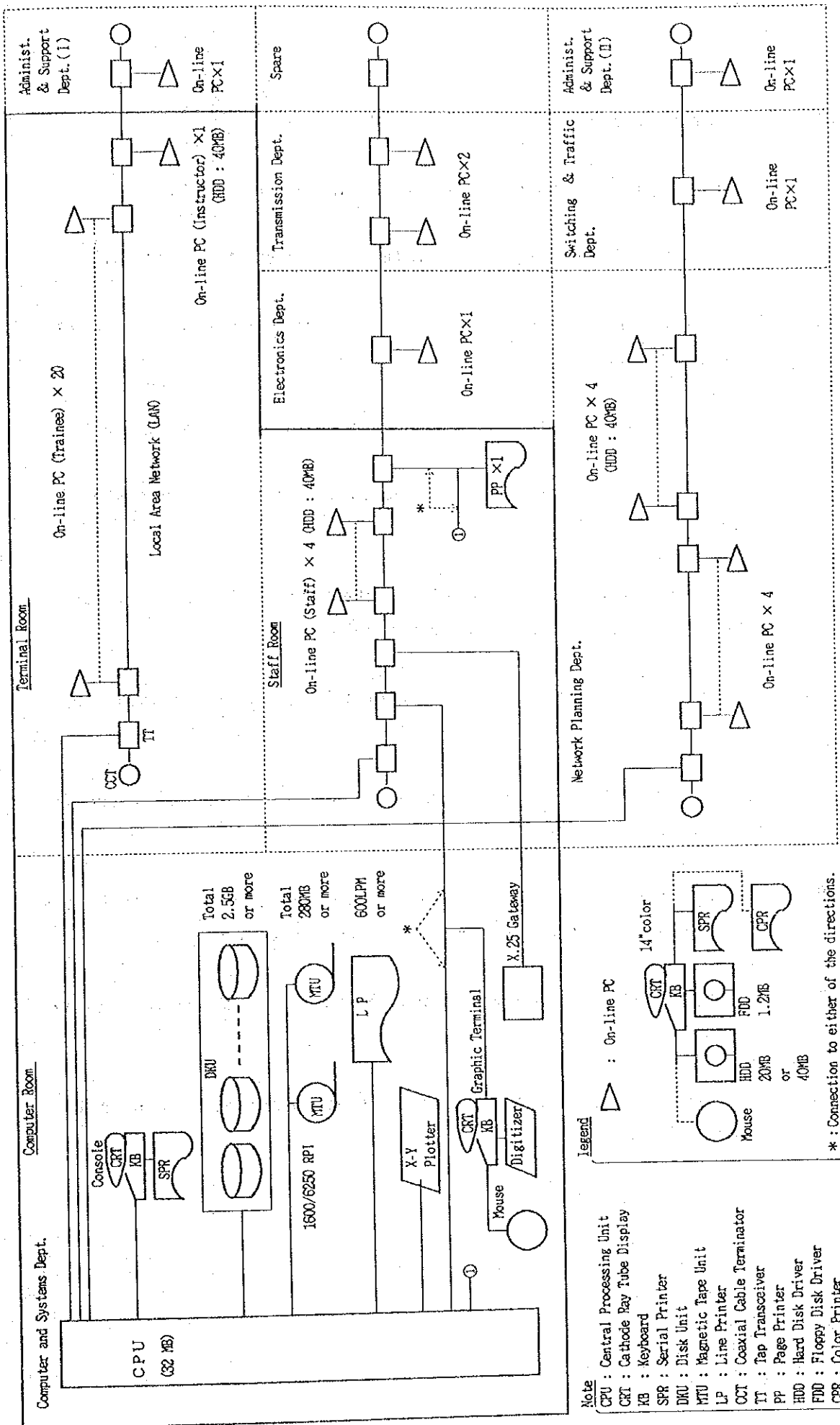


Fig. 4.3 On-line Computer System Configuration

4.2.4 Equipment Layout

Main equipment layouts are shown in Figures 4.4 to 15.

- 1) The layout of the switching equipment is shown in Figure 4.4.
- 2) The layout of the optical fiber transmission equipment is shown in Figure 4.5.
- 3) The layout of the transmission equipment is shown in Figure 4.6.
- 4) The layout of the satellite TV reception earth station system is shown in Figure 4.7
- 5) The layout of structural steel for the satellite antenna on the roof of Building A is shown in Figure 4.8.
- 6) The layout of the center computer system equipment is shown in Figure 4.9.
- 7) The layout of the on-line personal computers for training use is shown in Figure 4.10.
- 8) The layout of the on-line personal computers for the staff of the Computer and Systems Department is shown in Figure 4.11.
- 9) The layout of all on-line personal computers is shown in Figures 4.12 to 4.14.
- 10) The layout of the CAL (Computer Assisted Learning) terminals is shown in Figure 4.15.

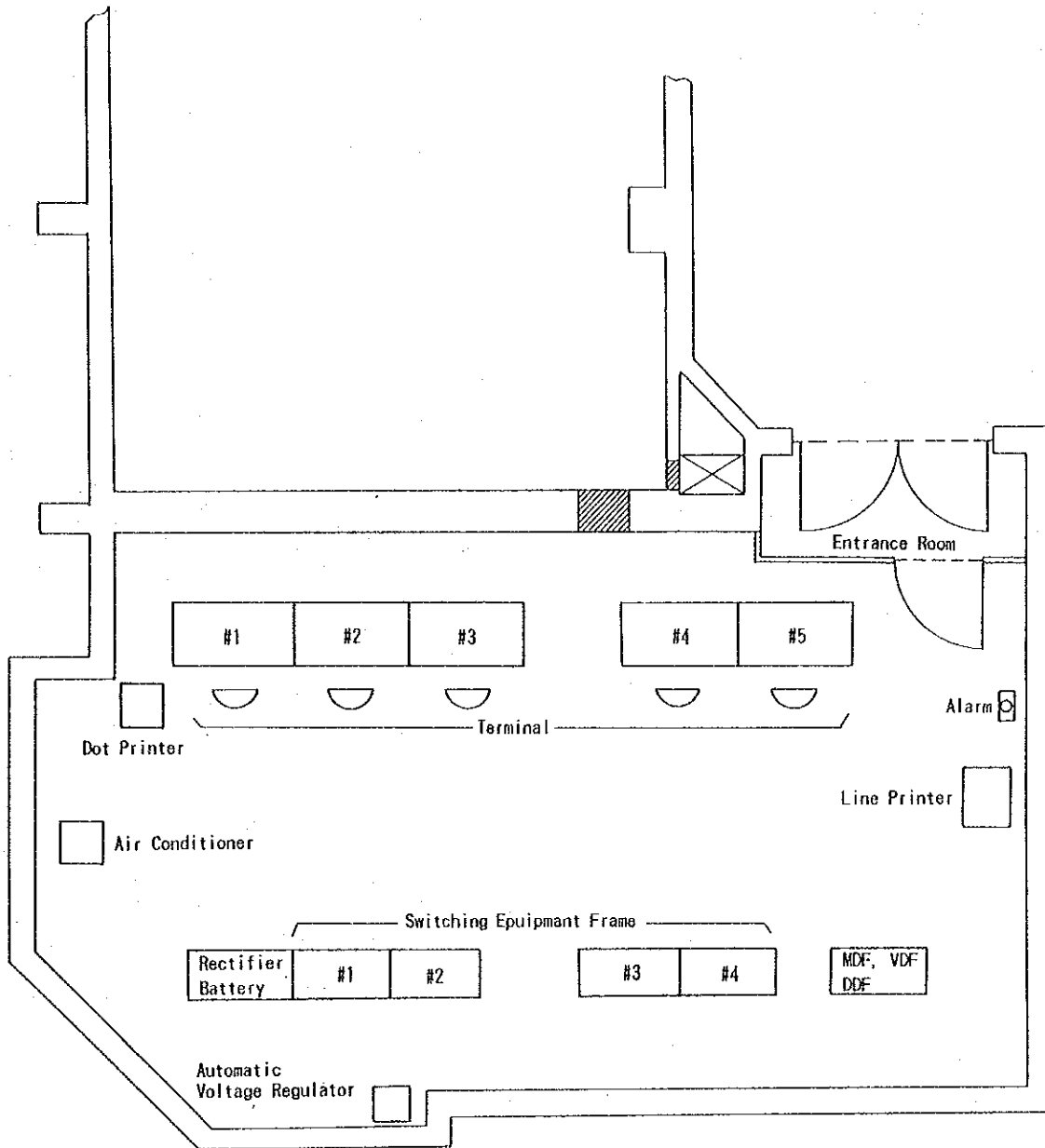


Fig. 4.4 Equipment Layout Plan in Switching Laboratory Room

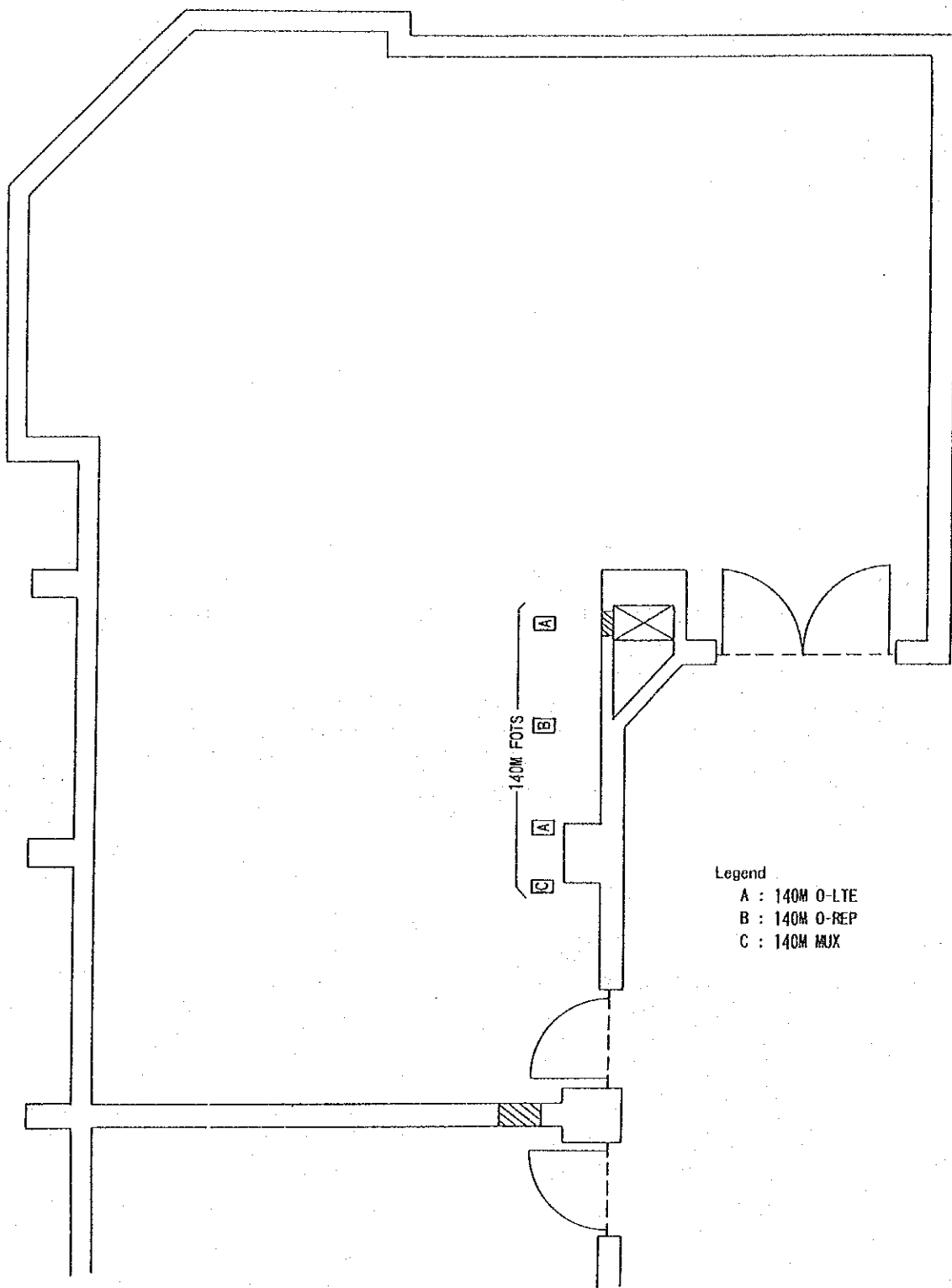


Fig.4.5 Equipment Layout Plan in Optical Fiber Lab.

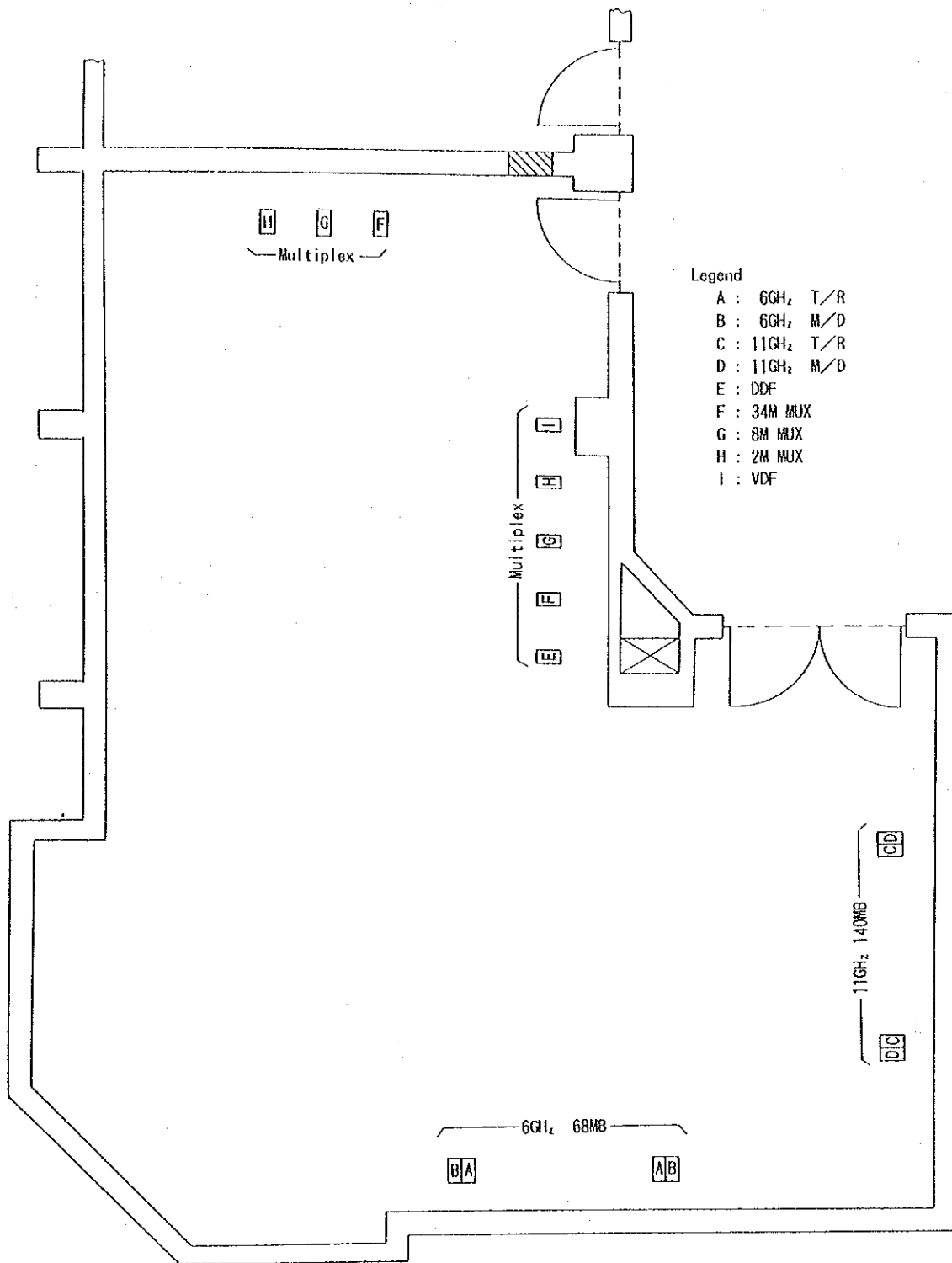


Fig. 4.6 Equipment Layout Plan in Transmission Lab.

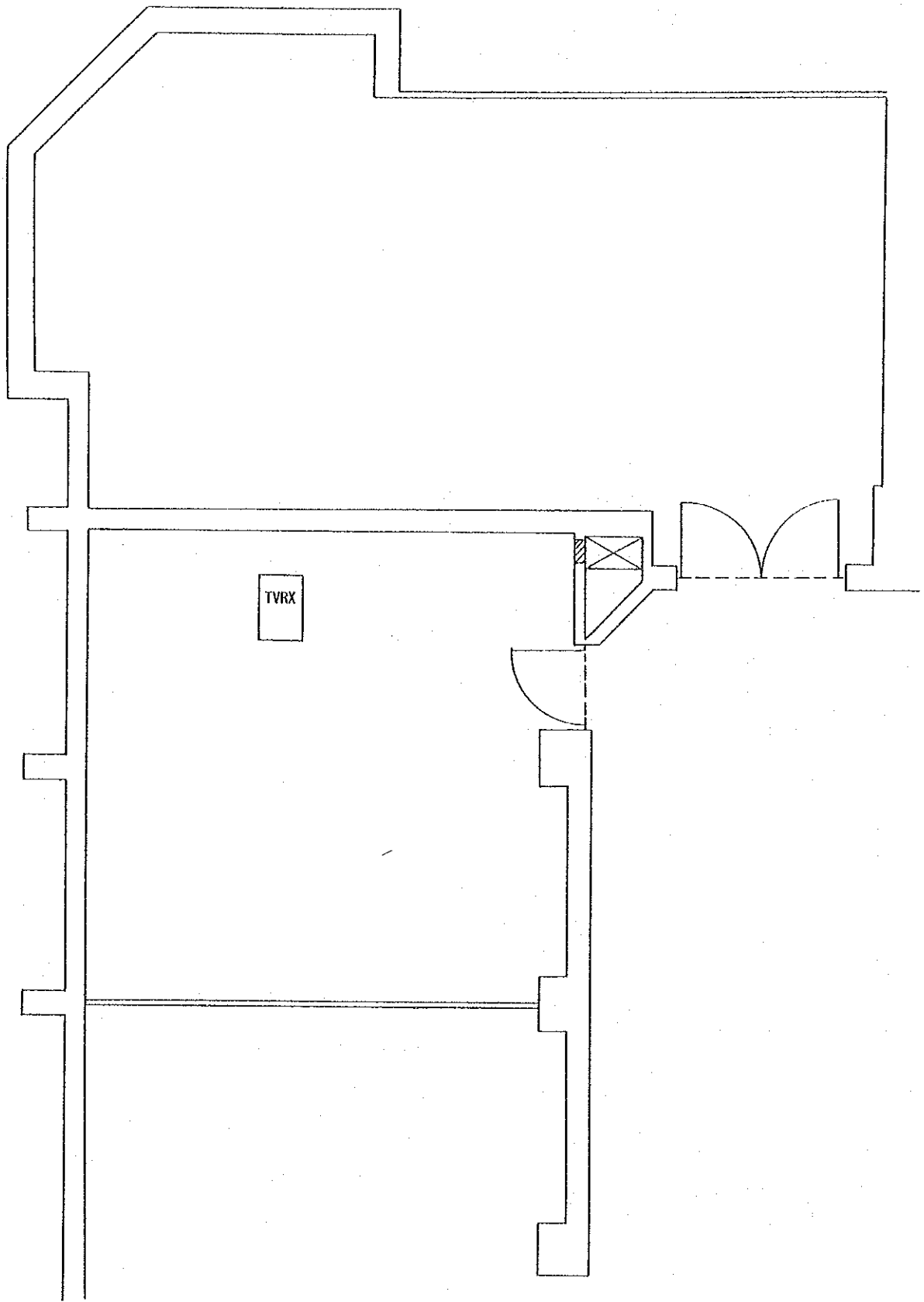


Fig. 4.7 Equipment Layout Plan in TV Reception Earth Station Room

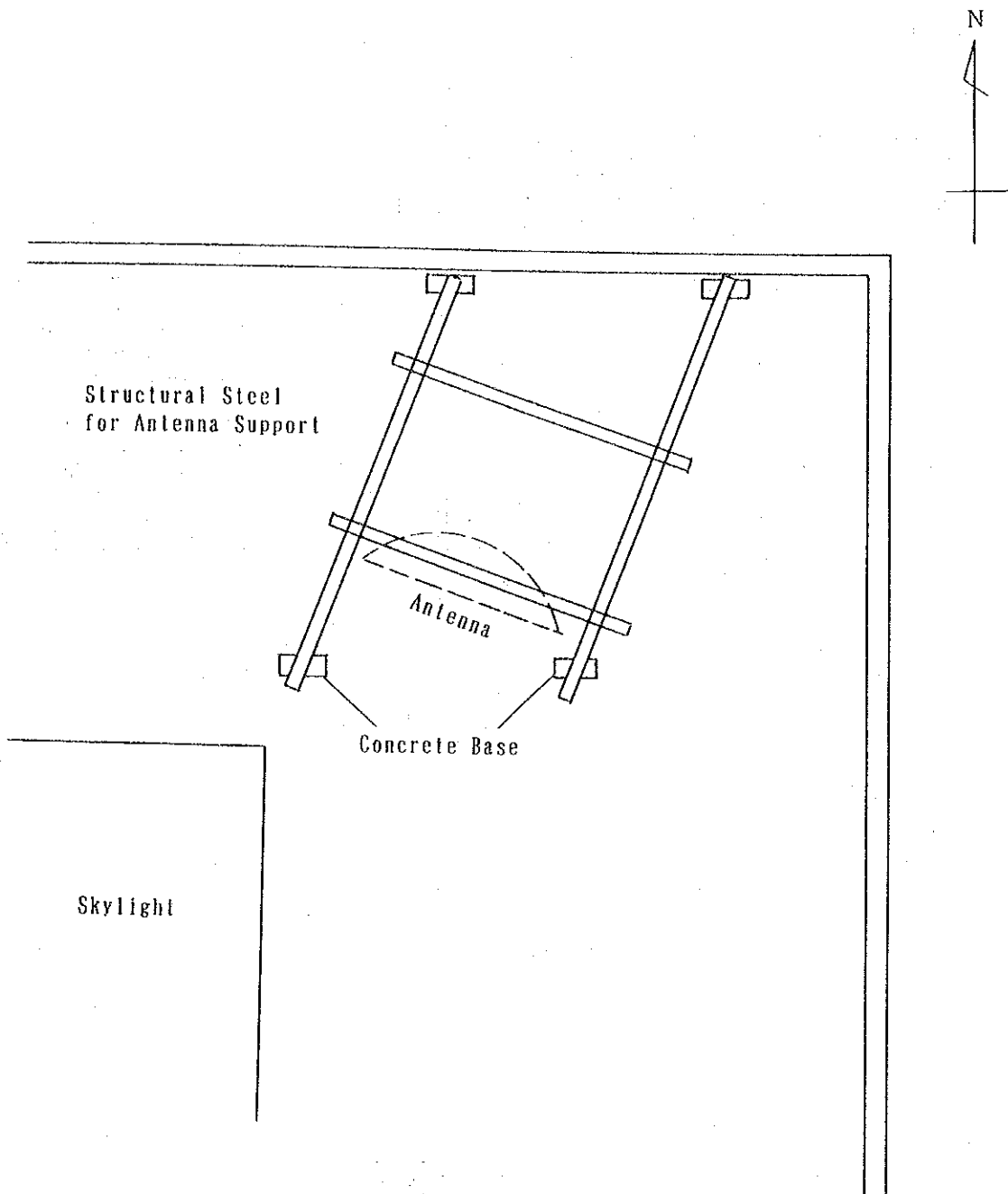


Fig. 4.8 Layout of Structural Steel for the Satellite Antenna on the Roof of Building B

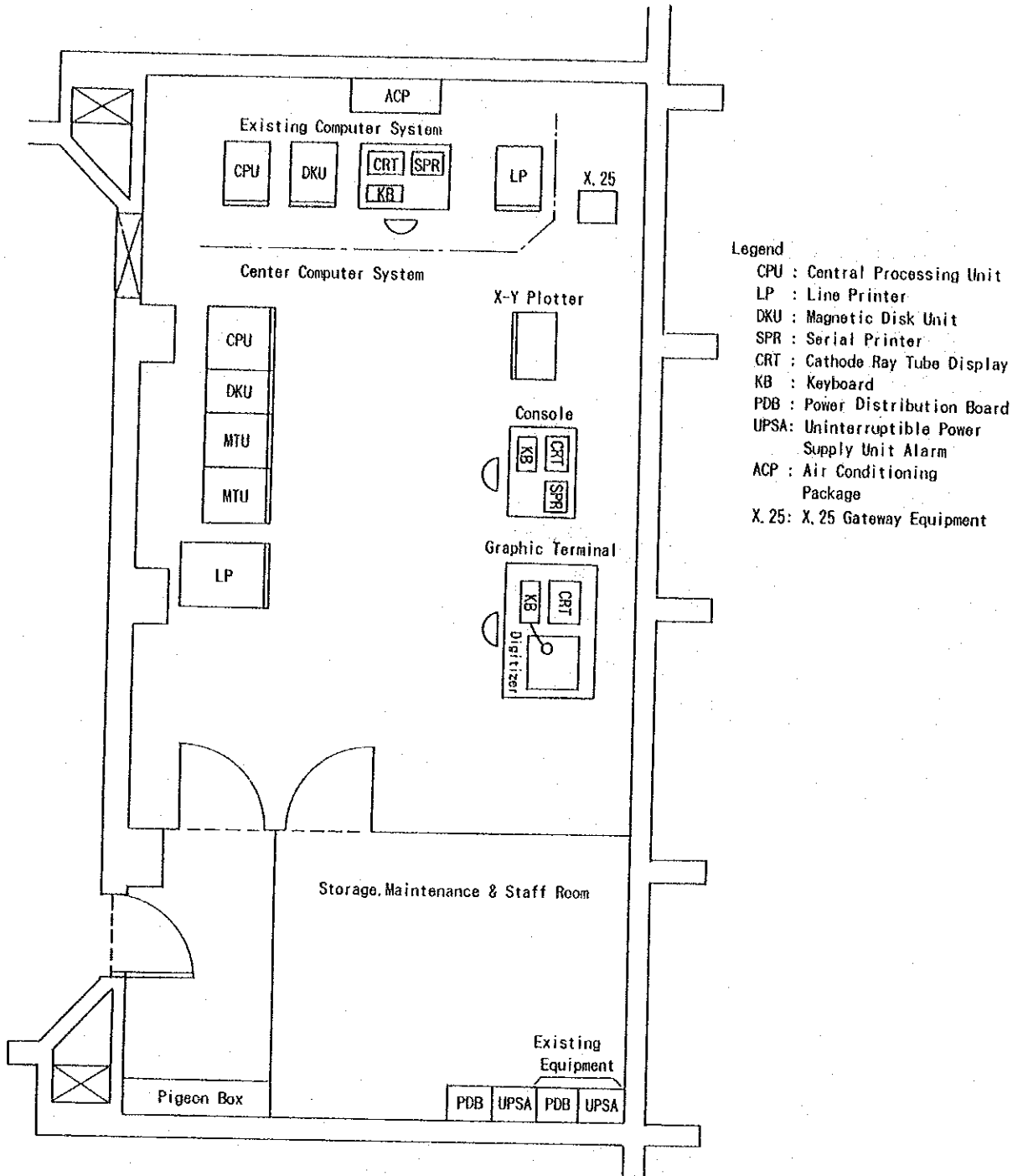
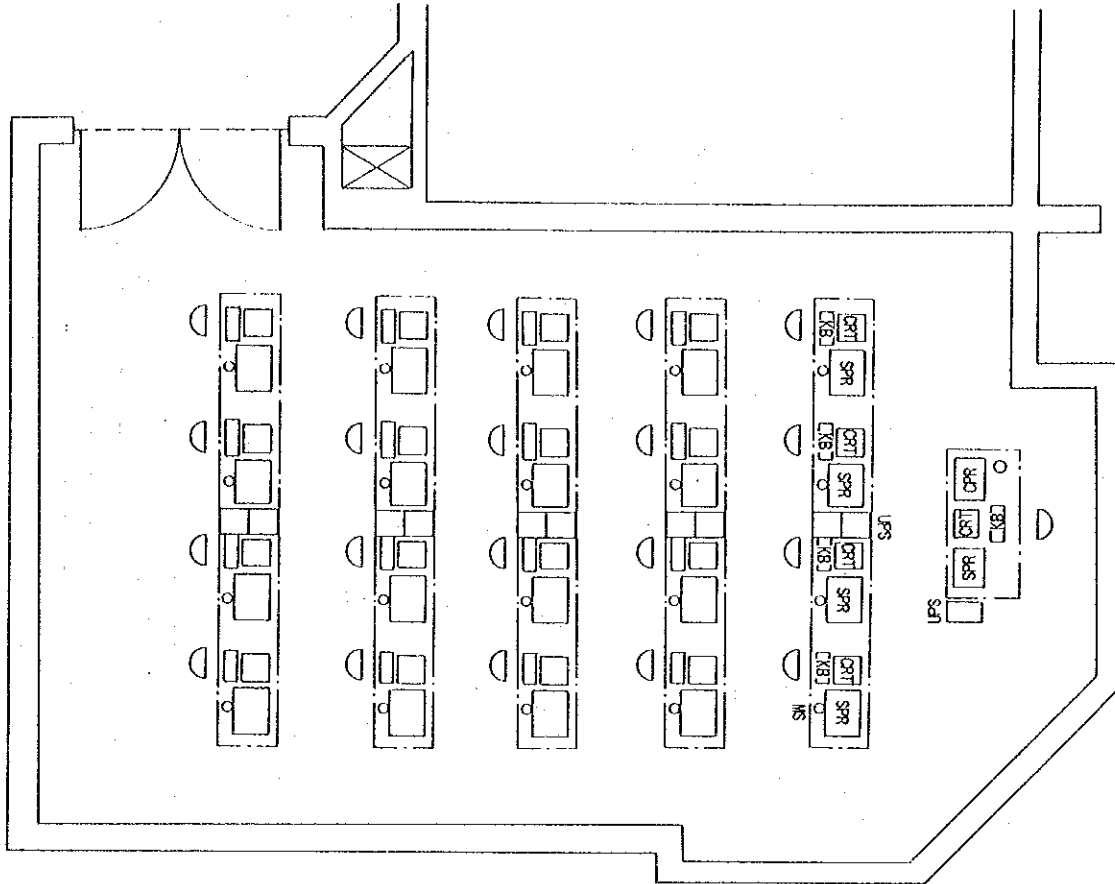


Fig. 4.9 Equipment Layout Plan in Computer Room



- Legend
- SPR : Serial Printer
 - CRT : Cathode Ray Tube Display
 - KB : Keyboard
 - MS : Mouse
 - CPR : Color Printer
 - UPS : Uninterruptible Power Supply Unit

Fig. 4.10 Equipment Layout Plan in Computer Terminal Room

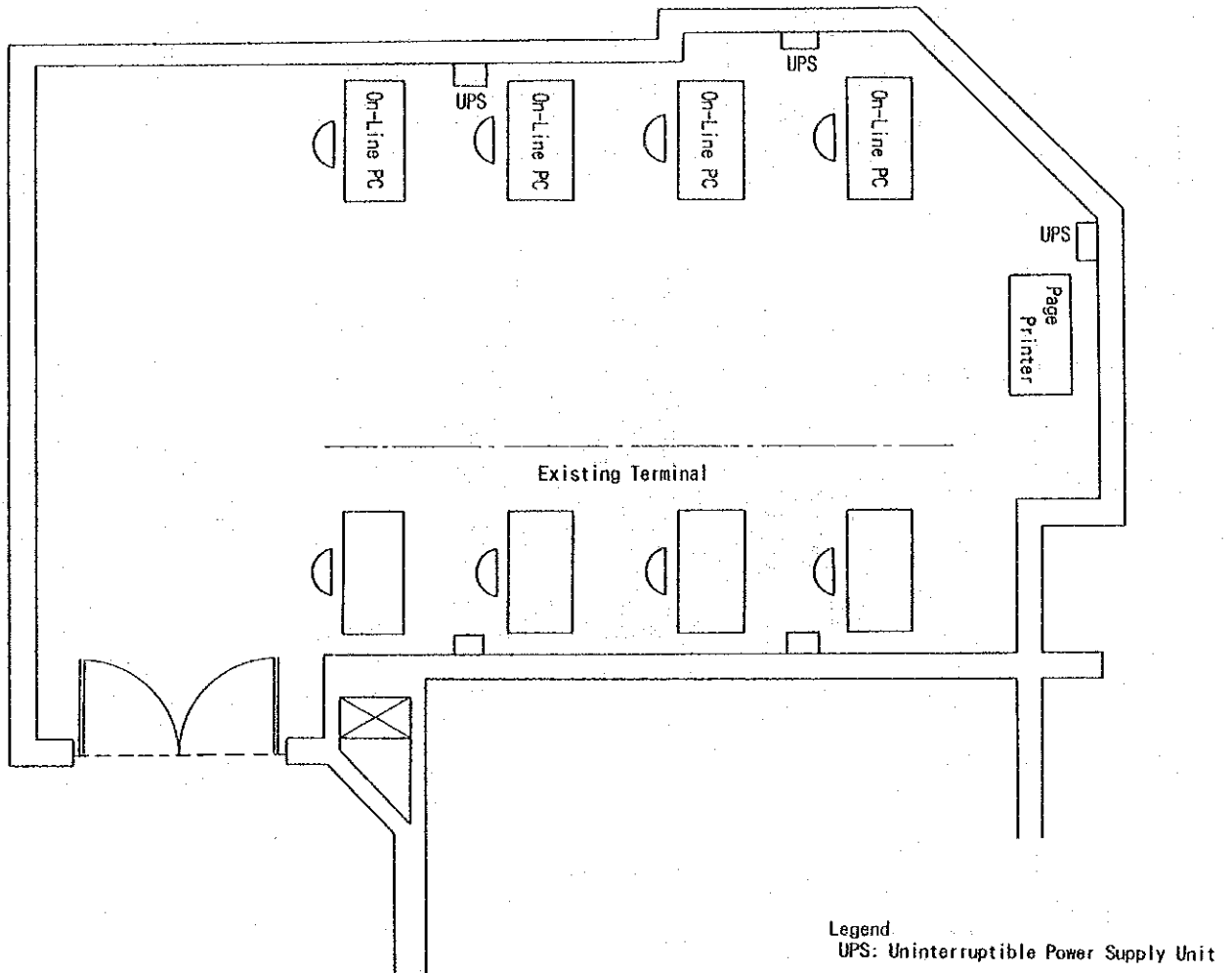


Fig. 4.11 Equipment Layout Plan in Staff Room
 (Computer & Systems Dept.)

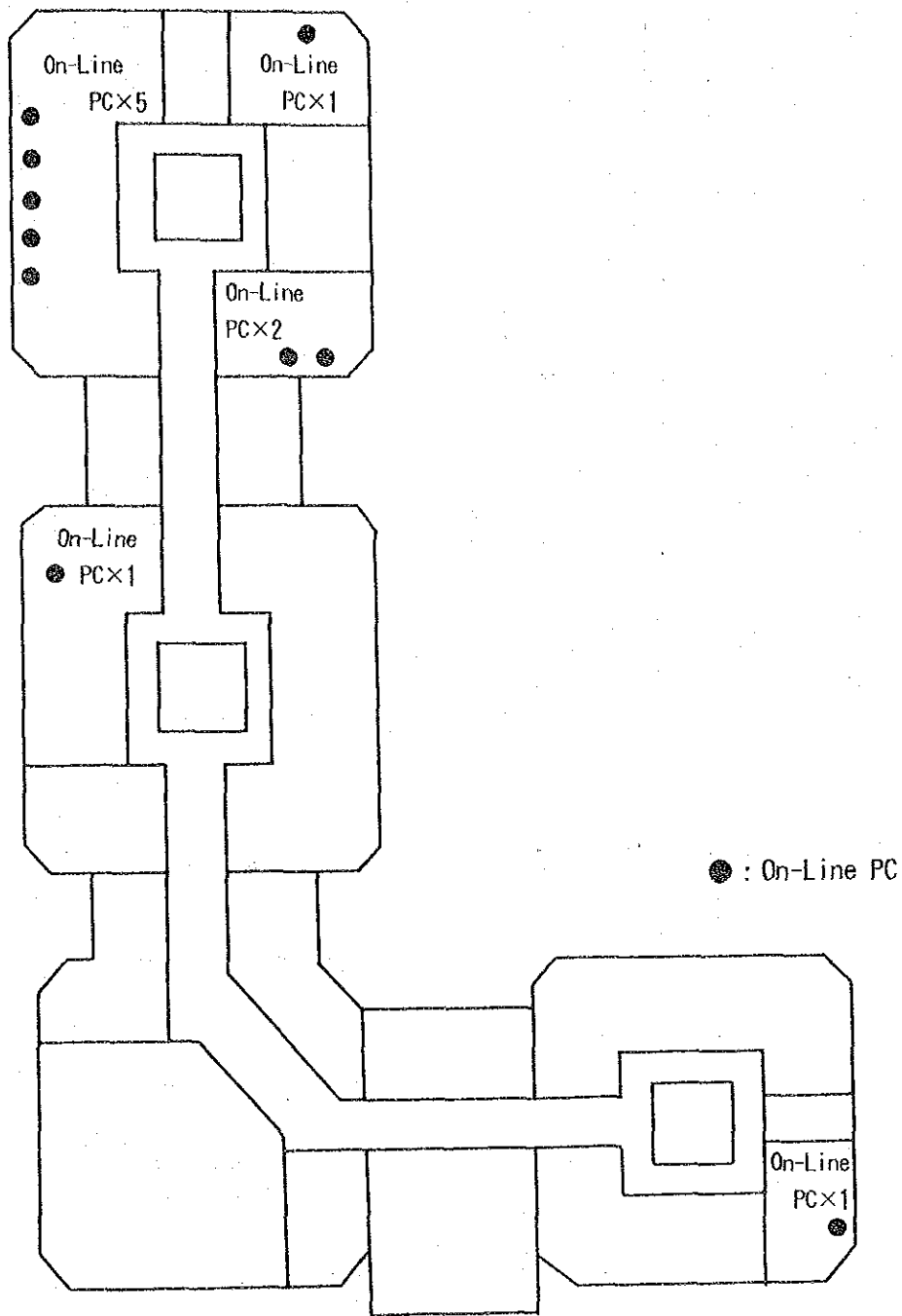


Fig. 4.12 Floor Layout Plan of On-line Personal Computers (1/3)
 -Ground Floor-

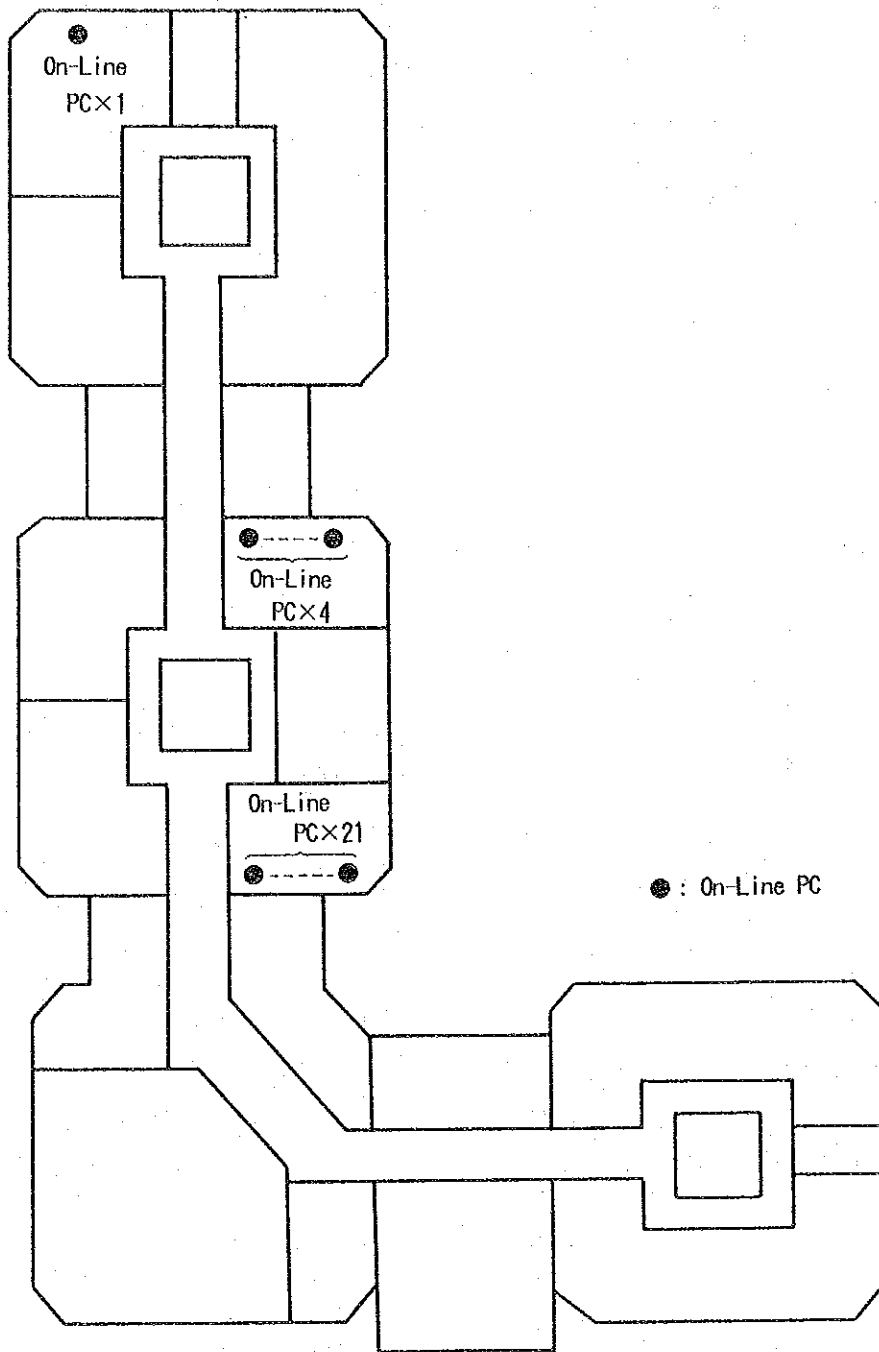


Fig. 4.13 Floor Layout Plan of On-line Personal Computers (2/3)
 —First Floor—

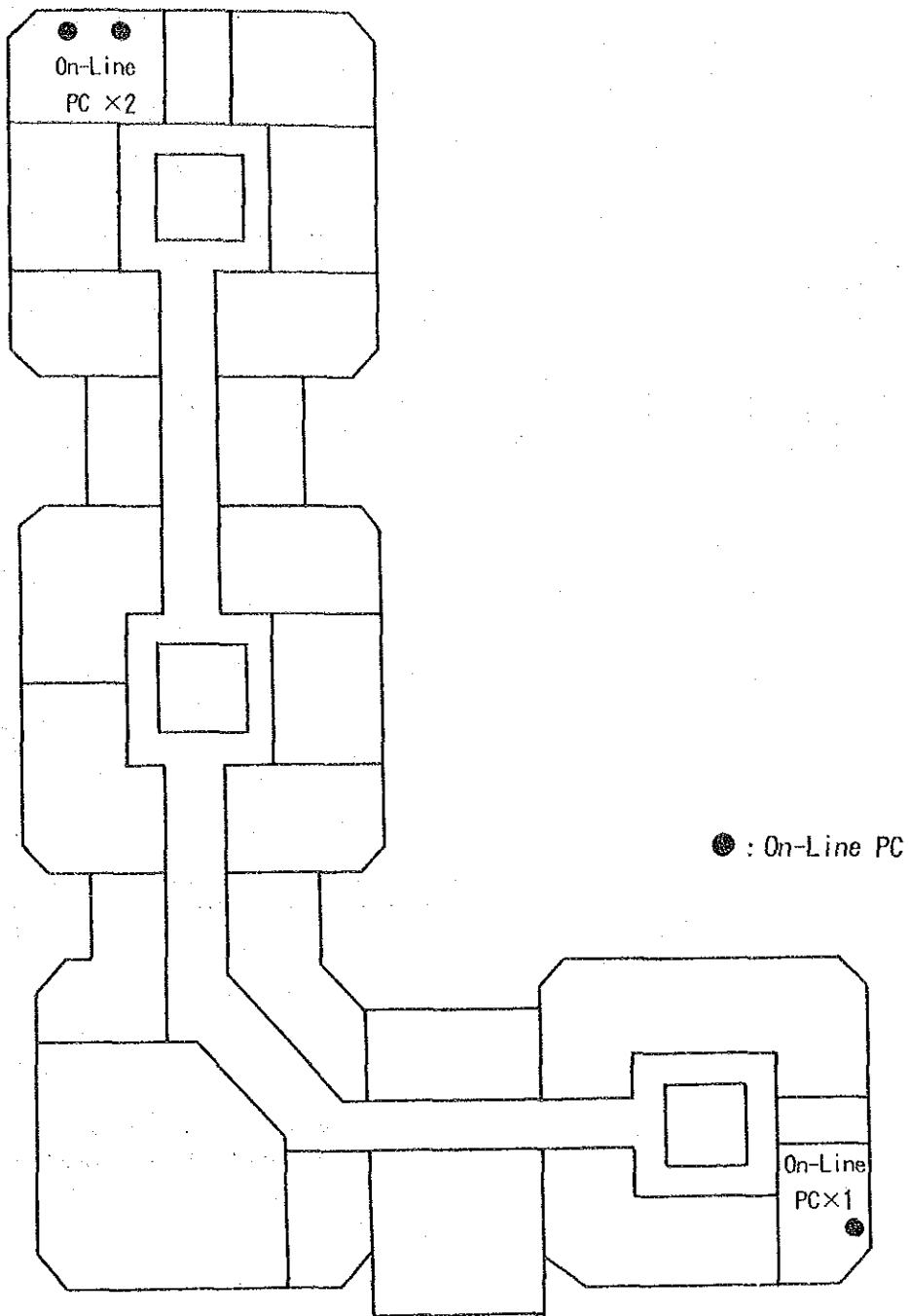


Fig. 4.14 Floor Layout Plan of On-line Personal Computers (3/3)
 -Second Floor-

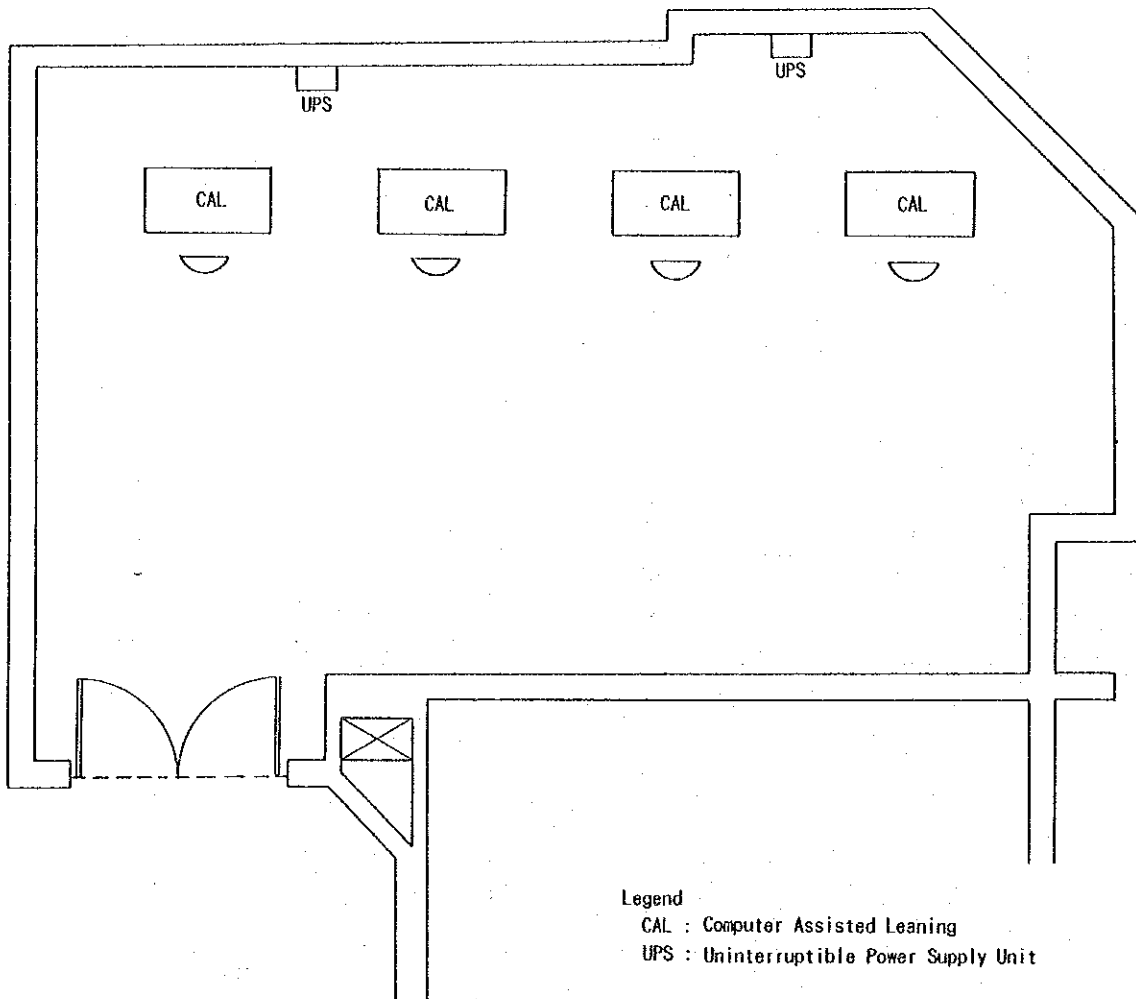


Fig. 4.15 Equipment Layout Plan in CAL Room

4.2.5 Cabling Plan

Fig. 4.16 shows the plan for cables to be newly installed inside the NTI new building by this project.

To connect the digital exchange to the optical fiber transmission equipment or the digital microwave transmission equipment, six 100 pair cables and ten coaxial cables are installed between the transmission department and the switching department.

In order to connect the LAN terminal equipment which are installed in each laboratory and administrative section with the main computer, coaxial cables for LAN are installed in almost the whole NTI building. Three routes of the coaxial cables are necessary on account of distance limit between the main computer and the terminal equipment, and equalization of load per cable.

4.2.6 Air Conditioning

Air conditioners are necessities for the main computer and the digital exchange among all of the selected equipment by this project taking account of the environmental condition.

The air conditioners are installed by NTI. According to the installation plan, a relation between calorific value from the installed equipment and capability of the air conditioners was inappropriate.

It is estimated that calorific values from the main computer and the digital exchange are about 20,000 kcal/hour, about 15,300 kcal/hour respectively, therefore the new installation plan has been amended as shown in Table 4.2.

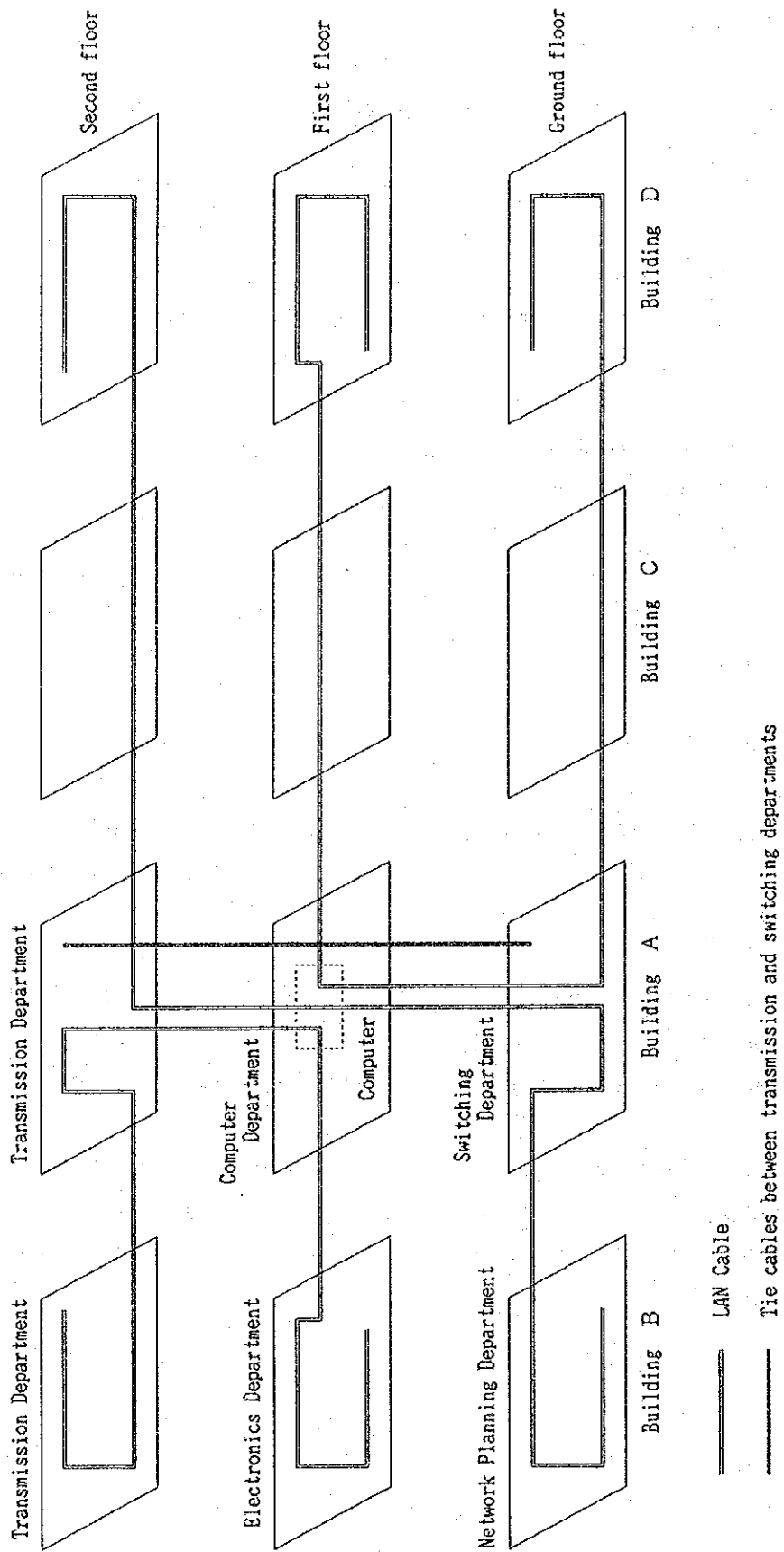


Fig. 4.16 Cabling Plan of NTI New Building

Table 4.2 Air Conditioner Installation Plan

Place of Installation	Network Department	Transmission Department	Computer Department	Electronics Department	Switching Department
Old plan	84,000	96,000	72,000	48,000	48,000
New plan	48,000	72,000	96,000	48,000	84,000

Unit : BTU (1 kcal/hour = 3.96825 BTU)

4.2.7 Electric Power Distribution

Fig. 4.17 shows configuration of electric power distribution at the NTI new building.

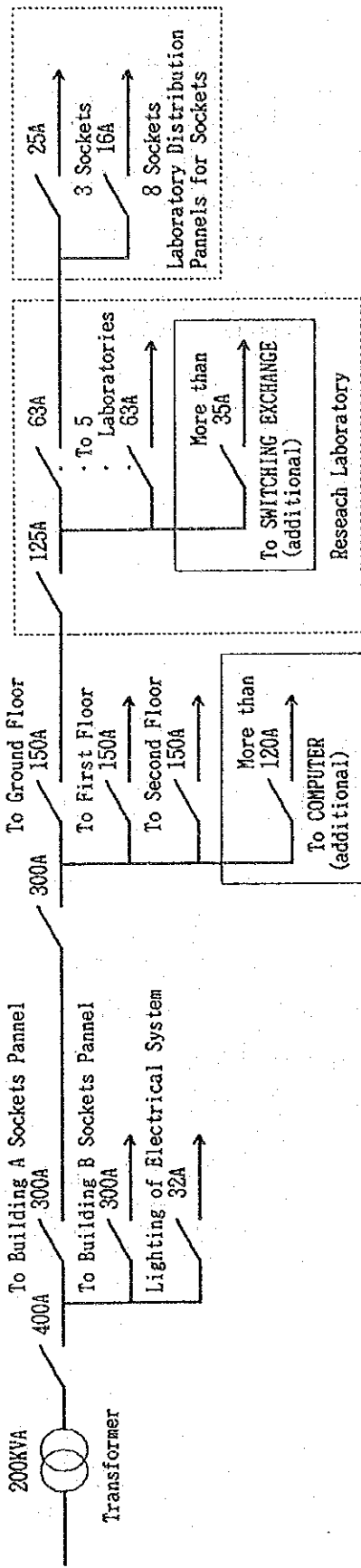
There are two systems. One is distribution for sockets on the wall of each laboratory, and the other is for lighting and air-conditioning.

It is desirable for the installed equipment to be supplied with electric power by the former system, because the latter is in danger of voltage fluctuation due to ON/OFF of operation of the air conditioners.

Most of the equipment can be supplied with electric power from the sockets on the wall of each laboratory, but additional exclusive distribution cables are necessary to supply electric power to the main computer and the digital exchange as shown in Fig. 4.17.

In the minutes of discussion on the Basic Design Study in Egypt, the Egyptian side agreed to take necessary actions concerning this matter and to complete them before the equipment installation work starts.

(1) Separate Distribution Pannels for the Sockets of Building A & B



(2) Main Pannel for Lighting and Air Conditioning of Building A & B

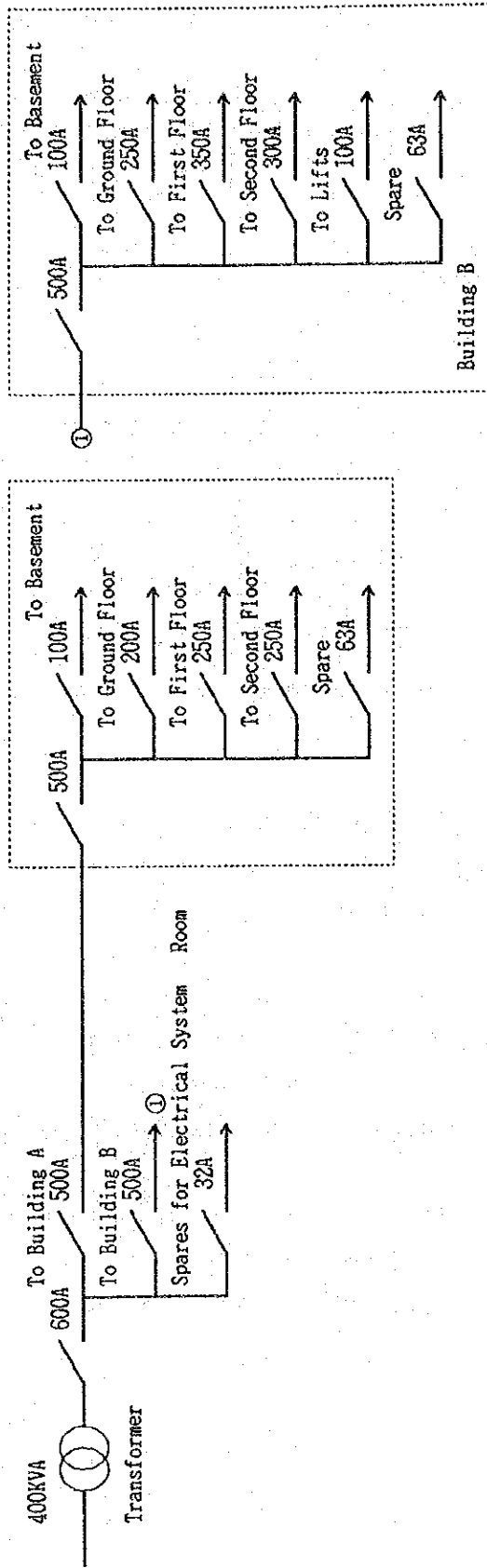


Fig. 4.17 Power Distribution Plan

CHAPTER 5 IMPLEMENTATION PLAN OF THE PROJECT

CHAPTER 5 IMPLEMENTATION PLAN OF THE PROJECT

5.1 Responsible Ministry and Executing Agency

The ministry responsible for the Project is the Ministry of Transport, Communications and Maritime Transport. The executing agency for the Project is NTI under the supervision of the Ministry of Transport, Communications and Maritime Transport.

5.2 Outline of Implementation Plan

The purpose of the Project is to install equipment and facilities necessary for the expansion of National Telecommunication Institute (NTI) in the Arab Republic of Egypt. The project site is the NTI's new building which is scheduled to be completed by the end of 1989.

After the Exchange of Notes has become effective between the Government of Japan and the Government of Egypt, NTI and a Japanese consultant will conclude a consulting agreement under which detailed design and construction management will begin.

Installation work for the Project shall be executed by a Japanese contractor and by NTI according to the scope of work stated in Section 5.4. Qualified staff for the installation, arrangement and confirmation of characteristics of the equipment shall be sent by the contractor to NTI, for high-level technique and experience are indispensable. The staff sent by the contractor shall instruct NTI staff in the operation and handling of the equipment during the period of construction.

The construction period is scheduled as follows: 6 months for practical designing, tender, and contract; and 12 months for supplying and installing equipment; totaling 18 months.

5.3 Implementation Management Plan

The Japanese consultant executes the following management tasks concerning the implementation of the Project.

(1) Detailed design

On the basis of the data determined under the present basic design study, the consultant carries out detailed design with NTI to decide on general conditions, special conditions and technical detailed specifications necessary for the implementation of the construction work. The consultant, depending on the result of the detailed design, prepares documents needed for tendering.

(2) Installation management

(a) Tender to select contractor

The consultant carries out the invitations for tender, acceptance and evaluation of tender documents and assists NTI and the Japanese contractor in concluding the agreement.

(b) Examination of approval drawings

The consultant, on behalf of NTI, examines the production drawings of materials and equipment submitted by contractors.

(c) Acceptance inspection at supplier's factory

Prior to the shipment of materials and equipment by the supplier, the consultant verifies, through inspection at the supplier's factory, that they conform to the terms and conditions of purchase agreements.

(d) Installation supervision

According to the terms of agreement concluded between NTI and the consultant, the latter sends to the project sites engineers as required to supervise installation work.

(e) Witness to acceptance tests

Upon completion of the installation, the consultant and NTI shall be present at the acceptance tests to make a final verification of facilities introduced under the Project.

5.4 Scope of Installation Work

The basic design team discussed, with the Director of NTI and officials concerned, the scope of the installation work for Japan and Egypt, the condition that grant aid by the Government of Japan is extended to the Project. Finally both sides reached the following agreement on the said matter.

5.4.1 Principle of Scope of Installation Work

The scope of respective responsibilities for the installation work to be taken by the Government of Japan and the Government of Egypt is defined in the following items.

- (1) The Japanese government carries out the installation of equipment and facilities pointed out in section 5.4.2 within those listed on the talk in Table 4.1.
- (2) The Egyptian side settles other equipment other than the above equipment.
- (3) The Egyptian side carries out construction work regarding the NTI building and other work related to the building.

- (4) The Egyptian side is responsible for the execution of construction defined in section 5.4.3. in addition to the matters expressed in the above items (2) and (3).

5.4.2 Scope of Work on the Japanese Side

- (1) Installation and cabling for the digital exchange and automatic voltage regulator (AVR)
- (2) Construction of a raised floor in the switching laboratory and the computer room
- (3) Installation and cabling for the transmission equipment (6 GHz, 11 GHz, optical and MUX) and distribution board in the transmission training and research room
- (4) Installation and cabling for the satellite TV receiver in the satellite training room and its antenna system, including steel supports for the antenna system
- (5) Installation and cabling for the center computer equipment and the uninterruptible power supply unit
- (6) Installation of cable racks and cables connecting between the equipment except cable racks for the signal cables between switch and transmission equipment
- (7) Installation and cabling for the power supply equipment and power distribution boards

5.4.3. Scope of Work on the Egyptian Side

- (1) Purchase and installation of power cables and power distribution boxes in all equipment rooms and for the satellite antenna on the roof.
- (2) Preparation of concrete bases for steel supports of the satellite antenna
- (3) Construction and installation of an antenna tower, antenna systems, and waveguides for the 6 and 11 GHz microwave systems in NTI and all work in transmission stations remote from NTI for microwave propagation tests
- (4) Construction of plain partitions in the computer room
- (5) Construction of a plain entrance room in the switching room
- (6) Purchase and installation of air-conditioning units necessary for the equipment

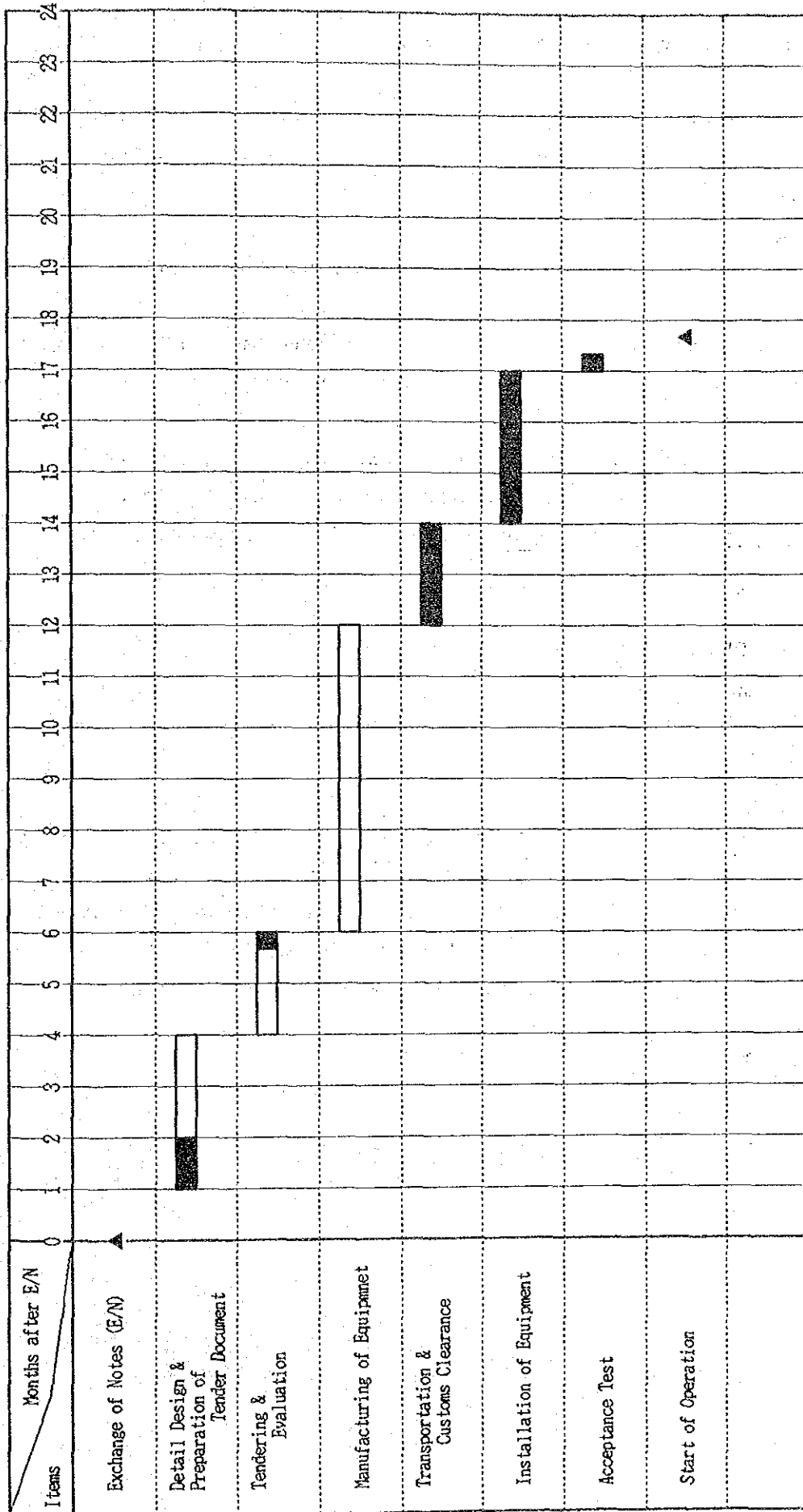
5.5 Undertakings by Egyptian Government

- (1) To secure appropriate place with necessary facilities for electricity and other incidental facilities for the installation of the equipment.
- (2) To ensure the necessary budget and personnel for the proper and effective operation and maintenance of facilities and equipment to be provided under the grant.
- (3) To ensure prompt unloading, tax exemption, customs clearance at the port of disembarkation in Egypt and prompt internal transportation of materials and equipment provided under the grant in accordance with the law and regulations concerned in Egypt.

- (4) 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 Egypt and stay therein for the execution of the Project.
- (5) Japanese nationals involved in the Project will not be subject to any customs duties, internal taxes, and other fiscal levies which may be imposed in Egypt with respect to the supply of the products and services under the verified contract.
- (6) To bear all expenses, other than those to be borne by the grant, necessary for construction on the facilities as well as for the transportation and installation of the equipment.
- (7) To provide assistants and facilities necessary for the Project.
- (8) To provide Japanese consultant and contractor with necessary data and information for engineering of the Project.
- (9) To prepare a furnished room as an office for each consultant and contractor.

5.6 Implementation Schedule

Figure 5.1 shows the implementation schedule after conclusion of the Exchange of Notes.



: Job in Japan
 : Job in Egypt

Fig. 5.1 Implementation Schedule of the NTI Project after E/N

5.7 Expenses Borne By Egyptian Government

The expense to be borne by the Government of Egypt is supposed to be a sum of ¥ 35,000,000 due to materials and personnel expenses of the following installation work.

(Installation work to be borne by the Government of Egypt)

- a) Foundation construction for satellite antenna.
- b) Microwave antenna steel tower construction.
- c) Waveguide tube installation.
- d) Installation of counter-exchange for propagation tests.
- e) Air-conditioning and power equipment installation.
- f) Partition and interior construction of rooms to place equipment.

5.8 Equipment Procurement Plan

All of the equipment except for the computer system will be procured in Japan.

As for the computer system equipment, the NTI side has strongly requested that the equipment be provided by one of the four big computer vendors (IBM, ICL, DEC, NCR) which have a reliable and stable maintenance and support organization in Egypt. The study team has decided to study the possibility of procuring the computer system equipment for this Project from third countries.

CHAPTER 6 MAINTENANCE MANAGEMENT PLAN

CHAPTER 6 MAINTENANCE MANAGEMENT PLAN

6.1 Technical Staffing and Technical Capability

NTI's technical staffing trend is as shown in Table 3.4. The number of persons increases in accordance with the development of NTI's activities. Table 6.1 shows the relation between the numbers of technical personnel working and planned personnel for the fiscal years 1987/88 and 1988/89.

Not all of the training equipment is currently in place. This has held up the hiring of technical personnel. However, as shown in Table 3.5, NTI is planning to increase the number of personnel in the future in accordance with the Project's progress.

Table 6.1 Current and Planned Numbers of Technical Staff

	: 1987/88	: 1988/89
Current number	: 77	: 85
Planned number	: 91	: 111

All of the current staff of 51 people presently in charge of training and study during the fiscal year 1988/89 are engineers of university graduates, and 40% of them have master's, or higher, degrees. NTI plans to hire the most qualified personnel, those who have technical capabilities above the level of a college researcher.

During selection of the equipment to be provided, the study team held repeated discussions with staff members in each technical division concerning the functions required for each item of equipment, how the equipment would be applied to training and research and study currently being executed. The result was that it was decided that the NTI technical staff could provide sufficient knowledge and technical capability to maintain and control equipment which will be provided.

6.2 Maintenance and Management of Existing Equipment

The study team investigated the management of existing equipment of NTI. According to its equipment list, equipment under repairing was two in number, and equipment out of order and not repaired was 10 in number; that is, only 4% of the total 325 pieces of equipment was out of order.

The repair of equipment out of order is controlled by means of repair slips. Most pieces of the equipment that have got out of order, excluding those which are provided under a repair contract such as a copy machine and a computer, are repaired by NTI itself, and the rest are sent for repairs.

NTI will strengthen the functions of the present equipment management system and provide a satisfactory management system for maintaining quality of the equipment to be provided under Japan's grand aid. NTI plans to strengthen the current equipment management system, and will maintain a complete quality control system for all provided materials.

6.3 Maintenance Management Expenses

- (1) Estimation of maintenance cost for equipment to be provided.

The Project provides the appropriate amount of spare parts for the equipment in order to maintain the equipment properly. NTI intends to conclude a maintenance contract with one of the computer vendors in Egypt for maintenance and operation of its computer system. For all other equipment, however, NTI intends to make necessary repairs itself using

diagnosis and test functions that the equipment is furnished, other additional measuring equipment and spare parts provided.

NTI has enough ability to maintain equipment by itself. Therefore the cost of maintenance of new equipment should only consist of the cost of the computer maintenance contract, the cost of repair of packages and measuring equipment by the manufacturer and the cost of purchasing additional spare parts. That is, total maintenance management expenses are estimated to be about 6 million yen per year.

(2) Preparation of the maintenance management budget

The operational budget for NTI is appropriated from the government's annual budget. Table 3.3 shows the trend of NTI's operational budgets. The total budget for purchasing spare parts and equipment maintenance in the fiscal year 1988/89 was L.E. 24,500 (approx. 1.3 million yen). However, NTI's maintenance cost is based on the cost of maintaining equipment currently in its possession. Thus, it will increase with the size of the facilities and the amount of equipment in use.

NTI intends to request a total budget of approximately L.E. 2,000,000 to 2,500,000 for maintenance management of the building, its related facilities, and materials for training and study for the fiscal year 1991/92, when this Project is expected to be completed. NTI expressed that there should be no difficulty in obtaining the required maintenance management budget for the equipment to be planned under the Project.

In addition to the above budget, NTI currently receives L.E. 24,000 per year from ARENTO for training expenses incurred by the ARENTO Special Training Program and charges L.E. 200 for each participant in a training course in the Continuing Education Program. However, part of the revenues from training fees is given to the teachers as a special allowance, with the remainder returned to the National Treasury. Currently, NTI is negotiating with the government for permission to use parts of these revenues for the purchase of equipment and maintenance management expense.

6.4 Evaluation of Maintenance Management Capability

As described in the study above, NTI's maintenance skill, present maintenance management condition, and maintenance budget show that NTI provides sufficient capability for maintenance management of equipment to be planned under the Project.