

CONCEPTUAL DESIGN REPORT
ON
SEA WATER DESALINATION TRAINING CENTER
IN
THE KINGDOM OF SAUDI ARABIA

September, 1984

Japan International Cooperation Agency

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SEPTEMBER, 1984

JAPAN INTERNATIONAL COOPERATION AGENCY

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1. INTRODUCTION

Most of modern desalination and power plants in Saudi Arabia are large in scale and critical in operation because of highly automated systems.

Therefore, safe and economical operation of them can not be achieved without well-trained man power for operation and maintenance of the plants.

This conceptual Design to establish a training center has been prepared aiming at forstering of maintenance technicians and operators for the plants, modifying the previous conceptual Design submitted to SWCC in August 1983, and based upon the discussion with SWCC and investigation of the existing administration building at project site held in May 1984 by Japanese Government Survey team.

The training center is designed to be constructed at the area adjacent to the existing SWCC plant in Yanbu, utilizing the existing administration building.

2. CONCEPTUAL DESIGN PHILOSOPHY

2.1 PURPOSE OF TRAINING

Training to be carried out in the Training Center to be constructed aims at providing Saudi Arabian trainees the basic skill and knowledge necessary for the operation and maintenance on power plants and desalination plants in Saudi Arabia so that they can operate and maintain the plants by themselves within possibly shortest time.

The trainees who will have successfully completed training courses in the Training Center will be trained further through on-the-job training conducted in an actual plant for one year by SWCC in order to ensure the basic skill and knowledge, learned in the Training Center, alongwith actual equipment and machines in a plant, afterwards they may be trained furthermore in a plant for around five years by doing their duties in posts assigned to be self-supporting operators and maintenance technicians for power plants or desalination plants.

In the Training Center, the basic skill and knowledge will be given to the trainees in effective way so as to be self-supporting operators or technicians as early as possible.

2.2 DESIGN PHILOSOPHY OF TRAINING

In order to foster necessary man-power to maintain continuous productivity of the plants, it is essential that training processes must make it possible to produce personnel who are capable of putting into effect necessary actions. It is no good simply to inculcate knowledge, what is required is training which enables its recipients to translate their knowledge and skills into positive actions to maintain the plants.

How should such people be fostered ?

Persons capable of positive actions can best be produced by means of training whose emphasis is placed especially upon actions.

The training of persons capable of taking actions in positive behavior, is based upon learner-centered training programs which will be conducted by using effective training equipment listed up in this Conceptual Design.

This is the basic principle employed in this Conceptual Design of training.

2.3 DESIGN PHILOSOPHY OF TRAINING BUILDING AND FACILITY

The conceptual design has been prepared on the basis of debates and investigations at project site by the survey team which was sent to Saudi Arabia in December 1982, March 1983 and May 1984, and discussions held in Japan at Expert Committee as core of the said team. The planning of the facilities will meet following basic design policy.

- (1) Existing building (approx. 1600 m²) shall be used for the administration and classroom.
- (2) Facilities will be in response to the training object and plan which are programmed by the request of the Saudi Arabian side, and buildings will be planned to show its functions sufficiently.
- (3) Layout of the facilities is planned in response to diversification of the training details in future.
- (4) Functions for vocational training is planned with great importance, and also establishment of generous environmental space for education and living for youth is provided.
- (5) The buildings will be planned to match the existing building and the locality in style, materials and construction method by considering weather, natural feature, custom and construction situations in Saudi Arabia to make the maintenance easy.

3. DESIGN OF TRAINING

3.1 TRAINING COURSES

Training courses to be conducted for one year in the Training Center for fostering of operators and technicians are divided into three stages, basic science, general basic technology and advanced technology courses. The former two stages will give training common to all trainees, while the last stage will be divided into each trade of plant operation and maintenance as follows:

Plant Maintenance Course

- Mechanical Maintenance
- Piping Equipment Maintenance
- Electrical Equipment Maintenance
- Instrumentation Maintenance

Plant Operation Course

- Boiler Plant Operation
- Steam Turbine & Power Generator Operation
- Desalination Plant Operation

The advanced technology courses involve in-plant training which will be carried out in the desalination and power plant adjacent to the Training Center.

Duration of each training course is tentatively decided as shown in Plan of Overall Training Schedule & Training Course attached to this Conceptual Design, however it may be modified based on detailed study of training programs.

Training objectives and contents are shown in 3.4 and 3.5 of this chapter, which are determined through job analysis. They may be revised, if required, based upon the entry level of trainees and to meet actual conditions of training.

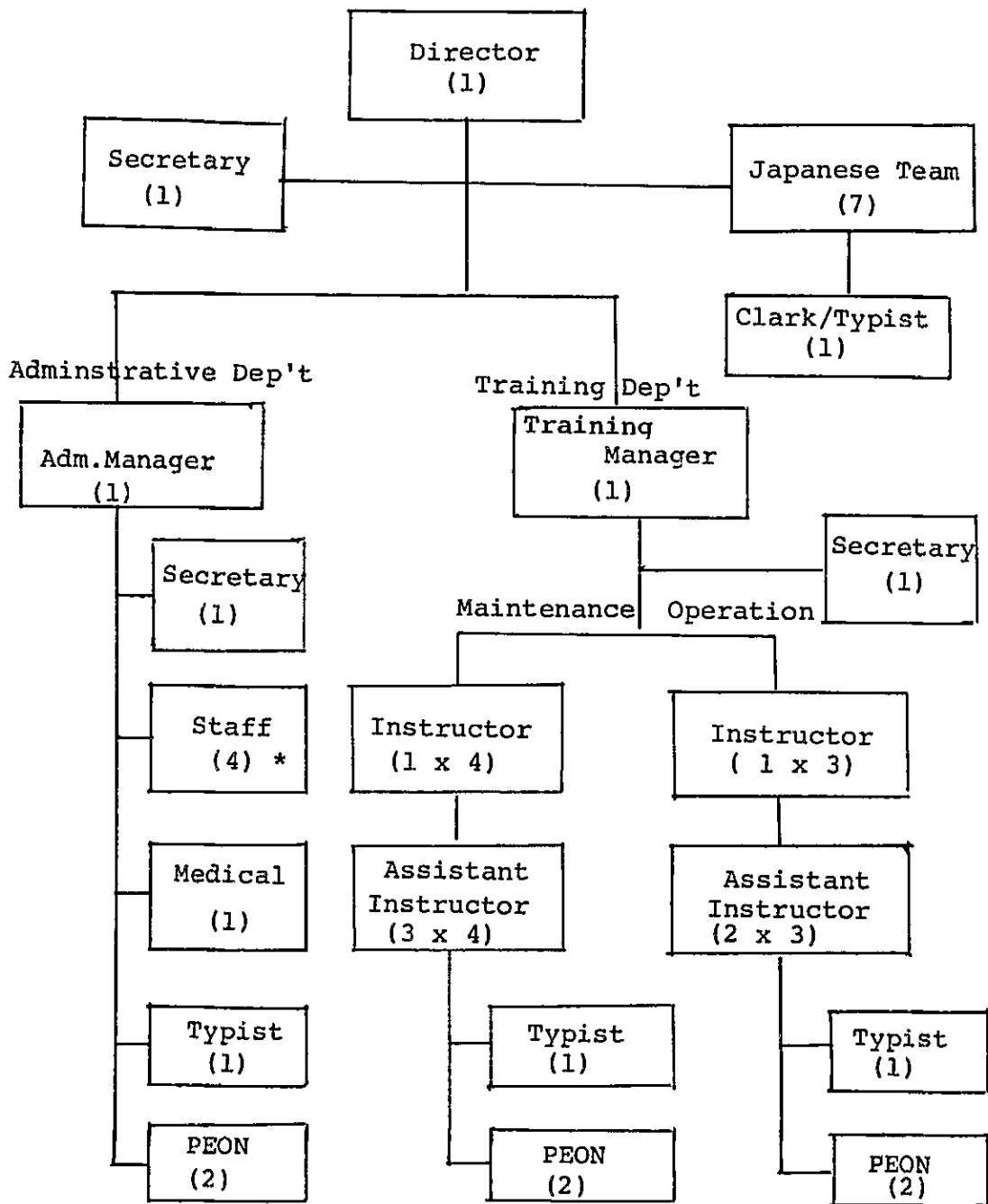
3.2 TRAINING CENTER ORGANIZATION

The organization of the Training Center must be established so that all people concerned will be able to effectively work in order to achieve the purpose of training.

Proposed organization, posts and number, is as shown in Organization for Training Center attached to.

The functions and jobs of each post will be decided later in detail to meet actual conditions of the Training Center operation. However, the functions of trainers (instructors) are so important that they are described in 3.3 Trainers and Trainees.

ORGANIZATION FOR TRAINING CENTER



(): Number of person

* Major Function of Staff

Total Number: 46 + 7 (Japanese)

- Personnel Affairs
- Accounting
- Purchasing
- Storekeeping
- Library
- Others

PLAN OF OVERALL TRAINING SCHEDULE & TRAINING COURSE

PLACE TRAINING STAGE TRAINING MONTH COURSE	IN TRAINING CENTER OR IN PLANT		
	Basic Science 1 - 2	General Basic Technology 3 - 4	Advanced Technology (include O.J.T.) 5 - 12
MAINTENANCE	Mechanical Maintenance	N.T.H.: <u>264</u> Contents: Orientation & Basic Science Review	N.T.H.: <u>264</u> Contents: Specific Technology for Maintenance do.
	Piping Equipment Maintenance	N.T.H.: <u>924</u> Contents: Fundamental Technology on the related plants	N.T.H.: <u>924</u> do.
	Electrical Equipment Maintenance		N.T.H.: <u>924</u> do.
	Instrument- tion Maintenance		N.T.H.: <u>924</u> do.
OPERATION	Boiler Plant Operation	N.T.H.: <u>924</u> Contents: Specific Technology for Operation do.	N.T.H.: <u>924</u> do.
	Steam Turbine & Power Gene- rator Opera- tion	N.T.H.: <u>924</u> do.	N.T.H.: <u>924</u> do.
	Disalination Plant Opera- tion		N.T.H.: <u>924</u> do.

LEGEND N.T.H.: Net Training Hour
 Calculation Base: 6 hours/day, 3 hours/thursday,
 4 weeks/month, 11 months/year
 (6H x 5D + 3H x 1D) x 4W x 11M = 1452H/Y

3.3 TRAINERS AND TRAINEES

TRAINERS

Trainers, who fulfil very important role to foster good operators and technicians, are composed of Instructors and Assistant Instructors whose major functions and required capability are as follows:

Instructor

(1) Qualification and Experience

- University graduates
- At least 5 years' experience of each trade in related plants

(2) Basic Function

- To conduct theorifical and practical training in class rooms and/or workshops with the assistance of assistant instructors
- To prepare teaching materials such as training programs, textbooks and audiovisual aids, assisted by assistant instructors and other staffs
- To coordinate and adjust training programs

(3) Capability

- To have a proper inclination for training and leading of assistant instructors
- To be good at reading, writing and speaking in English
- To have enough knowledge and experience to implement training of related trade

Assistant Instructor

(1) Qualification and Experience

- Technical high school graduate or eq.
- At least 10 years' experience of each trade in related plants

(2) Basic Function

- To assist instructors in theoretical and practical training in general
- To conduct practical training and preparation works of it at laboratories and work shops
- To act as a good leader and counselor for trainees

(3) Capability

- To have a proper inclination for training
- To be good at reading, writing and speaking in English
- To have enough knowledge and experience to implement practical training including preparatory works

TRAINEES

The number of trainees for each training course:

<u>Training course</u>	<u>Number of trainees</u>
Mechanical Maintenance	15
Piping Equipment Maintenance	15
Electrical Equipment Maintenance	15
Instrumentation Maintenance	15
Boiler Plant Operation	15

Steam Turbine & Power Generator Operation	15
Desalination Plant Operation	15

Total: 105

Qualification of Trainees

Graduated from intermediate schools or high schools,
with no industrial experience, and passed the entrance
examination of the Training Center.

3.4 TRAINING OBJECTIVES

3.4.1 Plant Maintenance Technician Course

(1) Mechanical Maintenance

When trainees complete this course, they will be able to:

1. Handle tools, measuring tools and machine tools.
2. Read mechanical drawings and P & I Diagrams.
3. Explain characteristics of materials used for rotating machine and static equipment.
4. Describe how to use gaskets.
5. Describe sort, role and characteristics of lubricating oil.
6. Practice non-destructive inspection (penetrant test, magnetic particle examination, ultrasonic flaw detection).
7. Disassemble, inspect and reassemble a simple rotating machine.
8. Describe structure and role of bearings, shaft seals and couplings.
9. Disassemble, inspect and reassemble a simple heat exchanger.
10. Conduct daily inspection of machines (rotating machines and heat exchangers).
11. Describe cautions on safety for maintenance work.
12. Describe plant maintenance systems (BM, PM etc.) and maintenance organizations.

(2) Piping Equipment Maintenance

When trainees complete this course, they will be able to:

1. Handle hand tools, measuring tools and machine tools.
2. Read piping drawings and P & I Diagrams.
3. Describe classification and characteristics of steel pipes.
4. Explain application ranges to temperature and pressure of steel pipes.
5. Describe types and applications of pipe fittings and pipe joints.
6. Connect and tighten pipe-flanges.
7. Disassembles, inspect and reassemble valves.
8. Practice periodic inspection of piping systems.
9. Describe how to clean pipes.
10. Handle an arc welding machine and oxy-acetylene welding & cutting equipment for simple welding work.
11. Carry out simple piping prefabrication.
12. Take temporal actions to stop leakages.
13. Explain insulation materials for piping.
14. Describe cautions on safety for field maintenance work.
15. Explain plant maintenance systems (BM, PM, etc.) and maintenance organizations.

(3) Electrical Equipment Maintenance

When trainees complete this course, they will be able to:

1. Describe the principle and theory of electricity, electronics, and AC & DC.
2. Conduct electric wiring installation and termination.
3. Explain basic sequence circuit and sequence control.
4. State principle, structure and function of DC electric circuit, induction motor, transformer and switchboards.
5. Explain the properties and application of several electric materials.
6. Classify electric measuring instruments and explain structure and principle of each instrument.
7. Conduct electric measuring, motor testing and transformer testing.
8. Read the electric wiring plan and sketch parts of a motor and a transformer.
9. Describe laws and regulations for electric appliance.
10. Handle electrical tools.
11. Measure the length, angle, voltage, current, resistance, watt and lux.

12. Conduct no-load test of a motor.
13. Conduct the daily inspection of transformers, motors, low-tension switch boards, wiring instruments and other electric equipment.

(4) Instrumentation Maintenance

When trainees complete this course, they will be able to:

1. Read and draw simple P & I Diagram and sequence Diagrams.
2. Describe how to measure temperature, pressure, flowrate, and level in process plants.
3. Inspect and adjust feedback control loops for temperature, pressure, flowrate and level in a conventional process.
4. Inspect and adjust simple sequence control systems by using instruction manual.
5. Explain structures and functions of typical instruments consisting of control loops, such as transmitter, controller and final control elements.
6. Explain the differences between feedback control and feed forward control.
7. Read emergency interlock system diagrams on a plant.
8. Describe function and structure of an instrument air supply system.
9. Use measuring tools and instruments in the instrumentation workshop or laboratory, correctly.

10. Explain how to conduct daily inspection and shutdown maintenance.
11. Communicate the problems of instrumentation with operation and other maintenance divisions and take appropriate means or report to his superior.

3.4.2 Plant Operator Course

(1) Boiler Plant Operation

When trainees complete this course, they will be able to:

1. Describe process flows of boiler plants.
2. Read piping & instrument flow diagrams.
3. Explain how to carry out combustion control.
4. Explain how to carry out water control.
5. Explain how to carry out steam control.
6. Describe structure and function of dearators.
7. Describe structure and function of furnaces.
8. Describe the operation of centrifugal and reciprocating pumps.
9. Describe the operation of draft fans.
10. Explain how to control boiler plant processes.
11. Explain the principle and handling of feed back control systems.
(temperature, pressure, flow, level)
12. Describe and explain normal operation procedures of boiler plants.
13. Explain typical causes of emergency stop and describe countermeasures to be taken.
14. Take necessary safety actions as an operator.
15. Operate the mini-plants.

(2) Steam Turbine & Power Generator Operation

When trainees complete the course, they will be able to:

1. Read piping & instrument flow diagrams.
2. Describe the principle of steam turbines.
3. Describe the principle of gas turbines.
4. Describe the principle of diesel engines.
5. Describe the principle of electric power generation.
6. Explain function and structure of steam condensers.
7. Describe and explain function and structure of steam turbines and power generators.
8. Describe operation procedures of steam turbines and power generators.
9. Describe test procedures of safety devices on steam turbines.
10. Read emergency system diagrams.
11. List typical causes of emergency stop and describe how to take actions in emergency.
12. Take necessary safety actions as an operator.
13. Operate the mini-plants.

(3) Desalination Plant Operation

When trainees complete this course, they will be able to:

1. Describe desalination plant processes.
2. Read piping & Instrument flow diagrams.
3. Explain pre-treatment of sea-water.
4. Describe a vacuum generation system.
5. Explain principle of multi-stage flash evaporating system.
6. Describe structure and function of brine heaters.
7. Describe and explain structures and operation procedures of horizontal and vertical type centrifugal pumps.
8. Describe process control of a typical plant system.
9. Explain the principle of feed back control systems and to handle them.
(temperature, pressure, flow, level)
10. Describe and explain normal operation procedures.
11. List up typical causes of emergency stop and to describe actions after the emergency stop.
12. Operate mini-plants.

3.5 TRAINING CONTENTS

3.5.1 Basic Science

1. Orientation

- SWCC guidance
- Training Center guidance
- Observation of factories.

2. Basic Science Review

- Industrial mathematics
- Physics applicable to process industry
- Industrial chemistry

3. General Safety

- Kinds of hazard
- Working safety
- Handling materials safety
- Using machinery safety
- Personal protective equipment
- Electrical safety
- Firefighting

3.5.2 General Basic Technology

1. Outline of Desalination Plant Processes

- Intake of sea water and preliminary treatment
- Multistage flush method
- Reverse osmotic membrane method

2. Outline of Boiler plant Processes

- Method of steam generation
- Types and structure of boilers

3. Outline of Electric Power

- Function and structure of steam turbines
- Function and structure of gas turbines
- Function and structure of diesel engines
- Mechanism of power generation and structure of generators

4. Outline of Mechanical Equipment

- Type and construction of pumps
- Type and construction of blowers
- Heat exchanger
- Vessel and tower

5. Outline of Piping Units

- Kinds of pipe and pipe method
- Type and structure of valves
- Kinds of fittings and packings
- Safety valves

6. Outline of Electrical Equipment
 - Construction and function of motors
 - Transformers
 - Distributing panel and incoming panel
 - Switches and circuit-breaker
 - Lighting equipment
7. Outline of Instrumentation
 - What is process instrumentation ?
 - How to measure process variables
 - Feedback control
 - Components of control loop
8. How to Read P & I Diagram
 - Symbols and diagrams
 - P & I Diagrams of related plants
9. Utility Facilities
 - Steam and boiler
 - Cooling water and cooling tower
 - Instrument air supply
 - Electric power supply system
10. Material of Facilities and Corrosion
 - Corrosion of steels in boiler and desalination plant
 - Anti-corrosion alloy

11. Plant Safety

- How to handle extinguishers
- Safety garb
- Emergency measure in plant

3.5.3 Advanced Technology

3.5.3.1 Plant Maintenance Course

(1) Mechanical Maintenance

1. Hand Tools, Measuring Tools and Machine Tools

- How to use various tools
- How to measure length and angle
- How to operate machine tools

2. Mechanical Drawings

- Kinds of mechanical drawings
- How to read assembly drawings of rotating machine and static equipment
- Simple drafting using drawing instruments
- How to read P & I Diagrams

3. Materials for Machine & Equipment and Destructive Test

- Composition, property and application
- Essential points of corrosion and corrosion prevention
- Characteristics of Cu, Al, Ti Alloys
- Characteristics of non-metallic materials and applications
- Principle and method of heat treatment

4. Gaskets

- Causes of leak and countermeasures
- Types and kinds of seals and their use
- Tightening pressure of gaskets
- Application ranges and features of typical gaskets
- How to tighten gaskets

5. Lubricating Oil

- Role of lubricating oil
- Classification, use and standard specification of lubricating oil
- How to identify degraded lub-oil

6. Non-destructive

- What is non-destructive inspection?
- Principle and method of penetrant test
- Principle and method of magnetic particle examination
- Principle and method of ultrasonic flaw detection
- Principle, method and safety counter-measure of X-ray inspection

7. Rotating Machines

- Type, construction and function pumps
- Type, construction and function of blowers
- Type, construction and function of reciprocating compressors
- Type, construction and function of steam turbines
- Type, construction and function of diesel engines
- Type, construction and function of bearings
- Type, construction and function of shaft-seals
- Type, construction and function of shaft-couplings
- Disassembling and assembling method of pumps and compressors
- Use of inspection equipment
- Examples of troubles

8. Heat Exchangers

- What is a heat exchanger?
- Classification of heat exchangers
- Disassembling and assembling method
- Fitting method of tubes to tube-plates
- How to clean tubes
- Daily inspection
- Examples of troubles

9. Mechanical Field Maintenance

- Preparation of maintenance tools
- Repair work and safety
- Daily inspection
- Plant maintenance system

10. Practice of Maintenance

- Mechanical maintenance using mini-plants

(2) Piping Equipment Maintenance

1. Hand Tools, Measuring Tools and Machine Tools.

- How to use various tools
- How to measure length and angle
- How to operate machine tools

2. Piping Drawings

- Kinds of piping drawings
- Symbols
- How to draw simple piping drawings & isometric drawings
- How to read P & I Diagrams

3. Pipes

- Classification and standard specification of pipes
- Causes of corrosion and material selection

- Kinds and characteristics of lining materials
- Thermal expansion of piping
- Significance and method of heat treatment

4. Gaskets

- Causes of leak and countermeasures
- Various gaskets for sealing
- Tightening pressure of gaskets
- Application ranges and characteristics of various types of gaskets
- Fitting method of gaskets

5. Piping Accessories

- Types and characteristics of pipe supports
- Types and applications of pipe joints and pipe fittings

6. Valves

- Type, structure and application of valves
- Disassembly and assembly
- Method of hydraulic and air tight test

7. Daily Inspection
 - Principle and handling method of inspection tools (Vibrometer, Sound-sensing bar, ultrasonic thickness meter, etc.)
 - Causes and measures of pulsation, water hammer and cavitation
 - Causes and countermeasures of erosion
8. Pipe Line Cleaning
 - Physical cleaning
 - Chemical cleaning
9. Pipe Bending Method
 - Method of profiling
 - Structure and handling method of pipe bending machine
10. Welding of Pipes
 - Principle of welding and classification of welding method
 - Arc welding and safety
 - Classification and selection of welding rods
 - Outline of inert-gas arc welding
 - Outline of CO₂ gas arc welding
 - Oxy-acetylene welding & cutting and safety

11. Destructive & Non-destructive inspection
 - Non-destructive inspection and welability test of welded parts
12. Countermeasure for Leakage
 - Calking
 - Kinds of adhesive and application
 - Method of band setting
13. Insulation Materials for Piping
 - Kinds and use of insulation materials
14. Piping Line Field Maintenance
 - Preparation of maintenance tools
 - Repair work and safety
 - Examples of troubles
 - Dialy inspection
 - Plant maintenance system
15. Practice of Piping Work
 - Piping prefabrication

(3) Electrical Equipment Maintenance

1. Theory of electricity
 - Introduction of electricity and electronics
 - Basic theory of DC & AC

2. Electric Wiring

- Connection and connection method of wiring, terminal and electric instruments
- Reading method of sequence control, circuit, connection method of fundamental circuits (self hold circuit, operation circuit of two place, automatic and manual control circuit, inching, circuit, reversible run circuit and star-delta starting circuit)

3. Electric machine, material and Inspection

- Principle, construction, theory and characteristics of D.C. generator, D.C motor and transformers
- Classification and construction of switchboards
- Wiring instruments (electromagnetic switch, mold case circuit breaker and lighting fixtures)
- Structural material, magnetic material, semi-conductor material
- Inspection of transformer, motor, low voltage distribution panel and wiring instrument

4. Measuring and Testing

- Indicating instrument (moving-coil type, moving-iron type, induction type, rectification type, electrodynamic type, thermoelectric type)
- Voltage, current, resistance, electric power, impedance
- Winding resistor, transformation ratio, non Load test, insulation resistance and insulation oil test of transformer
- Winding resistor, non Load test locked test and insulation

5. Drawing

- First-angle projection, third-angle projection
- Single-line diagram, Double-line diagram, switch boards diagram
- Transformer, motor

6. Law concerning electricity

- Laws system, definition of term, limit of accommodation
- General rules, insulation of electric circuit and earth, machine and implement etc.

7. Implement direction for use
 - How to use various tools
8. Measurement work
 - How to measure length, angle, size, level and etc.
 - Measurement of DC voltage, AC voltage, current, and watt
 - Measurement of resistance
 - Measurement of illumination
 - Winding resistor, transformation ratio, non load test, insulation resistance of transformer and motor
9. Inspection
 - Outside box, damage of radiator corrosion, leakage oil, looseness point of terminal fastening and stain of bushing for transformer
 - Sound of bearing, temperature, station noise draft condition, oscillation, looseness of clamping bolt for motor
 - Cleaning of meter and auxiliary apparatus, offensive smell, wire breakes of signal, looseness of terminal, damage of switch boards and wire by use low-tension switchboard
 - Electro magnetic switch, meter wiring breaker and lighting fixture

(4) Instrumentation Maintenance

1. Introduction to Instrumentation System
 - Purpose of process measurement
 - Concept of automatic control loop
 - System and components of instrumentation
 - Outline of maintenance system
2. Industrial Measuring Method
 - Temperature measurement
 - Pressure measurement
 - Flowrate measurement
 - Level measurement
 - pH and conductivity
 - Others
3. Construction and Functions of Instruments in Control Loop
 - Sensors or detectors
 - Transmitters or transducers
 - Recorders and indicators
 - Controllers
 - Final Control elements
 - Auxiliary instruments
4. Feedback Control
 - Open loop and closed loop
 - Control action
 - Application of control system

5. Sequence Control
 - Fundamental of logic theory
 - Sequence devices
 - Application of sequence and interlock system
6. Electrical and Pneumatic Power Supply
 - Electrical power supply system
 - Pneumatic power supply system
7. Drawings in Instrumentation
 - Kind and use of drawings
 - Symbols, terms and diagrams
 - Simple drafting of diagrams
 - P & I Diagrams, Instrument Loop Drawing, and Sequence Diagrams
8. Measuring Instrument
 - How to use mechanical measuring instrument
 - How to use electrical measuring instrument
9. Field Maintenance Work
 - Routine maintenance and shutdown maintenance
 - Adjusting and calibration technique in plant

- Drafting instrument hook up drawing
- Handling of tools and machine for instrument installation work

10. Workshop Maintenance Work

- Test and calibration of pneumatic instrument
- Test and calibration of electronic instrument
- Test and calibration of final control element
- How to disassemble and assemble typical instruments
- Work recording and reporting

3.5.3.2 Plant Operation Course

(1) Boiler Plant Operation

1. What is Steam ?
 - Change of water phases
 - Saturated steam and superheated steam
 - Relation between the volume and the pressure
 - Industrial use of water
2. Process of Steam Generation
 - Mechanism of steam generation
 - Function of major machinery and equipment
3. Control of Combustion System
 - What is combustion?
 - Meaning of atomizing
 - Measuring of excess air
 - Structure of burners and how to handle
 - Operation of combustion system and safety device
4. Control of Water System
 - Formation of scales
 - Role of boiler compounds
 - Injection method of boiler compounds
 - Meaning of blow
 - Function of deaerators

5. Control of Steam
 - Control on temperature, pressure and flow of steam
 - Function of desuperheaters
 - How to read steam table
6. Structure and Function of Furnaces
 - Materials and structure of furnaces
 - Mechanism of heat transfer-radiation and convection
 - Waste heat recovery
 - Control of pressure in furnaces
7. Operation of Centrifugal Pump
 - Start-up
 - Shut-down
 - Daily inspection
8. Operation of Draft Fan
 - Start-up and shut-down
 - Daily inspection
9. Control of Boiler System
10. Feed back control-Temperature, Pressure, Flow and Level
 - Mechanism of controls
 - Structure of instruments

11. Boiler Operation
 - Preparation of start-up
 - Start-up and shut-down
 - Measures to be taken after shut-down
12. Emergency System
 - Causes of emergency stop
 - Measures to be taken after emergency stop
13. Main Trouble of Boiler Operation and Counter-Measure
14. Practical Operation (Mini-Plant)

(2) Steam Turbine & Power Generator Operation

1. The Principle of Electric Power Generation

- Method of power generation
- Type of generators
- Type of drivers

2. Principle of Drivers

- Steam turbine
- Gas turbine
- Diesel engine

3. Composition and Fuction of Condensed
Water System

- Structure and function of condensers
- Structure and function of ejectors
- Operation of condensed water system

4. Composition and Fuction of Steam Turbine
System

- Structure of turbines
- Steam system
- Condensate system
- Cooling water system

5. Composition and Function of Power
Generation System

- Structure of generators
- Cooling system
- Electric power system
- Control system

6. Feed-back Control System
 - Mechanism of control
 - Structure of instruments
7. Operation of Steam Turbine Generators
 - Preparation for operation
 - Start-up and shut-down
 - Daily inspection
 - Function and operation test of safety devices
 - Parallel operation and single operation
8. Emergency System
 - Causes of emergency stop
 - Measures to be taken after the stop
 - Mutual relation of boiler-turbine-generation on operation
9. Trouble Shooting on Operation
10. Operation Practice (Mini-Plants)

(3) Desalination Plant Operation

1. Principle of Production of Pure Water
from Sea Water

- Principle of multi-stage flash method
- Principle of reverse osmosis membrane
- Other method

2. Process of Pure Water Production

- Mechanism of pure water production
and function of main machinery and
equipment (Multi-stage flash evapora-
ting method and reverse osmosis
membrane method)
- Reason for making vacuum and multi-
stage flash

3. Pre-treatment of Sea Water

- Why pre-treatment is needed?
- The role and injection procedure of
additives
- Structure and role of deaerators

4. Control of Vacuum System

- Mechanism to make vacuum
- Structure and function of ejectors
- Role of balometric condensers
- Operation of ejectors

5. Control of Evaporating System
 - Structure and function of multi-stage flash evaporators
 - Relation among concentration, temperature and vapor pressure of sea water
 - Factors to lower the quality of pure water
 - Causes of scale formation and preventive measure and cleaning method
6. Operation of Brine Heater System
 - Structure and role of brine heaters
 - Operation of brine heaters
7. Operation of Centrifugal Pumps (Horizontal & Vertical)
 - Difference between vertical pumps and horizontal pumps
 - Start-up
 - Shut-down
 - Daily inspection
8. Feed back Control System
 - Mechanism of control
 - Structure of instruments
(temperature, pressure, flow, level)

9. Operation of Desalination Plant
 - Preparation of start-up
 - Start-up and shut-down
 - Measures to be taken after shut-down
10. Emergency System
 - Causes of emergency stop
 - Measures to be taken after emergency stop
11. Trouble Shooting
12. Practical Operation (Mini-Plants)

4. LIST OF TRAINING EQUIPMENT

Training equipment selected hereinafter is very important to realize the training philosophy mentioned in 2. Conceptual Design Philosophy, that is, Learning By Doing utilizing training equipment and aids.

Following conditions shall be taken into consideration:

(1) Measurement System

The unit of measurement for engineering, design and documents of training equipment shall be in general the metric system and Celsius system.

One of the major exceptions is that the nominal size of pipes, etc. will be in inch system as a rule.

(2) Applicable Codes and Standards

All training Equipment shall be designed, assembled and/or manufactured in accordance with the internationally accepted standards, including the following Japanese standards:

- 1) Japanese Industrial Standards (JIS)
- 2) Japanese Electrotechnical Committee's Standards (JEC)
- 3) Japanese Electric Machine Industry Association (JEM)

(3) Electric Power Supply Condition

Electrical system for the training center shall be as follows:

- a) Primary side; 3 phase, 3 wires, 13,800 V, 60 Hz
- b) Secondary side; 3 phase, 4 wires, 230 V/133 V, 60 Hz

(4) Wording

English language shall be used for Training Equipment and all the related documents and drawings.

4.1 MAINTENANCE COURSE

4.1.1 Mechanical Maintenance

No.	ITEM	QUANTITY	DESCRIPTION
1.	Hand tool	1 lot	Wrenches, Pliers, Hammers, Screw drivers, Hak-saw, Files, Scrapers, Chisels, Hand taps, Dies sets, etc.
2.	Working tool	1 lot	Chain block, Wire ropes, Sling belts, Electric portable drills, Electric portable grinders, Electric disc grinders, Gear pullers, Bearing pullers, Hand lifter, Torque wrench set, etc.
3.	Measuring tool	1 lot	Dial gauges, Height gauges, Micrometers, Vernier calipers, Steel rules, Measuring rules, Thickness gauges, Screw pitch gauges, Squares, Levels, Straight edges, V blocks, Surface plates, etc.
4.	Hydraulic pressure test equipment	1 set	Max. test pressure 200 kg/cm ² G
5.	Lathe	1 set	Swing over bed 470 mm, W/accessories
6.	Drilling machine	1 set	Drilling capacity 25 mm (in steel), W/accessories
7.	Milling machine	1 set	Working table 950mm x 210mm, W/accessories
8.	Bench drill	1 set	Drilling capacity 13mm dia., W/accessories
9.	Duplex head grinder	2 sets	Grinding wheel dia. 255mm
10.	Shaper	1 set	Stroke 550mm, W/accessories
11.	Hack-sawing machine	1 set	Cutting capacity 180mm dia., W/accessories
12.	Electric hoist	1 set	Capacity 1 ton
13.	Reciprocating air compressor	1 set	Capacity 0.9 m ³ /min, air pressure 7kg/cm ² G, W/accessories

No.	ITEM	QUANTITY	DESCRIPTION
14.	Centrifugal pump.	1 set	Capacity 1.4m ³ /min., Head 20m
15.	Cutaway model of centrifugal pump.	1 set	Capacity 1.4m ³ /min., Head 20m
16.	Steam turbine	1 set	Output 0.9KW, Steam pressure 5kg/cm ² G
17.	Turbo blower	1 set	Capacity 20m ³ /min., 80 mm Aq.
18.	Heat exchanger	1 set	Design pressure 10 kg/cm ² , Heating surface area 20m ²
19.	Valve	1 lot	Gate, Glove, Check, Ball, Cock, etc. Cutaway Model of Gate, Glove, Check, Safety Valves
20.	Bearings	1 lot	Ball, roller & plain bearing
21.	Mechanical seal	1 lot	Mechanical seal, labyrinth & oil peal
22.	Coupling for shaft	1 lot	Flange, flexible, gear, diaphragm & steel flex type
23.	Drafting machine	8 sets	900mmH x 600mmV, A-1 type
24.	Working table	8 sets	2 drawers type
25.	Steam trap	1 lot	Disk, Bi-metal, Float
26.	Steam ejector	3 sets	Motive steam 3.5kg/cm ² G x 4l kg/h
27.	Materials for field work	1 lot	Pipes, pipe fittings, Steel plates packings, lub-oil, etc.
28.	Punching machine	1 set	Punching: 26 mmø x 6 mmt, Press.capacity 20 Ton Weight 700 Kg
29.	Puncher	1 set	Portable hydraulic type Max. 18 mmø x 3.2 mmt
30.	A.C. arc welder	1 set	Rated input 41 KVA, Rated current 500A, W/accessories

4.1.1.2 Piping Equipment Maintenance

No.	ITEM	QUANTITY	DESCRIPTION
1.	Hand tool	1 lot	Wrenches, Pliers, Hammers, Screw drivers, Hack-saw, Files, Chisels, Copper pipe cutter set, etc.
2.	Working tool	1 lot	Chain bloc, Wire ropes, Sling belts, Electric portable drills, Electric portable grinders, Electric disc grinders, Hand lifter, Torque wrench set, etc.
3.	Measuring tool	1 lot	Dial gauges, Height gauges, Micrometers, Vernier calipers, Steel rules, Measuring rules, Thickness gauges, Screw pitch gauges, Squares, Levels, Straight edges, V blocks, Surface plates, etc.
4.	Transit -	1 set	Scope x 27, Angle 1°8', Min. measuring distance 2m
5.	Tube cleaner	2 sets	Air driven, Tube I.D. 19mm, Air consumption 6 kg/cm ² G x 0.24m ³ /min. W/accessories
6.	Hydraulic pipe bender	1 set	Bending capacity 114.3mm ϕ x 4.5mm t, W/accessories
7.	A.C. arc welder	5 sets	Rated input 41KVA, Rated current 500A, W/accessories
8.	Inert-gas arc welding machine	1 set	Rated input 41KVA, Rated current 500A, W/accessories
9.	Oxy-acetylene welding & cutting equipment	5 sets	Gas welding torch 5 tips, Gas cutting torch 5 tips Hose each 10m, regulators, cylinders, carts, etc.
10.	Welding rod dryer	1 set	Operating temp. max. 300°C
11.	Plastic welder	2 sets	Air pressure & volume 0.37kg/cm ² G x 80l /min. W/accessories
12.	Hydraulic pressure test equipment	1 set	Max. test pressure 200kg/cm ² G, W/accessories

No.	ITEM	QUANTITY	DESCRIPTION
13.	Valve test rig	1 set	Rating 150 to 1500 psi, W/accessories
15.	Equipment for inspection	1 lot	Sound level meter, Gas detector, Stroboscope, tachometer, Vibrometer, Surface thermometer
16.	Non-destructive inspection equipment	1 lot	Penetrant check, Magnetic flaw detector, Digital thickness meter, Ultrasonic flaw detector
17.	Shore hardness tester	1 set	Dial indicating, W/accessories
18.	Universal testing machine	1 set	Six stages (0.5 ft, 1 tf, 2 tf, 5 tf, 10 tf, 20 tf) W/accessories
19.	Charpy's impact tester	1 set	Capacity 30 kg f.m, W/accessories
20.	Sump set	1 set	For corrosion examination
21.	Standard file for scratch hardness tester	1 set	General use for Rockwell "C"
22.	Test piece for spark test	1 set	Group "D", 15 kinds/set
23.	Lighting equipment for X-ray film	1 set	Drilling capacity 13mm dia, (in steel), W/accessories
24.	Bench drill	1 set	Drilling capacity 13mm dia, (in steel), W/accessories
25.	Duplex head grinder	2 sets	Grinding wheel dia. 255mm
26.	Drilling machine	1 set	Drilling capacity 25mm (in steel), W/accessories

No.	ITEM	QUANTITY	DESCRIPTION
27.	Shaper	1 set	Stroke 550mm, W/accessories
28.	High speed cut-off machine	1 set	Vice stroke 236mm, W/accessories
29.	Pipe threading machine	1 set	Threading capacity 1/4" to 1-1/2", W/accessories
30.	Electric hoist	1 set	Capacity 1 ton
31.	Working table	8 sets	2 drawers type
32.	Piping material	1 lot	Pipes, Pipe fittings, Steel plates, Packings, etc.
33.	Expansion joint	1 lot	Bellows type, Flexible tube type
34.	Steam trap	1 lot	Disk, Bi-metal, Float
35.	Steam ejector	1 lot	Motive steam 3.5 kg/cm ² G x 41kg/h
36.	Punching machine	1 set	Punching: 26 mm ϕ x 6 mm ^t , Press. capacity 20 Ton, Weight 700Kg
37.	Puncher	1 set	Portable hydraulic type Max. 18 mm ϕ x 3.2 mm ^t

4.1.3 Electrical Equipment Maintenance

No.	ITEM	QUANTITY	DESCRIPTION
1.	Exercise switchboard (High tention)	1 set	Metal-enclosed switchgear, incoming panel, 6KV, 25MVA incoming
2.	Exercise switchboard (Low tention)	2 sets	Power panel & lighting panel
3.	Induction regulator	12 sets	Induction regulator box type, slide type
4.	Rectifier	1 set	Silicon charger DC 110V-20A
5.	Motor for assembling practice	10 sets	Non explosion-proof induction type 400W
6.	Motor	20 sets	Non explosion-proof various 200W-2.2KW
7.	Transformer	14 sets	Pole TR., insulation TR. oil-immersed, self-cooled
8.	Ster-delta experiment circuit	3 sets	Enclosed self-standing panel for 230V 37KW motor
9.	Loading resistor	2 sets	Starting controller 2KVA & 5KVA
10.	Lighting fixture	6 sets	For 133V fixture various
11.	Relay	11 sets	Various protection relay
12.	Sequence circuit panel	3 sets	Enclosed self-standing panel, noncontact circuit
13.	Testing generator	1 set	Package type AC. M-DC.G 2KW
14.	Experiment motor generator	1 set	Package type DC.M-DC.G 2KW
15.	Control circuit board	3 sets	Enclosed self-standing panel, reversible circuit
16.	Control instrument board	1 set	Self-standing open type panel, fixed equipment

No.	ITEM	QUANTITY	DESCRIPTION
17.	Cutway motor	3 sets	35W, 200W, 750W
18.	Cutway transformer	1 set	4160V/230V 5KVA
19.	Arc. Welding machine set	1 set	AC 133V 60H 19KVA & accessory
20.	Double head bench grinder	1 set	300W
21.	Insulation test equipment	1 set	0-50KV manual type, box with caster
22.	Relay tester	1 set	Universal type
23.	Measurement instrument	1 set	Various instrument & tool
24.	Hand tool	1 set	Various hand tool
25.	Work bench	5 sets	Wooden bench with drawer
26.	Storage cabinet rack & other	1 set	Tool cabinet & drafting set
27.	Materials for practice	1 lot	
28.	Engine generator	3 sets	Portable gasoline engine generator 60Hz 230V 22A

4.1.4 Instrumentation Maintenance

No.	ITEM	QUANTITY	DESCRIPTION
1.	Instrument Calibration Desk	each 2	1,900 ^W x 760 ^D x 1,050 ^H for pneumatic, and Electronic Instrument
2.	Working Tool Set	each 5	Mechanical tool kit, Electrical tool kit, and Air tube connection set, with carrying canvas bag
3.	Mechanical Measuring Tool Set	each 2	Tape Measure (2m), Vernier Caliper (150mm), Micrometer, Dialgauge, and etc.
4.	Balance	each 1	Table Balance (100g), Spring Balance (10kg)
5.	Thermometer	each 1	Glass Thermometers; mercury, and Alcohol type, Wet Dry Bulb Thermometer, and Optical Pyrometer
6.	Aneroid Altimeter	1	930 - 1,070 mb, Portable type
7.	Manometer	each 2	Water column (2m), Hg column (1m) single tube with stand, and Digital Manometer
8.	Pressure standard	1	0 - 2.000 kg/cm ² , portable type
9.	Dead Weight Tester	1	Bench Type, Capacity: 100 kg/cm ²
10.	Manual Pressure Test Pump	each 1	0 - 1,000 mmHg (Air), and 0 - 70 kg/cm ² (Hydraulic)
11.	DC Voltage/Current Standard	2	Portable Type, Range: 10mV/100V, and 1mA/100mA
12.	Electric Measuring Instruments	each 3	Analogue DC Ammeter, Voltmeter, AC Ammeter, Voltmeter and Universal Tester
13.	Hybrid Multimeter	3	Digital, & Analogue multifunction meter, Portable type

No.	ITEM	QUANTITY	DESCRIPTION
14.	Resistance Standard	each 1	Plug type, and Decade dial setting type 0 - 111.1 Ω
15.	Wheatstone Bridge	2	1 Ω - 10M Ω , built in Galvanometer
16.	Insulation Tester	each 1	Battery type: 500V/100M Ω , Hand drive type: 500V/1,000M Ω and Insulation Polyster
17.	Oscilloscope	3 sets	Dc.250kHz
18.	Synchroscope	3 sets	Multi-function type 6", DC.50MHZ
19.	Auto-Transformer	1	Precision type, 0 - 160V
20.	DC Power Supply Unit	3	0 - 30V, 0 - 7A
21.	Cold Junction Bottles	4 pcs.	Ice-bottle type
22.	Refrigerator	1	400 ^W x 500 ^D x 700 ^H
23.	Standard Water Bath	1	10 - 80°C, on-off control
24.	Furnace for Thermocouple Calibration	1	0 - 1,000°C, I.D. x L: 50mm x 300mm
25.	Pressure Gauge	each 2	0 - 10 kg/cm ² , 1 - 1,000 mmAg, with accessories
26.	Temperature Sensing Element	each 1	Thermocouple, Resistance bulb, and Thermowell
27.	Limit Switch	each 1	Thermo (0 - 300°C), Pres. (0 - 10K), and Level (0 - 1m) Switch
28.	pH Meter	each 1	0 - 14 pH, desk top type, and On-line Transmitter (4 - 20mA)

No.	ITEM	QUANTITY	DESCRIPTION
29.	Conductivity Meter	1	0 - 100µv, on-Line Transmitter (4 - 20 mA)
30.	Explosive Gas Detector	1	Portable type, 0 - 20/0 - 100% (LEL)
31.	Flow Meter	each 1	Orifice assembly (1B), Area flowmeter (1B), Oval meter (2B) and Turbine meter (3B)
32.	Salt Density Meter	1	Portable type, 0 - 30% . .
33.	Transmitter	each 2	Pneumatic and Electronic Temp., Press., Differential Press. and Level Transmitter
34.	Recorder	each 1	2 pens, 6 points, and Trend Recorder
35.	Analogue Controller and Kit	each 2	Pneumatic and Electronic Panelmount type, and Field type Pneumatic Controller
36.	Auxiliary Panel Instrument	each 1	A/M Station, E/P & P/E Converter, Alarm set station, Ratio set station, and Pneumatic computer
37.	Nozzle & Flapper Assembly	2 sets	With Flapper displacement indicator; 0 - 2 mm (1/1,000 mm)
38.	Process Simulator	2 sets	Pneumatic type
39.	Circuit Tester Kit	15 sets	Parts of Tester for assembling practice
40.	Synchroscope Trainer	1	IWATSU ITF-4 or equivalent
41.	Electronic Circuit Training Kit	4 sets	Portable type, Programmed system, AVCC DT-III or equivalent
42.	Relay Sequence Training Kit	2 sets	Portable type with A.V. software

No.	ITEM	QUANTITY	DESCRIPTION
43.	DC Circuit Training Kit	each 2	Electronic basic elements DC source circuit, and Transistor Amp. Trainer
44.	Motor Training Kit	each 1	Assembling kit (200W, 1 ϕ), and Cut Model (200W, 3 ϕ)
45.	Air Compressor System	1 set	400 NL/min x 8.5 K, with Dehumidifier and Dryer
46.	Process Feedback Control Unit	each 1	Pneumatic and Electronic system: F.L.P.T Control Model
47.	Comparative Flow Measurement Unit	1	Venturi, Orifice, Rotameter with Manometer
48.	Electric Power Distribution Board	1	380V 3 ϕ 60A; 4 circuits, and 220V 1 ϕ ; 10 circuits
49.	Cable Winder	2	1 ϕ 220V, 15A x 30m
50.	Drill	each 1	Handy type (1 ϕ), and Stand type (3 ϕ ; 13mm ϕ 400V
51.	Grinder	1	Bench type, 150 ^O .D. 3,000 rpm
52.	Welding Machine	1 set	Primary; 133V, Second; 27(36)V, 110A
53.	Hand Tools for Construction Work	each 2 sets	Wiring Tools, Tubing Tools and Tool Boxes
54.	Surface Plate	each 1	Precision and Gramite type
55.	Vise	each 4 or 1	Standard Bench Type (4), Adjustable (2), and Pipe Vise (1)
56.	Control Valve Test Stand	2 sets	Applicable Size 1 - 3 B, Max. 600 lb.

No.	ITEM	QUANTITY	DESCRIPTION
57.	Control Valve	each 2	Glove, Angle, Butterfly, Ball Type, 1 1/2B - 3 B
58.	Valve Positioner	"	P/P Positioner and E/P Positioner
59.	Cut Model of Control Valve	each 1	Diaphragm-Air Motor and Electric Motor Drive, 1 1/2 B, 10 k
60.	Three Valve Manifold	4 sets	Material for Electric and Pneumatic FIC Loop
61.	Precision Pressure Gauge	2	0 - 2 kg/cm ² G, 300 mm ϕ
62.	Chain Block	1	Capacity 1t, Lift 2.5m
63.	Cart	1	500kg, 1,200 x 750 mm
64.	Cleaner	1	Vacuum cleaner, 13 liter, 1 kW
65.	Working Table	1	Transportable, 1,000 x 600 x 700, Capacity 1t
66.	Materials for practice	1 lot	

4.2 PLANT OPERATION COURSE

No.	ITEM	QUANTITY	DESCRIPTION
1.	Mini Plant A (Vacuum Evaporation Unit)	1	Evaporator, Receiver, Condenser, Reboiler, Steam ejector, Package boiler, Air compressor, Cooling tower, Pump, Control panel, Instrumentation
2.	Mini Plant B (Air Scrubbing Unit)	1	Packed tower, Receivers, Coolers, Air compressor, Prefilter, Air tank, Cooling tower, Pumps, Silencer, Control panel, Instrumentation
3.	Process Control Model	1	Control panel with instrument (Flow, Temperature, Pressure, and Level), Water tank, pump, Control valve, Air compressor
4.	Steam Turbine Generator Experimental Machine	1	Steam boiler, Steam turbine, Generator, Load resistor, Atmospheric condenser, Softener, Fuel tank, Others
5.	Hydraulic Bench	1	(for pump performance experiment) weigh tank, pump, Sump tank, Weigh balance
6.	Actual Equipment for Practice and Tools		
	(1) Centrifugal Pump	1	Horizontal
	(2) Reciprocating Pump	1	Metering pump
	(3) Valve	each 1	Gate, Glove, Cock, Check, Ball
	(4) Hand Tools	each 3	Spanner, Wrench, etc.
7.	Experiment Apparatus for Fundamental Chemistry and Physics		
	(1) Metal Cubes and Cylinder Set	2	For specific gravity experiment

No.	ITEM	QUANTITY	DESCRIPTION
	(2) Apparatus to Demonstrate Law of Gas	2	
	(3) Pressure Gauge	2	Burdon tube
	(4) Heat Expansion Demonstrator	2	Metal ball and holes
	(5) Bimetal Demonstrator	2	Electric contacts
	(6) Thermometer	10 & 20	Without scale & with scale
	(7) Metal acid reaction apparatus	3	
	(8) Electrolysis and Ion Experiment Apparatus	2	Electrode and test tube
	(9) Metal Erosion Experiment kit	1	Polarizing microscope
	(10) Pensky & Marten's Flash Point Tester	1	
	(11) Evacuation Experiments Set	1	Rotary vacuum pump
	(12) Glass Apparatus and others	1	Glass apparatus, Stand, Burner
8.	Experiment Apparatus for Fundamental Electricity		
	(1) Electrical Network Experiment Kit	2	
	(2) Ohm's Law Demonstrator	2	
	(3) Electromagnetic Phenomena Demonstrator	2	

No.	ITEM	QUANTITY	DESCRIPTION
(4)	Electromagnetic Force Demonstrator	2	
(5)	Electrostatics Experiment Kit	2	
(6)	Single Phase Induction Motor	1	
9.	Measuring Instrument		
(1)	Conductivity Meter	3	Digital, automatic type
(2)	pH Meter -1.	3	Glass electrode type
(3)	pH Meter -2.	3	Portable type, digital display
10.	Equipment for Safety Practice		
(1)	Safety Equipment	each 2	Dust protection mask, glasses, etc.
(2)	Combustible Gas & Oxygen Gas Detector	1	for O ₂ , CH ₄ , CO
(3)	Multi Gas Detector	1	Drager tube type detector
(4)	Oxygen Meter	2	Portable type
11.	Cut Model for Demonstration		
(1)	Valve	each 1	Gate, Glove, Check, Ball, Relief (1-1/2")
(2)	Steam Divices	each 1	Below, Disc, Thermo dynamic (3/4"), Steam ejector
(3)	Pump	each 1	Centrifugal, Reciprocating
12.	Work Table and Others		
(1)	Experiment Table for Students	4	

No.	ITEM	QUANTITY	DESCRIPTION
	(2) Experiment Table for Instructor (3) Sink (4) Cabinet (5) Spare parts and others	1 1 4 1 lot	with drying oven for apparatus and reagents

4.3 AUDIO-VISUAL AIDS

No.	ITEM	QUANTITY	DESCRIPTION
1.	Movie Projector	2	16mm with optical & magnetic talky system
2.	Slide Projector	2	Automatic Interval projection with slide corder
3.	Screen	2	1,500 x 1,500 portable stand type
4.	Overhead Projector	8 sets	250 x 250 mm with screen
5.	T/P producing Equipment	1 set	Strobe flash type
6.	TV Monitor	8	Color system PAL & NTSC 570mm
7.	Video Cassette Recorder	8	Signal system universal
8.	Language Laboratory System	1 set	For 18 students
9.	Video Camera	1 set	PAL System Camera & VTR

5. DESING OF TRAINING BUILDING AND FACILITY

5.1 SITE PLANNING

5.1.1 Location and Site Description

The site is flat land which is adjacent to existing SWCC Plant at Yanbu in Saudi Arabia and southwestern side of the site faces to access road to the facilities which branched off from main highway connecting Jidda and Yanbu.

Service system for each facility zone will be done by the outer service circulation system.

In accordance with the debate at Saudi Arabia on May 1984, in this conceptual design, concrete planning to facility zone for vocational training center will be programmed.

5.1.2 Training Center

Vocational Training facilities zone is planned to arrange administration, classroom, and training buildings in clustered formation respectively. As for administration and classroom, existing building shall be remodeled and used. Room composition of each building will be as follows.

(1) Administration building (Existing building):

Administrative functions of the vocational training center are accommodated in this building, which locates at front of the Center and appears as symbol of core building of the facilities in design. On the ground floor, entrance hall, reception, office, clinic, process control room, director room are arranged, rooms for Japanese experts , instructors (accommodate 7 instructors), assistant instructors,

meeting room (approx. 30 personnel capacity), library etc. are arranged on the first floor. Building is of reinforced concrete 2-storied construction.

Four classrooms for maintenance course, three classrooms for operation course are provided (15 personnel capacity in each). In response to audio-visual and experimental education for both course, a multipurpose room equipped with projector, screen and blackout curtain are provided. Besides above rooms, 16 seats library for student and stack room for 2,000 books, preparation studio for teaching materials and annex rooms are also provided in this building.

(2) Training building:

Five training buildings are arranged along the connecting corridor, which are mechanical, electrical, instrumentation, piping maintenance training and operation training buildings respectively.

Students, instructors and other personnel will approach to each building by the connecting corridor and services for carry out and in of equipment and materials will be done from the outer service circulation passage.

5.2 PROPOSED TECHNICAL SPECIFICATIONS

5.2.1 Proposed Architectural Design Conditions

(1) General Conditions

1) Applicable codes and standards:

As codes and standards for building design, following will be assumed to apply, but at phase of basic and detail design, detailed analysis for classification of applicable design standards, mutual relationship and scope or method of application with Saudi Arabian side will be necessary.

- (a) International codes and standards.
- (b) Saudi Arabian codes and standards.

2) Materials and construction method

As regard to building materials, possibility of local procurement will effect largely to total construction cost. Moreover, adoption of local products is advisable which will link up with promotion of regional industries. Local material adoption will be a policy in the project as far as possible, but at phase of basic and detail design, time of delivery and quantity of production etc. will be re-analyzed and effect to progress of work must be considered.

As for special materials and accommodating equipment, some items to be procured at foreign country which may fall under import restricted items, perfect negotiation with authorities concerned will be necessary. Having regard to construction circumstances in Saudi Arabia, labor

situation, material procurement circumstances and as the projected site situates adjacent to Red Sea, damages by salt will be assumed; column, beam, and floor will be constructed by reinforced concrete, walls will be of hollow concrete block masonry construction.

3) Modules

Because each building differs in its usage, no common module is adopted to all buildings. For workshop and laboratory, dimensions to fit main usage of each building, and to suit within appropriate scope in work ability and cost for reinforced concrete construction, are planned as standard.

(2) Structural Materials

Foundation, column, beam, roof, and floor will be constructed by reinforced concrete, and walls will be of hollow concrete block masonry construction.

(3) Proposed Finishing Materials

1) Floor finish

(a) PVC tile:

300mm x 300mm x 3mm (thickness)

Locally procurable, but shall conform to the Industrial Standard of Kingdom of Saudi Arabia.

(b) Ceramic tile:

50mm x 50mm

Same as above

(c) Terrazzo tile:

Glazed artificial stone which will be applied at common use portion such as lobby or corridor etc.

(d) Dustproof coated floor:

(Nonmetallic floor hardner)

Colored floor coating material containing cement and hard aggregate which will protect against pulverized dust from cement mortar, for use in workshop floor.

(e) Cement mortar steel trowel finish:

Thickness of coating will be 30mm

(f) Floor pit planning for piping and wiring for equipment in the workshops.

Piping and wiring floor pit for equipment shall be provided, according to the equipment layout, in the concrete finishing above the floor slab. The depth of pit shall be 200mm.

2) Wall finish materials

(a) Exterior wall:

Exterior walls will be trowelled to 25mm thickness by cement mortar, successive to base coating weather tight paint will be applied for finish.

(b) Interior wall:

i) Ceramic tile: 108mm x 108mm

Ceramic tile will be used for wall of rooms where moisture may generate; locally procurable, but shall conform to the Industrial Standards of Kingdom of Saudi Arabia

ii) Cement mortar steel trowel finish

Thickness of coating will be 20mm, apply paint on trowelled base for walls of office and classroom

iii) Acoustic wooden panel

Perforated plywood panel will be fabricated on wood furring where glass wools are stuffed into space between furring strips. These panels will be used in rooms where acoustical treatment is necessary such as studio etc.

3) Ceiling materials

(a) Calucium silicate board:

900mm x 900mm

The board will be used on the ceiling of rooms where moisture may generate or equipment to be installed, and will be finished by painting.

(b) Rockwool acoustic tile:

600mm x 300mm

The tile will be used on the ceiling of residing rooms such as office or classroom etc, locally procurable but the products shall conform to the Industrial Standards of Kingdom of Saudi Arabia.

(c) Wood wool board:

In rooms where suspended ceiling is not applicable such as workshop etc, these boards will monolithically be placed on the surface of roof slab to achieve insulation or acoustical property.

(d) Rockwool board:

Formed rockwool board will be installed on the surface of roof concrete slab in machine room etc. to achieve insulation or acoustical property.

4) Roof concrete and waterproofing

After roof concrete slab is placed with 2% fall, finishing flat with steel trowel, polystyrene foam board will be laid and place the asphalt waterproofing layer, then cast the protective concrete.

Expansion joint will be provided on the protective concrete at every 3 meters on both ways.

(4) Proposed Fittings and Glazing

1) Doors

(a) Exterior doors:

All doors other than heavy or large door or shutters will be of aluminum products and protection against damages by salt must be cared.

For doors in experiment room as precision devices will be equipped in these rooms, dustproofing must be considered.

(b) Interior doors:

Wooden door which install in ordinary rooms will be the local standard flush type door with paint finish.

Doors to be installed around machine room where sound insulation is required and those of large in scale or fire door will be of steel product.

2) Windows

(a) Exterior windows:

Considering dust proofing and protection against damage by salt, anodized aluminum sashes of high airtightness will be installed.

Materials will be extruded aluminum sections and finished by electrolytic process which will conform to manufacturer's standard available in Saudi Arabia.

Glazing around residing rooms, plain glass will mainly be used, for toilet, obscure glass will be used. Glasses will conform to manufacturer's standard available in Saudi Arabia.

for residing rooms such as office and classroom, horizontal blind of aluminum product will be installed.

(b) Interior windows:

All interior windows will be of wooden frame and finished by painting. Glasses will be of 5mm thick float-glass.

3) Hardware

(a) Locks:

Lock control system will conform to the controlling system of the SWCC of Saudi Arabia.

(b) Door closers:

All doors will be equipped with door closer as standard.

(c) Knobs and handles etc.:

Lever type handles will be installed on all doors as standard.

4) Others:

(a) Sunshade louvers:

Outside of the exterior wall of the training buildings, aluminum louvers will be installed to shade direct sun rays to improve working conditions and also to meet with the design of the existing building (Administration building).

5.2.2 Proposed Structural Design Conditions

(1) Design Concept

These buildings are planned as low storied type, i.e. single-storied or double-storied building to meet using purpose. The building will be of rigid frame reinforced concrete structure, and hollow concrete block masonry will be applied for walls fundamentally.

Considerations against damage by salt is indispensable because the site is adjacent to seashore, i.e. possibility of containing sulfur in soil is assumed, sulfate-proof cement will be used for substantial concrete work.

Having regard to thermal stress or differential settlement of building, expansion joint will be installed at about 60 m length of building, Soil investigation for the site has not been performed, hence types for building foundation will be determined by thorough investigations which will be performed prior to starting of basic and detail design.

(2) Applicable Codes and Standards

1) General

UBC-1978 (Uniform Building Code - 1978) will be conformed.

2) Design load

(a) Dead load, live load and load combination will conform to ANSI-A 58.1 (American National Standard Institute), but special load will be regarded to meet every situation.

(b) Seismic load

UBC-1978 will be conformed, but $Z =$ Zone No.1

(c) Wind load

i) Wind pressure

UBC-1978 will be conformed, but fundamental wind pressure will be assumed as q_{30} .

ii) Coefficient of wind pressure
ANSI-A58.1 will be conformed.

- 3) Reinforced concrete structures
ACI 318-77 (American Concrete Institute) will be conformed.
- 4) Steel frame structures
AISC-1978 (American Institute of Steel construction) will be conformed.
- 5) Masonry structures (Reinforced hollow concrete block construction) UBC-1978 will be conformed.

(3) Structural Materials

1) Concrete

Compressive strength at 28days will be $f_c=210\text{kg/cm}^2$ (3,000 psi), sulfate-proof cement will be used,

2) Reinforcing bar

ASTM No.A615 (American Society for Testing Materials) will be conformed, all bars will be Grade 60 (strength at yielding point 60,000 psi) or equal.

3) Steel frame

(a) Structural steel

JIS G-3101 (Japan Industrial Standard) will be conformed. Grade will be SS41 or equal.

(b) Bolts

- i) Ordinary bolt
JIS B 1180 or equal.
- ii) High strength bolt
JIS B 1186, Grade F 10T or equal.

5.2.3 Proposed Design Conditions for Building and Service Facilities

(1) Air Conditioning and Ventilating Design

1) General conditions

Legislations, regulations and standards etc., which is assumed to be applied in design of the system and specific items pertinent to project details shall be applied out of those which is enforced internationally or in Saudi Arabia, Japan and Britain.

2) Design conditions

(a) Conditions of atmosphere and interior

Atmospheric condition:

Summer - Dry bulb temp. (DB) 41'c,
Relative humidity (R) 70%
Winter - Dry bulb temp. (DB) 30'c,
Relative humidity (R) 70%

Interior condition:

Summer - Dry bulb temp. (DB) 26'c+2'c,
 Relative humidity (R) 50%+10%
 Winter - Dry bulb temp. (DB) 21'c+2'c
 Relative humidity (R) 50%+10%

(b) Conditions of solar radiation

Latitude: N.L. 24 degree

Summer: 21 August kcal/m²

HOUR	8	10	12	14	16	18
EAST	596	420	111	95	65	5
SOUTH	71	149	195	149	71	5
WEST	65	95	111	420	596	95
NORTH	71	98	103	98	71	16

Winter : 21 January kcal/m²

HOUR	8	10	12	14	16	18
EAST	515	390	79	62	33	5
SOUTH	309	542	615	542	309	68
WEST	33	62	79	390	515	168
NORTH	33	62	73	62	33	5

(c) Volume of fresh air intake

Volume of fresh air intake per 1 person ;
25m³/hr.

(d) Precipitation Data at Jidda

Jan.	Feb. - Oct.	Nov.	Dec.	Annual
5 mm	0	25 mm	30 mm	64 mm

(e) Counterplan against sand storm

Exposed air conditioning apparatus is especially liable to damage by sand storm, therefore each location will be determined regarding wind direction and eddy-current which is caused by buildings.

Baffleplate etc. shall be provided at suffered location by wind force.

Besides, at exhaust opening which is installed on exterior wall, manually operating shutter shall be equipped.

Especially at fresh air intake line to air conditioner, coarse mesh pre-filter shall be provided for protection.

(f) Counterplan against damage by salt

As buildings located adjacent to seashore, influence of damage by salt will be inevitable; for counterplan against damages, marine paint coating to exposed steel apparatus and fittings (louver

etc.), tin dipping finish to copper product (cooling coil etc.) and stainless foil cover on rugging of piping will be advisable.

(g) Allowable interior noise level

For rooms where air conditioning system is applied.

General office : NC-50
room

Analyzer and : NC-45
experiment room

3) Air Conditioning and Ventilating System

(a) Air Conditioning System

Considering the easy maintenance, reduction of the water consumption and the spread of the building, single duct system by air-cooled type air conditioner is suitable for this project.

Zoning of air conditioning shall be as follows.

- i) Mechanical Maintenance Building
- ii) Piping Maintenance Building
- iii) Electrical Machines Maintenance Building
- iv) Instrumentation Maintenance Building
- v) Operation Building
- vi) Electrical Room
- vii)-xi) Workshop for Each Building

Air-conditioning for workshops shall be by means of spot-cooling system.

Mechanical rooms for the air conditioner are located near the each air-conditioning zone.

Condensers shall be installed near the each mechanical room.

And, adding these 11 (eleven) zone, each room such as such sweeper room and locker room, will be air-conditioned by individual air conditioner.

(Refer to fig. 1)

(b) Ventilating System

i) WORK SHOP

Each WORK SHOP shall be ventilated by roof fans for the exhaust of sumorked air.

ii) STORAGE

Each STORAGE shall be ventilated by wall-mounted ventilators.

iii) LABORATORY

Each LABORATORY shall be installed centrifugal fan or wall-mounted ventilator for the exhaust air of experiment.

iv) LOCKER ROOM

Centrifugal fans shall be installed for the ventilation.

v) ELECTRICAL ROOM

Centrifugal fan or Wall mounted-ventilators shall be installed for the ventilation.

vi) TOILET

Each TOILET shall be installed centrifugal fan or wall-mounted ventilator for the exhaust air.

(2) Plumbing and Sanitary Design

1) General conditions

Correspond to the clause for air conditioning and ventilating system.

2) Design conditions

(a) Water service conditions

Water shall be led in by branch pipe from water supply main pipe which is embedded near the site.

(b) Sewage draining conditions

Disposed water shall be discharged into the percolating pit. Disposed water from existing and proposed building shall be combined.

(c) Rain water conditions

Rain water shall be discharged into percolating pit.

3) Plumbing and sanitary system

(a) Cold water supply installations

Branched off from water main pipe, cold water shall be stored tentatively in reservoir which is installed near the ELECTRICAL MACHINES MAINTENANCE BUILDING, and lift to elevated water tank mounted on roof of Electrical machines maintenance building by 2-lift pumps, and the cold water shall be supplied to the necessary places by gravity. Sterilizing apparatus will work simultaneously at operation of lift pump and automatic water supply apparatus. Refer to fig. 2.

Capacities of principal apparatus in cold water supply installations shall be as follows.

Volume of water consumption per day.

(approximate value)

Building	:	26 m ³ /day
Make-up water for cooling tower: (use for experiment)	:	36 m ³ /day
Total	:	62 m ³ /day

(b) Drainage work

Drain water is classified into "waste water for domestic", "drain from mechanical equipment", and "analyzer, experimental drain".

"Waste water for domestic" line is planned to have separate system of Sewer and waste line in interior plumbing, which joins at exterior collecting pit and lead to disposal installations.

"Drain from mechanical equipment" line discharges drainage from air conditioning system and mechanical training building.

The drainage from this line shall be infiltrated into nearby ground.

Chemical waste water from "Analyzer, experimental drain" line shall be tentatively disposed in neutralization tank and joins at waste water for domestic line. Refer to fig.3.

(c) Sewage disposal installations

Waste water for domestic will be disposed and discharged into percolating pit.

Sewage disposal system:

Activated sludge method, long-hour aeration system - half exposed and half underground system.

disposable sewage volume

Volume of Disposal water: $25 \text{ m}^3/\text{day}$

(d) Neutralization tank

Double compartments type (5 m³ x 2 tanks), chemical waste water is stored tentatively, pH is modulated by acid or alkali agent, 2 tanks shall be used alternatively at every 6 months.

In each neutralization tank, pH monitor shall be installed for supervision of effect.

(e) Plants sprinkling installations

Sprinkling pump for the HOSE BIBB shall be installed in pump room.

HOSE BIBB for the plant shall be installed with covering the whole planting.

(f) Drinking installations

Cold drinking fountain shall be installed at each building.

(g) Sanitary equipment installations

Arabic style shall be adopted principally, at certain location, installation of western style is considered.

(h) Fire fighting installations

Indoor hydrant shall be installed referring to Japanese Fire Act as standard. Water source is furnished by reservoir, fire pump unit is installed in pump room.

Capacity of fire pump enables discharge from 5 hydrants simultaneously and fire pump unit shall be operated automatically.

ZONING & PROPOSED AIR CONDITIONING SYSTEM

BUILDING AND ROOM NAME	Air Conditioning		
	Single Duct system	Individual Air Conditioner	Not Required
1. MECHANICAL MAINTENANCE BUILDING			
a.Laboratory	0		
b.Drawing room	0		
c.Storage			0
d.Workshop	0		
e.Mechanical room			0
2. ELECTRICAL MACHINES MAINTENANCE BUILDING			
a.Laboratory	0		
b.Drawing room	0		
c.Assistant instructor room	0		
d.Storage			0
e.Workshop	0		
f.Mechanical room			0
3. PIPING MAINTENANCE BUILDING			
a.Laboratory	0		
b.Assistant instructor room	0		
c.Storage			0
d.Workshop	0		
4. INSTRUMENTATION MAINTENANCE BUILDING			
a.Laboratory	0		
b.Assistant instructor room	0		
c.Model room	0		
d.Storage			0
e.Workshop	0		
5. OPERATION BUILDING			
a.Laboratory	0		
b.Assistant instructor room	0		
c.Control room	0		
d.Hall	0		
e.Storage -1, -2			0
f.Workshop	0		

BUILDING AND ROOM NAME	Air Conditioning		
	Single Duct system	Individual Air Conditioner	Not Required
g.Boiler & Compressor room			o
h.Toilet			o
i.Mechanical room	o		
6. SERVICE BUILDING			
a.Electrical room	o		
b.Locker room		o	
c.Sweeper room		o	
d.Pump room			o
e.Toilet			o

PROPOSED VENTILATING SYSTEM

BUILDING AND ROOM NAME	Ventilation			
	Wall-mounted Ventilator	Roof-mounted Ventilator	Centrifugal Fan	Not Required
1. MECHANICAL MAINTENANCE BUILDING				
a.Laboratory	0		0	
b.Drawing room	0			
c.Storage	0			
d.Workshop		0		
e.Mechanical room				0
2. ELECTRICAL MACHINES MAINTENANCE BUILDING				
a.Laboratory	0		0	
b.Drawing room	0			
c.Assistant instructor room				0
d.Storage	0			
e.Workshop		0		
f.Mechanical room				0
3. PIPING MAINTENANCE BUILDING				
a.Laboratory	0		0	
b.Assistant instructor room				0
c.Storage				0
d.Workshop	0			
4. INSTRUMENTATION MAINTENANCE BUILDING				
a.Laboratory	0		0	
b.Assistant instructor room				0
c.Model room	0			
d.Storage	0			
e.Workshop		0		
5. OPERATION BUILDING				
a.Laboratory	0		0	
b.Assistant instructor room				0
c.Control room				0
d.Hall				0
e.Storage -1, -2	0		0	
f.Workshop		0		

BUILDING AND ROOM NAME	Ventilation			
	Wall-mounted Ventilator	Roof-mounted Ventilator	Centrifugal Fan	Not Required
g.Boiler & Compressor room	o			
h.Toilet	o			
i.Mechanical room				o
6. SERVICE BUILDING				
a.Electrical room	o		o	
b.Locker room			o	
c.Sweeper room				o
d.Pump room				o
e.Toilet	o		o	

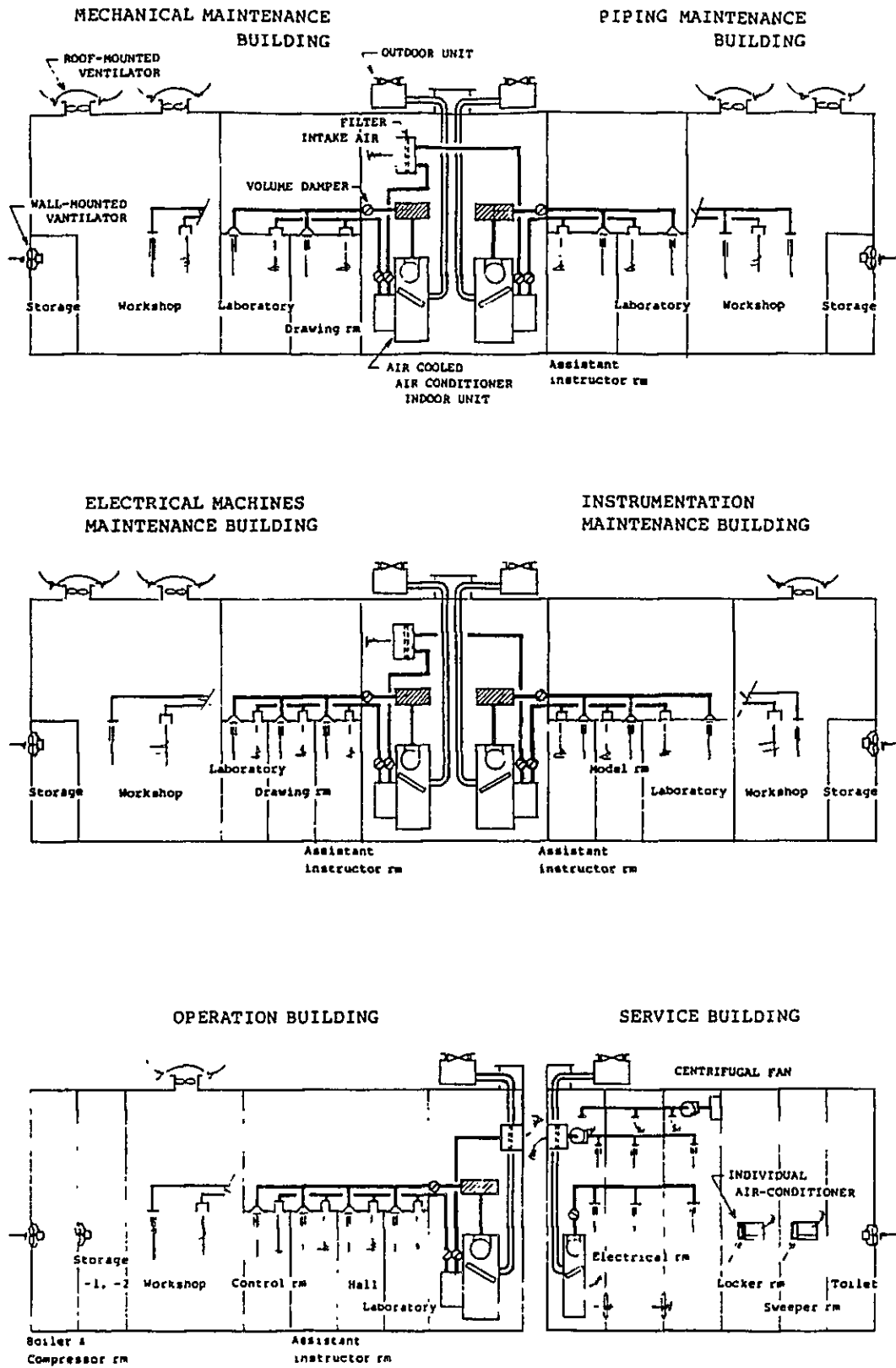


fig. 1 AIR CONDITIONING SYSTEM

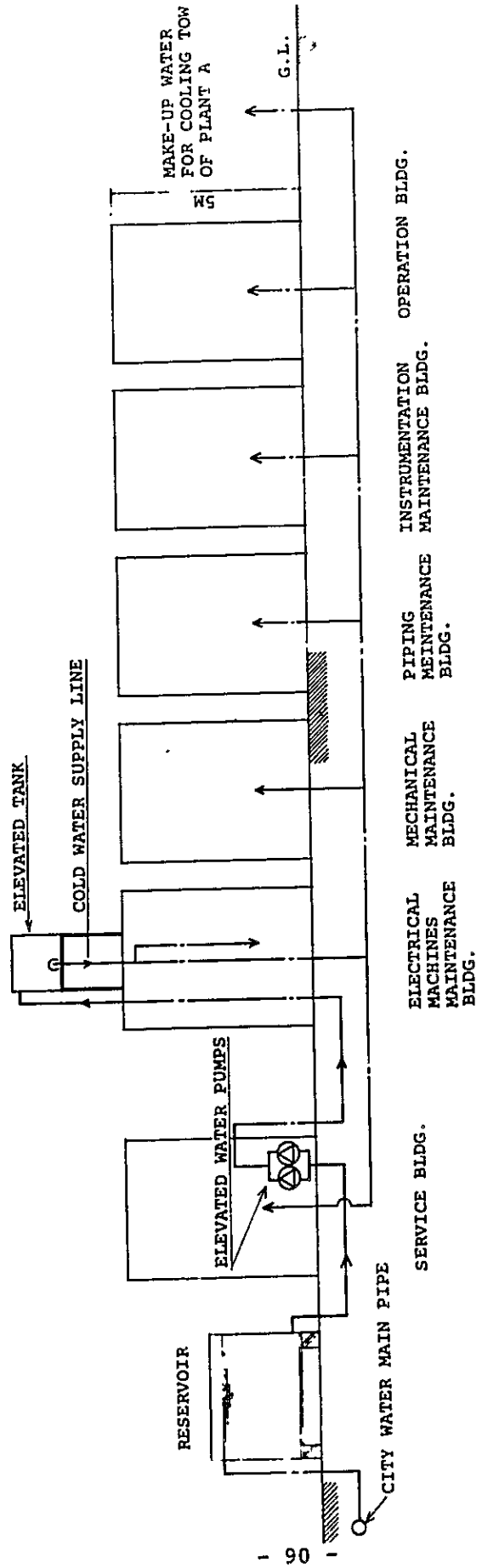


fig. 2 SCHEMATIC DIAGRAM OF COLD WATER SUPPLY SYSTEM

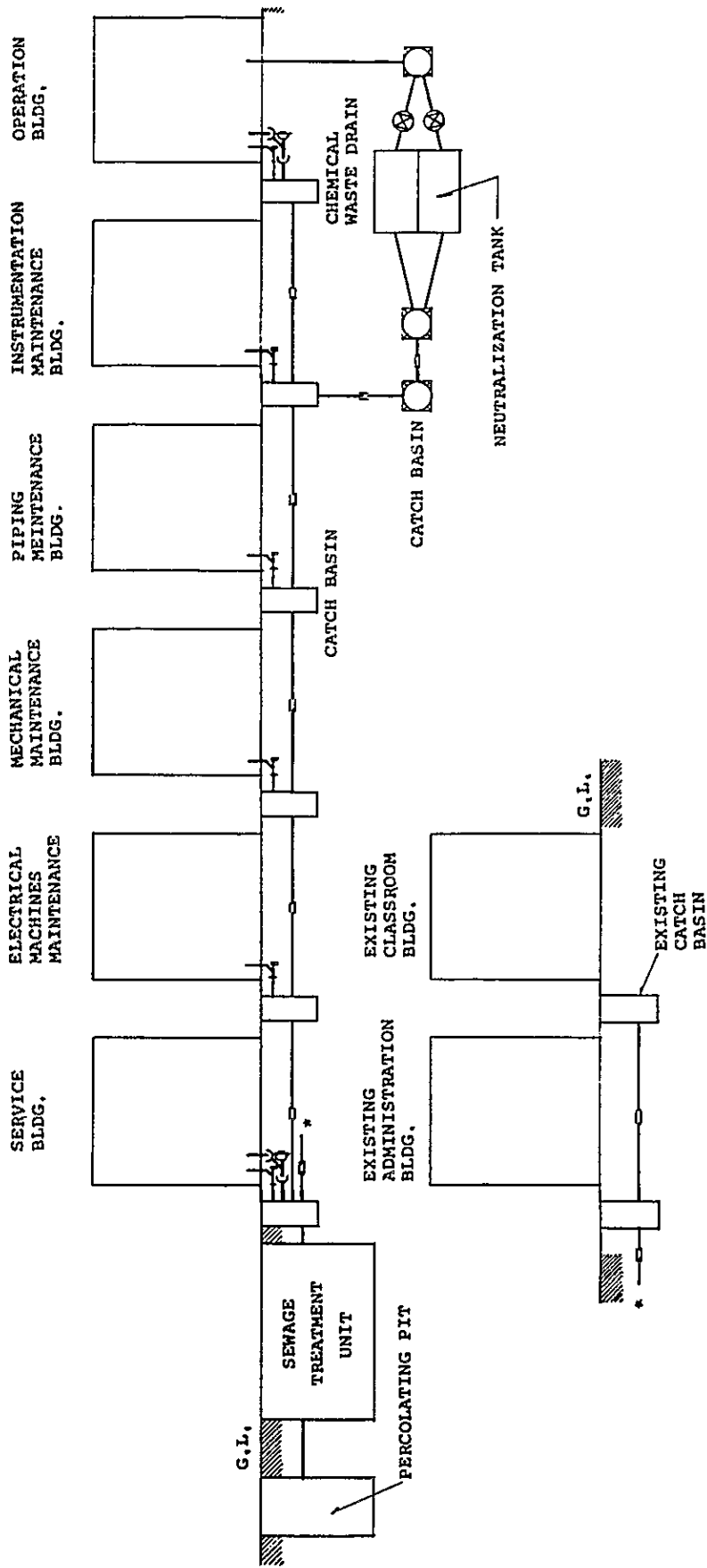


fig. 3 SOIL AND WASTE TREATMENT SYSTEM

(3) Electrical Design

1) Design concept

- Systems will be capable of easy maintenance and control
- Safety, reliability and economical efficiency will be studied,
- Provide possible systems for alteration in response to load increase and system extension in future.

2) Main items and outline of electrical systems

(a) Power-receiving and transforming system

Substation will be divided into 3 rooms, i.e. high tension panel room, transformer room and low tension panel room, and each room will be arranged so that direct access is available from exterior. All substation equipment other than transformer will be installed in enclosed type switch board.

Capacity of transformer will be of furnishing necessary capacity of power sufficient to vocational training center. Capacities of transformer will be determined by considering load increase in future which is assumable at present, demand and simultaneous consumption factor.

(b) Main power distribution system

Power will be supplied from low tension switch panel of substation to distribution board and motor control board in each building.

(c) Motor control system

Power supply and control for air conditioning and sanitary equipment will be provided.

(d) Lighting and socket outlet

Selection and arrangement of lighting fixtures will be determined by analyzing of functions, uses and required illumination level in each room; as light source, discharge lamps such as fluorescent lamp, mercury lamp and metal-halide lamp, which provides better efficiency and long life, will be employed.

Incandescent lamps will only be employed at the location where design is required. Socket outlet will be provided for power source to small electrical appliances.

(e) Public address system

System which is able to convey messages to each room from reception room in administration building, will be provided.

(f) Telephone system

Existing telephone exchange machine in the power plant will be able to use for the project.

Telephone set will be equipped in each principal room.

(g) Intercom system

Intercom will be equipped in mechanical room and substation for maintenance purpose.

(h) Electric clock system

Master clock will be installed to reception room in administration building, and slave clocks will be installed in each principal room.

(i) Automatic fire alarm system

Installation of receiving panel to reception room in administration building and sensors to each room which enables to supervise condition of vocational training center, will be provided.

(j) Power supply system for vocational training equipment.

Exclusive distribution board for training equipment will be installed in each training building, from where power will be supplied to each training equipment.

3) General Conditions

(a) Applicable codes and standards

Applicable codes and standards to electrical design will conform to IEC (International Electro-technical commission) and also to other codes or standards.

In case of application, examinations with concerning authorities of Saudi Arabia will be required.

(b) General descriptions

Equipment and materials will be treated to have proofing properties against dust, moisture, water, rust (especially protection against damage by salt) and vibration. And capacities of product will cover required functions as well as providing strength for electrically mechanically and thermally with sufficient life.

Arrangement and installation of equipment and materials will be planned for safety and easy maintenance and provide orderly appearance. Entire electrical system will employ no complicated system but those of easy repairing, remodeling or extension.

(c) Electric system

. Primary voltage (receiving voltage)

3phase 3wire 60Hz 13.8kV

. Secondary voltage

3phase 4wire 60Hz 230/133V

(d) Voltage drop

Voltage drop will be allowable within following value

Main line	2.5%
<u>Branch circuit</u>	<u>2.5%</u>
Total	5.0%

(e) Substation system

Equipment will be arranged to a state which enables maintenance and inspection safely.

All circuit breaker and fuse will possess sufficient capacity to break short-circuit current, transformers will be of oil-type or dry-type; and static capacitor for power factor improvement will be installed.

(f) Main power distribution system

Design analysis for cable size selection will be performed by current value to which allowance from 10% to 20% is added to actual loading current.

(g) Motor control system

Each motor control units will be equipped with overload protection and open-phase protection circuits and static capacitor for power factor improvement, at motor circuit on which large starting current will flow, motor starter such as Star-Delta starter to minimize starting current, will be installed.

(h) Lighting system

Illumination level of interior lighting will be determined referring to recommended value by IES (Illuminating Engineering Society). High efficiency type ballast will be installed for discharge lamps. Entire system will be designed to minimize glares.

(i) Plugs and socket outlet

All plugs and socket outlets will be of with earthing pin.

(j) Public address system

Output control switch will be installed on amplifiers; as additional apparatus, bell timer and chimes will be equipped. Output circuit will provide following numbers of circuits.

1. Administration and Classroom bldg.
2. Mechanical maintenance training bldg.
3. Piping maintenance training bldg.
4. Instrumentation maintenance bldg.
5. Electrical machines maintenance training bldg.
6. Operation training bldg.
7. Exterior.
8. All buildings.

Speakers will be mounted on ceiling or wall, and for each room other than corridor, attenuators will be equipped.

(k) Telephone system

Telephone exchange will be of centralized attendant answering system.

Assumed capacity of telephone exchange:
Central office line---20 circuits maximum
Extension line-----200 circuits maximum

(l) Intercom system

Intercom system will be of simultaneous communication type.

(m) Electric clock system

Master clock will be equipped with auto-charge type batteries; exclusive circuit will be provided so as not to stop clocks at failure of supply. Slave clock will be either of 2-hands type (minute, hour) or 3-hands type (second, minute, hour) according to uses of rooms.

(n) Automatic fire alarm system

Detectors will be selected from fixed-temperature type, rate-of-temperature rise type or smoke type which meet room conditions where the equipment to be installed. Alarm bell, location lamp and manual alarm push button will be installed on top of hydrant cabinet or nearby location. Hydrant pump will start automatically by detection of fire.

(o) Earthing system

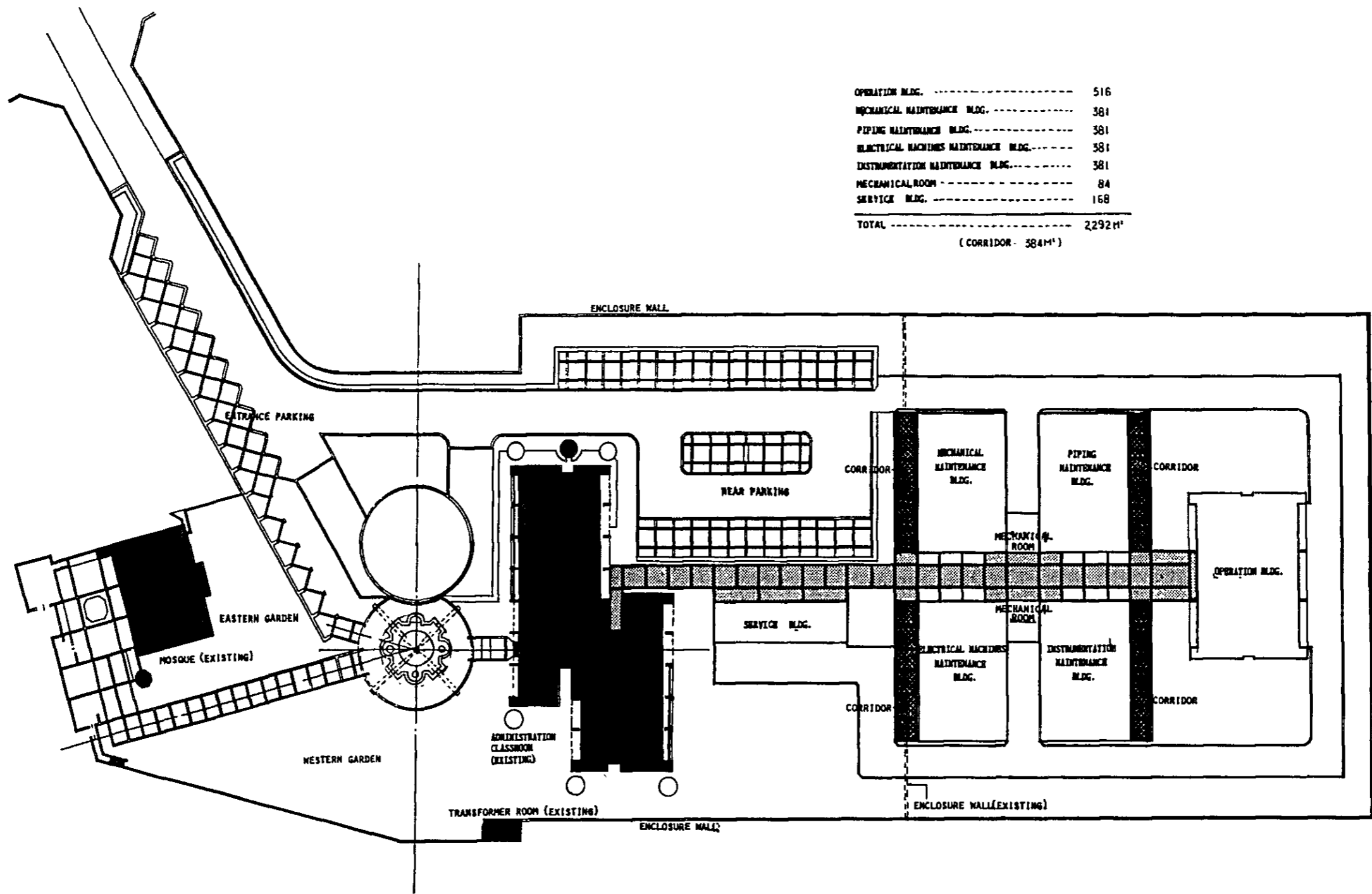
All electrical equipment and appliance will be earthed.

Earthing for telephone exchange and measuring equipment will never be connected jointly with earthing circuit for substation equipment, motors, heaters, lighting fixtures and plugs etc., exclusive earthing system will be provided.

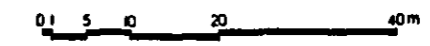
5.3 PROPOSED DRAWINGS

The following proposed drawings have been prepared, and attached herewith, as for reference, for the purposes of sufficient comprehensions of the conceptual design, and for easier developments of detailed design of the project.

- (1) General Lay-out of Training Center
- (2) Remodeling of Existing Administration Building
- (3) Workshop and Laboratory

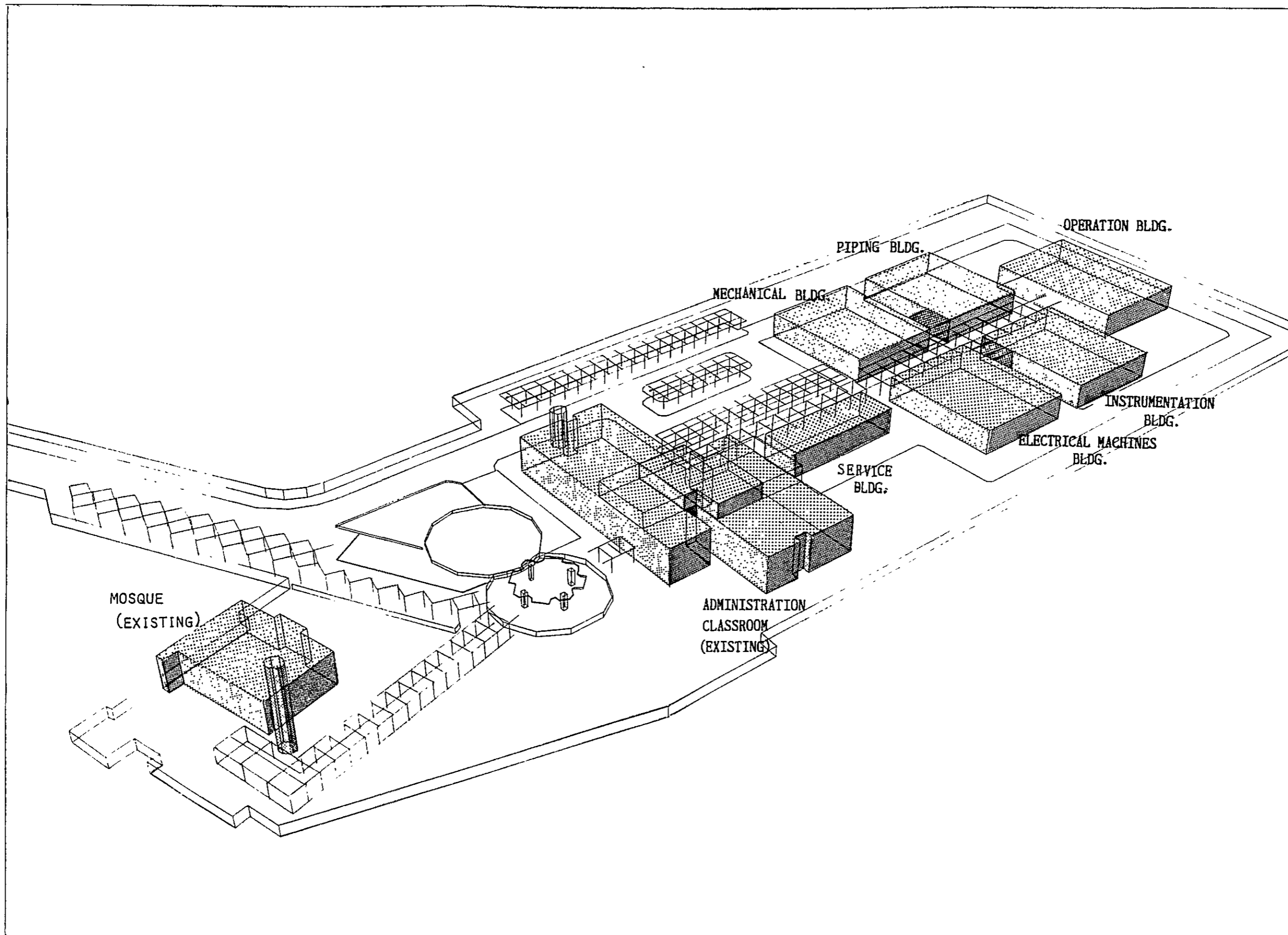


OPERATION BLDG.	516
MECHANICAL MAINTENANCE BLDG.	381
PIPING MAINTENANCE BLDG.	381
ELECTRICAL MACHINES MAINTENANCE BLDG.	381
INSTRUMENTATION MAINTENANCE BLDG.	381
MECHANICAL ROOM	84
SERVICE BLDG.	168
TOTAL	2292 M²
(CORRIDOR - 384 M ²)	

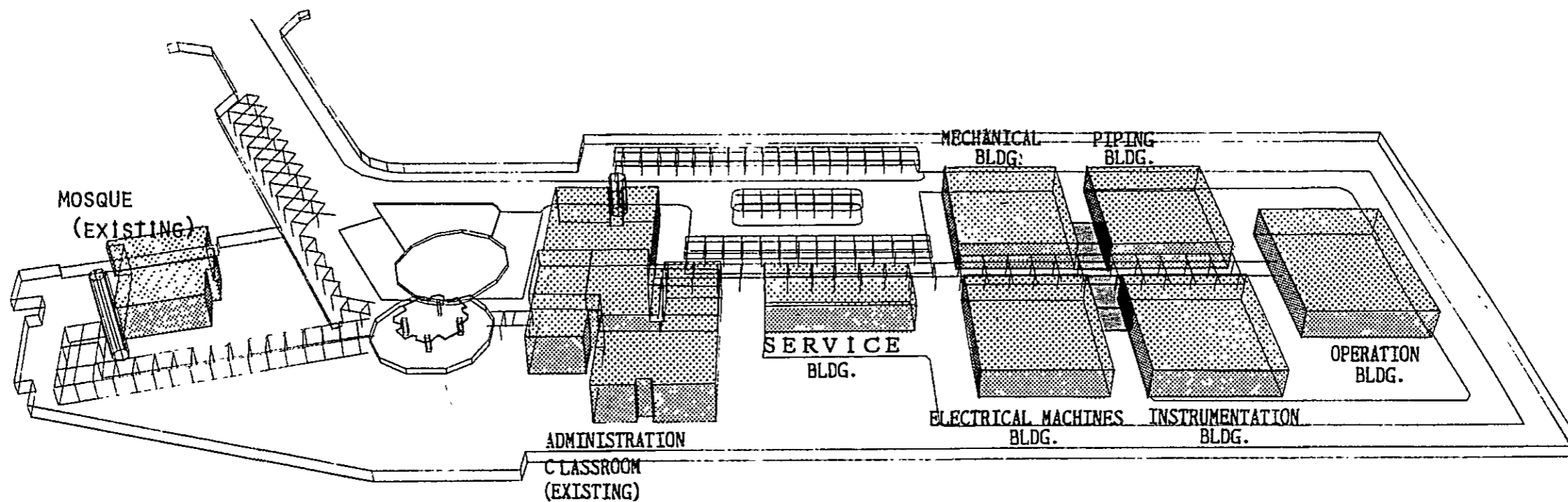


THE CENTER FOR SEA WATER DESALINATION TRAINING

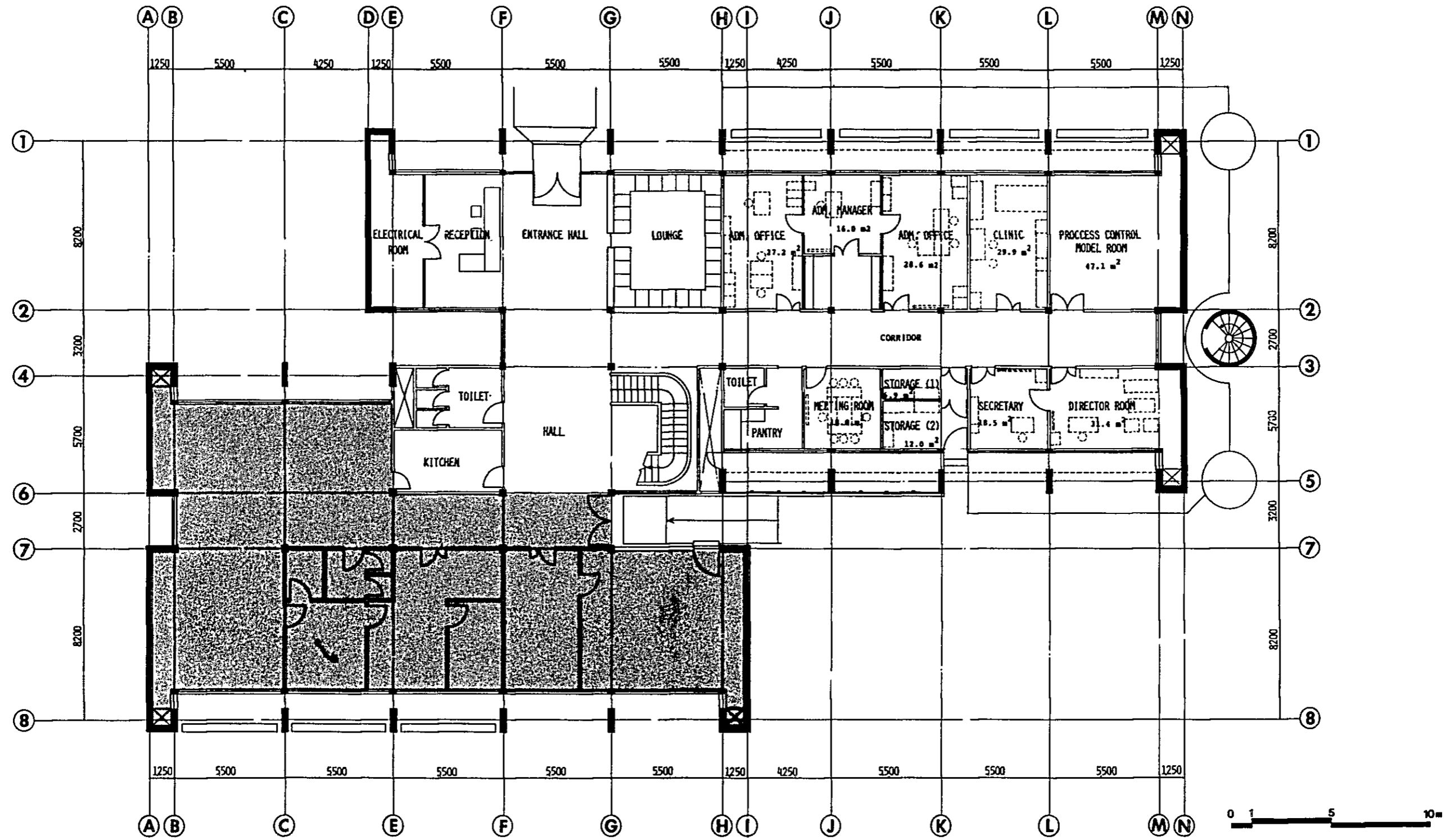
SITE PLAN



THE CENTER FOR SEA WATER DESALINATION TRAINING

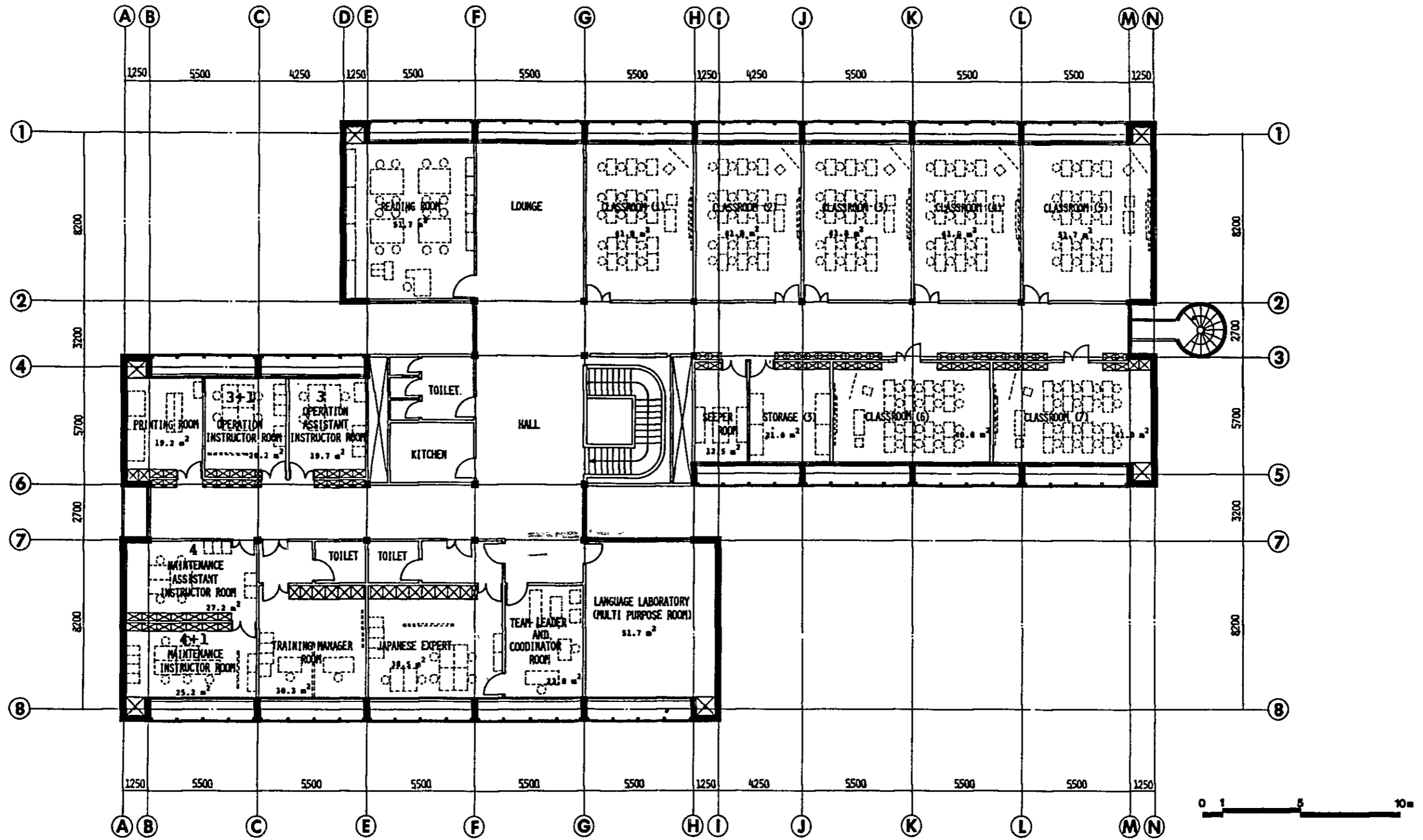


THE CENTER FOR SEA WATER DESALINATION TRAINING



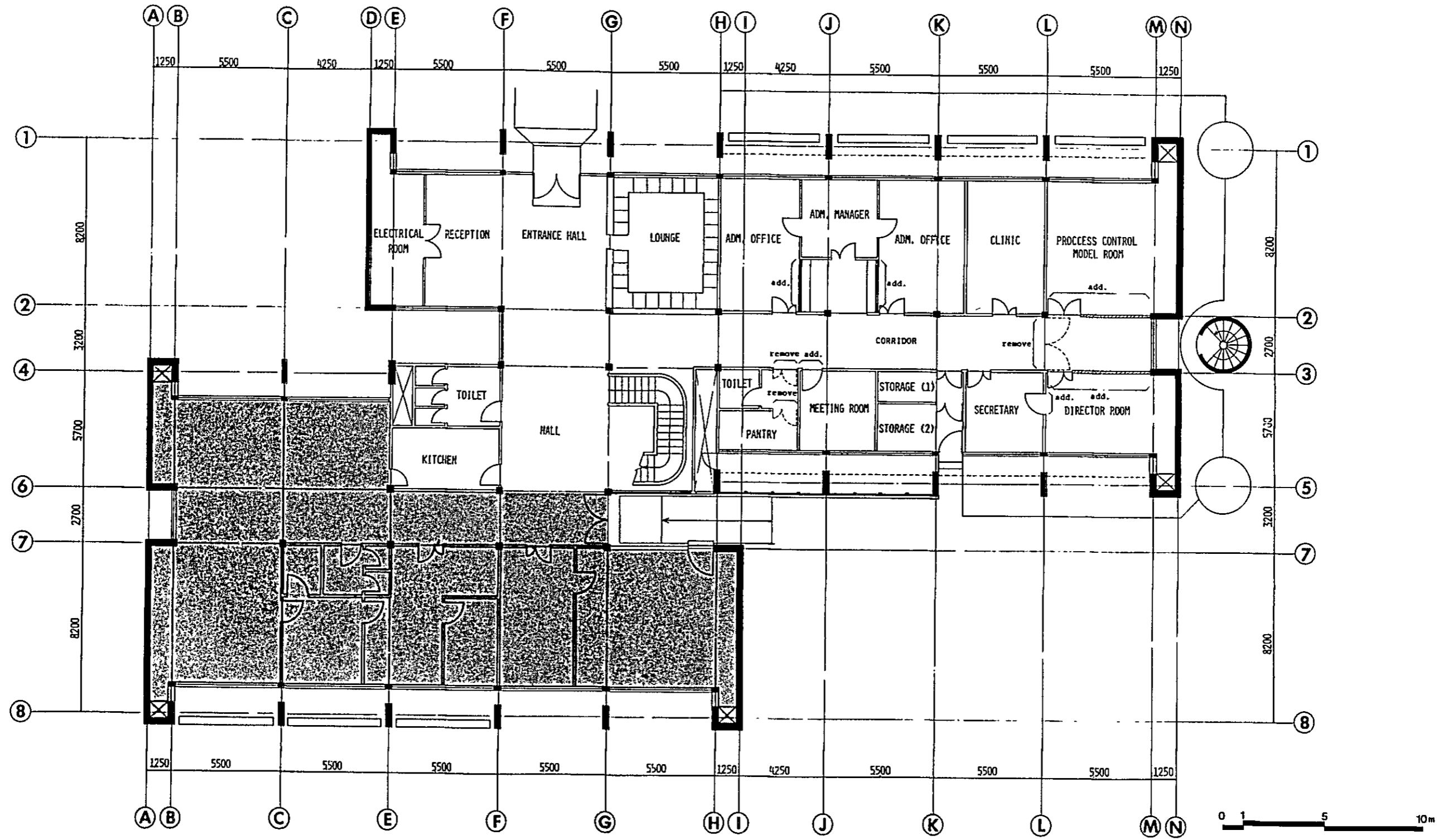
THE CENTER FOR SEA WATER DESALINATION TRAINING (EXISTING)

GROUND FLOOR PLAN



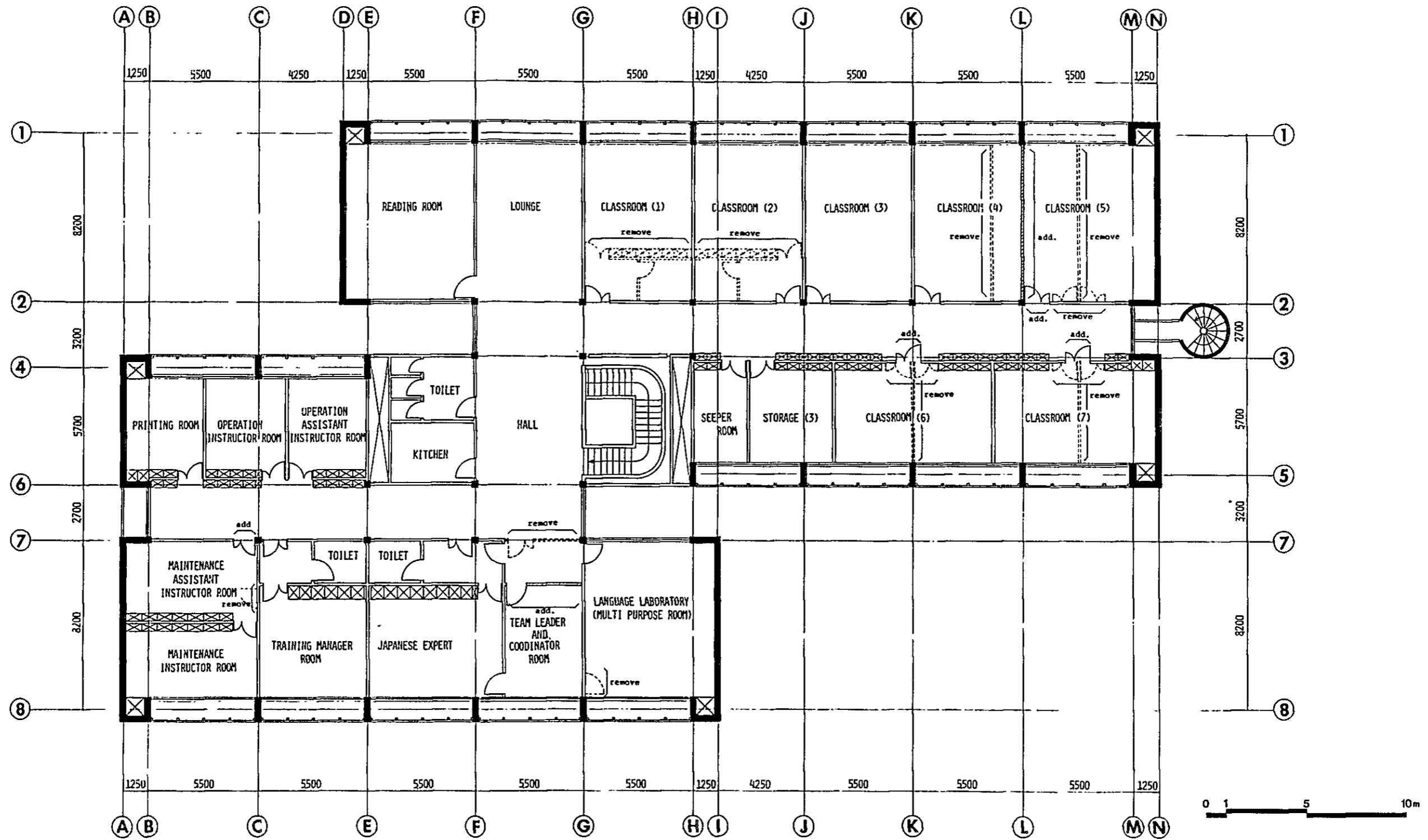
THE CENTER FOR SEA WATER DESALINATION TRAINING (EXISTING)

FIRST FLOOR PLAN



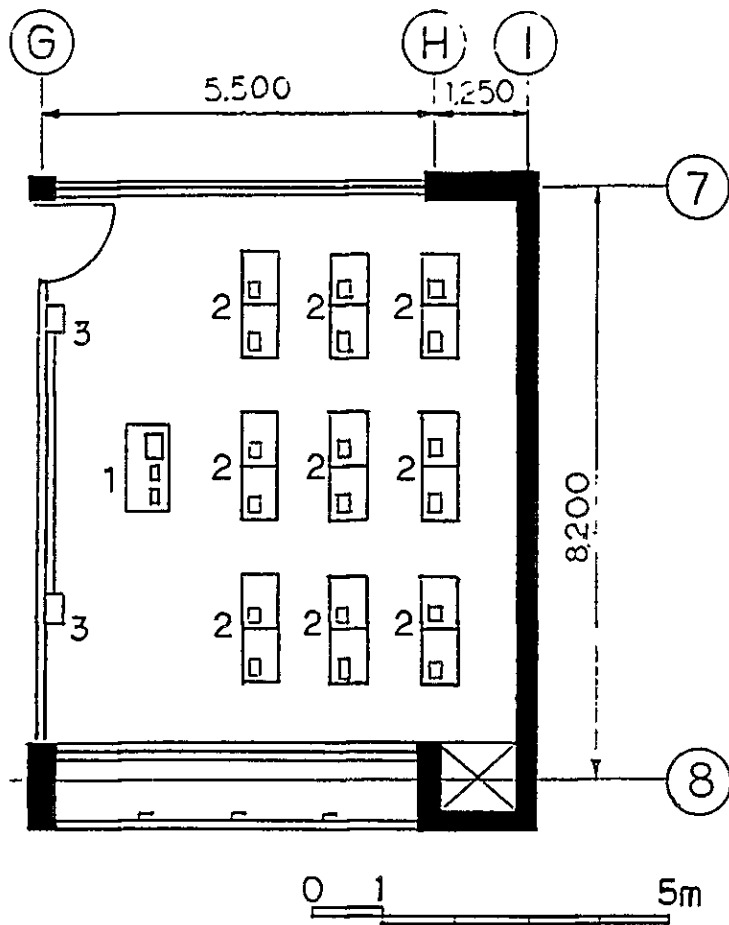
THE CENTER FOR SEA WATER DESALINATION TRAINING (EXISTING)

GROUND FLOOR PLAN



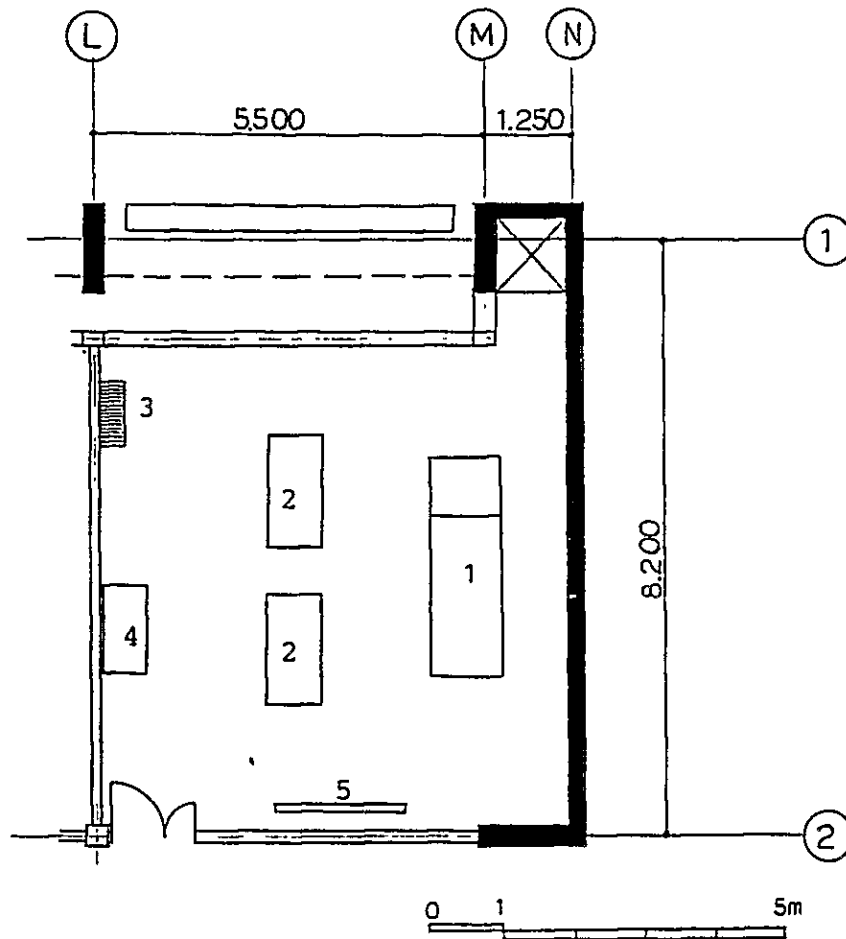
THE CENTER FOR SEA WATER DESALINATION TRAINING (EXISTING)

FIRST FLOOR PLAN



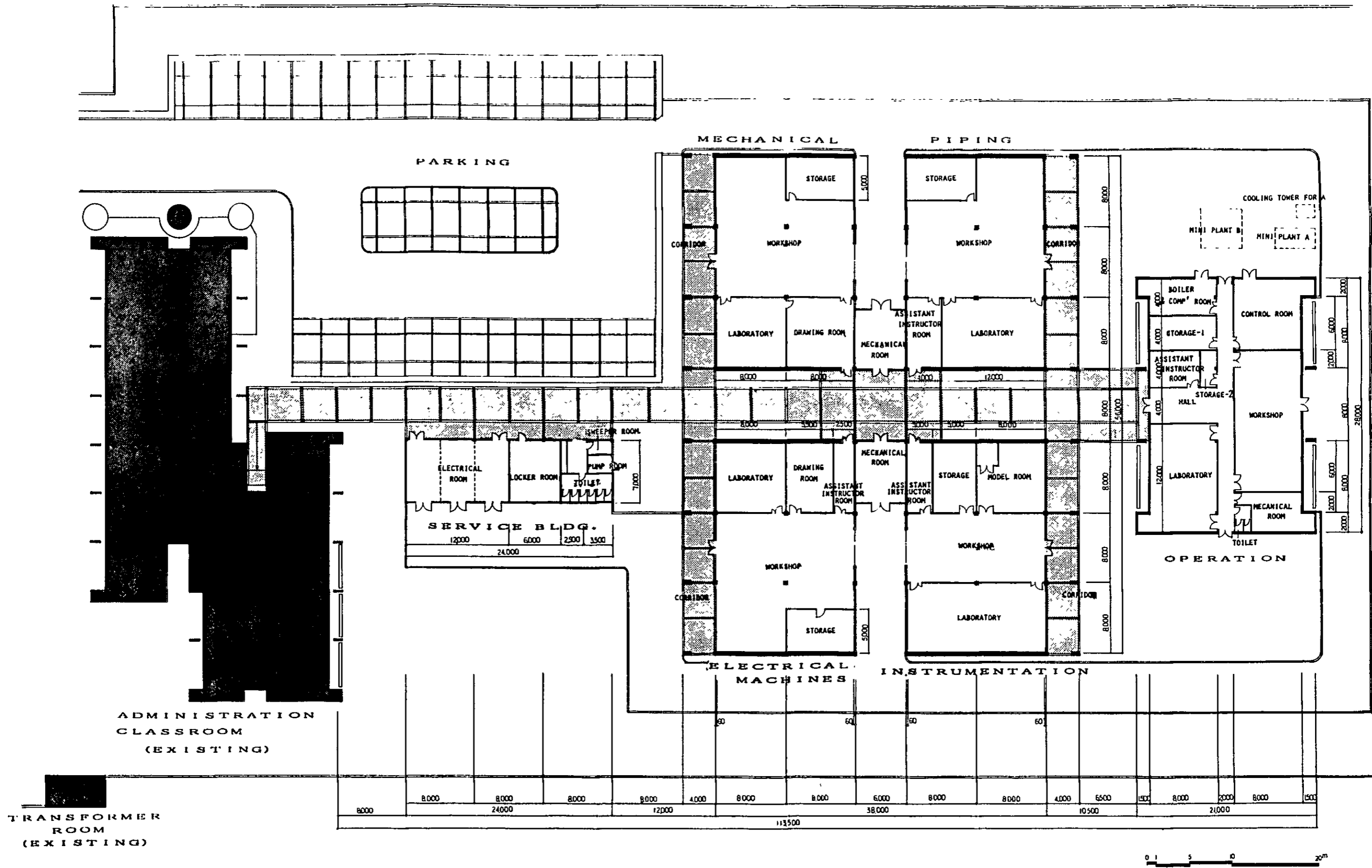
No.	Item No.	Description	Q'ty	Dimension (W x D x H mm)	Weight (Kg)	Remarks
1	SW-8-050 -(1)	Teacher console	1	1268x634x807	77	
2	-(2)	Booth console	9	1504x514x1002	34	each 2 students
3	-(3)	Room speaker	2			

Language Laboratory
Equipment Layout



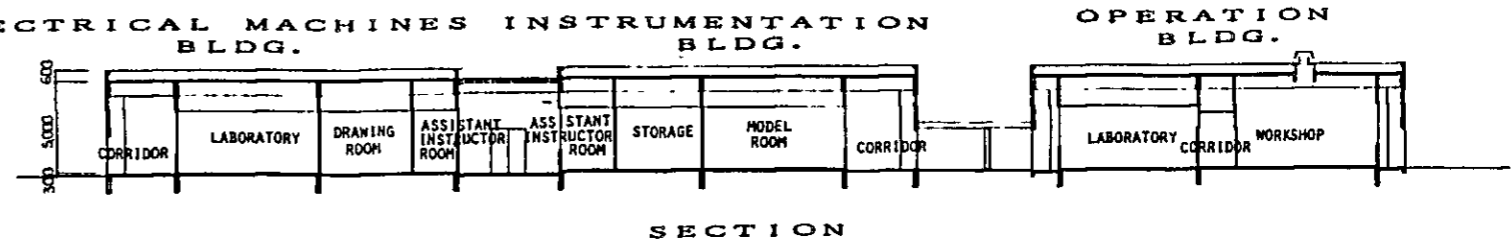
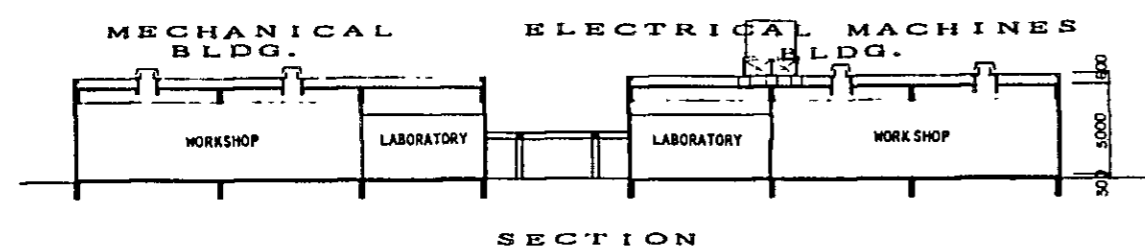
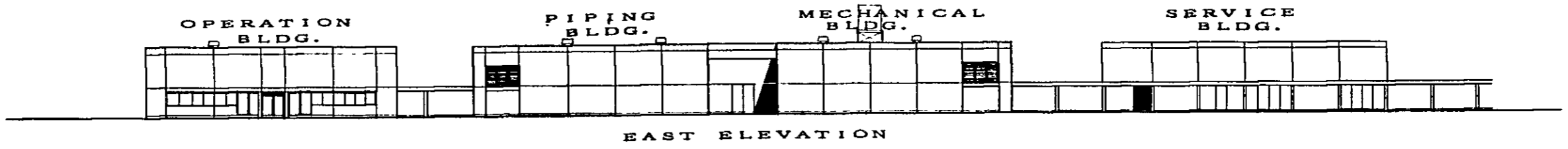
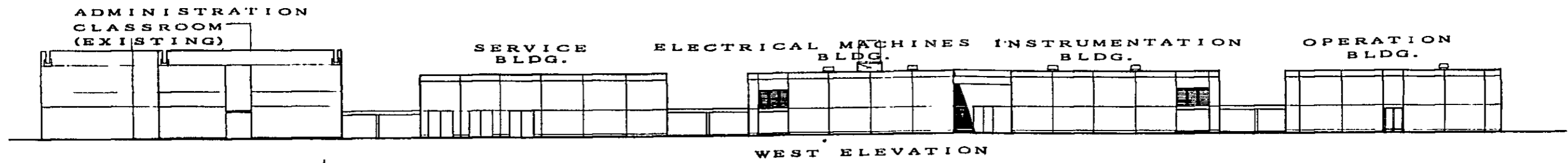
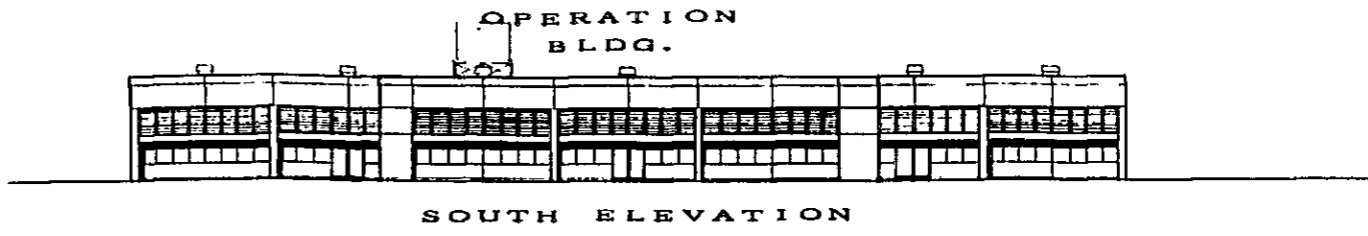
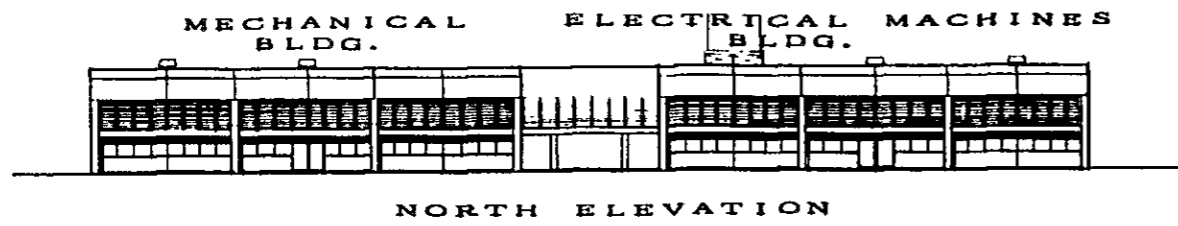
No.	Item No.	Description	Q'ty	Dimensions (W x D x Hmm)	Weight (Kg)	Remarks
1	SW-6-100	Process Control Model	1	3000x1000x2200	800	
2		Table	2	1500x750x750	63	
3		Chair (Collapsible)	15	360x360x425	6	
4		Shelf	1	1200x600x1800		
5		Black Board (Transportable)	1	1800x900/1800	1	

Process Control Model Room
Equipment Layout



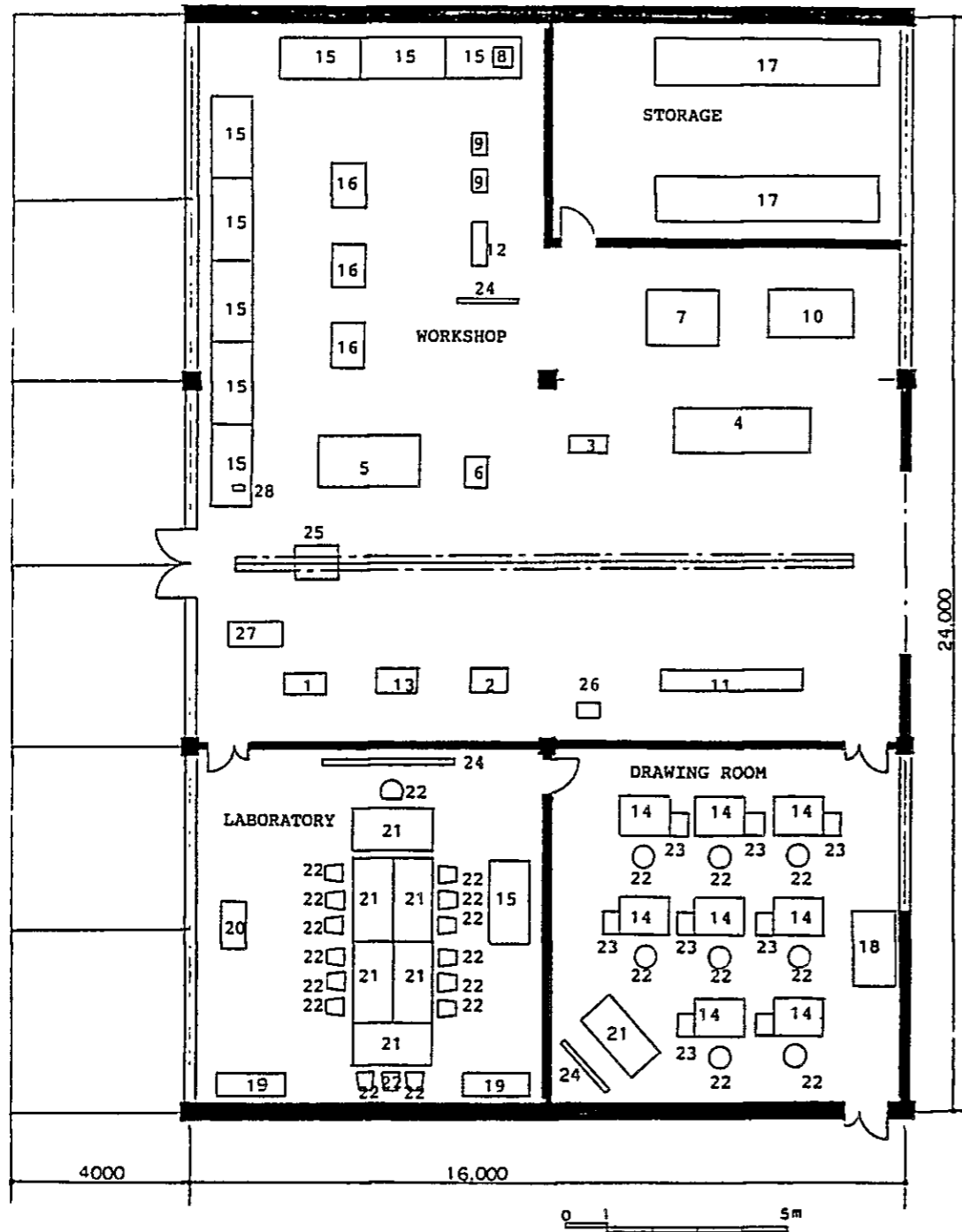
THE CENTER FOR SEA WATER DESALINATION TRAINING

GROUND FLOOR PLAN



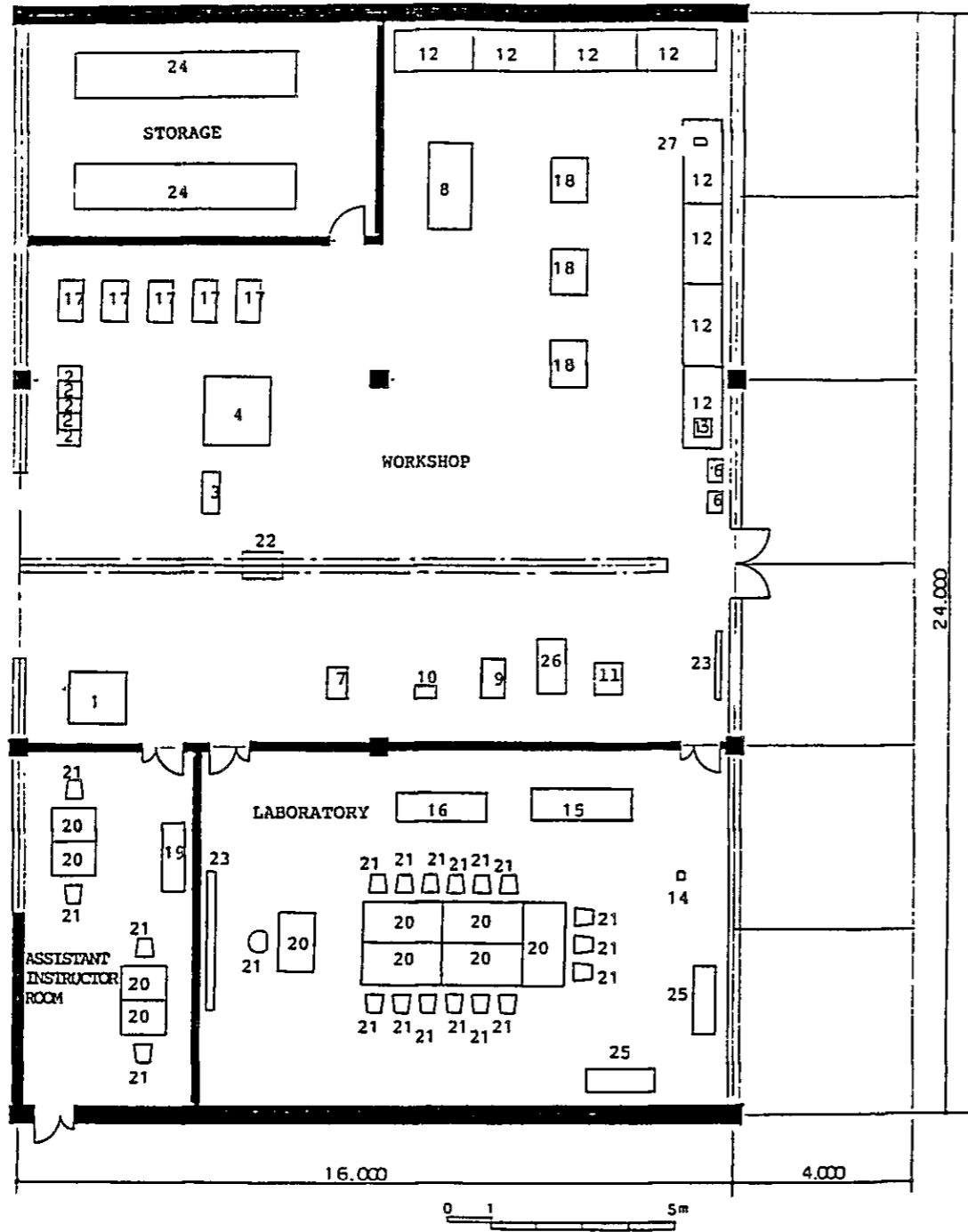
THE CENTER FOR SEA WATER DESALINATION TRAINING

ELEVATION & SECTION



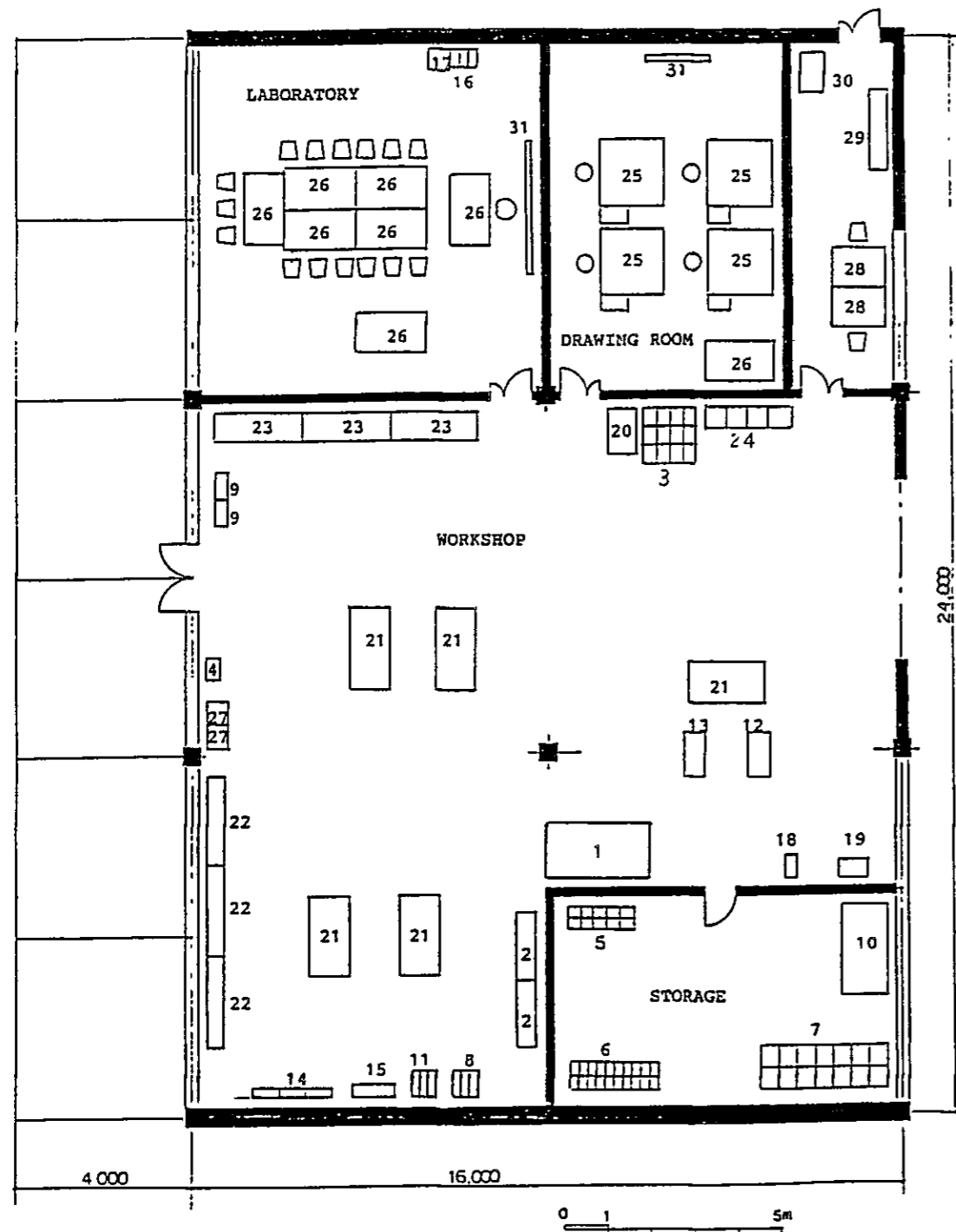
No.	Item No.	Description	Q'ty	Dimension (WxDxHmm)	Weight (Kg)	Remarks
1	SW-1-465	Centrifugal Pump	1	950x460x460		
2	-1-470	Steam Turbine	1	820x520x1120		
3	-1-400	Hydraulic Pressure Test Equipment	1	400x900x700		
4	-1-460	Reciprocating Air Compressor	1	3065x1000x1705		
5	-1-405	Lathe	1	2259x1110x1300		
6	-1-410	Drilling Machine	1	440x700x1860		
7	-1-420	Milling Machine	1	1585x1220x1560		
8	-1-425	Bench Drill	1	410x420x1010		
9	-1-430	Duplex Head Grinder	2	501x348x390		
10	-1-435	Shaper	1	1005x1900x1570		
11	-1-480	Heat Exchanger	1	500 ⁺ x3200H	2200	
12	-1-440	Hack-sawing Machine	1	370x1000x680		
13	-1-475	Turbo Blower	1	910x550x550		
14	-1-785	Drafting Machine	8	1116x840H		
15	-1-790	Working Table	9	1800x900x700	60	
16	-1-300	Surface Plate	3	1000x750x600	290	
17		Shelf for Storage	2			
18		Shelf for Drawing Room	1			
19		Shelf for Machine Laboratory	2			
20		Cutaway Model of Centrifugal Pump	1			
21		Desk	7			
22		Chair	24			
23		Side Table	8			
24		Black Board	3			
25	SW-1-445	Hoist	1			
26	-1-911	A.C. Arc Welder	1	315x490x530		
27	-1-912	Punching Machine	1	600x1200x1600		
28	-1-913	Puncher	1	70x325x407		

EQUIPMENT LAYOUT PLAN OF
WORKSHOP AND LABORATORY (1/5)
MECHANICAL MAINTENANCE



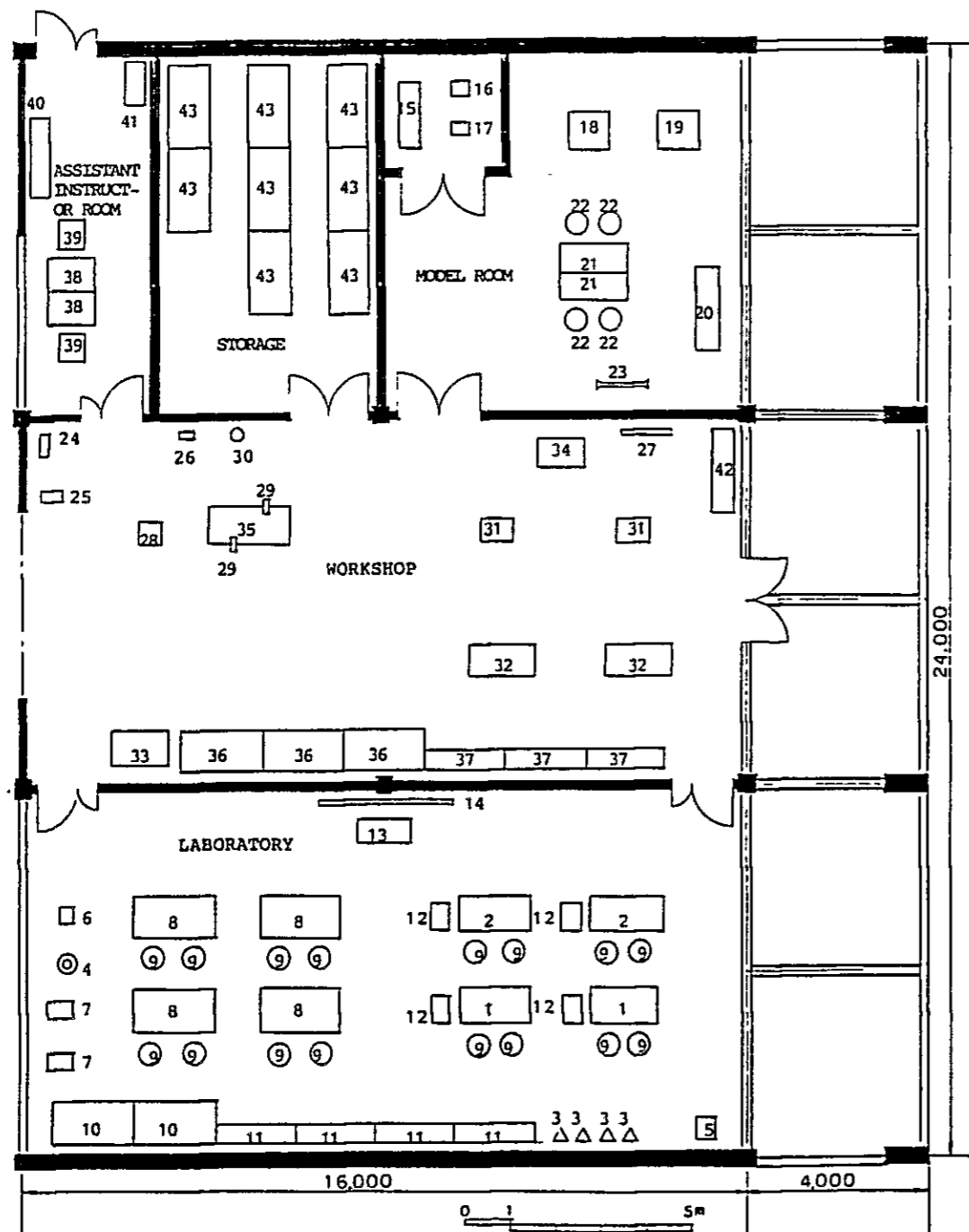
No.	Item No.	Description	Q'ty	Dimensions (W x D x Hmm)	Weight (Kg)	Remarks
1	SW-2-396	Pipe Bender	1	1300x1150x360		
2	-400	A.C. Arc Welder	5	315x490x530		
3	-416	Hydraulic Pressure Test Equipment	1	400x900x700		
4	-417	Valve Test Rig	1	1500x1500x800		
6	-515	Duplex Head Grinder	2	501x348x390		
7	-520	Drilling Machine	1	440x700x1860		
8	-524	Shaper	1	1005x1900x1570		
9	-525	High Speed Cut-off Machine	1			
10	-530	Pipe Threading Machine	1	410x280x310		
11	-535	Inert-gas Arc Welding Machine	1	600x700x1000		
12	-545	Working Table	8	1800x900x700		
13	-610	Bench Drill	1	410x420x1010	81	
14	-560	Shore Hardness Tester	1	150x162x360		
15	-565	Universal Testing Machine	1	2200x700x2100		
16	-570	Sharpy's Impact Tester	1	2100x640x2050		
17	-410	Oxy-acetylene Welding & Cutting Equipment	5	880x550		
18	-310	Surface Plate	3	1000x750x100	290	
19		Shelf for Instructor	1			
20		Desk	10			
21		Chair	20			
22	SW-2-641	Hoist	1			
23		Blackboard	2			
24		Shelf for Storage	2			
25		Shelf for Laboratory	2			
26	SW-2-761	Punching Machine	1	600x1200x1600		
27	-762	Puncher	1	70x325x407		

EQUIPMENT LAYOUT PLAN OF
WORKSHOP AND LABORATORY (2/5)
PIPING EQUIPMENT MAINTENANCE



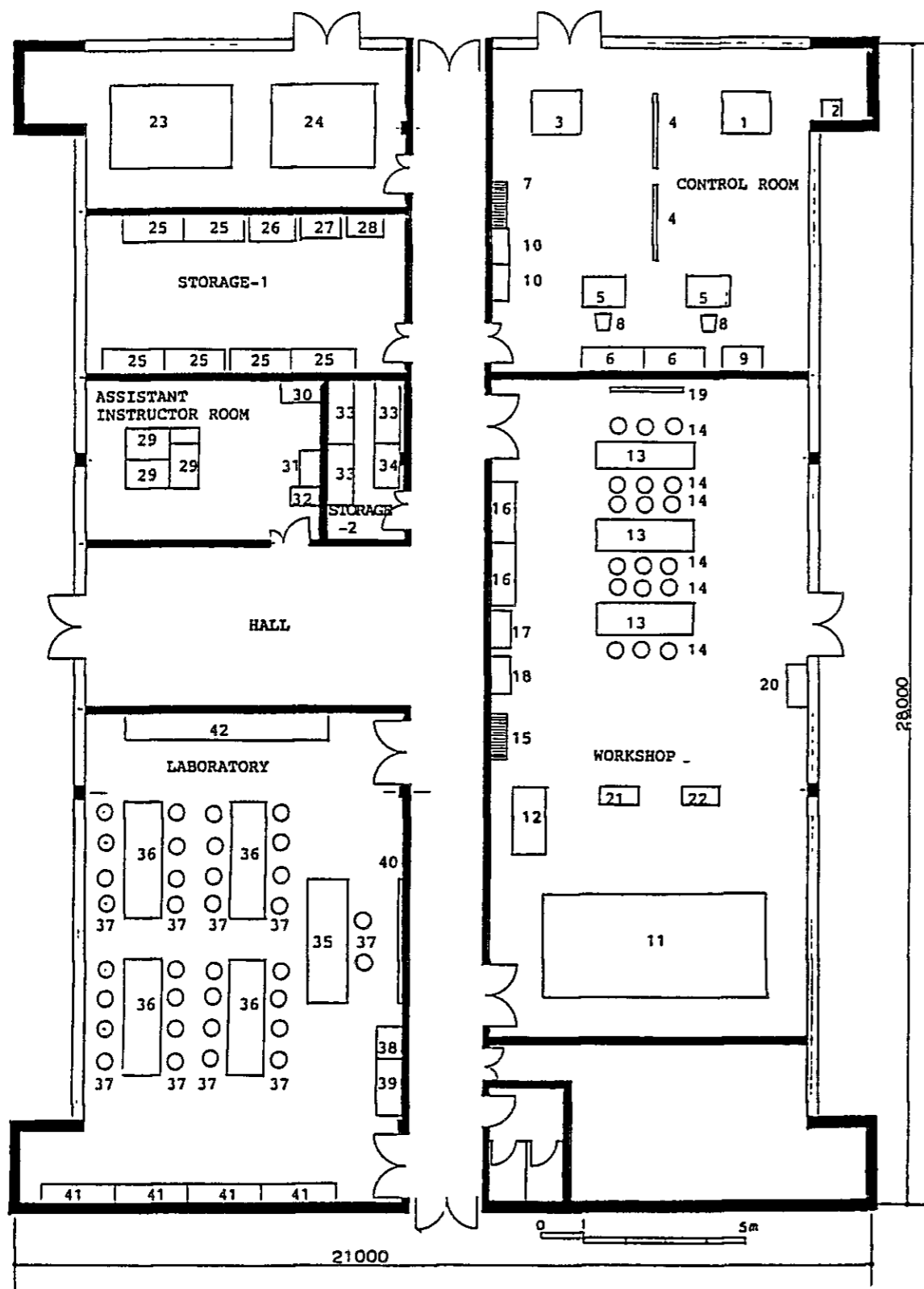
No.	Item No	Description	Q'ty	Dimensions (W x D x Hmm)	Weight (Kg)	Remarks
1	SW-3-001	Exercise Switchboard(High Tention)	1	1300x2300x2300	1200	
2	-002	Exarcise Switchboard(Low Tention)	2	1500x400x2000	300	
3	-003	Induction Regulator	12	400x300x800	30	
4	-004	Rectifier	1	500x300x600	50	
5	-005	Motor for Assembling Practice	10	240x300x230	15	
6	-006	Motor	20	200x300x200	31x4	
7	-007	Transformer	14	500x400x620	60	
8	-008	Star-delta Experiment Circuit	3	600x190x600	30	
9	-009	Loading Resister	2	500x300x900	60	
10	-010	Lighting Fixture	6	2000x1000x500	100x 1	
11	-012	Sequences Circuit Panel	3	600x190x600	30	
12	-013	Testing Generator	1	500x1000x500	100	
13	-014	Experiment Motor Generator	1	500x1000x500	100	
14	-015	Control Circuit Board	3	600x200x600	30	
15	-016	Control Instrument Board	1	1000x300x600	30	
16	-301	Cut Motor	3	200x300x200	15	
17	-302	Cut Transformer	1	500x400x620	45	
18	-401	Arc Welding Machine Set	1	250x500x430	35	
19	-402	Double Head Bench Grinder	1	600x400x1000	30	
20	-501	Insulation Test Equipment	1	650x1000x1500	500	
21	-901	Work Bench	5	1800x900x800		
22		Storage Cabinet	3	2000x400x1800		
23		Shelf	3	2000x600x2000		
24	-903	Tool Cabinet	4	500x500x900		
25	-905	Drafting Set	4	1500x1500x1500		
26		Training Desk & Chair	8	1600x900x800		
27	-749	Charger	2	500x500x700		
28		Instructor's Desk & Chair	2	1200x900x800		
29		Shelf	1	1750x400x1850		
30		Locker	1	900x515x1790		
31		Blackboard	2			

EQUIPMENT LAYOUT PLAN OF
WORKSHOP AND LABORATORY (3/5)
ELECTRICAL EQUIPMENT MAINTENANCE



No.	Item No.	Description	Q'ty	Dimension (W x D x H mm)	Weight (kg)	Remarks
1	SW-4-100-(1)	Pneumatic Inst. Calibration Desk	2	1525x760x1040	70	
2	-100-(2)	Electric "	2	1600x760x1070	100	
3	-114	Liquid Column Manometer	4	280x240x1810	75	
4	-161	Auto-Transformer	1		6.5	
5	-173	Refrigerator	1	440x500x780	21	
6	-175	Furnace for Thermocouple Test	1	350x300x560	15	
7	-251-(5)	Pneumatic Transmitter Kit	2	600x350x1200	50	
8		Working Table	4	1800x900x740		
9		Chair	16	490 ⁺ x480H		
10		Shelf	2	1800x900x1500		
11		Shelf	4	1760x400x1850		
12		Wagon	4	600x400x785		
13		Table	1	1200x500x740		
14		Blackboard (Fixed)	1	3000W x 1200H		
15	SW-4-301-(1)	Air Compressor	1	1420x420x980	185	
16	-(2)	Air Cooled Dehumidifier	1	396x300x545	18	
17	-(3)	Air Dryer	1	396x253x545	30	
18	-311-(1)	Pneumatic Process Control Model	1	900x800x1750	670	
19	-(2)	Electric "	1	"	"	
20	-313	Comparative Flow Measur. App.	1	1800x500x1700	200	
21		Table	2	1500x600x740		
22		Chair	4	490 ⁺ x480H		
23		Blackboard	1	1200W x 900H		
24	SW-4-401	Electric Power Distribution Board	1	500x200x800	50	
25	-404	Drilling Machine	1	290x450x940	70	
26	-405	Bench Grinder	1	350x200x250	15	
27	-411	Tool Set for Instrument	1	1100x106x620	43	
28	-413	Surface Plate	1	500x500x145	110	
29	-414	Bench Vise	2	300x100x100	24	
30	-415	Pipe Vise	1	300 ⁺ x1100H	15	
31	-431	Control Valve Test Stand	2	700x500x1500	30	
32		Working Table	2	1800x900x740		
33	SW-4-444	Cart	1	1200x750x850	20	
34	-446	Transportable Working Table	1	1000x600x700	60	
35		Working Table	1	1800x800x740		
36		Shelf	3	1800x900x1500		
37		Shelf	2	1760x400x1850		
38		Desk	2	1060x730x740		
39		Chair	2	620x620x835		
40		Shelf	1	1760x400x1850		
41		Locker	1	900x515x1790		
42		Sink	1	1800x400x750		
43		Shelf	8	1800x900x1500		

EQUIPMENT LAYOUT PLAN OF
WORKSHOP AND LABORATORY (4/5)
INSTRUMENTATION MAINTENANCE



No.	Item No.	Description	Q'ty	Dimensions (W x D x H mm)	Weight (Kg)	Remarks
1	SW-5-100-(202)	Control Panel (Mini Plant A)	1	1200x1000x2000		
2		Switch Box (Ditto)	1	500x500x1000		
3	-5-200-(202)	Control Panel (Mini Plant B)	1	1200x1000x2000		
4		Black Board (Transportable)	2	1800x900/1800		
5		Desk	2	1060x740x730	60	
6		Shelf	2	1500x600x1800		
7		Chair (Collapsible)	15	360x360x425		
8		Chair	2	395x385x400/495		
9		Sink	1			
10		Book Shelf	2	880x400x1200	30	
11	SW-7-100	Steam Turbine Experiment Unit	1			
12	-200	Hydraulics Bench	1	1600x800x1300		
13		Experiment Table	3	2400x750x750		
14		Chair	18	320fx455H		
15		Chair (Collapsible)	15	360x360x425		
16		Shelf	2	1500x600x1800		
17		Tool Box	1	900x500x1400	40	
18		Tool Rack	1	900x500x1400	40	
19		Blackboard (Transportable)	1	1800x900/1800		
20		Sink				
21	-7-310	Centrifugal Pump	1	460x950x460		
22	-320	Reciprocating Pump	1	460x950x460		
23	SW-5-100-(300)	Package Boiler Unit (for Mini Plant A)	1			
24	-5-100-(400)	Air Compressor Unit (for Mini Plant A)	1			
25		Shelf	6	1500x600x1800		
26		Rack	1	1100x600x1800	160	
27		Tool Box	1	900x500x1400	40	
28		Tool Rack	1	900x500x1400	40	
29		Desk	3	1060x740x730		
30		Locker (for 3 persons)	1	900x515x1790	140	
31		Book Shelf	1	880x400x1200	30	
32		Filling Cabinet	1	455x620x1400		
33		Shelf-1	3	1500x600x1800		
34		Shelf-2	1	1200x600x1800		
35	SW-7-902	Experiment Table for Instructor	1	3000x900x800		
36	-901	Experiment Table for Students	4	2800x900x800		
37		Chair	34	320fx455		
38	-903	Sink-1 (with Drying Oven)	1	600x750x1860		
39		Sink-2	1			
40		Blackboard	1	3000x1200		
41		Cabinet for Reagents & Apparatus	4	1800x500x1800		
42		Table	1	5000x600x700		

EQUIPMENT LAYOUT PLAN OF WORKSHOP AND LABORATORY(5/5) PLANT OPERATION

