

**TECHNICAL DOCUMENTS**



別添一 2

PROJECT FOR THE TECHNICAL COOPERATION  
ON SEA WATER DESALINATION  
BETWEEN JAPAN AND THE KINGDOM OF SAUDI ARABIA

TECHNICAL DOCUMENTS

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# # #



## 1. Outline of the Research Project

The Ministry of International Trade and Industry, the Government of Japan, has developed new technologies of sea water distillation process and is developing an efficient system of reverse osmosis process. On the basis of these results, a research project on desalination technology between Japan and the Kingdom of Saudi Arabia (hereinafter referred to as PROJECT) will be carried out on the problems that are required for adoption of the natural conditions of the Kingdom of Saudi Arabia.

The Japan International Cooperation Agency (JICA) and the Saline Water Conversion Corporation (SWCC) hope that a laboratory established for the PROJECT will be the nucleus of research on desalination in future and play an important role in the Kingdom of Saudi Arabia. For this purpose, the followings will be carried out in a five-year program of the PROJECT with the cooperation of JICA and SWCC.

### 1.1 Consultation and Exchange of Information

A joint meeting of high-level officials or specialists of both countries will be held in order to have consultations and exchange of information about the technology for sea water desalination and to promote the PROJECT.

### 1.2 Establishment of Desalination Research Laboratory

The Desalination Research Laboratory will be established in SWCC and will be furnished with necessary equipment.

### 1.3 Construction of Field Test Plant

Attached to the Desalination Research Laboratory, a field test plant of multi-stage evaporation process capable of desalting 500 m<sup>3</sup>/day (hereinafter referred to as Field

Test Plant) will be constructed to make a study on operation for the research of materials.

#### 1.4 Construction of Module Test Plant

Two units of test module capable of desalting 40 m<sup>3</sup>/day (20 m<sup>3</sup>/day per unit) by reverse osmosis process and one unit of pretreatment equipment (hereinafter referred to as Module Test Plant) will be constructed.

#### 1.5 Dispatch of Specialists from Japan

Specialists appointed by JICA will be dispatched to the Desalination Research Laboratory to engage in the research with their Saudi Arabian counterparts.

1.6 The specialists from JICA and SWCC will cooperate to conduct the research on the multi-stage flash evaporation and reverse osmosis processes in the Desalination Research Laboratory.

### 2. Research Themes

The research themes are divided into distillation and reverse osmosis. In the former, the emphasis will be put on research of concrete evaporator shells, corrosion and scale deposition in multi-stage flash evaporation process.

In the latter, the main interest will be the durability of modules under the natural conditions characterized by higher salinity and temperature. Further explanation of the research themes is given below:

#### 2.1 Distillation Process

Research on prevention of corrosion and scale deposition will be performed in an effective combination of the Field Test Plant with the Desalination Research Laboratory. The basic idea of the research is as follows:



The plant will be operated continuously for fixed periods. During the operations, test of tubing materials with a mini-brine heater, chemical analyses of sea water, brine, fresh water, etc., and tests of the ball cleaning system will be carried out. After the plant is shut down, metallic materials and concrete evaporator shells will be inspected in detail. The personnel of the Desalination Research Laboratory will study corrosion, scale prevention and standardization of chemical analysis.

The followings are explanations for each research item:

(1) Operation Study of the Field Test Plant

The operation schedule is divided into first and second research operations. After each operation, metallic and concrete materials will be inspected. Some tubes will be replaced for a detailed examination of corrosion at the end of the operation study.

1) First research operation

The maximum brine temperature will be increased to 80, 100 and finally 120°C step-wise and then the plant will be run continuously. Measurements will be made to elucidate the behavior of the concrete evaporator shells at one week's operation of each maximum brine temperature.

2) Second research operation

After the first research operation, the plant will be run for durability under the conditions based on the results obtained before.

(2) Material inspections

After each operation, the plant will be shut down to perform the followings:

- 1) Metallic material
  - Observation of metallic corrosion and scale deposition inside tubes
  - Analysis of corrosion products and scale deposits, if necessary
- 2) Concrete evaporator shells
  - Measurements of roughness and surface repulse hardness with Schmidt concrete test hammer
  - Measurements of Saudi-made test pieces of concrete for durability
  - Measurement of air leakage

(3) Corrosion testing with a mini-brine heater

A mini-brine heater placed in parallel with the brine heater is used for selection of the heat transfer tubing materials under the conditions of the plant site sea water and concrete shells. The tubes of the mini-brine heater are replaced after each operation to investigate the corrosion behavior in detail.

(4) Examination of ball cleaning system

Through the operations, experiments will be performed to obtain the following data:

- 1) Over-all heat transfer coefficients before and after ball cleaning
- 2) Heavy metal concentrations in brine after cleaning

## 2.2 Reverse Osmosis Process

Two kinds of modules--spiral wound and hollow fiber types developed by Japanese manufacturers--will be used for the research. Both of them are 8-inch modules used for single stage desalination and have shown stable performance in the experiments by the Water Re-Use Promotion Center (WRPC).

The Module Test Plant will consist of one pretreatment unit with a capacity of 150 m<sup>3</sup>/day and two reverse osmosis (RO) units with a capacity of 20 m<sup>3</sup>/day each. The research on the following themes will be conducted:

- (1) Operation study of pretreatment
  - 1) Availability test of in-line coagulation system
  - 2) Operation study of the high linear velocity (LV) filter
  - 3) Determination of the optimum operating condition
- (2) Quality control of RO feed sea water
  - 1) Availability test of fouling index (FI) auto-monitor developed by WRPC
  - 2) Study on the relation between FI value in the feed water and fouling of the membrane
- (3) Confirmation of performance of modules

The initial performance of modules will be observed with changes of operating conditions such as recovery ratio, pressure, temperature, salinity, etc.
- (4) Durability study of modules

The elapsed change of flux or salt rejection will be measured through the long term operations.
- (5) Analysis of product water quality
- (6) Inspection of contaminated modules

## 2.3 Study in Desalination Research Laboratory

### (1) Corrosion study

#### 1) Examination of tubes tested in the mini-brine heater

The weight loss will be measured and the corrosion of inner surface will be investigated in detail with a roughness meter, microscope, etc. As to titanium tubes, the main interest is absorption of hydrogen.

#### 2) Corrosion monitoring

Two kinds of instrument, the "Corrator" (by linear polarization method) and the "Corrosometer" (by electric resistance method) will be used for corrosion monitoring.

The test materials are Al-brass, 90/10 Cu-Ni and 70/30 Cu-Ni.

#### 3) Fundamentals in corrosion

Typical corrosion phenomena in the desalination environments (galvanic corrosion, crevice corrosion, etc.) and the prevention method against these corrossions will be studied with electrochemical and metallurgical equipments.

### (2) Chemical study

Routine chemical analysis of sea water, brine and product water is carried out to provide precise operation conditions of the test plants. When corrosion or scale deposition takes place, concentration of particular constituents will be analyzed in order to study the prevention method.

1) Chemical analysis

Standardization of analytical procedures and an instruction manual will be prepared for routine chemical analysis.

2) Corrosive environment in brine

The values of pH, dissolved oxygen, free chlorine, sulfide ion and heavy metals will be measured to define the corrosive environment, if necessary.

3) Scale deposition tendency of brine

Laboratory experiments will be conducted to study the scale deposition tendency under various conditions.

4) Chemical identification of corrosion products and scale deposits

X-ray diffraction data will be obtained for identification of solid compounds.

2.4 Recommendation

The most recommendable plant will be proposed on the basis of the data obtained in the PROJECT.

3. Organization for Research

A joint meeting of high-level officials or specialists of both countries will be held alternately in Japan and in the Kingdom of Saudi Arabia in order to review and to promote the PROJECT.

The Joint Technical Team will be formed for the execution of the PROJECT. All work in the PROJECT will be monitored and directed by the Joint Technical Team which consists of officials and specialists from JICA and SWCC.

Research work will be conducted by the personnel of the Desalination Research Laboratory.

A proposal of the required personnel is given below:

|  | <u>No. of Person</u> |
|--|----------------------|
| (1) Saudi Arabian side   |                      |
| Director   | 1                    |
| Administrative Office (served concurrently<br>General Affairs by the Director) |                      |
| Accountant   |                      |
| Purchaser  |                      |
| Field Test Plant   |                      |
| Operation Engineer   | 1                    |
| Mechanical Engineer  | 1                    |
| Instrument & Electrical Engineer   | 1                    |
| Concrete Engineer  | 1                    |
| Operation Crew   | 8                    |
| Desalination Research Laboratory   |                      |
| Corrosion Researcher   | 1                    |
| Chemistry Researcher   | 1                    |
| Reverse Osmosis Researcher   | 2                    |
| <b>Total</b>   | <b>17</b>            |
| (2) Japanese side  |                      |
| Chief Representative   | 1                    |
| Field Test Plant   |                      |
| Operation Engineer   | 1                    |
| Mechanical Engineer  | 1                    |
| Instrument & Electrical Engineer   | 1                    |
| Concrete Engineer  | 1                    |
| Operation Crew   | 2 (1)                |
| Inspector & Maintenance Engineer   | 2                    |
| Desalination Research Laboratory   |                      |
| Corrosion Researcher   | 1                    |
| Chemistry Researcher   | 1                    |
| Reverse Osmosis Researcher   | 1                    |
| Inspector of Corrosion & Scale   | 2                    |
| <b>Total</b>   | <b>14(13)</b>        |

#### 4. Schedule

The PROJECT is planned to be conducted in five years. The former two and half year is devoted to designing and construction of the research facilities, and the latter two and half year is given to research activity. The outline of the tentative schedule is shown in the Table 1.

#### 5. Documents and Drawings

The documents and drawings of the research facilities are as follows:

(1) General Layout

See APPENDIX I.

(2) Field Test Plant

See APPENDIX II.

(3) Module Test Plant

See APPENDIX III.

(4) Laboratory Equipment

See APPENDIX IV.

(5) Building of Desalination Research Laboratory

See APPENDIX V.

It is to be noted that the layout of the Desalination Research Laboratory building, Field Test Plant and Module Test Plant is tentative. The detailed layout including intake and discharge facilities will be designed with information on site conditions.

Table 1  
Tentative Schedule

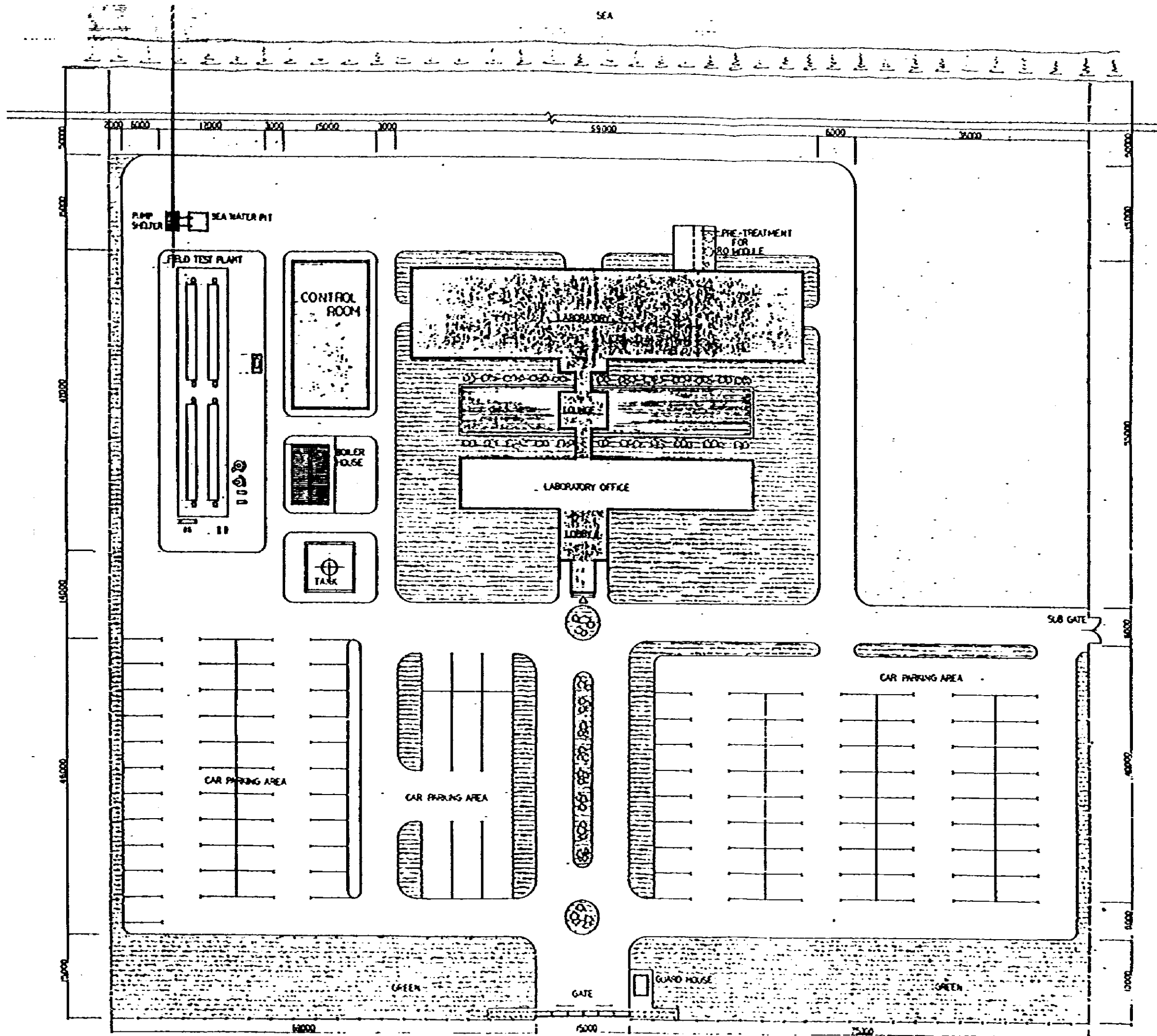
| Year                                      | 1980 | 1981 | 1982 | 1983 | 1984 |
|---|------|------|------|------|------|
| 1. Field Test Plant and Module Test Plant |      |      |      |      |      |
| (1) Decision of Site                      | ↔    |      |      |      |      |
| (2) Designing                             | ←    |      |      |      |      |
| (3) Fabrication                           | ←    | →    |      |      |      |
| (4) Civil Works                           |      | →    |      |      |      |
| (5) Transportation                        |      |      | ←    |      |      |
| (6) Installation                          |      |      | ↔    |      |      |
| (7) Operation                             |      |      |      | →    | →    |
| 2. Desalination Research Laboratory       |      |      |      |      |      |
| (1) Decision of Site                      | ↔    |      |      |      |      |
| (2) Concept Designing                     | ↔    |      |      |      |      |
| (3) Detailed Designing and Construction   |      | →    |      |      |      |
| (4) Research Activity                     |      |      |      | →    | →    |
| 3. Laboratory Equipment                   |      |      |      |      |      |
| (1) Procurement                           |      | ↔    |      |      |      |
| (2) Transportation and Installation       |      | ←    | →    |      |      |
| 4. Report                                 |      |      |      |      |      |
| (1) Annual Report                         | ↔    | ↔    | ↔    | ↔    |      |
| (2) Final Report                          |      |      |      |      | ←    |
| 5. Personnel                              |      |      |      |      |      |
| (1) Saudi Arabian side                    | ←    |      |      |      |      |
| (2) Japanese side                         | ←    |      |      |      |      |
| 6. Joint Meeting                          | ∇    | ∇    | ∇    | ∇    | ∇    |



APPENDIX I

General Layout







## APPENDIX II

### Field Test Plant

1. Design Condition
  - (1) Standard
  - (2) Condition of utility
  - (3) Condition of process
  - (4) Site condition
  
2. Specification of Main Equipment
  - (1) Field Test Plant
  - (2) Boiler
  - (3) Control room
  - (4) Boiler house

#### Attached Drawings

- (1) P & I diagram
- (2) Layout for the Field Test Plant
- (3) Control room
- (4) Boiler house
- (5) Boiler plant layout

1. Design Condition

(1) Standard

Materials, design, manufacturing and testing shall be based on the following standard:

JIS : Japanese Industrial Standard

JEC : Japanese Electrotechnical Committee

JEM : Japan Electric Manufacturer's Association

(2) Condition of utility

1) Sea water:

Clean seawater of TDS 48,200 ppm (max.) and 32.2 °C (max.) shall be supplied.

2) Electric power:

Power of 208 Volts, 3 Phase, 60 Hz and 120 Volts, Single Phase, 60 Hz shall be supplied within the battery limit of the plant.

3) Water:

Necessary amount of water including for pump cooling service etc. shall be supplied within the battery limit of the plant.

(3) Condition of process

Start-up and shut-down of the plant shall be made manually and automatic control (detected by instrumentations) shall be applied while the plant will be kept running.

(4) Site Condition

1) Soil conditions

Bearing capacity: 15 ton/m<sup>2</sup> (long duration)

2) External force conditions

Horizontal seismic coefficient: H = 0.1

3) Access road

Load capacity: 50 ton/m<sup>2</sup> (short duration)

2. Specification of Main Equipment

(1) Field Test Plant

1) General

|   |   |
|---|---|
| (1) Capacity                                    | 500 m <sup>3</sup> /day   |
| (2) Type of plant                               | Brine recirculating type<br>long tube design multi-<br>stage flash evaporator                       |
| (3) Material of shells                          | Concrete  |
| (4) Scale prevention                            | pH control by sulfuric<br>acid injection  |
| (5) Scale elimination                           | Ball cleaning system  |
| (6) Performance ratio                           | 6.0   |
| (7) Number of stages                            | Heat recovery: 15 stages<br>Heat rejection: 3 stages  |
| (8) Sea water                                   | TDS 48,200 ppm (max.)<br>Temperature(max.): 32.2°C<br>Intake quantity: 250 m <sup>3</sup> /<br>hour |
| (9) Steam (1) Heating                           | 3.5 t/h (1.5 kg/cm <sup>2</sup> G)  |
| (2) Steam<br>ejector                            | 0.5 t/h (10 kg/cm <sup>2</sup> G)   |
| (10) Concentration ratio                        | 1.24  |
| (11) Flow rate of<br>recirculating brine        | 174 t/h   |
| (12) Recirculating brine<br>maximum temperature | 120 °C  |

2) Heat recovery section

(1) Dimensions of module

|                   |           |
|-------------------|-----------|
| No. of module     | 3         |
| Length            | 15,000 mm |
| Width             | 1,500 mm  |
| Height            | 2,500 mm  |
| Thickness (shell) | 250 mm    |

(2) Material

|            |  |
|------------|--|
| Shell      | Concrete   |
| Tube       | Aluminum brass and<br>90-10 copper-nickel alloy<br>(16mm diameter and 1mm<br>thickness) and<br>Titanium tube<br>(16mm diameter and 0.4mm<br>thickness) |
| Tube plate | Copper-nickel alloy<br>(90/10 Cu-Ni)   |
| Water box  | Copper-nickel alloy<br>(90/10 Cu-Ni)   |

3) Heat rejection section

(1) Dimensions of module

|                  |           |
|------------------|-----------|
| No. of module    | 1         |
| Length           | 15,000 mm |
| Width            | 1,500 mm  |
| Height           | 2,500 mm  |
| Thickness(shell) | 250 mm    |

(2) Material

|            |   |
|------------|---|
| Shell      | Concrete  |
| Tube       | Titanium tube<br>(16mm diameter and 0.4mm<br>thickness) |
| Tube plate | Titanium plate  |
| Water box  | Titanium plate  |



4) Brine heater

(1) Dimensions

Length 2,500 mm

Shell diameter 500 mm

(2) Material

Shell Mild steel

Tube 70-30 and 90-10  
copper-nickel alloy  
(19mm diameter and 1mm  
thickness)

Tube plate Copper-nickel alloy  
(90/10 Cu-Ni)

Water box Copper-nickel alloy  
(90/10 Cu-Ni)

(2) Boiler

1) Specification

(1) Type Natural Circulation  
Package Type  
(9 VPM - 8 WS)

(2) Evaporation q'ty Max. 6 t/h

(3) Max. pressure 15 kg/cm<sup>2</sup> G

(4) Operating pressure 10 kg/cm<sup>2</sup> G

(5) Operating temperature 183.2 °C

(6) Boiler efficiency 88 %  
(L.H.V. base)

(7) Draft system Forced draft

(8) Burner system Steam Atomizing Burner

(9) Instrumentation system Electric Positioning

(10) Fuel consumption 450 kg/h  
(Light heavy oil)

2) Dimensions

(1) Length 3,079 mm

(2) Width 3,288 mm

(3) Height 3,495 mm

3) Material

(1) Furnace

Welded wall (STB-33-E)  
with Insulation and  
Outer casing

(2) Steam & Water drum

Carbon steel (SB46-SR)

(3) Tube

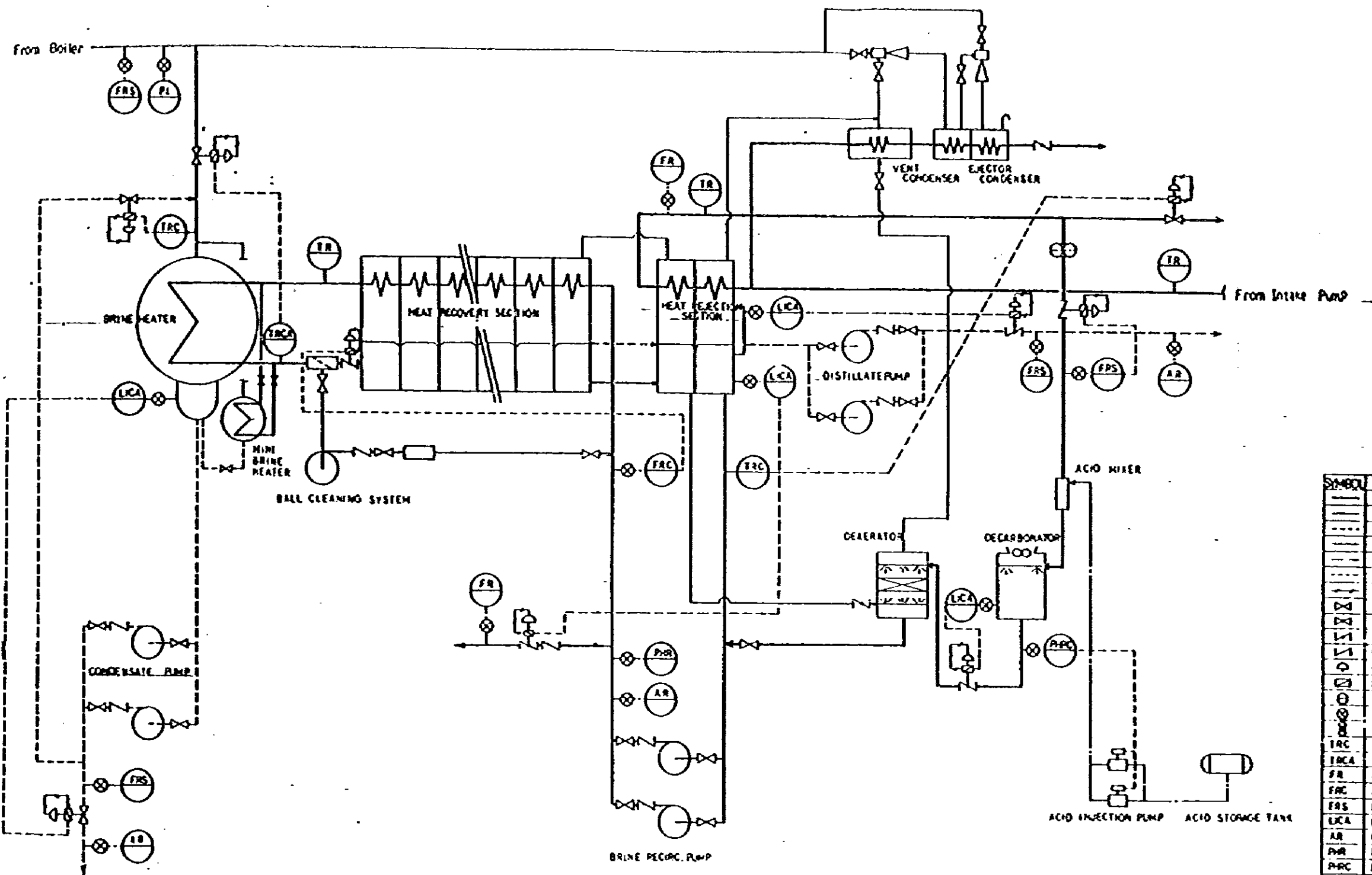
Carbon steel (STB-33-E)

(3) Control room

See attached Drawing.

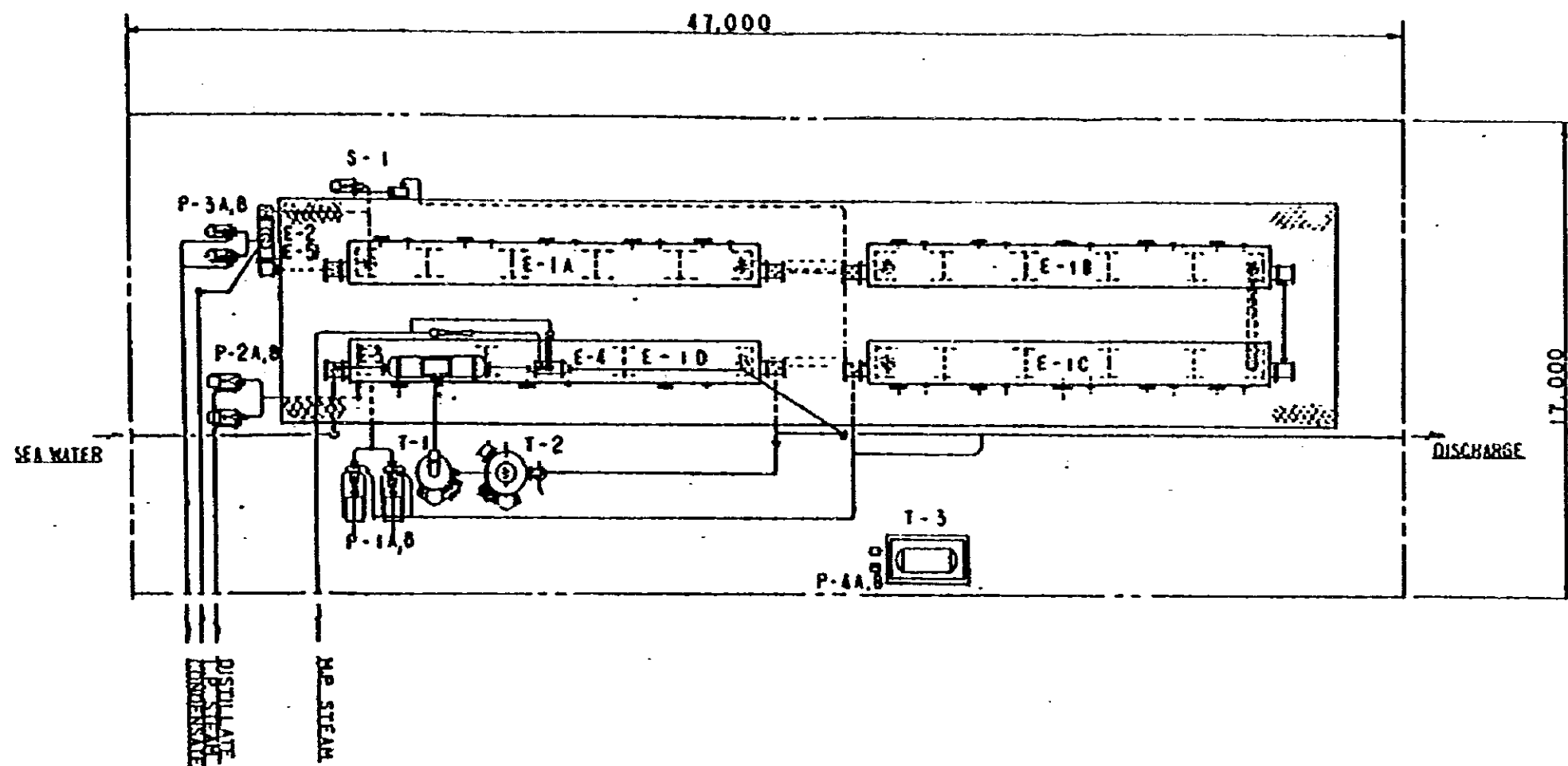
(4) Boiler house

See attached Drawing.



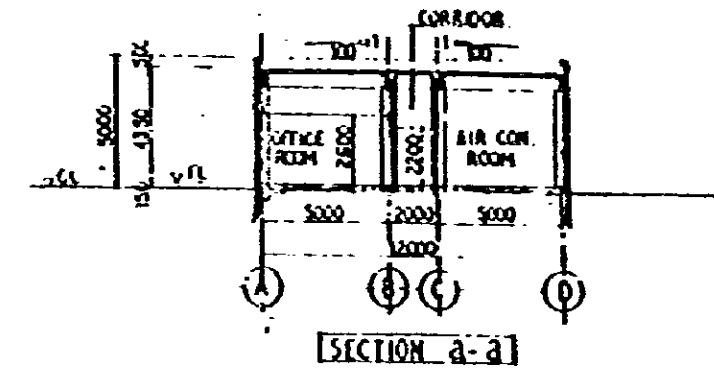
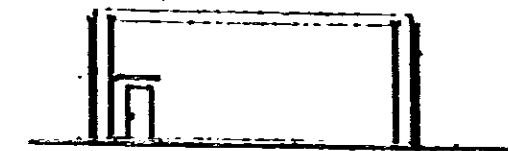
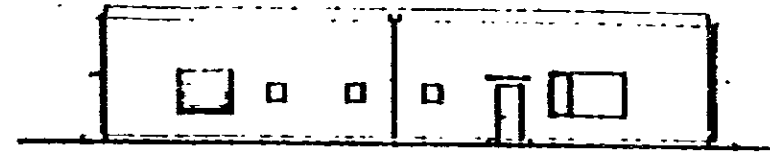
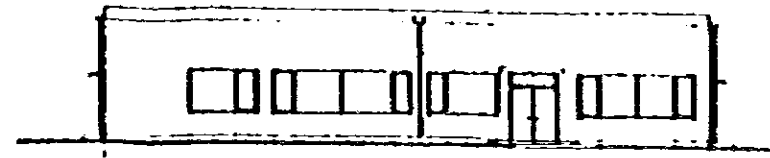
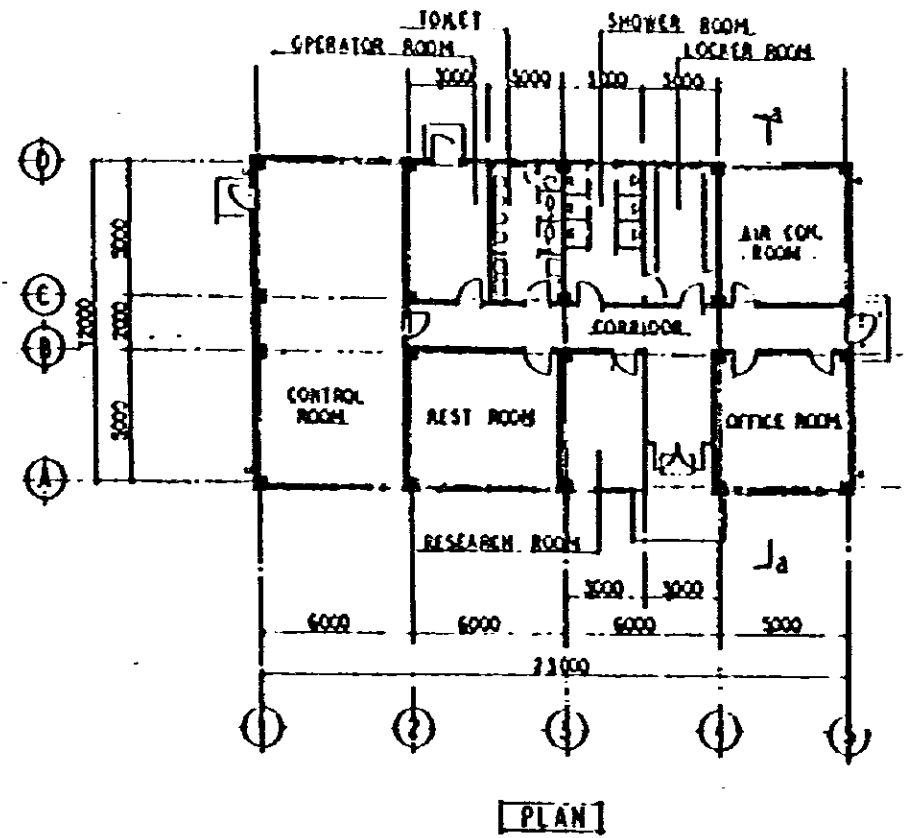
| SYMBOL | NAME                                       | REMARK |
|--------|--|--------|
| ---    | SEA WATER LINE                             |        |
| ---    | BRINE LINE                                 |        |
| ---    | DISTILLATE/CONDENSATE LINE                 |        |
| ---    | STEAM/VENT LINE                            |        |
| ---    | ACID LINE                                  |        |
| ---    | INSTRUMENTS CABLE                          |        |
| ---    | INSTRUMENTS AIR PIPING                     |        |
| ⌘      | GATE VALVE                                 |        |
| ⌘      | GLOBE VALVE                                |        |
| ⌘      | BUTTERFLY VALVE                            |        |
| ⌘      | CHECK VALVE                                |        |
| ⌘      | DIAPHRAGM ACTUATOR                         |        |
| ⌘      | POSTICOR                                   |        |
| ⊙      | PANEL INSTRUMENTS                          |        |
| ⊙      | TRANSMITTER                                |        |
| ⊙      | STRAINER                                   |        |
| TRC    | TEMPERATURE RECORDER/CONTROLLER            |        |
| TRCA   | TEMPERATURE RECORDER/CONTROLLER WITH ALARM |        |
| FR     | FLOW RECORDER                              |        |
| FAC    | FLOW RECORDER/CONTROLLER                   |        |
| FRS    | FLOW RECORDER                              |        |
| LCA    | LEVEL INDICATOR/CONTROLLER WITH ALARM      |        |
| AR     | CONDUCTIVITY RECORDER                      |        |
| PHR    | pH RECORDER                                |        |
| PHRC   | pH RECORDER/CONTROLLER                     |        |





| TAG NO. | PART NAME            | NO. REQ. |
|---------|----------------------|----------|
| E-1A-D  | EVAPORATOR           | 4        |
| E-2     | BRINE HEATER         | 1        |
| E-3     | VENT CONDENSER       | 1        |
| E-4     | EJECTOR CONDENSER    | 1        |
| E-5     | MINI BRINE HEATER    | 1        |
| P-1A B  | BRINE RECIRC. PUMP   | 2        |
| P-2A B  | DISTILLATE PUMP      | 2        |
| P-3A B  | CONDENSATE PUMP      | 2        |
| P-4A B  | ACID INJECTION PUMP  | 2        |
| T-1     | DEAERATOR            | 1        |
| T-2     | DECARBONATOR         | 1        |
| T-3     | ACID TANK            | 1        |
| S-1     | BALL CLEANING SYSTEM | 1        |





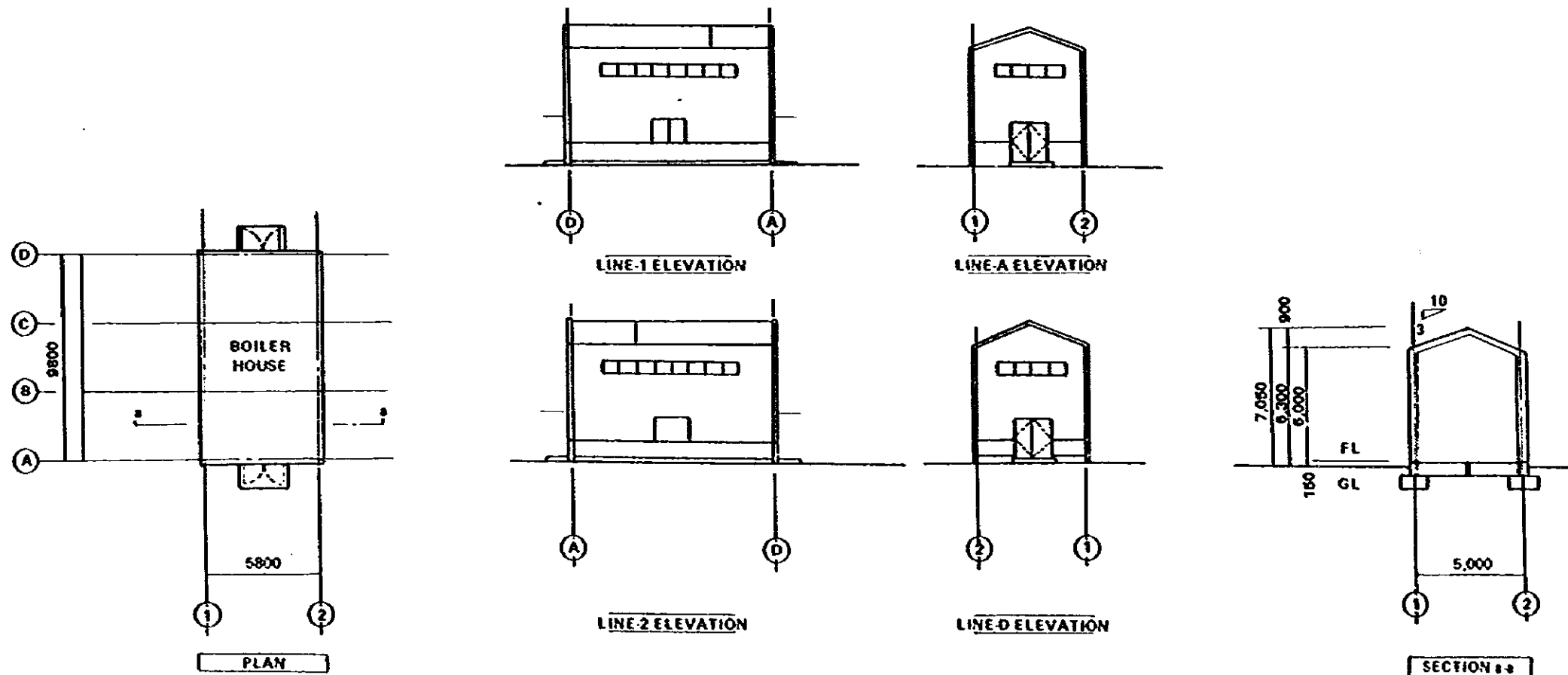
| SCHEDULE OF AREA              | MAIN STRUCTURE & EXTERIOR FINISH SCHEDULE |  |
|-------------------------------|---|--|
| 1ST. FLOOR 278 M <sup>2</sup> | MAIN STRUCTURE                            | REINFORCED CONCRETE STRUCTURE  |
|                               | ROOF                                      | ASPHALT WATERPROOFING AND CEMENT MORTAR  |
|                               | EXTERIOR WALL                             | CONCRETE BLOCK 150 <sup>1</sup> CEMENT MORTAR BRUSHED FINISH AND WHITE CEMENT SPRAYED FINISH |
|                               | DOOR                                      | STEEL DOOR   |
|                               | WINDOW                                    | STEEL SASH WINDOW  |

| INTERIOR FINISH SCHEDULE |               |                     |                |                             |                |         |
|--------------------------|---------------|---------------------|----------------|-----------------------------|----------------|---------|
| ROOM NAME                | FLOOR         | BASEBOARD           | WALL           | CEILING                     | CEILING HEIGHT | REMARKS |
| OFFICE ROOM              | CEMENT MORTAR | SAME TO FLOOR H-60  | PLASTER EP     | GIPSUM BOARD 7 <sup>1</sup> | 2.600          |         |
| REST ROOM                | DITTO         | DITTO               | DITTO          | DITTO                       | 2.600          |         |
| CONTROL ROOM             | VINYL TILE    | DITTO               | CEMENT MORTAR  | DITTO                       | 2.600          |         |
| OPERATOR ROOM            | CEMENT MORTAR | DITTO               | PLASTER EP     | GIPSUM BOARD 7 <sup>1</sup> | 2.600          |         |
| TOILET                   | MOSAIC TILE   | ---                 | DITTO          | DITTO                       | 2.100          |         |
| SHOWER ROOM              | CEMENT MORTAR | ---                 | DITTO          | DITTO                       | 2.100          |         |
| AIR CONDITIONING ROOM    | DITTO         | SAME TO FLOOR H-100 | CONCRETE BLOCK | EXPOSED CONCRETE            | ---            |         |
| LOCKER ROOM              | DITTO         | DITTO               | PLASTER EP     | GIPSUM BOARD 7 <sup>1</sup> | 2.100          |         |
| CORRIDOR                 | DITTO         | SAME TO FLOOR H-60  | DITTO          | DITTO                       | 2.200          |         |
| RESEARCH ROOM            | DITTO         | DITTO               | DITTO          | DITTO                       | 2.600          |         |

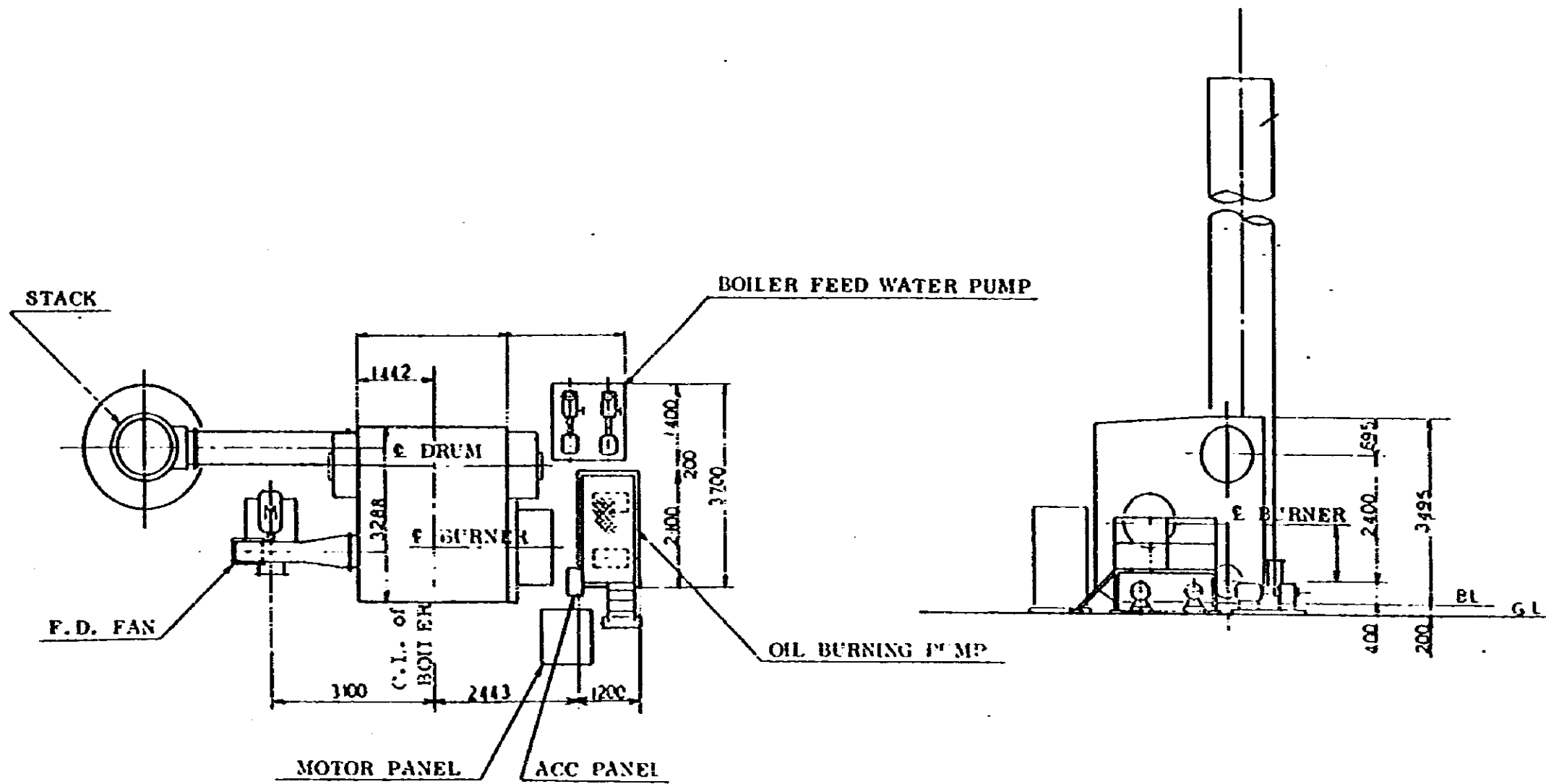




| SCHEDULE OF AREA          | MAIN STRUCTURE & EXTERIOR FINISH SCHEDULE |                                  |         |         |                |         |
|---------------------------|---|----------------------------------|---------|---------|----------------|---------|
| 1ST FLOOR 66 <sup>M</sup> | MAIN STRUCTURE                            | HEAVY WEIGHT STEEL STRUCTURE     |         |         |                |         |
|                           | ROOF                                      | CORRUGATED ASBESTOS CEMENT SHEET |         |         |                |         |
|                           | EXTERIOR WALL                             | DITTO                            |         |         |                |         |
|                           | DOOR                                      | STEEL DOOR                       |         |         |                |         |
|                           | WINDOW                                    | STEEL WINDOW W/WIRED GLASS       |         |         |                |         |
| INTERIOR FINISH SCHEDULE  |   |                                  |         |         |                |         |
| HOUSE NAME                | FLOOR                                     | BASEBOARD                        | WALL    | CEILING | CEILING HEIGHT | REMARKS |
| BOILER HOUSE              |   | SAME TO FLOOR H100               | EXPOSED | EXPOSED |                |         |
|                           |   |                                  |         |         |                |         |
|                           |   |                                  |         |         |                |         |
|                           |   |                                  |         |         |                |         |









**APPEDIX III**

**Module Test Plant**

1. Design Condition
2. Specification
3. Equipment
4. Drawings



## 1. Design Condition

### 1.1 Outline

The Module Test Plant of reverse osmosis (RO) process consists of one pretreatment unit and two kinds of RO units. The pretreatment unit involving reservoirs is established in the outside of the Laboratory building and has a capacity of 150 m<sup>3</sup>/day. Each of RO unit is installed in the room of the Laboratory and has the product capacity of 20 m<sup>3</sup>/day respectively.

### 1.2 Sea Water

Sea water to the Module Test Plant is supplied from the sea water reservoir of the Field Test Plant. Therefore, sea water condition is identical to that of the Field Test Plant.

### 1.3 Pretreatment

(1) System: In-line coagulation

(2) Filter: Linear velocity (LV) = 10 - 15 m/hour

Backwashing is done once a day automatically.

(3) Chemicals: FeCl<sub>3</sub>, H<sub>2</sub>SO<sub>4</sub>, NaClO and NaHSO<sub>3</sub>

### 1.4 RO Module

(1) Hollow Fiber module

Capacity: 20 m<sup>3</sup>/day

Salt Rejection: more than 99%

Element: Two elements with 8-inch diameter are held in a vessel.

Material: Cellulose tri-acetate

(2) Spiral Wound module

Capacity: 20 m<sup>3</sup>/day

Salt Rejection: more than 99%

Element: Three elements with 8-inch diameter are held in a vessel.

Material: Thin film composite membrane (PEC)

1.5 Operation Condition

Pressure: 55 - 70 kg/cm<sup>2</sup>

Recovery Ratio: 30 - 40%

Temperature: 28 - 35°C

Salinity: TDS 48,200 ppm (max.)

2. Specification

Specification of the Module Test Plant is as follows:

2.1 Pretreatment

(1) Filter

Type: Dual media filter (sand and anthracite)

Size: 1000 mm $\phi$  x 2040 mmTL

Accessories: Automatic valves & piping

(2) Coagulation Tank

Type: Vertical-cylindrical column

Size: 1000 mm $\phi$  x 2000 mmH

Accessories: Agitator & level controller

(3) Filtrated Sea Water Tank

Size & Volume: 2670 mm $\phi$  x 3,470 mmH, 15 m<sup>3</sup>

Material: Plastic

(4) Chemical Tanks and Pumps:

Tank: PVC, 200 liters

Pump: Diaphragm pump, 5 - 30 cm<sup>3</sup>/min

Quantity: 6 sets



(5) Pumps

- 1) Raw sea water pump:  $7.3 \text{ m}^3/\text{hr} \times 1.5 \text{ kg/cm}^2 \times 1.5 \text{ kw}$
- 2) Filter feed pump:  $7.3 \text{ m}^3/\text{hr} \times 2.0 \text{ kg/cm}^2 \times 1.5 \text{ kw}$
- 3) Backwashing pump:  $7.3 \text{ m}^3/\text{hr} \times 2.0 \text{ kg/cm}^2 \times 1.5 \text{ kw}$
- 4) Air blower:  $1 \text{ Nm}^3/\text{min} \times 0.35 \text{ kg/cm}^2 \times 0.75 \text{ kw}$

(6) Control Pannel

Various timers, relays and switches are involved.

(7) Instrument

- 1) Flow meter
- 2) Pressure gauge
- 3) FI Auto Monitor

(8) Skid

The pretreatment unit except the filtrated sea water tank and FI Auto Monitor is mounted on the skid made of shape steel.

Dimension: 3000 mmL x 2000 mmW

## 2.2 RO Unit

(1) Module & Vessel

- 1) Hollow Fiber module: 1 vessel
- 2) Spiral Wound module: 1 vessel

(2) High Pressure Pump

Type: Reciprocate type

Capacity:  $3 \text{ m}^3/\text{hr} \times 70 \text{ kg/cm}^2 \times 11 \text{ kw}$

Req. Number: 2

(3) Booster Pump

Capacity:  $3 \text{ m}^3/\text{hr} \times 3 \text{ kg/cm}^2 \times 1.5 \text{ kw}$

Req. Number: 2

(4) Cartridge Filter

4 elements for Holiow Fiber module (10<sub>p</sub> element)

2 elements for Spiral Wound module (25<sub>p</sub> element)

(5) Instrument

1) Electoro-conductivity

Detector: 5

Recorder: 1

2) pH Meter

Detector: 2

Recorder: 1

3) Flow Meter ( Rotary Meter ) : 6

4) Pressure Gauge: 8

(6) Control Pannel ( common ) : 1

(7) Product Water Tank

Volume: 1 m<sup>3</sup>

Site: Out door

Required Number: 2

Material: Plastic

(8) Skid

Each of RO Units except tanks and control panel is mounted on the skid seperately.

3. Equipment

Equipment of the Module Test Plant is as follows:

(1) FI Auto Monitor: 1 set

(2) FI Measurement Equipment: 1 set

(3) MF Measurement Equipment: 1 set

(4) Electrial Conductivity Meter: 1 set

(5) pH Meter, Portable Type: 1 set

(6) Residual Chlorine Meter: 1 set

(7) DO Meter, Portable Type: 1 set

- (8) Balance, max. 20 kg: 1 set
- (9) Water Bath, General Type: 1 set
- (10) Stop Watch: 5 sets
- (11) Dead Weight Pressure Tester: 1 set

4. Drawings

Drawings of the Module Test Plant are as follows:

- (1) Piping & Instrument Diagram

See Drawing No. SAJ-W101.

- (2) Plot Plan

See Drawing No. SAJ-W102.

|                           |    |
|---------------------------|----|
| 1. Introduction           | 1  |
| 2. Literature Review      | 10 |
| 3. Methodology            | 20 |
| 4. Results and Discussion | 30 |
| 5. Conclusion             | 40 |

Page 1 of 1

PRETREATMENT UNIT

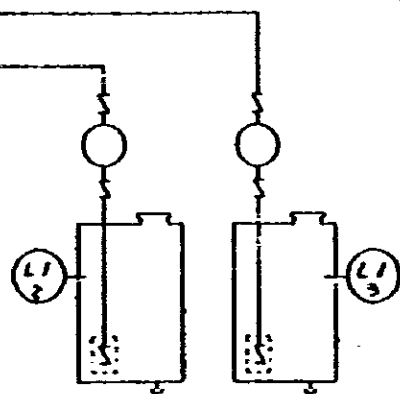
CHEMICAL FEEDERS

FOR COAGULANT (FERRIC CHLORIDE)

CP - 1  
CT - 1

FOR CHLORINE (SODIUM HYPO CHLORITE)

CP - 2  
CT - 2



COAGULATING TANK  
CT-1

AGITATOR

PS 1

MIXING PIPE  
MP-1

CV-1

DRAIN

OVER FLOW

SEA WATER

RAW SEA WATER

SWP - P-103

BAYET TYPE STRAINER

OVER FLOW TO LAGOON

DUAL MEDIA FILTER  
FI-1

FI 1

PI 2

PI 3

VENT

BACKWASHING W.

FILTRATED S.W.

BACK WASHING F.S.W.

SEAWATER PUMPS  
P-1 A, B

AIR BLOWER FOR  
FILTER BACK WASHING  
P-7

WASTE TO LAGOON

FILTRATED SEAWATER TANK  
FSW-1

LS 1

LI 1

OVER FLOW

DRAIN

OVER FLOW TO SEA

BOOSTER PUMP  
P-101, P-201

FOULING INDEX  
ANALYTIC MONITOR

SAMPLE DISCHARGE

LI 101

LI 102

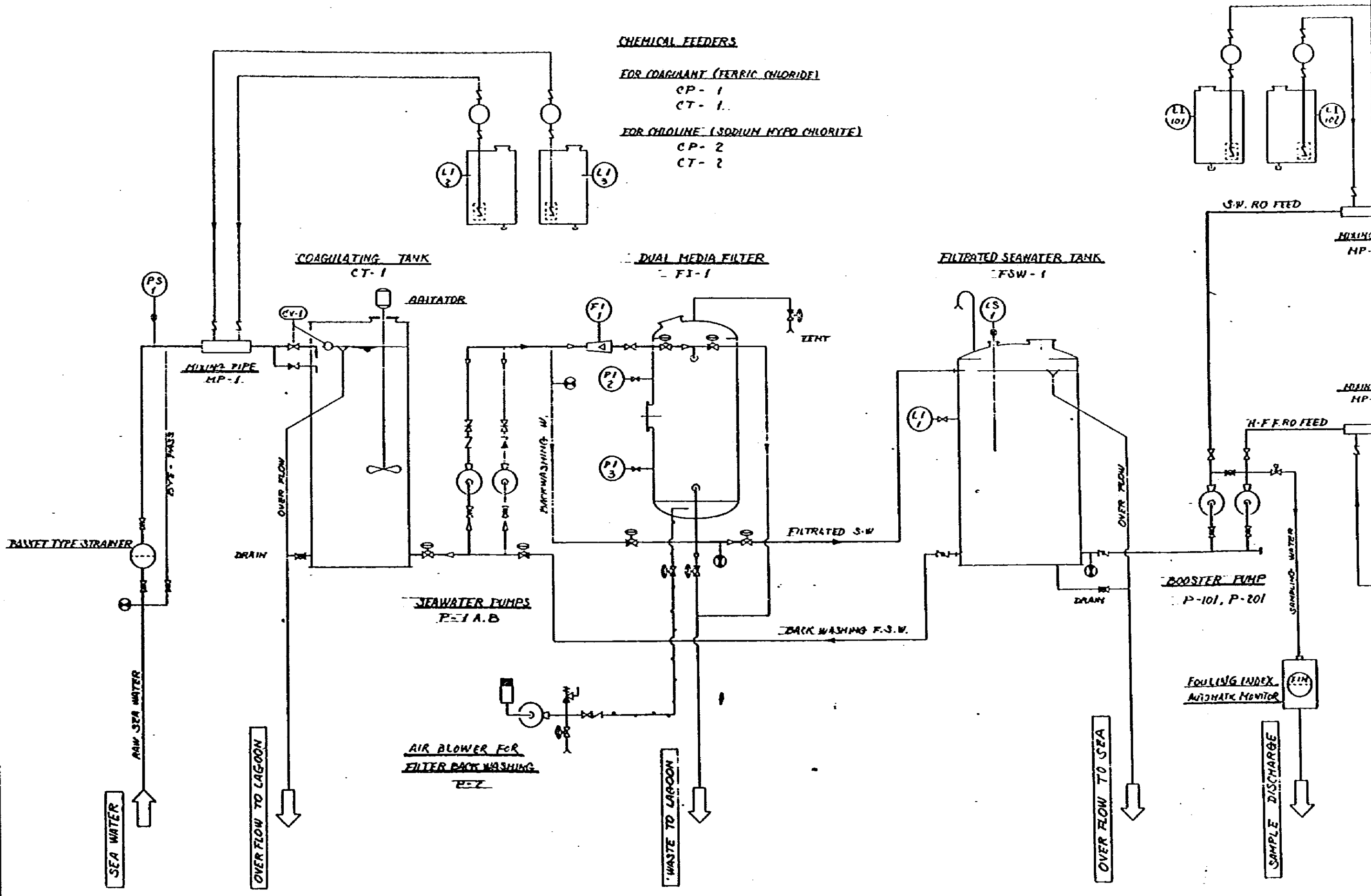
S.W. RO FEED

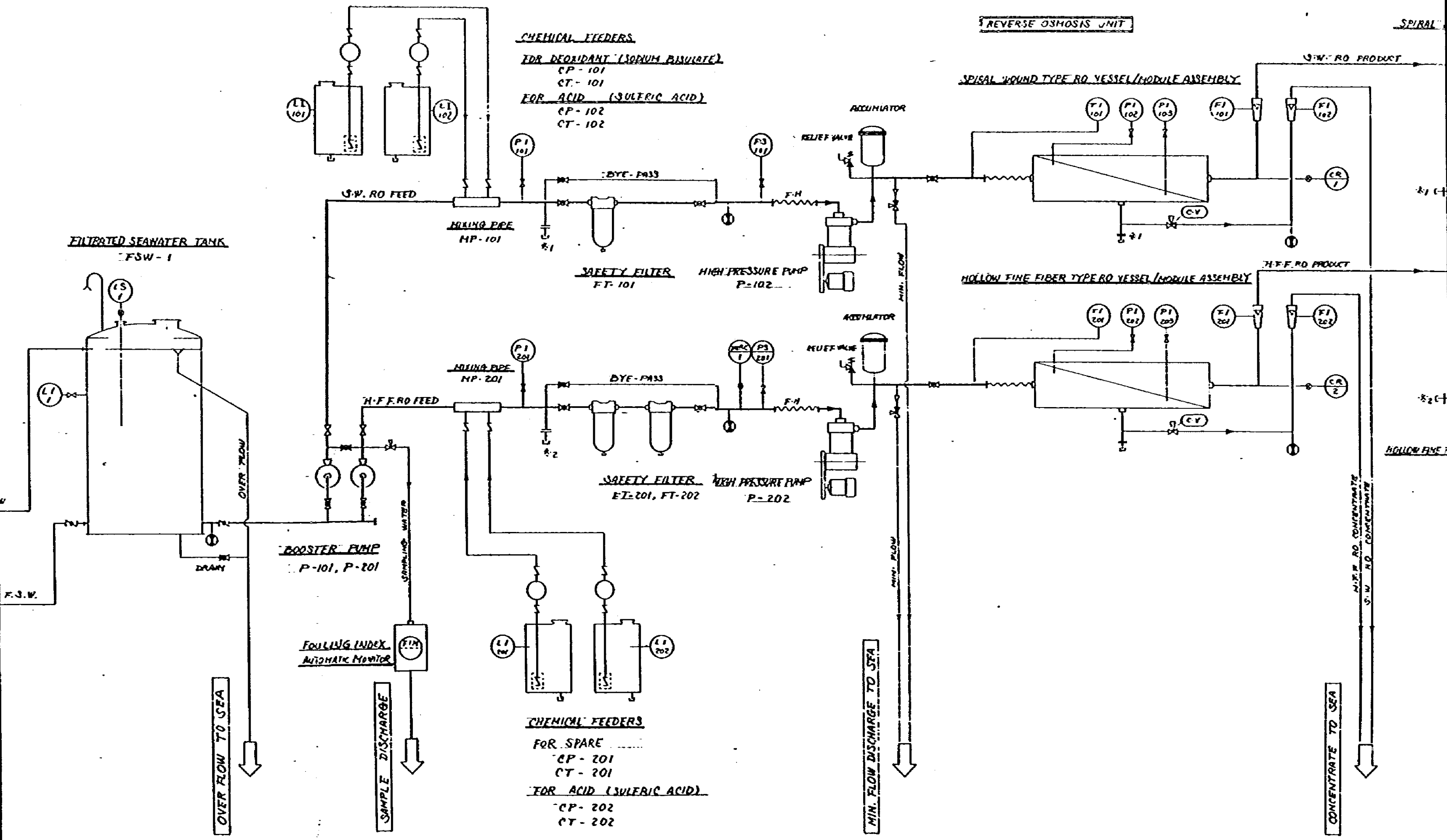
MAIN HP.

MAIN HP.

H.F.F. RO FEED

SAMPLING WATER





**CHEMICAL FEEDERS**  
EDR OXIDANT (SODIUM BISULFITE)  
 CP-101  
 CT-101  
EDR ACID (SULFURIC ACID)  
 CP-102  
 CT-102

**REVERSE OSMOSIS UNIT**

**SPIRAL**

**FILTERED SEAWATER TANK**  
 FSW-1

**SPIRAL WOUND TYPE RO VESSEL/MODULE ASSEMBLY**

**HOLLOW FINE FIBER TYPE RO VESSEL/MODULE ASSEMBLY**

**MIXING PIPE**  
 MP-101

**SAFETY FILTER**  
 FT-101

**HIGH PRESSURE PUMP**  
 P-102

**MIXING PIPE**  
 MP-201

**SAFETY FILTER**  
 FT-201, FT-202

**HIGH PRESSURE PUMP**  
 P-202

**BOOSTER PUMP**  
 P-101, P-201

**FOULING INDEX**  
 AUTOMATIC MONITOR

**CHEMICAL FEEDERS**

FOR SPARE  
 CP-201  
 CT-201

FOR ACID (SULFURIC ACID)  
 CP-202  
 CT-202

S.W. RO PRODUCT

H.F.F. RO PRODUCT

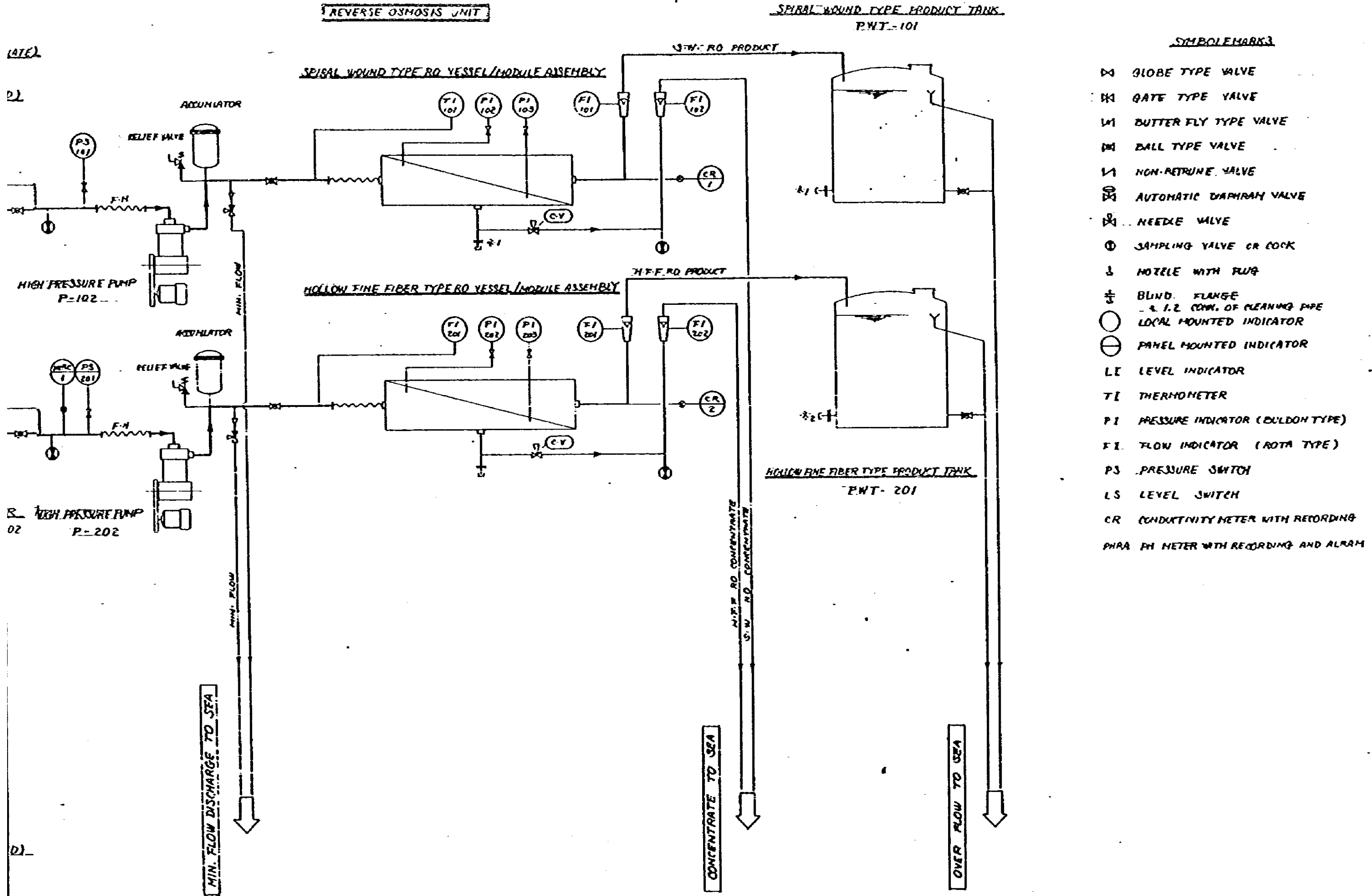
OVER FLOW TO SEA

SAMPLE DISCHARGE

MIN. FLOW DISCHARGE TO SEA

CONCENTRATE TO SEA

H.F.F. RO CONCENTRATE  
 S.W. RO CONCENTRATE



SYMBOL MARKS

- ⊘ GLOBE TYPE VALVE
- ⊞ GATE TYPE VALVE
- ⊞ BUTTER FLY TYPE VALVE
- ⊞ BALL TYPE VALVE
- ⊞ NON-RETURNE VALVE
- ⊞ AUTOMATIC DIAPHRAM VALVE
- ⊞ NEEDLE VALVE
- ⊞ SAMPLING VALVE OR COCK
- ⊞ NOZZLE WITH PLUG
- ⊞ BLIND FLANGE - 2 I.Z. COVN. OF CLEANING PIPE
- ⊞ LOCAL MOUNTED INDICATOR
- ⊞ PANEL MOUNTED INDICATOR
- LI LEVEL INDICATOR
- TI THERMOMETER
- PI PRESSURE INDICATOR (BULBON TYPE)
- FI FLOW INDICATOR (ROTA TYPE)
- PS PRESSURE SWITCH
- LS LEVEL SWITCH
- CR CONDUCTIVITY METER WITH RECORDING
- PHRA PH METER WITH RECORDING AND ALARM









APPENDIX IV

Laboratory Equipment List

1. Laboratory Equipment for Corrosion Test
2. Laboratory Equipment for Water and Chemical Analysis
3. General Equipment
4. Glassware and Others
5. Laboratory Furniture
6. Machine and Tools
7. Process Analyzer

1. Laboratory Equipment for Corrosion Test

| <u>ITEM NO.</u> | <u>DESCRIPTION</u>                        | <u>QUANTITY</u> |
|-----------------|---|-----------------|
| 1-1             | Corrosometer                              | 1 set           |
|                 | Probe                                     | (3)             |
|                 | Corrosometer                              | (1)             |
| 1-2             | Corrator (4 channels MAGNA)               | 1 set           |
|                 | Probe                                     | (6)             |
|                 | Controlling corrater                      | (2)             |
| 1-3             | Electrometer                              | 1 set           |
| 1-4             | Tester (volt-ohm meter)                   | 2 sets          |
| 1-5             | Recorder                                  | 2 sets          |
| 1-6             | Camera                                    | 1 set           |
| 1-7             | Photographic enlarger                     | 1 set           |
| 1-8             | Metallurgical microscope                  | 1 set           |
| 1-9             | Roughness meter                           | 1 set           |
| 1-10            | Mounting press                            | 1 set           |
| 1-11            | Wet grinder and polisher                  | 2 sets          |
| 1-12            | Spot welder                               | 1 set           |
| 1-13            | Electropolishing and descaling equipment  | 1 set           |
| 1-14            | Dryer                                     | 1 set           |
| 1-15            | Precision cutter                          | 1 set           |
| 1-16            | Plastic desiccator<br>(250 x 300 x 445 H) | 4 sets          |
| 1-17            | Potentiostat/galvanostat                  | 1 set           |
| 1-18            | Immersion corrosion testing equipment     | 2 sets          |
| 1-19            | Zero shunt ammeter                        | 1 set           |
| 1-20            | Micrometer vernier caliper & tools        | 1 set           |

2. Laboratory Equipment for Water and Chemical Analysis

| <u>ITEM NO.</u> | <u>DESCRIPTION</u>  | <u>QUANTITY</u> |
|-----------------|---|-----------------|
| 2-1             | Atomic absorption and flame photometer  | 1 set           |
|                 | (1) Air compressor  | 1 set           |
|                 | (2) Hollow cathode lamp<br>Fe, Cr, Ni, Ti, Na, Ca, K, Mg<br>Co, V, Cu, Mo, Al, Mn, Si | 1 each          |
|                 | (3) Fuel Gas with regulator<br>Acetylene<br>N <sub>2</sub> O                          | 1 set           |
|                 | (4) Recorder  | 1 set           |
| 2-2             | Spectrophotometer   |                 |
|                 | (1) Laboratory type   | 1 set           |
|                 | (2) Portable type   | 1 set           |
| 2-3             | X-ray diffractometer with x-y plotter   | 1 set           |
| 2-4             | Electrical conductivity meter   | 1 sets          |
| 2-5             | pH meter  |                 |
|                 | (1) Laboratory type   | 2 sets          |
|                 | (2) Portable type   | 1 sets          |
| 2-6             | Automatic titrater  | 1 set           |
| 2-7             | Residual chlorine meter   | 1 sets          |
| 2-8             | Portable water analysis kit   | 1 set           |
| 2-9             | Scale deposition testing equipment  | 2 sets          |
| 2-10            | Turbidity meter   | 1 set           |
| 2-11            | Oil content determination app.  | 1 set           |

### 3. General Equipment

| <u>ITEM NO.</u> | <u>DESCRIPTION</u>  | <u>QUANTITY</u> |
|-----------------|---|-----------------|
| 3-1             | Analytical balance, max. 161 g                                | 2 sets          |
| 3-2             | Chemical balance, direct reading, max. 1.2 kg                 | 2 sets          |
| 3-3             | Balance, max. 20 kg   | 1 sets          |
| 3-4             | Water distilling app. (distilling type and ion exchange type) | 2 sets          |
| 3-5             | Drying oven for glassware, 45 x 40 x 40 cm                    | 2 sets          |
| 3-6             | Drying oven for chemical, 45 x 30 x 30 cm                     | 1 set           |
| 3-7             | Muffle furnace, max. 1,150°C, 14 x 14 x 25 cm                 | 1 set           |
| 3-8             | Vacuum pump, 100 l/min.                                       | 2 sets          |
| 3-9             | Air compressor, tank capacity 16 l                            | 1 set           |
| 3-10            | Magnetic stirrer  | 5 sets          |
| 3-11            | Magnetic stirrer, with hot plate                              | 1 set           |
| 3-12            | Water bath, general type                                      | 1 sets          |
| 3-13            | Refrigerator  | 1 set           |
| 3-14            | Water circulating pump (Handy type)                           | 2 sets          |
| 3-15            | Stop watch  | 5 sets          |
| 3-16            | Hot plate   | 1 set           |
| 3-17            | Air pump (Handy type)   | 3 sets          |
| 3-18            | Gas flow meter  | 3 sets          |
| 3-19            | Constant temperature bath                                     | 2 sets          |
| 3-20            | Calculator  | 3 sets          |
| 3-21            | Digital thermometer   | 2 sets          |
| 3-22            | Pressure regulator  |                 |
|                 | (1) N <sub>2</sub>  | 3 sets          |
|                 | (2) H <sub>2</sub>  | 2 sets          |
| 3-23            | Vacuum evaporator   | 1 set           |

4. Glassware and Others

| <u>ITEM NO.</u> | <u>DESCRIPTION</u>                      | <u>QUANTITY</u> |
|-----------------|---|-----------------|
| 4-1             | <u>Beakers</u>                          |                 |
|                 | (1) Beaker, hard glass, standard type   |                 |
|                 | Capacity           50 ml                | 24              |
|                 | "                   100 ml              | 24              |
|                 | "                   200 ml              | 24              |
|                 | "                   300 ml              | 24              |
|                 | "                   500 ml              | 12              |
|                 | "                   1,000 ml            | 12              |
|                 | "                   2,000 ml            | 12              |
|                 | (2) Beaker, hard glass, tall type       |                 |
|                 | Capacity           500 ml               | 12              |
|                 | (3) Beaker, hard glass, conical type    |                 |
|                 | Capacity           300 ml               | 12              |
|                 | (4) Beaker, silicate glass              |                 |
|                 | Capacity           500 ml               | 6               |
|                 | (5) Beaker, stainless steel with handle |                 |
|                 | Capacity           2,000 ml             | 3               |
|                 | (6) Beaker, polyethylene with handle    |                 |
|                 | Capacity           500 ml               | 3               |
|                 | "                   2,000 ml            | 3               |
| 4-2             | <u>Flasks</u>                           |                 |
|                 | (1) Flask, Erlenmeyer, unstoppered      |                 |
|                 | Capacity           25 ml                | 12              |
|                 | "                   50 ml               | 12              |
|                 | "                   100 ml              | 24              |
|                 | "                   300 ml              | 48              |
|                 | "                   500 ml              | 24              |
|                 | "                   1,000 ml            | 12              |

| <u>ITEM NO.</u> | <u>DESCRIPTION</u>                 | <u>QUANTITY</u> |
|-----------------|------------------------------------|-----------------|
| (2)             | Flask with interchangeable stopper |                 |
|                 | Capacity 50 ml                     | 12              |
|                 | " 100 ml                           | 12              |
|                 | " 300 ml                           | 12              |
|                 | " 500 ml                           | 12              |
| (3)             | Flask, iodine                      |                 |
|                 | Capacity 300 ml                    | 3               |
| (4)             | Flask, volumetric                  |                 |
|                 | Capacity 10 ml                     | 12              |
|                 | " 25 ml                            | 12              |
|                 | " 50 ml                            | 12              |
|                 | " 100 ml                           | 12              |
|                 | " 250 ml                           | 12              |
|                 | " 500 ml                           | 12              |
|                 | " 1,000 ml                         | 12              |
| (5)             | Flask, volumetric, amber           |                 |
|                 | Capacity 10 ml                     | 6               |
|                 | " 25 ml                            | 6               |
|                 | " 50 ml                            | 6               |
|                 | " 100 ml                           | 6               |
|                 | " 250 ml                           | 6               |
|                 | " 500 ml                           | 6               |
|                 | " 1,000 ml                         | 6               |



| <u>ITEM NO.</u> | <u>DESCRIPTION</u>                  | <u>QUANTITY</u> |
|-----------------|-------------------------------------|-----------------|
| 4-3             | <u>Pipette</u>                      |                 |
|                 | (1) Pipette, volumetric             |                 |
|                 | Capacity           0.5 ml           | 12              |
|                 | "                   1 ml            | 12              |
|                 | "                   2 ml            | 12              |
|                 | "                   5 ml            | 24              |
|                 | "                   10 ml           | 24              |
|                 | "                   20 ml           | 12              |
|                 | "                   25 ml           | 12              |
|                 | "                   50 ml           | 12              |
|                 | (2) Pipette, graduated              |                 |
|                 | Capacity           1 ml             | 12              |
|                 | "                   2 ml            | 12              |
|                 | "                   5 ml            | 12              |
|                 | "                   10 ml           | 12              |
|                 | "                   25 ml           | 12              |
|                 | (3) Pipette, safety automatic       |                 |
|                 | Subdivision 0.05 ml, Capacity 5 ml  | 3               |
|                 | "    10 ml                          | 3               |
| 4-4             | <u>Burettes</u>                     |                 |
|                 | (1) Burette, plain, teflon plug     |                 |
|                 | Subdivision 0.05 ml, Capacity 5 ml  | 6               |
|                 | "           0.05 ml,   "    10 ml   | 6               |
|                 | "           0.1 ml,   "    25 ml    | 3               |
|                 | "           0.1 ml,   "    50 ml    | 3               |
|                 | (2) Burette, blue line, teflon plug |                 |
|                 | Subdivision 0.1 ml, Capacity 50 ml  | 3               |
|                 | (3) Burette, amber, teflon plug     |                 |
|                 | Subdivision 0.1 ml, Capacity 50 ml  | 3               |

| <u>ITEM NO.</u> | <u>DESCRIPTION</u>   | <u>QUANTITY</u> |
|-----------------|--|-----------------|
| (4)             | Burette, micro, plain, teflon plug with stand                  |                 |
|                 | Capacity 1 ml  | 3               |
|                 | " 2 ml   | 3               |
|                 | " 5 ml   | 2               |
|                 | " 10 ml  | 2               |
| (5)             | Burette, automatic, plain, teflon plug with bulb and reservoir |                 |
|                 | Subdivision 0.1 ml, Capacity 10 ml                             | 3               |
|                 | " 0.1 ml, " 25 ml  | 6               |
|                 | " 0.1 ml, " 50 ml  | 6               |
| (6)             | Burette, automatic, amber, teflon plug with bulb and reservoir |                 |
|                 | Subdivision 0.1 ml, Capacity 25 ml                             | 6               |
|                 | " 0.1 ml, " 50 ml  | 6               |

4-5

Bottles

|     |   |    |
|-----|---|----|
| (1) | Bottle, plastic with screw cap                    |    |
|     | Capacity 250 ml                                   | 36 |
|     | " 500 ml  | 36 |
|     | " 1,000 ml  | 36 |
| (2) | Bottle, reagent, narrow mouth with stopper        |    |
|     | Capacity 250 ml                                   | 48 |
|     | " 500 ml  | 48 |
|     | " 1,000 ml  | 48 |
| (3) | Bottle, reagent, amber, narrow mouth with stopper |    |
|     | Capacity 250 ml                                   | 24 |
|     | " 500 ml  | 24 |
|     | " 1,000 ml  | 24 |
| (4) | Bottle, reagent, wide mouth with stopper          |    |
|     | Capacity 100 - 120 ml                             | 12 |

| <u>ITEM NO.</u> | <u>DESCRIPTION</u>                              | <u>QUANTITY</u> |
|-----------------|---|-----------------|
| (5)             | Bottle, reagent, amber, wide mouth with stopper |                 |
|                 | Capacity 100 - 120 ml                           | 12              |
|                 | " 250 ml  | 6               |
|                 | " 500 ml  | 6               |
| (6)             | Bottle, dropping with pipette and teat          |                 |
|                 | Capacity 100 - 120 ml                           | 12              |
| (7)             | Bottle, dropping, amber with pipette and teat   |                 |
|                 | Capacity 100 - 120 ml                           | 12              |
| (8)             | Bottle, filtering, buchner type                 |                 |
|                 | Capacity 250 ml                                 | 12              |
|                 | " 500 ml  | 12              |
|                 | " 1,000 ml                                      | 6               |
| (9)             | Bottle, wahing, polyethylene                    |                 |
|                 | Capacity 500 ml                                 | 24              |
| (10)            | Bottle, polyethylene with stopcock              |                 |
|                 | Capacity 10 ml                                  | 3               |
| (11)            | Bottle, gas washing                             |                 |
|                 | (a) Dressel type Capacity 250 ml                | 12              |
|                 | (b) Fritted disc type " 250 ml                  | 12              |
| (12)            | Bottle, weighing                                |                 |
|                 | 40 mm (high) x 20 mm (diameter)                 | 12              |
|                 | 60 mm (high) x 30 mm (diameter)                 | 12              |

4-6

Cylinders

|     |   |    |
|-----|---|----|
| (1) | Cylinder, glass, graduated with stopper |    |
|     | Capacity 25 ml                          | 24 |
|     | " 50 ml                                 | 24 |
|     | " 100 ml                                | 24 |
|     | " 250 ml                                | 24 |
|     | " 500 ml                                | 24 |
|     | " 1,000 ml                              | 24 |
|     | " 2,000 ml                              | 6  |

| <u>ITEM NO.</u> | <u>DESCRIPTION</u>                      | <u>QUANTITY</u> |
|-----------------|---|-----------------|
| (2)             | Cylinder, glass, graduated, unstoppered |                 |
|                 | Capacity 5 ml                           | 12              |
|                 | " 10 ml                                 | 12              |
|                 | " 10 ml (cone type)                     | 12              |
|                 | " 100 ml                                | 12              |
|                 | " 250 ml                                | 12              |
|                 | " 500 ml                                | 12              |
|                 | " 1,000 ml                              | 12              |
|                 | " 2,000 ml                              | 6               |
| 4-7             | <u>Condensers</u>                       |                 |
| (1)             | Condenser, Liebig type                  | 3               |
|                 | Length 300 - 350 mm                     |                 |
| (2)             | Condenser, Dimroth type                 | 3               |
|                 | Length 300 - 350 mm                     |                 |
| (3)             | Condenser, Graham type                  | 3               |
|                 | Length 300 - 350 mm                     |                 |
| 4-8             | <u>Crucibles and Dishes</u>             |                 |
| (1)             | Crucible, porcelain with cover (B-type) |                 |
|                 | Capacity 30 ml                          | 12              |
| (2)             | Crucible, porcelain, Gooch type         |                 |
|                 | 40 mm diameter with 24 mm inlet board   |                 |
|                 | Capacity 35 ml                          | 12              |
| (3)             | Dish, evaporating                       |                 |
|                 | Diameter 85 mm, Capacity 100 ml         | 12              |
|                 | " 120 mm, " 260 ml                      | 12              |
| (4)             | Crucible, platinum                      |                 |
|                 | Capacity 120 - 150 ml                   | 2               |

| <u>ITEM NO.</u> | <u>DESCRIPTION</u>  | <u>QUANTITY</u> |
|-----------------|---|-----------------|
| 4-9             | <u>Funnels</u>  |                 |
| (1)             | Funnel, separatory with teflon plug                         |                 |
|                 | Capacity 100 ml   | 12              |
|                 | " 250 ml  | 12              |
|                 | " 500 ml  | 12              |
|                 | " 1,000 ml  | 12              |
| (2)             | Funnel, filtering   |                 |
|                 | ID at top 75 mm   | 24              |
|                 | " 100 mm  | 12              |
|                 | " 200 mm  | 6               |
|                 | " 75 mm (Long stem)   | 6               |
| (3)             | Funnel, Buchner type, porcelain                             |                 |
|                 | ID at top 100 - 120 mm                                      | 6               |
| (4)             | Funnel, Buchner type, fritted glass disc                    |                 |
|                 | ID at top 60 - 70 mm  | 3               |
| (5)             | Funnel with fritted disc                                    |                 |
|                 | JIS No. 1, Capacity 30 ml                                   | 6               |
|                 | JIS No. 2, " 30 ml  | 6               |
|                 | JIS No. 3, " 30 ml  | 6               |
|                 | JIS No. 4, " 30 ml  | 6               |
|                 | Steam for above   | 6               |
| 4-10            | <u>Desiccators with Perforated Porcelain Plate</u>          |                 |
| (1)             | Desiccator, Scheibler type with perforated, porcelain plate |                 |
|                 | Diameter, inside 150 mm                                     | 6               |
|                 | " 300 mm  | 2               |
| (2)             | Desiccator, vacuum type with cover and stopcock             |                 |
|                 | Diameter, inside 300 mm                                     | 2               |
| (3)             | Desiccator, Scheibler type, amber                           |                 |
|                 | Diameter, inside 150 mm                                     | 2               |

| <u>ITEM NO.</u> | <u>DESCRIPTION</u>                                      | <u>QUANTITY</u> |
|-----------------|---|-----------------|
| 4-11            | <u>Test Tubes</u>                                       |                 |
|                 | Hard glass 200 (L) x 21 (D) mm                          | 100             |
|                 | " 150 (L) x 12 (D) mm                                   | 100             |
| 4-12            | <u>Watch Glasses</u>                                    |                 |
|                 | Diameter 75 mm  | 36              |
|                 | " 120 mm  |                 |
| 4-13            | <u>Glass Tubing</u>                                     |                 |
|                 | (1) 1,500 mm length, 6 - 7 mm OD, glass rod             | 10              |
|                 | (2) 1,500 mm length, 1 mm ID capillary, hard glass      | 5               |
|                 | (3) 1,500 mm length, 2 mm ID 6 - 7 mm OD, hard glass    | 5               |
|                 | (4) 1,500 mm length, 4 mm ID medium wall, hard glass    | 30              |
|                 | (5) 1,500 mm length, 6 mm ID medium wall, hard glass    | 30              |
|                 | (6) 1,500 mm length, 8 mm ID medium wall, hard glass    | 30              |
|                 | (7) 1,500 mm length, 12 mm ID medium wall, hard glass   | 10              |
|                 | (8) 1,500 mm length, 16 mm ID medium wall, hard glass   | 5               |
|                 | (9) 1,500 mm length, 19 mm ID medium wall, hard glass   | 5               |
|                 | (10) 1,500 mm length, 26 mm ID medium wall, hard glass. | 3               |
| 4-14            | <u>Glass Stopcocks, Interchangeable Plug for Liquid</u> |                 |
|                 | (1) Straight type, Arms 5 - 6 mm OD                     | 12              |
|                 | (2) Straight type, Arms 7 - 8 mm OD                     | 12              |
|                 | (3) Three way type, Arms 7 - 8 mm OD                    | 6               |

| <u>ITEM NO.</u> | <u>DESCRIPTION</u>   | <u>QUANTITY</u>       |
|-----------------|--|-----------------------|
| 4-15            | <u>Tubes, Connecting, T-shaped, Glass</u><br>Arms 7 - 8 mm OD  | 12                    |
| 4-16            | <u>Tubes, Connecting, Y-shaped, Glass</u><br>Arms 7 - 8 mm OD  | 12                    |
| 4-17            | <u>Filter Pump (Aspirator)</u><br>Length 300 - 350 mm  | 12                    |
| 4-18            | <u>Glass stopcock for Gas</u><br>(1) Stopcock, high vacuum, oblique bore<br>Arms 7 - 8 mm OD<br>" 10 - 12 mm OD<br>" 13 - 15 mm OD<br>(2) Stopcock, high vacuum, three way bore<br>Arms 7 - 8 mm OD<br>" 10 - 12 mm OD | 6<br>6<br>6<br>3<br>3 |
| 4-19            | <u>Drying Tubes, U-shape with Side Arms and Stoppers</u><br>Height of tube, 100 - 150 mm   | 6                     |
| 4-20            | <u>Stopper, Cork</u><br>Size No. <u>Top Diameter mm/Bottom Diameter mm</u>   |                       |
|                 | 1                      15/12   | 100                   |
|                 | 2                      16.5/13.5   | 100                   |
|                 | 3                      18/15   | 100                   |
|                 | 4                      19.5/16.5   | 100                   |
|                 | 6                      22.5/19.5   | 100                   |
|                 | 8                      25.5/22.5   | 50                    |
|                 | 10                     30/27   | 50                    |
|                 | 12                     36/33   | 50                    |
|                 | 14                     42/39   | 50                    |
|                 | 16                     48/45   | 50                    |
|                 | 18                     54/51   | 50                    |

| <u>ITEM NO.</u> | <u>DESCRIPTION</u>  | <u>QUANTITY</u> |
|-----------------|---|-----------------|
| 4-21            | <u>Stopper, Rubber</u>                                    |                 |
|                 | <u>Size No.</u> <u>Top Diameter mm/Bottom Diameter mm</u> |                 |
|                 | 03                      11/ 9                             | 20              |
|                 | 01                      14/10                             | 20              |
|                 | 0                        15/12                            | 20              |
|                 | 1                        16/12                            | 20              |
|                 | 2                        18/14                            | 20              |
|                 | 3                        19/15                            | 50              |
|                 | 4                        20/16                            | 20              |
|                 | 5                        22/19                            | 20              |
|                 | 6                        23/20                            | 20              |
|                 | 7                        25/21                            | 20              |
|                 | 8                        28/23                            | 20              |
|                 | 9                        30/25                            | 20              |
|                 | 10                       32/28                            | 20              |
|                 | 12                       37/32                            | 10              |
|                 | 14                       41/37                            | 10              |
|                 | 16                       46/40                            | 10              |
|                 | 18                       52/46                            | 10              |
|                 | 20                       58/51                            | 10              |
|                 | 25                       74/63                            | 10              |
|                 | 30                       90/84                            | 10              |

|      |   |    |
|------|---|----|
| 4-22 | <u>Stopper, Silicone</u>                                  |    |
|      | <u>Size No.</u> <u>Top Diameter mm/Bottom Diameter mm</u> |    |
|      | 3                      19/15                              | 20 |
|      | 8                      28/23                              | 10 |

|      |                           |      |
|------|---------------------------|------|
| 4-23 | <u>Tubings</u>            |      |
|      | (1) Tubings, rubber, red  |      |
|      | 3 mm (ID) x 4.6 mm (OD)   | 10 m |
|      | 5 mm (ID) x 7 mm (OD)     | 20 m |
|      | 8 mm (ID) x 11.6 mm (OD)  | 50 m |
|      | 12 mm (ID) x 17.0 mm (OD) | 50 m |



| <u>ITEM NO.</u> | <u>DESCRIPTION</u>   | <u>QUANTITY</u>                                      |
|-----------------|--|--|
| (2)             | Tubing, rubber for gas burner<br>8 mm (ID) x 12 mm (OD)  | 30 m   |
| (3)             | Tubing, rubber for vacuum<br>4.5 mm (ID) x 15 mm (OD)<br>6 mm (ID) x 21 mm (OD)<br>9 mm (ID) x 24 mm (OD)  | 10 m<br>10 m<br>10 m                                 |
| (4)             | Tubing, rubber for high pressure<br>8 mm (ID) x 18 mm (OD)   | 10 m   |
| (5)             | Tubing, synthetic rubber<br>5 mm (ID) x 7 mm (OD)<br>7 mm (ID) x 10 mm (OD)<br>10 mm (ID) x 14.5 mm (OD)   | 10 m<br>10 m<br>10 m                                 |
| (6)             | Tubing, silicone<br>6 mm (ID) x 8 mm (OD)<br>8 mm (ID) x 11 mm (OD)<br>12 mm (ID) x 16 mm (OD)   | 10 m<br>10 m<br>10 m                                 |
| (7)             | Tubing, polyvinyl chloride<br>3 mm (ID) x 5 mm (OD)<br>6 mm (ID) x 8 mm (OD)<br>8 mm (ID) x 11 mm (OD)<br>10 mm (ID) x 13 mm (OD)<br>15 mm (ID) x 19 mm (OD)<br>18 mm (ID) x 22 mm (OD)<br>25 mm (ID) x 29 mm (OD) | 10 m<br>50 m<br>30 m<br>30 m<br>20 m<br>10 m<br>10 m |
| 4-24            | <u>Bucket, polyethylene</u><br>Capacity 10 l   | 12   |
| 4-25            | Siphone, polyethylene, middle type   | 6  |

| <u>ITEM NO.</u> | <u>DESCRIPTION</u>                                 | <u>QUANTITY</u> |
|-----------------|--|-----------------|
| 4-26            | <u>Thermometer, General Use</u>                    |                 |
|                 | Temperature range 0 - 100°C                        | 12              |
|                 | " 0 - 250°C  | 6               |
|                 | " 0 - 360°C  | 6               |
| 4-27            | Transformer, variable, total capacity 1 KW         | 3               |
| 4-28            | <u>Boring Apparatus</u>                            |                 |
|                 | (1) Borer, for cork, set                           | 3               |
|                 | (2) Borer, for rubber, set                         | 3               |
|                 | (3) Cork borer sharpener                           | 2               |
| 4-29            | Cork press, rotary                                 | 1               |
| 4-30            | Tripod, iron 20 - 22 cm high, 10 - 12 cm OD        | 12              |
| 4-31            | Triangle, with clay pipe stem                      | 24              |
| 4-32            | Asbestos wire gauge, 18 cm x 18 cm square          | 100             |
| 4-33            | <u>Asbestos</u>                                    |                 |
|                 | (1) Asbestos, band, 3 cm width, high quality (AAA) | 60 m            |
|                 | (2) Asbestos, bank, 5 cm width, high quality (AAA) | 60 m            |
|                 | (3) Asbestos, yarn, 3 mm, high quality (AAA)       | 50 m            |
| 4-34            | Pinch cock, middle type                            | 24              |
| 4-35            | <u>Screw Cocks</u>                                 |                 |
|                 | (1) Screw cock, large type (5 cm)                  | 24              |
|                 | (2) Screw cock, middle type (3 cm)                 | 24              |

| <u>ITEM NO.</u> | <u>DESCRIPTION</u>  | <u>QUANTITY</u> |
|-----------------|---|-----------------|
| 4-36            | <u>Mortars</u>  |                 |
|                 | (1) Mortar and pestle, porcelain, 150 mm OD               | 3               |
|                 | (2) Mortar and pestle, agate, 150 mm OD                   | 2               |
| 4-37            | <u>Tongs</u>  |                 |
|                 | (1) Tong, crucible, 150 - 180 mm long                     | 6               |
|                 | (2) Tong, crucible, 220 - 250 mm long                     | 2               |
|                 | (3) Tong, crucible, 500 - 600 mm long                     | 2               |
|                 | (4) Tong, breaker, safety, 300 mm long                    | 2               |
|                 | (5) Tong, crucible with platinum shoes, 200 - 250 mm long | 2               |
| 4-38            | <u>Forceps</u>  |                 |
|                 | (1) Forcep, general use, 120 mm long                      | 12              |
|                 | (2) Forcep, general use, 180 mm long                      | 12              |
|                 | (3) Forcep, general use, 300 mm long                      | 6               |
|                 | (4) Forcep, teflon coating, 180 mm long                   | 3               |
| 4-39            | <u>Spoons</u>   |                 |
|                 | (1) Spoon, general use, 150 mm long                       | 12              |
|                 | (2) Spoon, general use, 180 mm long                       | 12              |
|                 | (3) Spoon, with spatula, 150 mm long                      | 6               |
|                 | (4) Spoon, with spatula, 180 mm long                      | 6               |
| 4-40            | Spatula, stainless steel, 150 mm long                     | 6               |
| 4-41            | <u>Clamps</u>   |                 |
|                 | (1) Clamp, versatile, small size                          | 12              |
|                 | (2) Clamp, versatile, medium size                         | 12              |
|                 | (3) Clamp, versatile, large size                          | 24              |
|                 | (4) Clamp holder, regular type                            | 48              |

| <u>ITEM NO.</u> | <u>DESCRIPTION</u>  | <u>QUANTITY</u> |
|-----------------|---|-----------------|
| 4-42            | <u>Supports</u>   |                 |
|                 | (1) Support stand, tripod base, 50 cm high                    | 6               |
|                 | (2) Support stand, tripod base, 90 cm high                    | 6               |
|                 | (3) Support, funnel for two funnel                            | 2               |
|                 | (4) Support, buret with holder and porcelain base             | 6               |
|                 | (5) Support, test tube  | 2               |
|                 | (6) Support, pipet  | 3               |
| 4-43            | <u>Rings</u>  |                 |
|                 | (1) Ring support, cast iron with clamp, small size            | 6               |
|                 | (2) Ring support, cast iron with clamp, medium size           | 12              |
|                 | (3) Ring support, cast iron with clamp, large size            | 6               |
| 4-44            | <u>Gas Burners</u>  |                 |
|                 | (1) Gas burner, standard type                                 | 12              |
|                 | (2) Gas burner, Meker type                                    | 3               |
| 4-45            | Blower, rubber (Spray)  | 12              |
| 4-46            | Pipette filler, rubber  | 6               |
| 4-47            | <u>Papers</u>   |                 |
|                 | (1) Paper, filtering, qualitative No. 1<br>12.5 cm (diameter) | 600             |
|                 | (2) Paper, filtering, qualitative No. 1<br>18.5 cm (diameter) | 600             |
|                 | (3) Paper, filtering, qualitative No. 2<br>12.5 cm (diameter) | 600             |

| <u>ITEM NO.</u> | <u>DESCRIPTION</u>  | <u>QUANTITY</u> |
|-----------------|---|-----------------|
| (4)             | Paper, filtering, quantitative No. 5A<br>12.5 cm (diameter) | 600             |
| (5)             | Paper, filtering, quantitative No. 5B<br>12.5 cm (diameter) | 600             |
| (6)             | Paper, filtering, quantitative No. 5C<br>12.5 cm (diameter) | 600             |
| (7)             | Paper, filtering, oil, 800 x 300 mm square                  | 200             |
| (8)             | Paper, paraffin, pack of 500 sheets                         | 6 packs         |
| (9)             | Paper, for pH test, pH range 0.4 - 13.6                     | 6 sets          |
| 4-48            | <u>Emery Paper</u>  |                 |
| (1)             | Pine  | 24 sheets       |
| (2)             | Medium  | 24 sheets       |
| (3)             | Coarse  | 24 sheets       |
| 4-49            | <u>Brushes</u>  |                 |
| (1)             | Brush, for test tube  | 12              |
| (2)             | Brush, for burette  | 12              |
| (3)             | Brush, for flask, middle type                               | 12              |
| (4)             | Brush, for flask, large type                                | 12              |
| (5)             | Brush, for pipette  | 12              |
| (6)             | Brush, for beaker   | 6               |
| 4-50            | Vessel, evacuated with case capacity 1 l                    | 6               |
| 4-51            | Platinum dish   | 2               |
| 4-52            | DO measuring bottle   | 10              |
| 4-53            | Electric tool set   | 3               |

## 5. Laboratory Furniture

| <u>ITEM NO.</u> | <u>DESCRIPTION</u>                                   | <u>QUANTITY</u> |
|-----------------|--|-----------------|
| 5-1             | Center table with 2 sink, length 4 m                 | 2 sets          |
| 5-2             | Center table with 1 sink, length 4 m                 | 1 set           |
| 5-3             | Work table for micro-polishing room, 3 x 1.2 m       | 1 set           |
| 5-4             | Work table for machine shop, 3 x 1 m                 | 1 set           |
| 5-5             | Side bench with utility box, length 3 m              | 3 sets          |
| 5-6             | Side bench with utility box, length 2.4 m            | 6 sets          |
| 5-7             | Side bench with utility box, length 1.8 m            | 4 sets          |
| 5-8             | Side bench with utility box, length 1.5 m            | 2 sets          |
| 5-9             | Side bench without utility box, length 3 m           | 3 sets          |
| 5-10            | Side bench without utility box, length 2.4 m         | 1 set           |
| 5-11            | Side bench without utility box, length 1.8 m         | 1 set           |
| 5-12            | Corner bench with utility box                        | 4 sets          |
| 5-13            | Special side bench for dark room                     | 1 set           |
| 5-14            | Balance table, length 0.9 m                          | 1 set           |
| 5-15            | Fume hood, length 1.8 m                              | 3 sets          |
| 5-16            | Cabinet, length 1.5 m                                | 8 sets          |
| 5-17            | Cabinet, length 1.2 m                                | 3 sets          |
| 5-18            | Shelf, length 1.5 m                                  | 7 sets          |
| 5-19            | Shelf, for stock room<br>(Total length approx. 25 m) | 1 set           |
| 5-20            | Desk with chair                                      | 5 sets          |
| 5-21            | Special labo. chair                                  | 30 sets         |
| 5-22            | Sink, length 1 m                                     | 2 sets          |
| 5-23            | Special blind for microscopic anal. room             | 2 sets          |
| 5-24            | Back curtain   | 1 set           |
| 5-25            | Tool box and tool cabinet for machine shop           | 1 set           |

6. Machine and Tools

| <u>ITEM NO.</u> | <u>DESCRIPTION</u>              | <u>QUANTITY</u> |
|-----------------|---------------------------------|-----------------|
| 6-1             | Precision lathe                 | 1 set           |
| 6-2             | Bench drilling machine          | 1 set           |
| 6-3             | Electric bench grinder          | 1 set           |
| 6-4             | Cutter                          | 1 set           |
| 6-5             | Electric drill                  | 2 sets          |
| 6-6             | Hand lever shear                | 1 set           |
| 6-7             | Hack sawing machine             | 1 set           |
| 6-8             | Band sawing machine             | 1 set           |
| 6-9             | Universal swivelling bench vice | 1 set           |
| 6-10            | Cast anvil                      | 1 set           |
| 6-11            | Hack saw frame                  | 1 set           |
| 6-12            | File each size                  | 1 set           |
| 6-13            | Caliper                         | 1 set           |
| 6-14            | Steel tape measuring            | 1 set           |
| 6-15            | Steel rule                      | 1 set           |
| 6-16            | Vernier caliper                 | 1 set           |
| 6-17            | Micrometer (All kinds)          | 1 set           |
| 6-18            | Adjustable tap wrench           | 1 set           |
| 6-19            | Electric soldering iron         | 1 set           |
| 6-20            | Spanner (Each size)             | 1 set           |
| 6-21            | Adjustable angle wrench         | 1 set           |
| 6-22            | Water pump plier                | 1 set           |
| 6-23            | Side cutting plier              | 1 set           |
| 6-24            | Radio plier                     | 1 set           |

| <u>ITEM NO.</u> | <u>DESCRIPTION</u>        | <u>QUANTITY</u> |
|-----------------|---------------------------|-----------------|
| 6-25            | Diagonal cutting nipper   | 1 set           |
| 6-26            | Figure and letter punch   | 1 set           |
| 6-27            | Wire stripper             | 1 set           |
| 6-28            | Hammer                    | 1 set           |
| 6-29            | Plastic hammer            | 1 set           |
| 6-30            | Tinners scissors          | 1 set           |
| 6-31            | Oil guns                  | 1 set           |
| 6-32            | Screw drivers (All kinds) | 1 set           |
| 6-33            | Box spanner               | 1 set           |
| 6-34            | Gas cutter                | 1 set           |



7. Process Analyzer

| <u>ITEM NO.</u> | <u>DESCRIPTION</u> | <u>QUANTITY</u> |
|-----------------|--------------------|-----------------|
| 7-1             | DO meter           | 1 set           |



APPENDIX V

Plan of Desalination Research Laboratory

1. General
2. Building
3. Building Facilities

Attached Drawings and List

- (1) Desalination Research Laboratory Floor Plan
- (2) Desalination Research Laboratory Elevation and Section
- (3) Desalination Research Laboratory View from Lounge
- (4) Building Facility Equipment List



1. General

Function of each part of the laboratory is briefly explained below:

(1) Entrance (No. 1)

Double-door will be installed for the purpose of air conditioning and of preventing entry of sand.

(2) Lobby (No. 2)

The lobby will be spacious enough to give a splendid impression and to allow installation of a set of lounge furniture for talking with guests for a short time.

(3) Director's room (No. 3) and Secretary room (No. 4)

The secretary room will be provided in front of the director room for enabling the secretary to satisfactorily conduct his ~~her~~ work.

(4) Reception rooms (No's 5, 6)

The reception room will have a space capable of accommodating approximately 7 - 8 guests per room.

(5) Office rooms (No's, 7 - 10)

While being arranged as engineers' rooms, the office rooms can be used for a variety of purposes.

Office room No. 7 can be used as an office for the laboratory administration and clerical work.

Accordingly, the information counter will be provided with a door to office room No. 7.

(6) Conference room (No. 11)

The conference room will have a space sufficient to hold a conference attended by 15 - 16 persons and to accommodate, if fully utilized, all of the expected number of laboratory personnel amounting to 30.

(7) Tea service (Nos. 14, 15, 34)

These will have a space sufficient for conducting tea service and installing a kettle.

(8) Corridor (No. 17)

The corridor will be 3 m in width and will give a wide impression.

(9) Lounge (No. 18)

The lounge is a place where chemists and engineers will have recess.

(10) Machine shop (No. 19)

The machine shop will accommodate lathe, shaper and other machine tools, and will enable preparation of test pieces for material corrosion test and those for maintenance of the plant for field testing of materials, etc.

(11) Mechanical test room (Future) (No. 20)

This room will accommodate the tensile testing machine and vacuum furnace which will be installed in the future.

(12) Preparation room (No. 21)

This room is for serving as a spare room for use for various purposes.

(13) Laboratory technicians' room (No. 22)

This is a waiting room to be used by laboratory technicians.

(14) Library (No. 23)

Although being somewhat small in floor area, the library will be capable of considerably large amount of accommodation by microfilming as far as possible the documents and drawings to be accommodated.

(15) Dark room (No. 24)

The dark room is for development of photographs necessary mainly in the course of material tests. Meanwhile, each door of the laboratory room will be of the outside opening type for the purpose of easy escape in the event of an emergency.

(16) Preparation room (No. 25)

The preparation room is mainly for preparing specimen for the X-ray diffractometer, and will be provided with desks, cabinets, etc. for data analysis.

(17) X-ray room (No. 26)

The X-ray room will accommodate the X-ray diffractometer indispensable for analysis of scales, materials and other solids, and will be of the dark room type.

(18) Microscopic analysis room (No. 27)

The microscopic analysis room is for accommodating various optical facilities for materials corrosion research, i.e. microscope, projector, hardness tester, roughness tester, etc., and will be of the dark room type.

(19) EPMA room (No. 28)

This room accommodates the electron probe microanalyzer (EPMA) which will be installed in the future and it will be of the dark room type.

(20) Micropolishing room (No. 29)

In micropolishing room, various operating table, centered on the micropolishers for preparing test pieces, will be arranged.

(21) Corrosion test and chemical analysis room (Nos. 30, 31)

These rooms are for conducting small scale corrosion tests using test pieces and analysis of several wateres, and will mainly be mainly be provided with the lobaratory bench.

(22) Instrumental analysis room (No. 32)

This room will be provided with facilities necessary for analysis of water.

Being for conducting common items of work, these two (2) rooms Nos. 31 and 32 will be connected to each other by connecting doors.



(23) Locker room (No. 38)

The locker room will be provided with locker for laboratory technicians.

(24) Storage (No. 39)

This is for accommodating a variety of laboratory spare items.

(25) RO Module test room (No. 40)

This room is a reverse osmosis module test room.

The pretreatment facility and tankages are installed just outside of the laboratory.

(26) Stock room for glassware and chemicals (No. 41)

This stock room is for accommodating spare glassware and chemicals.

(27) Air conditioning machine room (No. 42)

This room is accommodating the air conditioner and heater.

## 2. Building

### 2.1 Outline

(1) The Desalination Research Laboratory will be of a reinforced concrete construction and one-storied, with a total floor area of 1,400 m<sup>2</sup>.

The outline building specifications are as per attached drawings No. SAJ-J102 and No. SAJ-J103.

(2) The shelter for pretreatment facility for RO module test will be of a steel frame construction with corrugated asbestos-cement sheet roof with total floor area of 49 m<sup>2</sup>.

### 2.2 Design Basis

(1) Applicable code, standards, etc.

(a) AISC

(b) UBC

(c) ASTM & JIS (for materials)

(2) Soil conditions

Bearing capacity      15 t/m<sup>2</sup> (long duration)

(3) External force conditions

Seismic coefficient      Negligible

(4) Wind velocity

30 m/sec

## 2.3 Design Schematic

### (1) Desalination Research Laboratory

|                     |                      |
|---------------------|----------------------|
| Floor Plan          | Drawing No. SAJ-J102 |
| Elevation & Section | Drawing No. SAJ-J103 |
| View from Lounge    | Drawing No. SAJ-J104 |

### 3. Building Facilities

#### 3.1 Outline

The Desalination Research Laboratory shall be provided with the following facilities:

- (1) Air conditioning
- (2) Ventilation
- (3) Sanitary facilities
- (4) Septic tank
- (5) Electric facilities
- (6) City gas
- (7) Cold and hot water supply
- (8) Telephone system
- (9) Sewer system (Laboratory waste, rain water, etc.)

#### 3.2 Design Basis

- (1) Applicable code, standards, etc.
  - (a) NPC, ASHRAE (for design)
  - (b) ASTM, JIS (for equipment and materials)
- (2) Temperature conditions

|                    | <u>Ambient Temp.</u> | <u>Room Temp.</u> |
|--------------------|----------------------|-------------------|
| Winter Dec. - Feb. | 30°C                 | 21°C              |
| Summer Mar. - Nov. | 41°C                 | 26°C              |
|                    | Humidity (70%)       | Humidity (50%)    |
| At night           | 0°C                  | 21°C              |

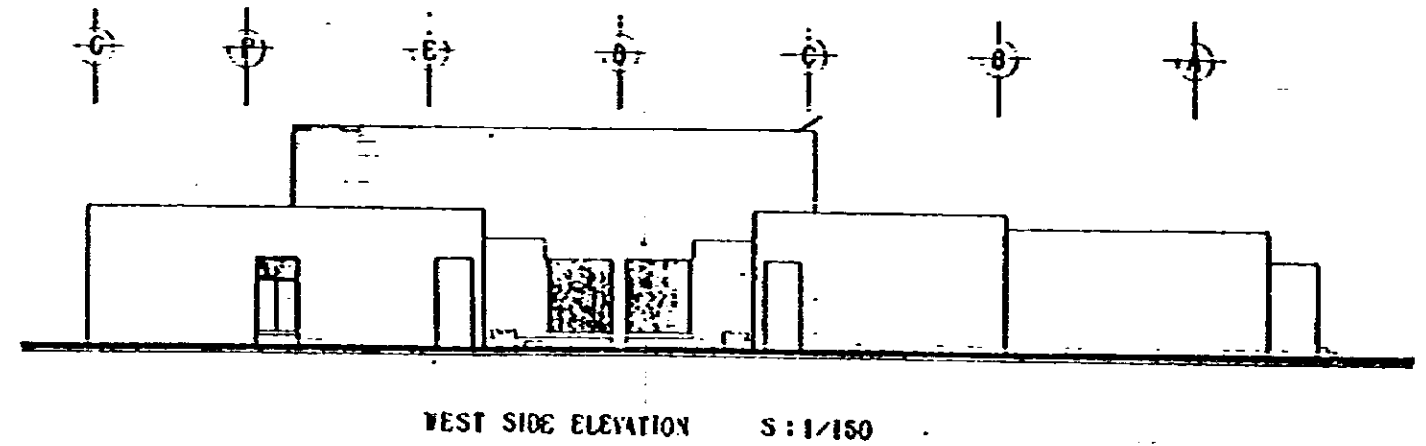
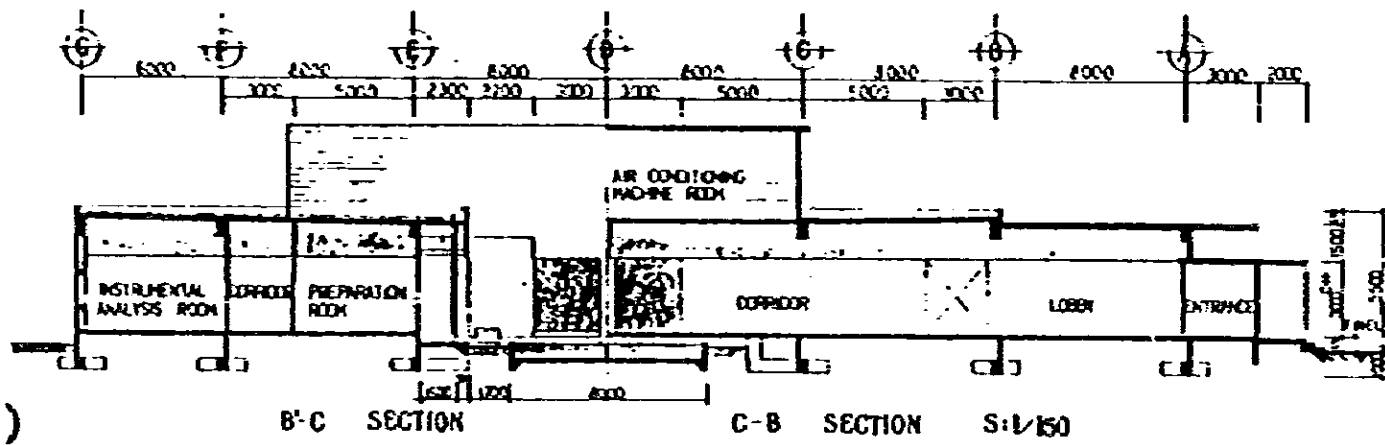
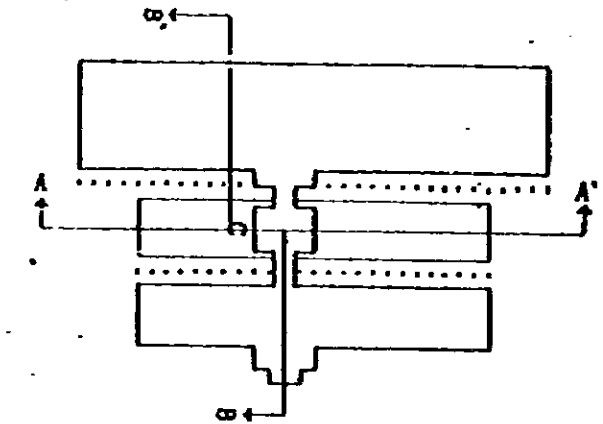
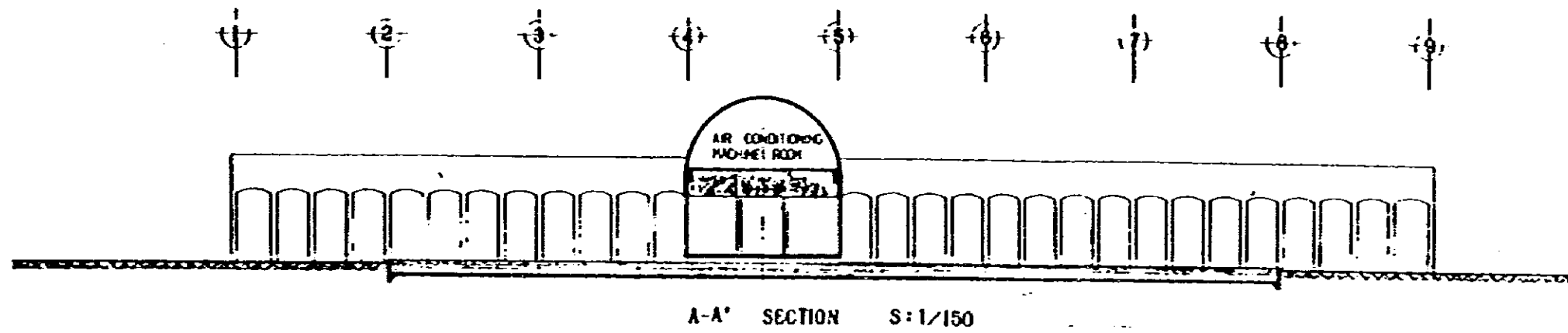
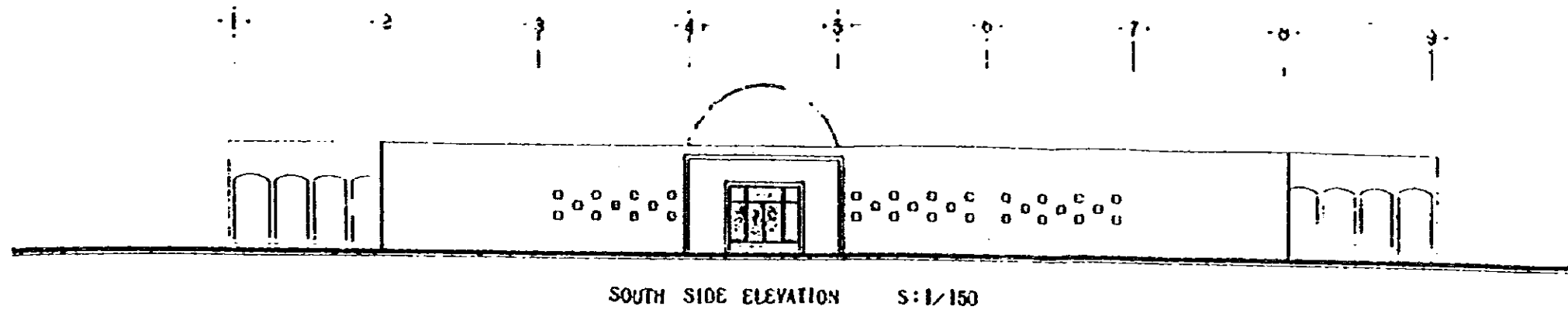
- (3) Electric power source of laboratory equipments
- AC 3 $\phi$  208 V, 60 Hz
  - AC 1 $\phi$  120 V, 60 Hz
- (4) Air-conditioning and ventilation system (each room)
- Centralized system
- o No. 1 Line (L-1) All fresh system including water chilling and air handling facilities, air duct, and pressure fan.
  - o No. 2 Line (L-2) Recycling system including water chilling and air handling facilities and air duct.
  - o No. 3 Line (L-3) Recycling system including water chilling and air handling facilities, and air duct.
- (5) Sewage
- Rain water and waste water from sanitary facilities, laboratory and septic tanks are collected at a common pit.
- (6) Indoor illumination
- (a) Luminous intensity above the laboratory table is 500 lux. Fluorescent lighting is of 2-tube, semi-embedded type.
  - (b) Loop test shop is 400 lux above the floor.





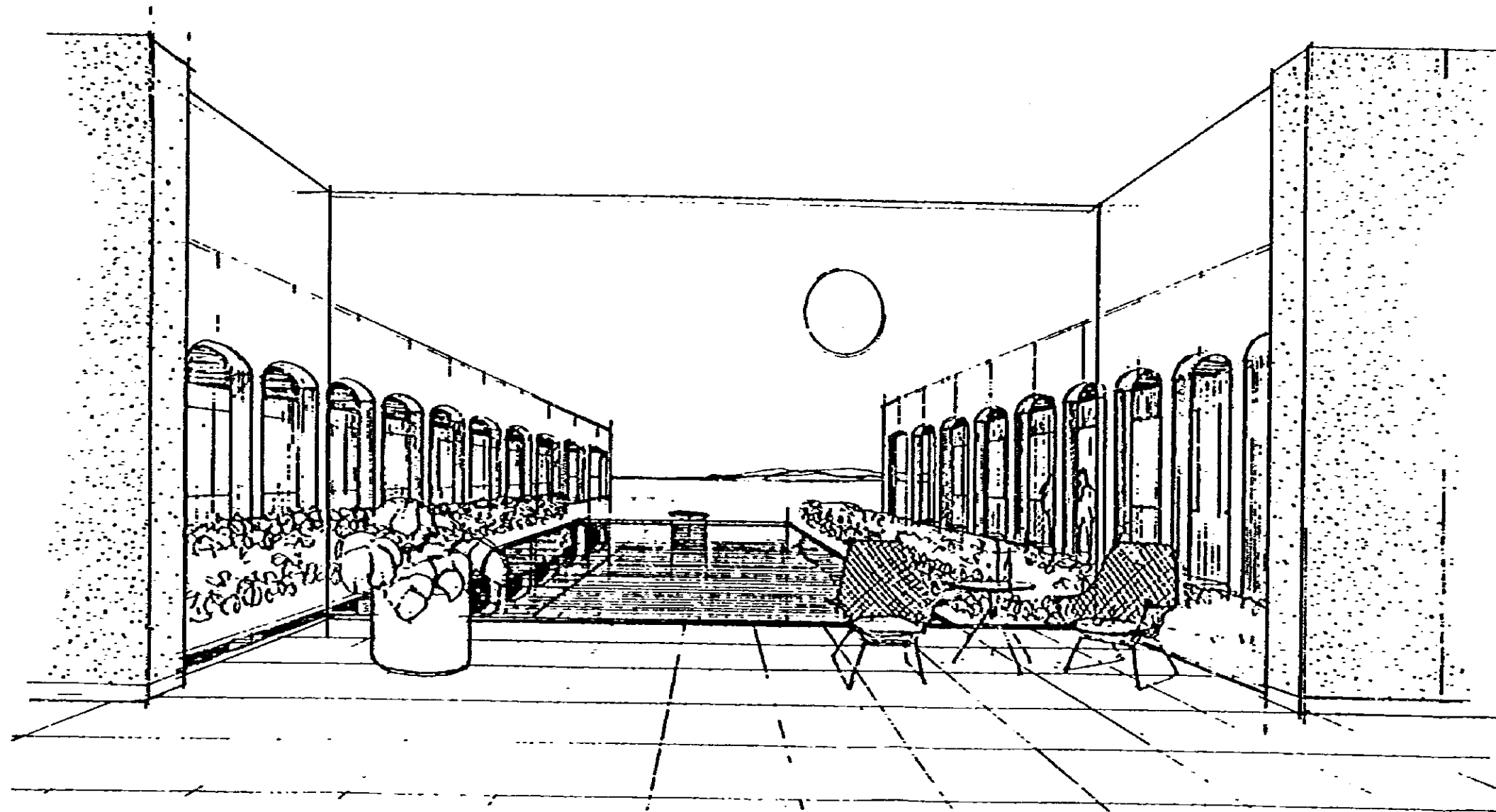






| INTERIOR FINISH SCHEDULE |                             |                                     |                               |                               |       |   |                    |         |         | EXTERIOR FINISH SCHEDULE              |   |  |  |
|--------------------------|-----------------------------|-------------------------------------|-------------------------------|-------------------------------|-------|---|--------------------|---------|---------|---------------------------------------|---|--|--|
| ROOM NO.                 | ROOM NAME                   | FLOOR                               | BASE                          | WALLS                         | WALLS | WALL                                    | CEILING            | CEILING | REMARKS | SURFACE OR PARTS                      | MATERIAL                                  | FINISH   | REMARKS  |
| 1, 2                     | OFFICE AND LOBBY            | TERRAZZO TILE                       | CEMENT MORTAR<br>STEEL TROWEL |                               |       | CEMENT PLASTER STEEL<br>TROWEL & T.E.P. | AUSTIC FLOOR BOARD | 3 IN    |         | FRAME                                 | REINFORCED CONCRETE                       | PAINT COAT   |  |
| 1, 2, 3, 4               | PUBLIC ROOM                 | CARPET                              |                               |                               |       |   |                    |         |         | FOUNDATION                            |   |  |  |
| 1, 2, 3, 4               | OFFICE AND CORRIDOR         | VINYL TILE                          |                               |                               |       |   |                    |         |         | ROOF                                  |   | 3/8" GALV. SHEET WATER PROOF -<br>SLOPE: 1/2" PER<br>FOOT                  |  |
| 1, 2, 3, 4               | LABORATORY AND<br>TEST ROOM |                                     |                               |                               |       |   |                    |         |         | GRIDS, COLUMNS, PARTS<br>AND SUPPORTS |   |  |  |
| 1, 2, 3, 4               | MACHINE SHOP AND<br>STORAGE | CEMENT MORTAR<br>& STEEL TROWEL     |                               |                               |       |   |                    |         |         | WALL                                  | PT. BRICK CONCRETE BLOCK<br>CEMENT MORTAR | PAINT COAT<br>CEMENT PLASTER 3/4" &<br>BRUSHED FINISH 1/2" &<br>PAINT COAT |  |
| 1, 2, 3, 4               | TOILET AND BATH             | PORCELAIN NON-GLAZED<br>MOSAIC TILE |                               | SEM. PORCELAIN<br>GLAZED TILE |       |   |                    |         |         | DOOR AND FRAME                        | STEEL<br>(L.A.S. WOOD)                    |  |  |
| 1, 2, 3, 4               | AIR MACHINE ROOM            | CONCRETE STEEL TROWEL               |                               |                               |       |   |                    |         |         | WINDOW AND FRAME                      | ALUMINUM                                  |  | 1/2" GALV.<br>SHEET<br>STEEL<br>WITH<br>PAINT COAT |
|                          |                             |                                     |                               |                               |       |   |                    |         |         | DOOR SPOUT                            | 1/2" GALV. SHEET STEEL<br>WITH PAINT COAT |  |  |







**(4) Building Facility Equipment List**

**(4.1) Air Conditioning**

**(4.2) Ventilation**

**(4.3) Hot Water Supply**

**(4.4) Power Receiving**

(4.1) Air Conditioning

|         | <u>DESCRIPTION</u>               | <u>QUANTITY</u> | <u>RECOED</u> |
|---------|----------------------------------|-----------------|---------------|
| (4.1.1) | Chilling Unit                    |                 |               |
| (L-1)   | Water Chilling Units             | 2 sets          |               |
|         | Cooling Capacity                 | 205,100 kcal/hr |               |
|         | Compressor                       | 74 KW           | (37 KW x 2)   |
|         | Chilling Water Flow Rate         | 683.7 l/min     |               |
|         | Cooling Water Inlet Temperature  | 12°C            |               |
|         | Cooling Water Outlet Temperature | 7°C             |               |
|         | Condenser Water Flow Rate        | 976 l/min       |               |
| (L-2)   | Water Chilling Unit              | 1 set           |               |
|         | Cooling Capacity                 | 53,790 kcal/hr  |               |
|         | Compressor                       | 19 KW           |               |
|         | Chilling Water Flow Rate         | 179.3 l/min     |               |
|         | Cooling Water Inlet Temperature  | 12°C            |               |
|         | Cooling Water Outlet Temperature | 7°C             |               |
|         | Condenser Water Flow Rate        | 246 l/min       |               |
| (L-3)   | Water Chilling Unit              | 1 set           |               |
|         | Cooling Capacity                 | 155,300 kcal/hr |               |
|         | Compressor                       | 60 KW           | (30 KW x 2)   |
|         | Chilling Water Flow Rate         | 517.7 l/min     |               |
|         | Cooling Water Inlet Temperature  | 12°C            |               |
|         | Cooling Water Outlet Temperature | 7°C             |               |
|         | Condenser Water Flow Rate        | 784 l/min       |               |

|         | <u>DESCRIPTION</u>               | <u>QUANTITY</u>         | <u>RECORD</u>             |
|---------|----------------------------------|-------------------------|---------------------------|
| (4.1.2) | Air Handling Unit                |                         |                           |
| (L-1)   | Air Handling Unit                | 1 set                   | All fresh                 |
|         | Cooling Capacity                 | 389,000 kcal/hr         |                           |
|         | Heating Capacity                 | 395,000 kcal/hr         |                           |
|         | (Electric Heater)                | (460 KW)                | Steam heater<br>740 kg/hr |
|         | Air Flow                         | 360 m <sup>3</sup> /min |                           |
|         | Static Pressure Outside the Unit | 40 mmAq                 |                           |
|         | Motor for Fan                    | 11 KW                   |                           |
| (L-2)   | Air Handling Unit                | 1 set                   | Recycling                 |
|         | Cooling Capacity                 | 49,800 kca/hr           |                           |
|         | Heating Capacity                 | 51,600 kca/hr           |                           |
|         | (Electric Heater)                | (60 KW)                 | Steam heater<br>100 kg/hr |
|         | Air Flow                         | 188 m <sup>3</sup> /min |                           |
|         | Static Pressure Outside the Unit | 40 mmAq                 |                           |
|         | Motor for Fan                    | 5.5 KW                  |                           |
| (L-3)   | Air Handling Unit                | 1 set                   | Recycling                 |
|         | Cooling Capacity                 | 127,200 kcal/hr         |                           |
|         | Heating Capacity                 | 129,000 kcal/hr         |                           |
|         | (Electric Heater)                | (150 KW)                | Steam heater<br>240 kg/hr |
|         | Air Flow                         | 231 m <sup>3</sup> /min |                           |
|         | Static Pressure Outside the Unit | 60 mmAq                 |                           |
|         | Motor For Fan                    | 11 KW                   |                           |

|         | <u>DESCRIPTION</u>      | <u>QUANTITY</u>    | <u>RECORD</u> |
|---------|-------------------------|--------------------|---------------|
| (4.1.3) | Cooling Tower           |                    |               |
| (L-1)   | Water Cooling Tower     | 1 set              |               |
|         | Cooling Ton             | 175 CT             |               |
|         | Cooling Water Flow Rate | 1,952 l/min        |               |
|         | Motor For Fan           | 5.5 KW             |               |
| (L-2)   | Water Cooling Tower     | 1 set              |               |
|         | Cooling Ton             | 20 CT              |               |
|         | Cooling Water Flow Rate | 246 l/min          |               |
|         | Motor For Fan           | 0.75 KW            |               |
| (L-3)   | Water Cooling Tower     | 1 set              |               |
|         | Cooling Ton             | 60 CT              |               |
|         | Cooling Water Flow Rate | 784 l/min          |               |
|         | Motor For Fan           | 1.5 KW             |               |
| (4.1.4) | Pump                    |                    |               |
| (L-1)   | Chilling Water Pump     | 2 sets             |               |
|         | Water Flow Rate         | 1,368 l/min        |               |
|         | Head                    | 125 $\phi$ 20 m aq |               |
|         | Motor Output            | 11 KW              |               |
| (L-2)   | Chilling Water Pump     | 2 sets             |               |
|         | Water Flow Rate         | 180 l/min          |               |
|         | Head                    | 650 $\phi$ 20 m aq |               |
|         | Motor Output            | 1.5 KW             |               |
| (L-3)   | Chilling Water Pump     | 2 sets             |               |
|         | Water Flow Rate         | 518 l/min          |               |
|         | Head                    | 80 $\phi$ 20 m aq  |               |
|         | Motor Output            | 3.7 KW             |               |



|         | <u>DESCRIPTION</u>               | <u>QUANTITY</u>          | <u>RECORD</u> |
|---------|----------------------------------|--------------------------|---------------|
| (L-1)   | Cooling Water Pump               | 2 sets                   |               |
|         | Water Flow Rate                  | 1,952 l/min              |               |
|         | Head                             | 150 <del>ø</del> 20 m aq |               |
|         | Motor Output                     | 15 KW                    |               |
| (L-2)   | Cooling Water Pump               | 2 sets                   |               |
|         | Water Flow Rate                  | 246 l/min                |               |
|         | Head                             | 65 <del>ø</del> 20 m aq  |               |
|         | Motor Output                     | 2.2 KW                   |               |
| (L-3)   | Cooling Water Pump               | 2 sets                   |               |
|         | Water Flow Rate                  | 784 l/min                |               |
|         | Head                             | 100 <del>ø</del> 20 m aq |               |
|         | Motor Output                     | 18.5 KW                  |               |
| (4.1.5) | Pool for Cooling Tower Supply    | 2 sets                   |               |
|         | Water Flow Rate                  | 2,982 l/min              |               |
|         | Head                             | 150 <del>ø</del> 20 m aq |               |
|         | Motor Output                     | 18.5 KW                  |               |
| (4.1.6) | Laboratory Chilling Water Supply |                          |               |
|         | (1) Water Chilling Unit          | 1 set                    |               |
|         | Cooling Capacity                 | 11,000 kcal/hr           |               |
|         | Compressor                       | 3.75 KW                  |               |
|         | Chilling Water Flow Rate         | 35 l/min                 |               |
|         | Cooling Water Inlet Temperature  | 12°C                     |               |
|         | Cooling Water Outlte Temperature | 7°C                      |               |
|         | Condenser Water Flow Rate        | 55 l/min                 |               |
| (2)     | Water Cooling Tower              |                          |               |
|         | Cooling Ton                      | 5 CT                     |               |
|         | Cooling Water Flow Rate          | 55 l/m                   |               |
|         | Motor for Fan                    | 0.2 KW                   |               |

| <u>DESCRIPTION</u>             | <u>QUANTITY</u>                    | <u>RECORD</u> |
|--------------------------------|------------------------------------|---------------|
| (3) Chilling Water Pump        | 2 sets                             |               |
| Water Flow Rate                | 35 l/min                           |               |
| Head                           | 40 <del>ø</del> 15 m aq            |               |
| Motor Output                   | 0.75 KW                            |               |
| (4) Cooling Water Pump         | 2 sets                             |               |
| Water Flow Rate                | 55 l/min                           |               |
| Head                           | 40 <del>ø</del> 20 m aq            |               |
| Motor Output                   | 1.5 KW                             |               |
| (5) Chilling Water Tank        | 1 set                              |               |
| Capacity                       | 0.2 m <sup>3</sup>                 |               |
| (6) Chilling Supply Water Pump |                                    |               |
| Water Flow Rate                | 10 l/min                           |               |
| Head                           | 25 <del>ø</del> 50 m aq            |               |
| Motor Output                   | 2.2 KW                             |               |
| (4.1.7) Power Control Panel    | 1 set                              |               |
|                                | 3 <del>ø</del> 208 V 60 Hz 4 Wires |               |

#### (4.2) Ventilation

| <u>DESCRIPTION</u>                             | <u>QUANTITY</u>    | <u>RECORD</u>         |
|--|--------------------|-----------------------|
| (4.2.1) Wall Pressure Fan/with Filter Box      |                    |                       |
| 500 $\phi$ x40m <sup>3</sup> /minx8mmAqx0.4KW  | 2 sets             |                       |
| 450 $\phi$ x33m <sup>3</sup> /minx8mmAqx0.25KW | 4 sets             |                       |
| 400 $\phi$ x31m <sup>3</sup> /minx8mmAqx0.26KW | 2 sets             |                       |
| 350 $\phi$ x20m <sup>3</sup> /minx8mmAqx0.13KW | 4 sets             |                       |
| 300 $\phi$ x13m <sup>3</sup> /minx8mmAqx0.05KW | 2 sets             |                       |
| (4.2.2) Wall Ventilating Fan                   |                    |                       |
| 250 $\phi$ x6m <sup>3</sup> /minx0.041KW       | 10 sets            |                       |
| 200 $\phi$ x1m <sup>3</sup> /minx0.037KW       | 1 set              |                       |
| (4.3) Hot Water Supply                         |                    |                       |
| (4.3.1) Hot Water Boiler                       | 1 set              |                       |
| Capacity                                       | 22,500 kcal/h      |                       |
| Electric                                       | 26.5 KW            | 1 $\phi$ 120 V, 60 Hz |
| (4.3.2) Storage Tank                           | 1 set              |                       |
| Capacity                                       | 0.6 m <sup>3</sup> |                       |
| (4.3.3) Hot Water Pump                         | 2 sets             |                       |
| Water Flow Rate                                | 10 l/min           |                       |
| Head   | 25 $\phi$ 6 m      |                       |
| Motor Output                                   | 0.4 KW             | 1 $\phi$ 120 V, 60 Hz |
| (4.4) Power Receiving                          |                    |                       |
| (4.4.1) Main Panel                             | 1 set              |                       |
| 3 $\phi$ 208 V, 60 Hz, 4 Wires                 |                    |                       |
| 1,500 W x 1,500 L x 500 H                      |                    |                       |

| <u>DESCRIPTION</u>  | <u>QUANTITY</u> | <u>RECORD</u> |
|---|-----------------|---------------|
| (4.4.2) Lighting Control Panel<br>3 $\phi$ 208 V, 60 Hz, 4 Wires<br>600 W x 150 L x 1,400 H | 1 set           |               |
| (4.4.3) Power Control Panel<br>3 $\phi$ 208 V, 60 Hz, 4 Wires<br>1,000 W x 350 L x 2,000 H  | 1 set           |               |
| (4.4.4) Cable   |                 |               |
| (4.4.5) Cable Back  |                 |               |
| (4.4.6) Other Material  |                 |               |

**ESTIMATED COST**



( 別添 3 )

PROJECT FOR THE TECHNICAL COOPERATION  
ON SEA WATER DESALINATION  
BETWEEN JAPAN AND THE KINGDOM OF SAUDI ARABIA

ESTIMATED COST

(TENTATIVE)

DOCUMENT NO. SAJ-114

FEBRUARY 1980





Tentative estimated cost of the joint research project on desalination technology between Japan and the Kingdom of Saudi Arabia is as follows:

Unit: US\$ 1,000

| Item  | Cost           | SWCC<br>Portion | JICA<br>Portion | Description   |
|---|----------------|-----------------|-----------------|---|
| <b>1. Desalination Research Laboratory</b>          |                |                 |                 |   |
| <b>1.1 Laboratory</b>                               | <b>(4,439)</b> |                 |                 |   |
| (1) Concept Design                                  | 80             | 0               | 80              |   |
| (2) A/E   | 40             | 40              | 0               |   |
| (3) Construction                                    | 3,055          | 3,055           | 0               | Laboratory Furniture included   |
| (4) Laboratory Equipment                            | 955            | 0               | 955             | C.I.F.  |
| (5) Inland Transportation of Equipment              | 9              | 9               | 0               |   |
| (6) Installation & Adjustment of Equipment          | 300            | 0               | 300             |   |
| <b>1.2 Field Test Plant</b>                         | <b>(5,630)</b> |                 |                 |   |
| (1) Design  | 220            | 0               | 220             | Process & Mechanical Design   |
| (2) Fabrication                                     | 2,200          | 935             | 1,265           | JICA Portion is <sup>C.I.F.</sup> F.O.B.                                |
| (3) Inland Transportation                           | 110            | 110             | 0               |   |
| (4) Installation                                    | 830            | 688             | 142             |   |
| (5) A/E for Plant Civil Control Room & Boiler House | 70             | 70              | 0               |   |
| (6) Civil Work                                      | 1,000          | 1,000           | 0               | Foundation of Equipment & Construction of Intake & Discharge Facilities |
| (7) Control Room & Boiler House                     | 1,200          | 1,200           | 0               |   |
| <b>1.3 Module Test Plant</b>                        | <b>(214)</b>   |                 |                 |   |
| (1) Design  | 15             | 0               | 15              |   |
| (2) Fabrication & Transportation                    | 163            | 0               | 163             | C.I.F. including Inland Transportation                                  |
| (3) Installation                                    | 32             | 0               | 32              |   |
| (4) Civil Work                                      | 4              | 4               | 0               | Foundation of RO & Pretreatment Units                                   |

| Item                     | Cost          | SWCC Portion  | JICA Portion | Description   |
|--------------------------|---------------|---------------|--------------|---|
| 1.4 Ancillary Facilities | (484)         |               |              | A Guard House, Fence, Gardening, Lamp Posts & Pavement included                   |
| (1) A/E                  | 14            | 14            | 0            |   |
| (2) Construction         | 470           | 470           | 0            |   |
| 2. Research              |               |               |              |   |
| 2.1 Research Personnel   | (2,968)       |               |              |   |
| (1) Saudi Arabian side   | 1,115         | 1,115         | 0            |   |
| (2) Japanese side        | 1,853         | 0             | 1,853        |   |
| 2.2 Consumable Materials | 60            | 60            | 0            |   |
| 2.3 Utility              | 307           | 307           | 0            | Maintenance Expense of Field Test Plant & Module Test Plant & Laboratory Building |
| 2.4 Maintenance          | 574           | 574           | 0            |   |
| 2.5 Transportation       | 165           | 165           | 0            | Expense for Vehicles & Domestic Trips   |
| 3. Accommodation         |               |               |              |   |
| 3.1 A/E                  | 330           | 330           | 0            |   |
| 3.2 Construction         | (14,200)      |               |              |   |
| (1) Housing              | 11,000        | 11,000        | 0            |   |
| (2) Mosque               | 1,200         | 1,200         | 0            |   |
| (3) Gymnastic Facility   | 200           | 200           | 0            | A Pool & Two Tennis Courts  |
| (4) Utility              | 300           | 300           | 0            |   |
| (5) Ancillary Facilities | 1,500         | 1,500         | 0            |   |
| 3.3 Maintenance          | 500           | 500           | 0            | Man-power Cost for Guardsmen, Janitors, etc. included                             |
| 4. Joint Meeting         | 180           | 80            | 100          |   |
| <b>Total</b>             | <b>30,051</b> | <b>24,926</b> | <b>5,125</b> |   |

Note: 1. The above cost is a preliminary one. Especially, the costs of the items 1.2 (6) (Civil Works) and 3.2 (Construction) are only rough estimates, and the precise values should be determined after the decisions of the site and its detail investigation.

2. This estimate does not reflect the increase in cost generated by inflation in the future.

( 別添 4 )

提出した経緯資料のLIST

- 1- Agreement On Economic and Technical Cooperation Between The Government of Japan and The Government of the Kingdom of Saudi Arabia, (March 1, 1975) ..... ANNEX 1
- 2- Minutes of Meetings between SWCC and Japanese experts in the period of 5th to 7th November, 1977 ..... ANNEX 2
- 3- Documents submitted to 2nd Saudi-Japanese Joint Committee, (April 1978) ..... ANNEX 3
- 4- Minutes, (April 4, 1978, Tokyo) ..... ANNEX 4
- 5- Minutes, (December 20, 1978) ..... ANNEX 5
- 6- Record of Discussions Between the Japan International Cooperation Agency and the Saline Water Conversion Cooperation of the Kingdom of Saudi Arabia, (September 6, 1979) ..... ANNEX 6
- 7- Minutes, (December 24, 1979) ..... ANNEX 7
- 8- Minutes of Meetings, (February 24, -1980) ..... ANNEX 8

( 別添 5 )

Equipments List in Fabrication of Field Test Plant.

| Item  | SWCC       | JICA         |
|---|------------|--------------|
| 1. Evaporator   |            | 1,150        |
| 2. Auxilliary equipments<br>Brine heater, deaerator,<br>decarbonator, pumps, etc. | 350        |              |
| 3. Electric equipments  | 185        |              |
| 4. Instrument equipments  |            | 115          |
| 5. Boiler and oil day tank  | 400        |              |
| <b>TOTAL</b>  | <b>935</b> | <b>1,265</b> |

■ 55年3月 農業水大臣一行の来日

( SWCCとのミーティング )



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## 1. まえがき

昭和55年3月26日から30日まで、サウディ アラビア王国のアル・シェイク農業水大臣（海水淡水化公団〈SWCC〉総裁代行）がわが国の正式招請に応じ、外務省の公賓として来日した。この来日には、大臣のほか農業水省およびSWCCの高官、要人も随行し、日本側の関係省庁および団体の担当者と海水淡水化技術協力プロジェクトおよびその他の案件について協議を行った。

なお、前回の訪サ・ミッションのMinutes of Meeting (Feb. 24th 1980) に基づき、この機会にSWCCおよびJICA代表者により細目R/Dに調印を行う予定であったが、次回の日サ合同委員会において行うこととなった。

## 2. 来日ミッションのメンバー

アル・シェイク農業・水大臣

H.E. Dr. Abdul Rahman Ibn Abdul Aziz Al Al-Shaikh  
Minister of Agriculture and Water  
The Government of the Kingdom of Saudi Arabia

アル・グライカ農業・水省担当次官

Mr. Abdalla Al-Ghulaikah  
Deputy Minister for Water Affairs

ジャムジューム海水淡水化公団訓練調査部長

Mr. Hassan A. Jamjoum  
Saline Water Conversion Corporation

シナード海水淡水化公団西部地区次長

Mr. Talal Abo Zinada  
Saline Water Conversion Corporation

アル・ムディフム海水淡水化公団東部地区次長

Mr. Ahmed Al-Mudihim  
Saline Water Conversion Corporation

カーン農業・水省(水総局)プロジェクト執行部

Mr. Mohamad Aqeel Khan  
Ministry of Agriculture and Water

アボ・ジョバル農業・水省対外関係課長

Mr. Hameed Abo Joball  
Ministry of Agriculture and Water

アル・サアディ元農業・水省次官

Dr. Mohamed Amin Al-Saa'di  
Former Deputy Minister of Agriculture and Water

アル・サーレハ サウディ漁業公社総裁  
Dr. Nasser Othman Al-Saleh

3. 来日中のスケジュール

3月26日 成田着  
27日 外務大臣表敬  
農林・水産大臣表敬  
通商産業大臣表敬  
昼食会(造水促進センター主催、於椿山荘)  
SWCCとのミーティング  
農業・水省とのミーティング  
ディナー(外務省主催)  
28日 総理大臣表敬  
ディナー(通産大臣主催)  
カクテルパーティー(日本機械輸出組合主催)  
29日 農業・水大臣叙勲  
茅ヶ崎海水淡水化 臨海研究所設視察  
ディナー(日本機械輸出組合主催)  
30日 経 日

4. SWCCとのミーティング

(1) 日 時 昭和55年3月27日 14:00~16:30

(2) 場 所 椿山荘 楓の間(9F)

(3) 出席者

o サウジ側

ジャムシューム SWCC訓練調査部長

ジナーダ " 西部地区次長

アル・ムディフィム " 東部地区次長

o 日本側

清滝 通産省 技術協力課長  
牧野 " 技術協力課長補佐  
松本 " 西欧アフリカ中東課  
宮崎 " 工業用水課  
後藤 工業技術院化学技術研究所第1課長  
梶野 " " 第4課長  
角田 " 国際研究協力官室班長  
平田 国際協力事業団資源調査課長  
末森 "  
田原 鹿島建設技術研究所次長  
佐藤 日揮(株)技術研究本部環境研究部マネージャー  
土屋 笹倉機械(製)東京事務所副所長  
福塚 三菱重工業(株)技術部主務

(4) 協議内容

① SWCCから次の申し入れがあった。

SWCCは現在総合的な研究所の設立を検討しており、本技術協力の研究所もその一環として位置づけることを考えている。したがって、本研究所の建物および施設は、必ずしも本件のためだけに準備するのではなく、他のSWCCのプロジェクトの一部として建設された建物および施設を提供することもあり得ることを了承願いたい。

これに対し、日本側は、本研究の目的、スケジュールに適合するものである限り、この申し入れを受け入れることとした。

② SWCCから、日本人専門家およびその家族のための宿舍および家具はSWCCの基準に従ったものとしたいとの要望があり、日本側はこれを了承することとした。

③ SWCCから、日本人専門家およびその家族に提供される宿舍はSWCCの他のプロジェクトの予算で建設されたものを当てる計画であるので、本プロジェクトの宿舍関係の予算15,030千ドルは削除したい旨申し出があり、日本側はこれを了承した。

④ SWCCから、Field Test Plantのスケール防止方式は磷酸添加によるpHコントロール方式のほか、Chemical dosing方式も試験できるようにしたいとの提案があり、日本側はこれを受入れ、この方式を追加することとした。

⑤ SWCC側から、細目R/Dへの調印は、前記のように内容を修正する必要があること、サウジ側の予算がまだ承認されていないこと等の理由により、今回は見送ることとし、2カ月以内に、リアドで開催が予定されている日-サ合同委員会の機会に行うこととした。この意向表明があり、日本側もやむを得ないこととして、これを了解した。

#### 5. 農業・水省とのミーティング

SWCCとのミーティングと平行して、農業・水省とのミーティングが行われ、脱塩排水の処理および下水のRe-useに関する技術協力についても、今後両国間でその方策を検討することとなった。

(1) 日 時 昭和55年3月27日 14:00~16:30

(2) 場 所 椿山荘 楓の間 (9F)

#### (3) 出席者

##### ○サウジ側

アル・グライカ 農業・水省水担当次官  
カーン " プロジェクト執行部  
アボ・ジュバル " 対外関係課長

##### ○日本側

石坂 工業技術院長  
岩城 通産省工業用水課長  
武田 " 西欧アフリカ中東課中東室長  
山本 造水促進センター専務理事  
村山 " 常務理事  
菊地 " 脱塩技術部長  
井上 " 水処理技術部次長  
小貫 " 脱塩技術部

#### (4) 主要議事

##### ① 脱塩濃縮排水の処理

リアドには、地下かん水を逆浸透法により脱塩し、上水として供給する20万 $\text{m}^3$ /日装置を建設しているが、この濃縮排水をそのまま捨てる、地下に浸透して、地下水の塩分

濃縮度を上昇させる問題が生じ、脱塩装置の運転は停止せざるを得なくなっている。濃縮排水の処理および地下水への塩分の循環を防止する方策を早急に確立したいので、日本の技術協力を得たい。

## ② 都市下水再生処理による農業用水への利用

サウディ・アラビアでは、下水道および下水処理設備が整備されつつあるが、これを農業用水として再生し、灌漑に使用して食糧の生産に役立てたいので、日本の技術協力をお願いしたい。

(なお、本件は海水淡水化技術協力計画とは直接の関連がないので、詳細は省略する。)

## 6. ミーティングの結果

以上の討議の結果を盛り込んで、総BR/DおよびANNEXならびに附属文書を修正(修正点については別添1のとおり)するとともに、討議内容を「Record of Discussions」として取りまとめ、サウジ録農業・水大臣および日本国外務大臣が署名した。

(別添2. Record of Discussions)

## 7. 茅ヶ崎臨海研究施設の視察

3月29日(土)、茅ヶ崎の臨海施設を訪れ、(財)造水促進センターが適産省の委託により行っている逆浸透法海水淡水化の実験状況を視察した。

当日は、アル・シェイク農業・水大臣への叙勲と日時が重複することとなったため、来訪者はAhmed Al-Mudihim SWCC東部地区次長のみとなったが、適産省岩城工業用水課長はじめ関係者の参加を得て、映画「新しい海水淡水化」の上映、800<sup>g</sup>/日実証プラントを中心とした実験施設の案内を行った。

## 8. 提出資料

- (1) Utilization of cement concrete as an evaporator shell material
- (2) The present status of the development of concrete evaporator shell for desalting plants.
- (3) Behavior of concrete evaporator shells during operation of the module plant at the Chigasaki test facilities



| 条 項               | 原 案   | 修 正  |
|-------------------|---|--|
| (細目R/D)<br>前 文    | <p>The delegate of the Saline Water Conversion Corporation headed by _____, visited Japan from the _____ th of _____, 1980, to the _____ th of _____, 1980, for the purpose of making detailed agreement of the project for the technical cooperation on sea water desalination between Japan and the Kingdom of Saudi Arabia (hereinafter referred to as the PROJECT) with the Japan International Cooperation Agency.</p> | <p>The <u>Japan International Cooperation Agency</u>, headed by _____, visited <u>Saudi Arabia</u> from the _____ of _____, 1980, to the _____ of _____, 1980, for the purpose of making detailed agreement of the project for the technical cooperation on sea water desalination between Japan and the Kingdom of Saudi Arabia (hereinafter referred to as the PROJECT) with the <u>Saline Water Conversion Corporation</u>.</p>         |
| Article 3. (1) C. | <p>c. Building and their necessary facilities for the Desalination Research Laboratory, control room and boiler house for the Field Test Plant.</p>   | <p>c. Building and their necessary facilities for the Desalination Research Laboratory, control room and boiler house for the Field Test Plant. <u>SWCC claims the following option, SWCC may provide buildings and facilities constructed as part of other SWCC's projects in place of constructing above mentioned buildings and facilities as long as they are appropriate to the motive of this project and meet the schedule.</u></p> |
| Article 3. (1) F. | <p>f. A fully furnished suitable accommodation for each Japanese specialist and his family.</p>   | <p>f. A fully furnished suitable accommodation for each Japanese specialist and his family <u>according to SWCC's standard.</u></p>  |





| 条 項                                       | 原 案  |               |              |   | 修 正  |     |     |   |  |                    |     |     |   |                                       |                  |  |  |  |  |         |     |     |   |  |                  |          |  |  |  |             |        |        |   |  |            |       |       |   |  |                        |     |     |   |                            |             |     |     |   |  |                          |       |       |   |  |                 |     |     |   |   |                  |     |    |     |  |              |               |               |              |  |  |  |  |  |                 |     |     |   |  |                    |     |     |   |                                       |       |  |  |  |  |                  |     |    |     |  |              |               |              |              |  |
|---|--|---------------|--------------|---|--|-----|-----|---|--|--------------------|-----|-----|---|---------------------------------------|------------------|--|--|--|--|---------|-----|-----|---|--|------------------|----------|--|--|--|-------------|--------|--------|---|--|------------|-------|-------|---|--|------------------------|-----|-----|---|----------------------------|-------------|-----|-----|---|--|--------------------------|-------|-------|---|--|-----------------|-----|-----|---|---|------------------|-----|----|-----|--|--------------|---------------|---------------|--------------|--|--|--|--|--|-----------------|-----|-----|---|--|--------------------|-----|-----|---|---------------------------------------|-------|--|--|--|--|------------------|-----|----|-----|--|--------------|---------------|--------------|--------------|--|
| Article 10.                               | <p>Estimated Costs</p> <p>Given below are the estimates of magnitude which will be refined with the progress of the PROJECT.</p> <p>The total cost of services to be provided by JICA is estimated US\$5,125,000. Other costs to be incurred by SWCC during the implementation of the PROJECT by way of direct contracts to private industry for civil works, transportation, procurement of equipment not provided by JICA are estimated to be US\$24,926,000.</p> <p>The total estimated costs for the PROJECT is US\$30,051,000.</p>  |               |              |   | <p>Estimated Costs</p> <p>Given below are the estimates of magnitude which will be refined with the progress of the PROJECT.</p> <p>The total cost of services to be provided by JICA is estimated US\$5,125,000. Other costs to be incurred by SWCC during the implementation of the PROJECT by way of direct contracts to private industry for civil works, transportation, procurement of equipment not provided by JICA are estimated to be <u>US\$9,896,000.</u></p> <p>The total estimated costs for the PROJECT is <u>US\$15,021,000.</u></p> |     |     |   |  |                    |     |     |   |                                       |                  |  |  |  |  |         |     |     |   |  |                  |          |  |  |  |             |        |        |   |  |            |       |       |   |  |                        |     |     |   |                            |             |     |     |   |  |                          |       |       |   |  |                 |     |     |   |   |                  |     |    |     |  |              |               |               |              |  |  |  |  |  |                 |     |     |   |  |                    |     |     |   |                                       |       |  |  |  |  |                  |     |    |     |  |              |               |              |              |  |
| ANNEX III                                 | <p>4. Scale prevention                      pH control by sulfuric acid injection</p>  |               |              |   | <p>4. Scale prevention                      pH control by sulfuric acid injection and chemical dosing</p>  |     |     |   |  |                    |     |     |   |                                       |                  |  |  |  |  |         |     |     |   |  |                  |          |  |  |  |             |        |        |   |  |            |       |       |   |  |                        |     |     |   |                            |             |     |     |   |  |                          |       |       |   |  |                 |     |     |   |   |                  |     |    |     |  |              |               |               |              |  |  |  |  |  |                 |     |     |   |  |                    |     |     |   |                                       |       |  |  |  |  |                  |     |    |     |  |              |               |              |              |  |
| ( 関連資料 )<br><br>Tentative estimated cost. | <table border="1"> <tr> <td>2.4 Maintenance</td> <td>574</td> <td>574</td> <td>0</td> <td></td> </tr> <tr> <td>2.5 Transportation</td> <td>165</td> <td>165</td> <td>0</td> <td>Expense for Vehicles &amp; Domestic Trips</td> </tr> <tr> <td>3. Accommodation</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>3.1 A/E</td> <td>330</td> <td>330</td> <td>0</td> <td></td> </tr> <tr> <td>3.2 Construction</td> <td>(14,200)</td> <td></td> <td></td> <td></td> </tr> <tr> <td>    (1) Housing</td> <td>11,000</td> <td>11,000</td> <td>0</td> <td></td> </tr> <tr> <td>    (2) Mosque</td> <td>1,200</td> <td>1,200</td> <td>0</td> <td></td> </tr> <tr> <td>    (3) Gymnastic Facility</td> <td>200</td> <td>200</td> <td>0</td> <td>A Pool &amp; Two Tennis Courts</td> </tr> <tr> <td>    (4) Utility</td> <td>300</td> <td>300</td> <td>0</td> <td></td> </tr> <tr> <td>    (5) Ancillary Facilities</td> <td>1,500</td> <td>1,500</td> <td>0</td> <td></td> </tr> <tr> <td>3.3 Maintenance</td> <td>500</td> <td>500</td> <td>0</td> <td>Man-power Cost for Guardsmen, Janitors, etc. included</td> </tr> <tr> <td>4. Joint Meeting</td> <td>180</td> <td>80</td> <td>100</td> <td></td> </tr> <tr> <td><b>Total</b></td> <td><b>30,051</b></td> <td><b>24,926</b></td> <td><b>5,125</b></td> <td></td> </tr> </table> |               |              |   | 2.4 Maintenance  | 574 | 574 | 0 |  | 2.5 Transportation | 165 | 165 | 0 | Expense for Vehicles & Domestic Trips | 3. Accommodation |  |  |  |  | 3.1 A/E | 330 | 330 | 0 |  | 3.2 Construction | (14,200) |  |  |  | (1) Housing | 11,000 | 11,000 | 0 |  | (2) Mosque | 1,200 | 1,200 | 0 |  | (3) Gymnastic Facility | 200 | 200 | 0 | A Pool & Two Tennis Courts | (4) Utility | 300 | 300 | 0 |  | (5) Ancillary Facilities | 1,500 | 1,500 | 0 |  | 3.3 Maintenance | 500 | 500 | 0 | Man-power Cost for Guardsmen, Janitors, etc. included | 4. Joint Meeting | 180 | 80 | 100 |  | <b>Total</b> | <b>30,051</b> | <b>24,926</b> | <b>5,125</b> |  | <table border="1"> <tr> <td>2.4 Maintenance</td> <td>574</td> <td>574</td> <td>0</td> <td></td> </tr> <tr> <td>2.5 Transportation</td> <td>165</td> <td>165</td> <td>0</td> <td>Expense for Vehicles &amp; Domestic Trips</td> </tr> <tr> <td colspan="5" style="text-align: center;">} 削 除</td> </tr> <tr> <td>3. Joint Meeting</td> <td>180</td> <td>80</td> <td>100</td> <td></td> </tr> <tr> <td><b>Total</b></td> <td><b>15,021</b></td> <td><b>9,896</b></td> <td><b>5,125</b></td> <td></td> </tr> </table> |  |  |  | 2.4 Maintenance | 574 | 574 | 0 |  | 2.5 Transportation | 165 | 165 | 0 | Expense for Vehicles & Domestic Trips | } 削 除 |  |  |  |  | 3. Joint Meeting | 180 | 80 | 100 |  | <b>Total</b> | <b>15,021</b> | <b>9,896</b> | <b>5,125</b> |  |
| 2.4 Maintenance                           | 574  | 574           | 0            |   |  |     |     |   |  |                    |     |     |   |                                       |                  |  |  |  |  |         |     |     |   |  |                  |          |  |  |  |             |        |        |   |  |            |       |       |   |  |                        |     |     |   |                            |             |     |     |   |  |                          |       |       |   |  |                 |     |     |   |   |                  |     |    |     |  |              |               |               |              |  |  |  |  |  |                 |     |     |   |  |                    |     |     |   |                                       |       |  |  |  |  |                  |     |    |     |  |              |               |              |              |  |
| 2.5 Transportation                        | 165  | 165           | 0            | Expense for Vehicles & Domestic Trips                 |  |     |     |   |  |                    |     |     |   |                                       |                  |  |  |  |  |         |     |     |   |  |                  |          |  |  |  |             |        |        |   |  |            |       |       |   |  |                        |     |     |   |                            |             |     |     |   |  |                          |       |       |   |  |                 |     |     |   |   |                  |     |    |     |  |              |               |               |              |  |  |  |  |  |                 |     |     |   |  |                    |     |     |   |                                       |       |  |  |  |  |                  |     |    |     |  |              |               |              |              |  |
| 3. Accommodation                          |  |               |              |   |  |     |     |   |  |                    |     |     |   |                                       |                  |  |  |  |  |         |     |     |   |  |                  |          |  |  |  |             |        |        |   |  |            |       |       |   |  |                        |     |     |   |                            |             |     |     |   |  |                          |       |       |   |  |                 |     |     |   |   |                  |     |    |     |  |              |               |               |              |  |  |  |  |  |                 |     |     |   |  |                    |     |     |   |                                       |       |  |  |  |  |                  |     |    |     |  |              |               |              |              |  |
| 3.1 A/E                                   | 330  | 330           | 0            |   |  |     |     |   |  |                    |     |     |   |                                       |                  |  |  |  |  |         |     |     |   |  |                  |          |  |  |  |             |        |        |   |  |            |       |       |   |  |                        |     |     |   |                            |             |     |     |   |  |                          |       |       |   |  |                 |     |     |   |   |                  |     |    |     |  |              |               |               |              |  |  |  |  |  |                 |     |     |   |  |                    |     |     |   |                                       |       |  |  |  |  |                  |     |    |     |  |              |               |              |              |  |
| 3.2 Construction                          | (14,200)   |               |              |   |  |     |     |   |  |                    |     |     |   |                                       |                  |  |  |  |  |         |     |     |   |  |                  |          |  |  |  |             |        |        |   |  |            |       |       |   |  |                        |     |     |   |                            |             |     |     |   |  |                          |       |       |   |  |                 |     |     |   |   |                  |     |    |     |  |              |               |               |              |  |  |  |  |  |                 |     |     |   |  |                    |     |     |   |                                       |       |  |  |  |  |                  |     |    |     |  |              |               |              |              |  |
| (1) Housing                               | 11,000   | 11,000        | 0            |   |  |     |     |   |  |                    |     |     |   |                                       |                  |  |  |  |  |         |     |     |   |  |                  |          |  |  |  |             |        |        |   |  |            |       |       |   |  |                        |     |     |   |                            |             |     |     |   |  |                          |       |       |   |  |                 |     |     |   |   |                  |     |    |     |  |              |               |               |              |  |  |  |  |  |                 |     |     |   |  |                    |     |     |   |                                       |       |  |  |  |  |                  |     |    |     |  |              |               |              |              |  |
| (2) Mosque                                | 1,200  | 1,200         | 0            |   |  |     |     |   |  |                    |     |     |   |                                       |                  |  |  |  |  |         |     |     |   |  |                  |          |  |  |  |             |        |        |   |  |            |       |       |   |  |                        |     |     |   |                            |             |     |     |   |  |                          |       |       |   |  |                 |     |     |   |   |                  |     |    |     |  |              |               |               |              |  |  |  |  |  |                 |     |     |   |  |                    |     |     |   |                                       |       |  |  |  |  |                  |     |    |     |  |              |               |              |              |  |
| (3) Gymnastic Facility                    | 200  | 200           | 0            | A Pool & Two Tennis Courts                            |  |     |     |   |  |                    |     |     |   |                                       |                  |  |  |  |  |         |     |     |   |  |                  |          |  |  |  |             |        |        |   |  |            |       |       |   |  |                        |     |     |   |                            |             |     |     |   |  |                          |       |       |   |  |                 |     |     |   |   |                  |     |    |     |  |              |               |               |              |  |  |  |  |  |                 |     |     |   |  |                    |     |     |   |                                       |       |  |  |  |  |                  |     |    |     |  |              |               |              |              |  |
| (4) Utility                               | 300  | 300           | 0            |   |  |     |     |   |  |                    |     |     |   |                                       |                  |  |  |  |  |         |     |     |   |  |                  |          |  |  |  |             |        |        |   |  |            |       |       |   |  |                        |     |     |   |                            |             |     |     |   |  |                          |       |       |   |  |                 |     |     |   |   |                  |     |    |     |  |              |               |               |              |  |  |  |  |  |                 |     |     |   |  |                    |     |     |   |                                       |       |  |  |  |  |                  |     |    |     |  |              |               |              |              |  |
| (5) Ancillary Facilities                  | 1,500  | 1,500         | 0            |   |  |     |     |   |  |                    |     |     |   |                                       |                  |  |  |  |  |         |     |     |   |  |                  |          |  |  |  |             |        |        |   |  |            |       |       |   |  |                        |     |     |   |                            |             |     |     |   |  |                          |       |       |   |  |                 |     |     |   |   |                  |     |    |     |  |              |               |               |              |  |  |  |  |  |                 |     |     |   |  |                    |     |     |   |                                       |       |  |  |  |  |                  |     |    |     |  |              |               |              |              |  |
| 3.3 Maintenance                           | 500  | 500           | 0            | Man-power Cost for Guardsmen, Janitors, etc. included |  |     |     |   |  |                    |     |     |   |                                       |                  |  |  |  |  |         |     |     |   |  |                  |          |  |  |  |             |        |        |   |  |            |       |       |   |  |                        |     |     |   |                            |             |     |     |   |  |                          |       |       |   |  |                 |     |     |   |   |                  |     |    |     |  |              |               |               |              |  |  |  |  |  |                 |     |     |   |  |                    |     |     |   |                                       |       |  |  |  |  |                  |     |    |     |  |              |               |              |              |  |
| 4. Joint Meeting                          | 180  | 80            | 100          |   |  |     |     |   |  |                    |     |     |   |                                       |                  |  |  |  |  |         |     |     |   |  |                  |          |  |  |  |             |        |        |   |  |            |       |       |   |  |                        |     |     |   |                            |             |     |     |   |  |                          |       |       |   |  |                 |     |     |   |   |                  |     |    |     |  |              |               |               |              |  |  |  |  |  |                 |     |     |   |  |                    |     |     |   |                                       |       |  |  |  |  |                  |     |    |     |  |              |               |              |              |  |
| <b>Total</b>                              | <b>30,051</b>  | <b>24,926</b> | <b>5,125</b> |   |  |     |     |   |  |                    |     |     |   |                                       |                  |  |  |  |  |         |     |     |   |  |                  |          |  |  |  |             |        |        |   |  |            |       |       |   |  |                        |     |     |   |                            |             |     |     |   |  |                          |       |       |   |  |                 |     |     |   |   |                  |     |    |     |  |              |               |               |              |  |  |  |  |  |                 |     |     |   |  |                    |     |     |   |                                       |       |  |  |  |  |                  |     |    |     |  |              |               |              |              |  |
| 2.4 Maintenance                           | 574  | 574           | 0            |   |  |     |     |   |  |                    |     |     |   |                                       |                  |  |  |  |  |         |     |     |   |  |                  |          |  |  |  |             |        |        |   |  |            |       |       |   |  |                        |     |     |   |                            |             |     |     |   |  |                          |       |       |   |  |                 |     |     |   |   |                  |     |    |     |  |              |               |               |              |  |  |  |  |  |                 |     |     |   |  |                    |     |     |   |                                       |       |  |  |  |  |                  |     |    |     |  |              |               |              |              |  |
| 2.5 Transportation                        | 165  | 165           | 0            | Expense for Vehicles & Domestic Trips                 |  |     |     |   |  |                    |     |     |   |                                       |                  |  |  |  |  |         |     |     |   |  |                  |          |  |  |  |             |        |        |   |  |            |       |       |   |  |                        |     |     |   |                            |             |     |     |   |  |                          |       |       |   |  |                 |     |     |   |   |                  |     |    |     |  |              |               |               |              |  |  |  |  |  |                 |     |     |   |  |                    |     |     |   |                                       |       |  |  |  |  |                  |     |    |     |  |              |               |              |              |  |
| } 削 除                                     |  |               |              |   |  |     |     |   |  |                    |     |     |   |                                       |                  |  |  |  |  |         |     |     |   |  |                  |          |  |  |  |             |        |        |   |  |            |       |       |   |  |                        |     |     |   |                            |             |     |     |   |  |                          |       |       |   |  |                 |     |     |   |   |                  |     |    |     |  |              |               |               |              |  |  |  |  |  |                 |     |     |   |  |                    |     |     |   |                                       |       |  |  |  |  |                  |     |    |     |  |              |               |              |              |  |
| 3. Joint Meeting                          | 180  | 80            | 100          |   |  |     |     |   |  |                    |     |     |   |                                       |                  |  |  |  |  |         |     |     |   |  |                  |          |  |  |  |             |        |        |   |  |            |       |       |   |  |                        |     |     |   |                            |             |     |     |   |  |                          |       |       |   |  |                 |     |     |   |   |                  |     |    |     |  |              |               |               |              |  |  |  |  |  |                 |     |     |   |  |                    |     |     |   |                                       |       |  |  |  |  |                  |     |    |     |  |              |               |              |              |  |
| <b>Total</b>                              | <b>15,021</b>  | <b>9,896</b>  | <b>5,125</b> |   |  |     |     |   |  |                    |     |     |   |                                       |                  |  |  |  |  |         |     |     |   |  |                  |          |  |  |  |             |        |        |   |  |            |       |       |   |  |                        |     |     |   |                            |             |     |     |   |  |                          |       |       |   |  |                 |     |     |   |   |                  |     |    |     |  |              |               |               |              |  |  |  |  |  |                 |     |     |   |  |                    |     |     |   |                                       |       |  |  |  |  |                  |     |    |     |  |              |               |              |              |  |



( 別添 2 )

Tokyo, March 29, 1980

### Record of Discussions

As a result of the invitation by the Government of Japan, H.E. Dr. Abdul Rahman Ibn Abdul Aziz Al Al-Shaikh, Minister of Agriculture and Water of the Kingdom of Saudi Arabia, visited Japan in the period of March 26-30, 1980. Based on discussions between H.E. Dr. Saburo Okita, Minister for Foreign Affairs, H.E. Mr. Yoshitake Sasaki, Minister of International Trade and Industry and H.E. Mr. Kabun Muto, Minister of Agriculture, Forestry and Fisheries, on Japanese side and H.E. the Minister of Agriculture and Water on Saudi side with respect to matters of mutual interest, both sides wish to record the following:

1. The following items were discussed:

Water re-use and waste water use for irrigation

Methods of disposing of brine rejects from Reverse Osmosis Plants

Record of Discussions on the Sea-Water Desalination Project

Cooperation between the Ministry of Agriculture and Water of Saudi Arabia and the Ministry of Agriculture, Forestry and Fisheries of Japan

2. After detailed discussions between specialized delegates of both countries, the following proposals were made by the Saudi side:

(1)

- (1) Due to the different conditions and usage criteria, and in order to have a more extensive evaluation, a team of Japanese experts may visit Saudi Arabia regarding water re-use projects.
- (2) As regards the field of fisheries industry, the Saudi side has proposed cooperation with the Japanese side in various fields, namely:
  - i) Provision of training facilities for Saudis in various fields of production
  - ii) Provision of experts to advise Saudi fishing companies in various economic investments in the field of fisheries
  - iii) Provision of a list of well-recognized and reputable companies to cooperate and invest in the development of fisheries industry.
3. The Japanese side agreed that the possibility of the proposed cooperation would be explored between the two sides within the framework of the bilateral technical cooperation programme.
4. Representatives from SWCC and JICA reviewed the final draft of the Record of Discussions on the Sea-Water Desalination Project and agreed on its content. This Record of Discussions is to be signed by the representatives of both organizations in the next Joint Committee meeting in Riyadh.

In

In case that this procedure becomes difficult,  
appropriate alternative arrangement will be made through  
consultation between SHCC and JICA.

Minister of Agriculture and  
Water of the Kingdom of  
Saudi Arabia

Minister for Foreign Affairs  
of Japan



1 56. 1. 29

日本・サウジアラビア海水淡水化技術協力

昭和56年1月 交渉団報告書

昭和56年1月

(財) 造水促進センター





## 1. 交渉団の編成

|     |           |                                 |
|-----|-----------|---------------------------------|
| 団 長 | 後 藤 藤 太 郎 | 通商産業省工業技術院化学研究所<br>プロセス開発部第1課課長 |
| 団 員 | 角 田 周 一   | 通商産業省工業技術院国際研究協力課<br>課長補佐       |
| "   | 平 田 一 隆   | 国際協力事業団鉱工業計画調査部<br>資源調査課課長      |
| "   | 太 田 敬 一   | (財)造水促進センター脱塩技術部<br>課長補佐        |

## 2. 交渉日程

|              |  |
|--------------|--|
| 1980年1月9日(金) | 東京発 → アブダビ着  |
| 10日(土)       | 交渉方針確認<br>アブダビ発 → リヤド着   |
| 11日(日)       | 日-サ合同委員会事務局交渉方針打合せ<br>SWCCへ交渉団致着のあいさつ および<br>アブドル・ラハマン訓練部長と会談  |
| 12日(月)       | SWCC イサム・ジャムジュール副総裁および<br>ラハマン訓練部長と交渉<br>SWCC から「サウジ側協定書(案) (アラビア語)」<br>が提出された。<br>日-サ合同委員会事務局 サ側協定書(案)の英文翻訳、<br>内容検討および今後の交渉方針打合せ |
| 13日(火)       | SWCC ラハマン訓練部長と交渉<br>サウジ側協定書(案)の英訳文を提示し<br>内容について 質疑応答<br>SWCC から「業務範囲の概要書(案) (英文)」<br>が提出され、内容について質疑応答<br>交渉議事録(署名用)原案作成           |
| 14日(水)       | SWCC ジャムジュール副総裁およびラハマン<br>訓練部長と「サ側協定書(案)」および<br>「業務範囲(案)」について引きつづき質疑応答   |

「サウदी協定書(案)」の英文訳が 17日(土)に  
日-サ合同委員会に提出される予定であることを確認  
交渉議事録署名

15日(木) 日-サ合同委員会事務局と今後の対処方針打合せ  
リヤド発 → ジェッダ着  
16日(金) ジェッダ発 → ロンドン着  
交渉経過, SWCC 打合せ内容の確認および資料整理  
17日(土) ロンドン発  
18日(日) 東京着

### 3 交渉の内容

SWCC との交渉の内容は以下に示すとおりである。

#### 3-1 SWCC 会談内容

日 時 昭和56年1月11日  
場 所 SWCC 本部 (Rigadh)

会談出席者

SWCC アブドル・ラハマン 訓練部長

日本側 ミッション

後藤, 角田, 平田, 太田

日-サ合同事務所

長田, 小森

(1) 日本側ミッションは SWCC のアブドル・ラハマン部長を訪問して会談を行った。

(2) 会談の主な内容は次のとおり

ラハマン部長の発言要旨は次のとおり

① SWCC はコンクリート 体テストプラントは必要ない。

② SWCC は研究所の充実と訓練所の設置を図りたい。

(以上 (1), (2) SWCC 計画変更)

③ SWCC の計画変更 Draft はすでにアラビア語で作成されており, 現在総裁の承認を待っているところである。

④ これまで日本側から提示された Draft は大きく変更することは考えていないが, (1), (2) の点に関する事項の変更を行いたい。

⑤ Draft について今回のミッションは サインを行う予定か。

これに対して日本側ミッションは次の要請および回答を行った。

- ⑥ SWCC の計画変更内容、変更理由等を知りたいので、アラビア語でも良いから Draft の提示をして欲しい。
  - ⑦ SWCC の計画変更 Draft について説明を受けるとともに Discussion の機会を得たい。
  - ⑧ 今回の日本側ミッションはサインの権限を与えられていないので、サインは行わない。しかし、Draft の内容が受け入れられるものであれば、帰国後に日本側の検討を加えたものによりサインすることになるだろう。  
これに対しラハマン部長は次のように回答した。
  - ⑨ SWCC の Draft は総裁の承認決裁があれば、明日にでも提示することができる。もし、Draft の提示ができない場合でも計画の変更内容、変更理由等の説明を行うことは可能である。
  - ⑩ ⑨ の件については明日（1月12日）午前9時から日本側ミッションと打合わせする機会を持つように予定する。
- (3) 日本側ミッションは明日午前9時に SWCC を再訪し、打合わせを行うことになった。

### 3-2 第1回 SWCC 打合せ内容

日 時 昭和56年1月12日

場 所 SWCC 本部 (Riyadh)

出席者

SWCC イサム・ジャムジュール副総裁

アブドル・ラハマン訓練部長

バビーブ技師

日本側ミッション 後藤、角田、平田、太田

日-サ合同事務局 小森

日本側ミッションは SWCC 副総裁イサム・ジャムジュールを表敬訪問するとともに、本海水淡化プロジェクトに関し打合せを行った。その結果は次のとおり

- (1) 日本側の今回、ミッションの使命はサウジ側の本件に対する意向 (Needs) およびこれまでの経緯と変更があった内容について、サウジ側の十分な説明と資料を得ることにあること、およびサウジ側の Detailed R/D の Draft を是非手渡し願いたい旨を伝えた。
- (2) これに対してサウジ側は計画変更はわずかである旨強調した。
- (3) サウジ側よりアラビア語の D, R/D Draft が提示され日本側はこれを受領した。(別添1)

3-3 第2回 SWCC 打合せ内容

日 時 昭和56年1月13日

場 所 SWCC 本部 ( Riyadh )

出席者

SWCC ラハマン訓練部長

バビーブ技師

日本側ミッション 後藤, 角田, 平田, 太田

日-サ合同事務局 小森

(1) 日本側ミッションは、昨日 SWCC から提示された、アラビア語の R/D Draft の英訳文 (別添 2) および現在までの調印書類 (要約版 別添 3) を SWCC に提出し、サウジ側 Draft について、SWCC の考え方等、以下の質問を行った。質問の内容およびこれに対するサウジ側の回答は以下のとおりである。

① Q. コンクリート 体テストプラント ( F. T. P ) が不要になった理由は何か。

A. コンクリート 体は将来技術であり、現在サウジでは新しい技術開発を実施する余裕はなく、まずは、現実起っている問題を解決することだ。

② Q. サウジ側の Draft はいくつかの点で、アル・シェイク農水大臣と (日本) 外務大臣との合意書 (1980年3月) - Final Draft - とは重要な変更があるので、Draft を日本へ持ち帰り検討する。についてはサウジ側の意向をできる限り聞きたいので質問する。

A. 予算規模、必要な人員ほどのくらいか、 (これによってプロジェクトの大きさが判る。)

A. 現在、特に決まった案はない。

(規模、人員等については日本からも提案を出せ)

I. 費用の比率分担の項は、1979年12月にナシーフ部長との間に了解済みであるが、今回の Draft に再び示されたのはどういうことか。

A. 日本側 Draft - Detailed R/D - と SWCC の要望 ( F. T. P 削除と Training 追加 ) とを持って Lawyer に文章作成させて、大臣決裁を得たところ、このようになった。

③ Q. サウジ側の Personnel はどの程度出せるか。

また、Draft では Training Center におけるサウジの Employees Laiboures の訓練について、日本の Instructor 等がアドバイスすることになっているが、サウジ側もスタッフを出すと言われていない。サウジ側スタッフは何人ぐらい出せるのか。

A. サウジ側には人材がないので、スタッフは出せない。

Research Center の方には大学卒業生を入れることも考えており、将来はサウジ側で Research and Training Center を運営していきたい。

④ Q. Employees and Laboures の訓練は JICA の技術協力 Scheme では出来ないことになっている。

A. Employees and Laboures の訓練はぜひやって欲しい。

⑤ Q. Training の内容をもう少し具体的に聞きたい。

Draft に示された項目は、工業全般に共通な基礎技術であり、多岐に渡って広い範囲となっており、Desalination に特に関係しているものと読み取れない。

また、訓練の内容も大規模かつ広範に渡る計画であるように見うけられるので、帰国後に検討するが、日本側の対応は困難であると思う。

A. SWCC が Desalination Plant で現在かかえている問題の解決には必要な Training なので是非協力して欲しい。

⑥ Q. " Detailed R/D " の Annex に相当する内容 ( Center の規模、機能、予算、スケジュール等 ) について聞きたい。

A. 日本側から本件に関する適切な Proposul を提出してくれれば、SWCC 内で検討の上、大臣 ( 総裁 ) の了解をとる。現在、SWCC には案がない。

⑦ Q. Pilot Plant とはどんなものか。

A. 屋外の試験装置という意味で、Plant の種類は RO、蒸発法のどちらとも決めてないが小規模なものを想定している。種類、規模等の仕様は Joint Team の中で検討して適切なものを選ぶ。設置場所 ( Pad ) は確保しておく。

⑧ その他次の事項を確認した。

1) 本 Draft は SWCC 総裁 ( 大臣 ) の決裁を得ている。

2) 今後締結する合意書 ( R/D ) の形式、前文の内容等については、" Detailed R/D " を基に、今回の SWCC Draft を考慮して訂正したものを提出すれば、SWCC はそれを検討し総裁の了解を得る用意がある。

3) サウジ国内出張、国内輸送は " Detailed R/D " の案と変っていない。

(2) SWCC から Scope of Work ( 英文 ) ( 別添 4 ) を受領した。また、これについて質問、対案があれば書面で提出するよう要請があった。

3-4 第3回 SWCC 打合せ内容

日 時 昭和56年1月14日

場 所 SWCC 本部 (Riyadh)

出席者

SWCC ジャムジュール副総裁

ラハマン訓練部長

日本側ミッション 後藤, 角田, 平田, 太田

日-サ合同事務局 小森

(1) 日本側ミッションはSWCCのジャムジュール副総裁, ラハマン訓練部長と打合せを行い, 昨日に引き続きサウジ側R/D Draftに関して質問した。

① サウジ側が昨日提出したScope of Workに示されているMachine Shop, Engine Shop, Boiler Shopとは何か, との質問に対してサウジ側の回答は次のとおり

ア. Machine Shop 海水淡水化プラントの修理などに必要な機械工作所

イ. Engine Shop

特に考えはないが, .....

ウ. Boiler Shop

(海水淡水化プラントのメンテナンスに必要なものと考えている。)

② 訓練を受けるEmployees, Labouresの数および技術レベルはどんなものかを考えているか, との質問については, SWCCの全訓練者数は1,000人/年程度で, そのうち100~200人が本センターの対象と考えているがはっきり決まってない。技術レベルは, はっきりしていない。

③ Scope of Workに示されているJapan - Saudi Joint Teamと"Detailed R/D"に示されている「Joint Technical Team」とは同じかとの質問に対して

Training Center (訓練センター)を含めれば"Detailed R/D"に示された「Technical Joint Team」に相当する。

④ 研究所の設置場所はYanbuが有力であるが, まだ決定していない。

⑤ サウジ側の予算は, 合計1,000万ドルであり, 日本側提案の内容と変りない。

⑥ Training Centerの追加などにより当初に計画していた予算を越える分について, サウジ側R/D Draftでは60%, 40%の比率でサウジと日本がそれぞれ供託金方式で分担するようになっているが, 日本側は供託金方式は受け入れられないし, 負担の増額は不可能であるとの反論に対して, サウジ側の負担の増加は可能であり, 今後, 日本側の検討により予算増加が必要なら卒直に提示してもらえればサウジ側は検討

する用意があるとの回答があった。

- ⑦ 資金（予算）の制約により日本側の技術協力、実施の可否を判定しないでもらいたい旨のサウジ側の意向が示された。

（資金の増額が必要ならサウジ側の負担を検討する。（6）と同じ）

- ⑧ サウジ側の予算手続上、日本－サウジ間の合意書の締結は、ここ3ヶ月より早い時期に急いで行う必要がある。遅れた場合には次年度の予算要求は困難である。

（サウジの今年の会計年度は1981年4月末である。）

- ⑨ 合意書の内容、形式については日本側で検討して作成して障えないが総裁の判断を仰ぐ必要がある。検討中に質問およびコメントがあれば、Jamjoorm 当てに書簡を送付することになった。

- ⑩ サウジ側提案の不可欠必要事項はコンクリート 体の削除と、Training Center の追加である。

- (2) これまでに行った打合せの結果、（別添 5）に示す Minutes of Meeting を作成した。

#### 4. 問題点

- (1) コンクリート 体テストプラントがなくなったことと技能訓練機能の追加が SWCC の新たな要請として加ったことにより、これまでの SWCC との協議内容および基本合意書の内容の大部分（腐食およびスケールの研究を除く）が放棄されたも同然となり、本プロジェクトの協力計画の再検討を行わなければならなくなった。
- (2) コンクリート 体テストプラントがなくなったことにより、工業技術院の大型プロジェクトによって開発された日本の海水淡水化技術のサウジアラビアへの適用化試験が実質的に不可能になり、共同研究における日本側の技術的利得は薄れた。
- (3) SWCC には、技能訓練の内容およびコンクリート 体が変わるパイロットプラントについて具体的かつ詳細な計画案は全くないので、日本側の提案を行うように要請があり、これらの対案である詳細計画案を準備しなければならない。
- (4) 技能訓練機能として、SWCC から溶接、配管、鋸付および板金、機械工作、電気および計装、空調、エンジン、ボイラーの8項目の分野の協力要請があり、海水淡水化プラントだけでなく、発電プラント（二重目的プラントに付随する）のメンテナンス技能の訓練等を含み、基礎的かつ広範囲な技術協力が必要となり、しかも、サ側の要求限度が不明瞭である。従って、日本側の協力範囲の限度が定めにくい。
- (5) 本プロジェクトに対するサ側のカウンターパートおよびスタッフ（研究者、指導教官等）は、サ側人材が無いということで今回提出された「サ側協定書（案）」および「業務範囲

書（Scope of Work）」にもサ側の人員配置計画は示されていない。

また、訓練対象は必ずしもサウジ人であるとは限らない面もあり、これまでの日本側の協力体制で対応できるのか懸念される。特に、訓練機能（年間100～200人の技能訓練）が加わったことにより、指導教育等の日本側派遣人員の増加およびその人材の手配、選定は今後の対応策検討の上からも大きな障害となる。

サ側カウンターパートおよびスタッフの確保については再度要請する必要がある。

- (6) 予算については、協力期間5年間の合計金額が、サ側負担1,000万ドル（約20億円）日本側負担500万ドル（約10億円）の合計1,500万ドルの基本案は変わらないことが確認された。従って、コンクリート 体テストプラント（フィールド・テストプラント）を削除することによる日本側負担費の減額は考えられない。

また、基本案（合計1,500万ドル）以外にかかる諸費用はサ側60%、日本側40%の比率で分担するという方法がサ側から提案されているが、日本側としては受け入れられない旨申し伝え、サ側も一応了解した。さらに、サ側は必要があれば、サ側の費用負担の増加も検討する用意があることを示唆した。

- (7) サ側の本プロジェクト実施に対する日本側の対応策を至急提案するようにとの要請とともに、サ側の会計年度（4月末）および日本側の会計年度を考慮すれば、対応策の検討は短期間に行うことが要求されている。

## 5. 対応策および今後の進め方

### (1) 研究所（Research Center）について

研究所の分析および測定機能については大巾な変更および追加はないと思われるが、細部については若干の再検討を行う。

### (2) 技能訓練機能の追加について

対応策の原案作成を急ぐが、これまでの交渉経過にもないことであり、日本側としても技術協力の実施例が少なく、特に、海水淡水化に関連したものは皆無である。

また、サ側の要求範囲は海水淡水化プラントの範囲を越えるものもあり、訓練機能8項目のうち、とりあえず、空調、エンジンおよびボイラーに関するものを除いた5項目について原案の作成を急ぐ。

### (3) 細目合意書に関する交渉団の派遣および調印について

サ側要請に対する対策を十分に検討し、対応策原案ができた段階で、SWCCへ交渉団を派遣し、原案の検討および了承について打合せを行う。さらに原案の修正作業等を経て、本プロジェクトの実施細目合意書の作成および署名の準備を急ぐ。

なお、原案の作成に当たっては、これまでの大型プロジェクト関連企業の協力だけに止ま



らず、広く海水淡水化関連企業の協力を得て行う。

(4) 本プロジェクトのサ側予算措置について

本プロジェクトについてサ側の予算枠が取れた模様であり、SWCCは本件の実施を急いでいるので、今後とも日本側の対応を早くするように要請されると思われるが、SWCCの真の要請がどこにあり、どの範囲に及んでいるかを把握するために、十分に調査してから協力計画を進める必要がある。

a. まとめ

日-サ海水淡水化技術協力に対するサ側の要望事項の概要が判り、これまでの計画を大巾に変更しなければ日本側の対応が困難なことが明らかとなった。

また、サ側の具体的な実施計画案について質し、出来る限り情報を得るよう努力したが、サ側には何ら具体的な案はなく、日本側の対案をみて検討したい意向であることが判り、サ側の要望に対する日本側の実施計画、実施体制等対案を作成し、その内容について早い時期に再度サ側と折衝する必要があると考えられる。

## Minutes of Meetings

January 14, 1981.

The Japanese mission dispatched by Japan International Cooperation Agency ( hereinafter referred to as JICA) held several meetings with the engineers of the Saline Water Conversion Corporation ( hereinafter referred to as SWCC ) concerning the technical cooperation on sea water desalination technology, during their stay in the Kingdom of Saudi Arabia from the 10th to the 15th of January, 1981. ( The list of attendants to the meetings is attached in Annex I).

The outline of the meetings is as follows:-

1. The SWCC side proposed to the JICA side a record of discussions (draft) (The tentative English translation is attached in Annex II).
2. The JICA side pointed out that the contents of the draft proposed by SWCC is different considerably from the "Basic Record of Discussions" concluded between SWCC and JICA in September, 1979, and from the discussions in the course of finalizing the "Detailed Record of Discussions" between JICA and SWCC.
3. The JICA side stated that they would examine the draft proposed by SWCC immediately after their returning to Japan, and would inform the results to SWCC as soon as possible. The SWCC side understood that.

4. The JICA side mentioned the necessity of enough information from SWCC to examine the draft proposed by SWCC. The SWCC side promised to give necessary information on request of JICA.
5. The JICA side suggested the possibility to send a JICA mission to the Kingdom of Saudi Arabia at the earliest convenience after their examination in order to discuss with SWCC on the Detailed Record of Discussions. The SWCC side promised to welcome the mission.
6. With regard to cost sharing scheme as mentioned in Article 6 of the proposed draft by SWCC, the Japanese side indicated that it should be impossible because the Japanese laws and regulations will not permit that, and the SWCC side asked them to submit their comment about this matter and others later after the JICA side examine the proposed draft so that the SWCC side could act on it.



Isam M.R. Jamjoom  
Deputy Governor for Projects  
and Technical Affairs  
S.W.C.C.



Dr. TOTARO GOTO  
Team Leader  
J I C A .

ANNEX I

SWCC Side

|                           |   |
|---------------------------|---|
| Isam M.R. Jamjoom         | Deputy Governor for Projects and Technical Affairs  |
| Abdul Rahman F. Al-Yousef | General Director for Technical Affairs and Research |
| Mr. Hafeeb Mohammed       | Engineer, Research and Technical Department.        |

JICA Side

|                     |  |
|---------------------|--|
| Dr. Totaro Goto     | Team Leader<br>Director, 1st Section of Process Research and Development Division<br>National Chemical Laboratory for Industry<br>Agency of Industrial Science and Technology<br>Ministry of International Trade and Industry. |
| Mr. Shuichi Tsunoda | Policy Adviser<br>Deputy Director, International Research and Development Cooperation<br>Agency of Industrial Science and Technology<br>Ministry of International Trade and Industry.  |
| Mr. Kazutaka Hirata | Coordinator<br>Director, Natural Resources Survey Division<br>Mining and Industrial Planning and Survey Department<br>Japan International Cooperation Agency   |
| Mr. Keiichi Ohta    | Saline Conversion Technical Adviser<br>Senior Engineer, Desalination Technology Division<br>Water Re-Use Promotion Center.   |

(With attendance of)

|                    |  |
|--------------------|--|
| Mr. Naotoshi Osada | Deputy Representative for the Secretariat to the Saudi-Japanese Joint Committee. |
| Mr. Takeshi Komori | President Representative<br>Japan International Cooperation Agency.              |

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بمعون الله

لقد تم في هذا اليوم / / ١٤٠١ هـ الموافق / / ١٩٨١ م  
ابرام هذا العقد بالرياض ( هذا الاتفاق Accord - مذكرة التفاهم هذه - محضر الاجتماع  
هذا ) بين كل من

١-

طرف أول ( المؤسسة SHCC )

٢- السيد / شيزو كيشيرا المدير التنفيذي للوكالة اليابانية للتعاون الدولي  
( الوكالة JICA )

طرف ثاني

إطلاقاً من اتفاقية التعاون الفني والاقتصادي بين حكومة المملكة العربية السعودية  
واليابان الموقعة في اليوم الأول من شهر مارس ١٩٧٥ م ( يشار إليها فيما بعد بالاتفاقية )  
وتطبيقاً لتوصيات اللجنة السعودية - اليابانية من حيث نقل التقنيه ( التكنولوجية )  
التي طورتها وزارة التجارة والصناعة الدولية اليابانية ( الوزارة اليابانية ) فيما يتعلق بتحلية  
المياه المالحة .

فقد قام وفد الوكالة اليابانية للتعاون الدولي برئاسة السيد / شيزو كيشيرا المدير  
التفذي للوكالة المذكورة بزيارة المملكة العربية السعودية خلال الفترة من ٢ - ٧ سبتمبر  
١٩٧٩ م وقام الوفد المذكور بالتباحث مع المختصين بالمؤسسة العامة لتحلية المياه المالحة  
بالرياض برئاسة  
حول التعاون الفني في مجال  
تحلية المياه المالحة ولاسيما في محيط البحوث والدراسات والتدريب وذلك مواصلة للمناقشة

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التي تمت خلال الاجتماعات التي عقدت في شهر نوفمبر ١٩٧٧ م .  
وحيث أن الطرفان قد عطا أهمية قصوى على تعاونهما في مجال التحلية تستوجب  
الاسراع في وضع البرنامج التفصيلي لهذا التعاون فقد تم الاتفاق على مايلي :

البند (١) نطاق التعاون الفني :

يتم التعاون الفني والتقني بين الوكالة JICA وبين المؤسسة SWCC  
في مجال البحوث والدراسات والتدريب بهدف نقل التقنية اليابانية ولا سيما  
تلك التقنية التي طورتها الوزارة التقنية اليابانية في مجال تحلية مياه  
البحر المالحة وكذلك دراسة طرق التحلية المستعملة في المملكة العربية  
السعودية حاليا والتي تمكن ان تستعمل فيما بعد، واختيار آسب الطرق  
المتبعة في تحلية المياه . وكذلك مدى ملاءمة الاجهزة والالات والمعدات  
للظروف السائدة في المملكة من حيث مقاومتها للصدأ والاكسدة والتلوث  
ومقاومتها للظروف الطبيعية السائدة وساعدة المؤسسة في تدريب موظفيها  
وعمالها على استعمال واصلاح الاجهزة والالات والمعدات .

البند (٢) عناصر مشروع التعاون :

يستتبع التعاون الفني انشاء مركز للبحوث والدراسات والاختبارات والتدريب  
(المركز) يشتمل على مايلي :

- ١-٢ في مجال البحوث والدراسات والاختبارات .
  - ١-١-٢ مختبر كيميائي للقيام بالتحاليل والاختبارات والمقاسات  
الدورية العادية .
  - ٢-١-٢ مختبر لدراسة المعادن وتأثيرها .
  - ٢-١-٢ مختبر فتوغرافي
  - ٢-١-٢ مختبر كيميا كهربائية

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٢-١-٢ ٥-١-٢ مختبر لفحص المواد وكذلك ملصة خارجية تكون صالحة

لاستعمالها للوحدة التجريبية pilot plant

وللاختبارات الاطارية • test Loop

٢-٢ في مجال التدريب

٢-٢-١ ورشة للتطعيم

٢-٢-٢ ورشة للانابيب

٢-٢-٢ ورشة لتطليح الآلات والمعدات mechanics and millwright shop

٢-٢-٤ ورشة ميكانيكية machine shop

٢-٢-٥ ورشة لعمال الكهرباء واصلاح المعدات الكهربائية

٢-٢-٦ ورشة لعمال التكيف

٢-٢-٧ ورشة لاصلاح العكائن Engine shop

٢-٢-٨ ورشة للغلايات Boiler shop

٢-٢ يتم توريد وتركيب الاجهزة والآلات والمعدات وادوات التدريب اللازمة

للمركز بحيث يكون مجهزا تجهيزا كاملا للدراسات والبحوث واجراء

الاختبارات والمقاييس وكذلك لتدريب السعوديين على جميع المهن

والعهارات التي تحتاج اليها المؤسسة •

البدء (٢) طريقة تنفيذ المركز

١-٢ تقوم المؤسسة والوكالة فوراً بتعيين فريق من المختصين السعوديين

واليابانيين ( الهيئة ) لوضع برنامج انشاء المركز وتحديد احتياجاته

ورسم طريقة تنفيذه بأسرع ما يمكن •

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- ٢-٢ تقوم الهيئة بالاشراف على المركز بعد تنفيذ ه ووضع برنامج البحوث والدراسات وبرنامج التدريب وكذلك جميع التفاصيل الفنية فيما يتعلق بعمل المركز .
- ٣-٢ يكون اعضاء الهيئة السعوديين مسئولين امام المؤسسة عن تنفيذ هذا العقد ويكون الاعضاء اليابانيين مسئولين عن تنفيذ امام الوكالة .
- ٤-٢ يقوم الجانب الياباني بتزويد المركز بالخبراء والباحثين والمدربين من ذوي الاختصاصات العالية من الجنسية اليابانية او من غيرها .
- ٥-٢ تقدم اسماؤه ومؤهلات الخبراء والباحثين والمدربين الى المؤسسة قبل تعيينهم في المركز للموافقة عليها .

## البند (٤) التزامات المؤسسة :

- ١-٤ تؤمن المؤسسة مساحة من الارض كافية لانشاء المركز وتكون في موقع مناسب حسبما تقدره الهيئة .
- ٢-٤ تتحمل المؤسسة تكاليف بناء المركز بما فيه منصبة الاختيار وساكن الاختصاصيين من خبراء وباحثين ومدربين .
- ٣-٤ تتحمل المؤسسة تكاليف النقل الداخلي في المملكة العربية السعودية للبضائع المستوردة والمؤمنة من قبل الوكالة للمركز وفقا للبند ٧-٤ .
- ٤-٤ تتحمل المؤسسة الرسوم الجمركية وغيرها من الرسوم التي تجبى على البضائع المستوردة والمؤمنة من قبل الوكالة للمركز وفقا للبند ٧-٤ .
- ٥-٤ تتحمل المؤسسة التكاليف الناشئة عن عقد الاجتماعات المشتركة في المملكة العربية السعودية وكذلك مصاريف سفر الموظفين السعوديين عند سفرهم لليابان لحضور الاجتماعات المشتركة التي تعقد هناك .





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٣-٥-٥ التكاليف الناشئة من عقد الاجتماعات المشتركة في اليابان

وكذلك مصاريف سفر الموظفين اليابانيين عند سفرهم

للمملكة لحضور الاجتماعات المشتركة في المملكة .

## البند (٦) التكاليف الاخرى

تكاليف تجهيز المركز بالالات والاجهزة والمعدات ما لم يرد ذكره فب البندين

( ٥ و ٤ ) وكذلك مصاريف الخبراء والباحثين والدرسين والاداريين والخدم

العاملين في المركز بما في ذلك رواتبهم ومكافأتهم واجازاتهم وكذلك المصاريف

الاخرى اللازمة للمركز لتحملها المؤسسة والوكالة بالنسب التالية :

١-٦ تتحمل المؤسسة ستون بالمائة ٦٠٪ منها .

٢-٦ تتحمل الوكالة اربعون بالمائة ٤٠٪ منها .

٣-٦ يتم طرح مناقصة اشاء المركز وملاحقه للمقاولين المنفذين من قبل

المؤسسة ويتم ترصية المشروع من قبلها على ان تقوم الوكالة بطماعتها

من حيث تحليل العطاءات والتعاقد مع المقاول او المقاولين المنفذين .

٤-٦ تقوم الهيئة بوضع العيزانية السنوية للمركز التي يحدد مصاريف وتكاليف

ادارة المركز وتيامه باعماله وتقوم كل من المؤسسة والوكالة برصد

حمتها منها في احد البنوك المحلية بالمملكة بالنسب المنصوص

عليها في البند ٤-١٢ حتى تتمكن الهيئة من الصرف منها .

## البند (٧) مهمات الهيئة

١-٧ تقوم الهيئة المنصوص عليها في البند ٢-١ بعقد اجتماعات مشتركة

دورية لبحث تطور اعمال المركز وحصر النتائج التي تم التوصل اليها .

وعلى اعضاء الهيئة بالاضافة الى مهماتهم المنصوص عليها في هذا

العقد ان يتعاونوا فيما بينهم ويتشاوروا حول جميع الامور التي لها

علاقة بموضوع المركز والتعاون الفني السعودي - الياباني .

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٢٧- على الهيئة أن تقوم بإعداد تقرير شامل كل ثلاثة اشهر بحيث يغطي التقرير كل نشاطات المركز وتطور العمل فيه وكل ما يتعلق به وان تقدم هذا التقرير الي معالي محافظ المؤسسة العامة لتحلية المياه المالحة .

البند (٨) امتيازات الخبراء اليابانيين  
١٨- يتمتع الخبراء والباحثين اليابانيين وعائلاتهم العاطلين في المركز اثناء تواجدهم في المملكة العربية السعودية بالحصانات والاعفاءات والامتيازات التي تخولهم اياها الفقرة (ج) من المادة الثالثة من الاتفاقية .

٢٨- تتحمل المؤسسة جميع المطالبات - ان وجدت - التي قد تقدم ضد الخبراء اليابانيين عن اعمال حدثت اثناء تأديتهم لواجباتهم . او تكون متعلقة بتأديتهم لواجباتهم في المملكة العربية السعودية وذلك فيما عدا تلك المطالبات الناشئة من عمل غير قانوني متعمد او اهمال جسيم من قبل الخبراء اليابانيين .

البند (٩) السريّة:

تلتزم المؤسسة والوكالة بالمحافظة على وجه العموم بسرية المعلومات والبيانات التي تقدم من اى منهما للاخر او التي يحصل بسبب العمل في المشروع ولكن يجوز للمؤسسة والوكالة بموجب اتفاق متبادل بينهما ومسبق أن تقوم اى منهما او اى من موظفيها بنشر بعض المعلومات والبيانات المرخص بنشرها .

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البلد (١٠) حقوق الاختراع :

- ١-١٠ في حالة ما اذا توصل المركز الي اختراع او اكتشاف فانه يكون ملكا للمركز على ان يتبع بشأه مايلي :
- ٢-١٠ تقوم المؤسسة بتسجيل ملكيتها وحقوقها على هذا الاختراع او الاكتشاف في المملكة العربية السعودية .
- ٣-١٠ تقوم الوكالة بتسجيل ملكيتها وحقوقها على هذا الاختراع او الاكتشاف في اليابان .
- ٤-١٠ تقوم المؤسسة والوكالة بتسجيل ملكيتها وحقوقها المشتركة على هذا الاختراع او الاكتشاف في البلدان الاخرى .
- ٥-١٠ للمؤسسة والوكالة ان ترخصا في استعمال هذا الاختراع او الاكتشاف من قبل طرف ثالث على ان يكون ذلك وفقا لاحسن الشروط المتاحة وبالاتفاق بينهما .

البلد (١١) سرعان العقد :

- ١-١١ يبدأ سرعان هذا العقد من تاريخ اليوم الذي يتم التوقيع عليه من قبل المؤسسة والوكالة ويكون ساري المفعول لمدة خمس سنوات .
- ٢-١١ ينتهي هذا العقد قبل مدته وفقا للبند ( ) الثاني او عند نهاية مدة الاتفاقية ايها اسبق .

البلد (١٢) الظروف القاهرة :

- ١-١٢ اذا تعذر على اي من المؤسسة والوكالة تنفيذ التزاماتهما المنصوص عليها اعلاه بسبب قوة القاهرة لايد له فيها ولا يمكن دفعها فان التزاماته تعلق حتى انتهاء الطرف القاهر ويصبح قادرا على تنفيذ التزاماته .

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٢-١٢ تشتل القوة القاهرة • افعال الطبيعة بقدرة الله ،  
اعمال العدو ، الحروب • الاضطرابات المدبسة  
وماشابه ذلك من الاعمال التي لم يتسبب فيها اي من  
الطرفين ولا يستطيع التحكم بها •

٣-١٢ اثناء تعليق الالتزامات بسبب القوة القاهرة يجوز للمؤسسة  
ان تقوم بدفع تكاليف الخبراء والمدرسين والموظفين  
اليابانيين وفي هذه الحالة يستمررون في اعمالهم فسي  
المملكة العربية السعودية •

٤-١٢ في حالة تعليق الالتزامات بسبب القوة القاهرة على المؤسسة  
والوكالة التشاور ومحاولة التغلب على الصعوبات التسي  
سببها القوة القاهرة •

البند (١٣) تعديل والتجديد وانهاء العقد :

يجوز تعديل وتجديد وانهاء هذا العقد باتفاق المؤسسة والوكالة  
كتابيا •

بالتوافق بين الطرفين

البند (١٤) حل الخلافات :

يجب على المؤسسة والوكالة بناء على طلب اي منهما حل الصعوبات  
والخلافات التي قد تنشأ بسبب هذا العقد وديا وعليهما الاجتهاد  
بروح تعاونية وعلى اساس الثقة لحل مثل هذه الخلافات وسوء الفهم  
الذي قد يحمل بينهما •

الأستاذ الدكتور عبد الله المنيفي محامون ومستشارون قانونيون

المملكة العربية السعودية، الرياض، م.ب. ١٥٢٠: عمارة الشركة العقارية، شارع السنين، الملا

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البند (١٥) المراسلات :

الاشعارات والمراسلات التي تتبادل بين المؤسسة والوكالة تكون بطريق  
البريد المسجل او التلكن او بالتصليم باليد لقاء ايصال على العناوين  
المدونه ادناه .

المؤسسة :  
المؤسسة العامة لتحلية المياه الطالحة  
شارع المطار - ص ٥ ب رقم  
الرياض  
المملكة العربية السعودية

الوكالة :  
الوكالة اليابانية للتعاون الدولي

حرر هذا العقد من ثلاث نسخ اصلية باللغة العربية والانجليزية وقد استلم  
كل طرف نسخة منها ويحتفظ بالنسخة الثالثة في المركز للرجوع اليها .

عن الوكالة

عن المؤسسة

In The Name of God The Merciful & Compassionate.

(注) アラビア語原文の直訳英文

With God help

Today \_\_\_\_\_/\_\_\_\_/1401 H, corresponding \_\_\_\_/\_\_\_\_/1981 A.D.,

This contract was concluded in Riyadh (this accord - this memorandum of understanding - this record of discussion) between

1- \_\_\_\_\_

SKCC

First Party

2- Mr. Shizuo Kishida, Executive Director of Japan International Cooperation Agency (JICA)

Second Party

Pursuant to the Agreement on economic and technical cooperation between the Government of the Kingdom of Saudi Arabia and the Government of Japan signed on 1st of March 1975 (hereinafter referred to as the Agreement), and in application of recommendations of the Saudi Japanese Committee vis a vis transferring the technology developed by the Ministry of International Trade and Industry (The Japanese Ministry) in respect of the desalination of saline water.

The Japan International Cooperation Agency delegation headed by Mr. Shizuo Kishida, the executive director of the said agency made a visit to the Kingdom of Saudi Arabia from 2-7 Sep. 1979 A.D.,

the said delegation discussed with specialists of the Saline Water Conversion Corporation in Riyadh headed by \_\_\_\_\_ the technical cooperation in the field of the desalination of saline water particularly the field of researches, studies, and training in continuation of the conversation which took place during the meetings held in November 1977 A.D as the two parties relied utmost significance on the cooperation in the field of desalination which requires quickening in laying out the detailed program for this cooperation, they agreed on the following:-

#### Article 1

##### Scope of Technical Cooperation:

The technical cooperation between JICA & SWCC in the field of researches, studies and training aims at transferring the Japanese technology particularly that technology developed by the technical Japanese Ministry in the field of the sea water desalination and studying the methods of desalination used currently in the Kingdom of Saudi Arabia which may be used later on and selecting the most appropriate methods used in water desalination as well as the extent of the adoption of the equipments and machinery to the prevailing conditions in the Kingdom vis a vis its resistance to rust, oxydization, corrosion and the natural prevailing conditions and assisting SWCC in training its employees and labourers to use and repair the equipments, machinery, and instruments.



## Article 2

### Elements of the Cooperation Scheme.

The technical cooperation shall be followed by the establishment of a center for researches , studies, tests, and training. (the center) shall include the following:-

#### 2-1 In the field of researches studies and tests

2-1-1 A chemical laboratory to undergo analyses, tests, ordinary regular measurements.

2-1-2 A laboratory to study metals and its properties.

2-1-3 A photographic laboratory

2-1-4 An electrochemical laboratory

2-1-5 A laboratory to test materials as well as an outside platform suitable to be used for the pilot plant and test loop.

#### 2-2 In the field of training

2-2-1 Welding shop

2-2-2 Piping shop

2-2-3 Mechanics and millwright shop

2-2-4 Machine shop

2-2-5 A shop for electric works and repairing electrical equipments.

2-2-6 A shop for conditioning works

2-2-7 Engine shop

2-2-8 Boiler shop

- 2-3 Securing and installation of equipment, machinery and instruments as well as the necessary training tools will be made in the center so that it will be fully equipped for studies, researches and running tests and measurements as well as training Saudis on all jobs and skills required by SWCC.

### Article 3

#### Method of Implementation of the Center.

- 3-1 SWCC and JICA will appoint immediately a team of Saudi-Japanese specialists (panel) to prepare the program of the establishment of the center and to limit its requirements and to lay-out the method of its implementation as soon as possible.
- 3-2 The Panel shall supervise the center after its implementation and prepare the program of researches and studies the program of training as well as all technical details related to the work of the center.
- 3-3 The Saudi members of the Panel shall be responsible for the SWCC for the execution of this contract and the Japanese members shall be responsible for JICA for its execution .
- 3-4 The Japanese side shall supply the center with experts, researchers and instructors of high specialization of the Japanese nationality or otherwise.

#### Article 4

##### SWCC Commitments.

- 4-1 SWCC shall secure an adequate piece of land to construct the center to be in a suitable location according to the Panels assessment.
- 4-2 SWCC shall bear costs of the construction of the center including testing platform and the accommodation of specialists of experts, researchers and instructors.
- 4-3 SWCC shall bear costs of domestic transportation in the Kingdom of Saudi Arabia of the imported goods insured by JICA for the center according to article 4-7/
- 4-4 SWCC shall bear custom duties and other duties to be paid of the imported goods insured by JICA for the center according to article 4-7
- 4-5 SWCC shall bear costs resulted out of holding joint meetings in the Kingdom of Saudi Arabia as well as expenses of the travel of Saudi employees to Japan to attend joint meetings to be held there.
- 4-6 SWCC shall bear, appointing the Saudi members of the panel, paying their salaries and other costs.
- 4-7 Securing transportation methods inside the Kingdom of Saudi Arabia for Japanese experts, researchers and instructors.

4-8 Providing the center with all information, data and statistics related to the work of the center and which may help in achieving its aims.

### Article 5

#### JICA Commitments.

- 5-1 JICA shall appoint Japanese (or otherwise) members of the Panel and the specialists and pay their salaries and other costs.
- 5-2 JICA shall train the Saudi employees deputized by the Center to Japan and pay costs of their training in Japan.
- 5-3 JICA shall provide the center on its own with major equipments, machinery and instruments for desalination researches, annex No. (5) includes the specifications of these equipments, machinery and instruments.
- 5-4 The equipments, machinery referred to in article (4-6) above shall be used for the purpose of researches, studies, experiments and training inside the center and upon directions of the Japanese or otherwise specialists.
- 5-5 JICA shall bear on its own expense the following:-
- 5-5-1 Costs of preparing designs for the Center

5-5-2 Costs of supervising the execution of the Centers building. JICA shall despatch a specialized team to design and supervise the execution including the testing platform.

5-5-3 Costs resulting out of holding joint meetings in Japan as well as costs of the travel of Japanese employees to the Kingdom to attend joint meetings in the Kingdom.

#### Article 6

##### Other Costs.

The costs of equipping the center with equipments, machinery and instruments which were not mentioned in articles (4 & 5) as well as expenses of experts, researchers, instructors, administrative staff and servants working in the Center including their salaries, rewards, leaves and other expenses necessary for the center shall be born by SKCC and JICA according to the following proportions:-

6-1 SKCC shall bear 60% of it.

6-2 JICA shall bear 40% of it.

6-3 SKCC shall put into tender the construction of the center and follow up executive contractors and further shall decide upon the winner provided that JICA shall assist vis a vis analysing tenders and concluding contract with the contractor or executive contractors.

6-4 The Panel shall prepare the annual budget which defines expenses and costs of the administration of the Center and the performance of its duties. Each of SWCC and JICA shall allocate each of their shares in a local bank in the Kingdom as per the proportions stipulated in article 4-13, so that the Panel shall be able to spend.

#### Article 7

##### Panel's Tasks

- 7-1 The Panel stipulated in article 3-1 shall hold regular joint meetings to discuss the development of the work of the Center and limit the results acquired. Members of the Panel in addition to their tasks stipulated in this contract shall cooperate and consult each other on all matters of concern to the question of the Center and the technical Saudi-Japanese Cooperation.
- 7-2 The Panel shall prepare an inclusive report every three months to cover all activities of the center, its work development and all what is related to it and shall submit this report to His Excellency the Governor of SWCC.

Article 8

Privileges of Japanese or Otherwise experts.

8-1 The Japanese or otherwise experts researchers working in the Center and their families shall enjoy during their stay in the Kingdom of Saudi Arabia the immunities, exemptions and privileges according to Article 3(c) of the Agreement.

8-2 SWCC bears all claims, if any arise, against the Japanese or otherwise experts occurring in the course of /or otherwise connected with the discharge of their official functions in the Kingdom of Saudi Arabia, excepting those claims arising from willful illegal act or gross negligence of the Japanese or otherwise experts.

Article 9

Confidentiality:-

SWCC and JICA shall keep , in general, confidential any information or data provided by each of them to the other or generated as a result of the work under the project, but in case of previous mutual agreement, each of them or their employees can publish pieces of information or data permitted to be published.

Article 10

Patents.

10-1 If invention or discovery arise out of work by the Center it shall be owned by the Center provided that the following shall be applied:-

10-2 SWCC shall register its ownership and rights vis a vis this invention or discovery in the Kingdom of Saudi Arabia.

10-3 JICA shall register its ownership and rights vis a vis this invention or discovery in Japan .

10-4 SWCC and JICA shall register their ownership and joint rights vis a vis this invention or discovery in other countries.

10-5 SWCC and JICA may license such invention or discoveries to a third party provided that this shall be on terms most favorable upon mutual agreement.

Article 11

Effectiveness of the Contract.

11-1 This contract shall be effective as of date of signature, by SWCC and JICA and shall remain in effect for the period of five years.



11-2 This contract is terminated prior to its period in accordance with Article ( ) second or the termination of the Agreement, whichever shall occur first.

Article 12

Force Majeure.

12-1 If either SWCC or JICA is rendered unable to perform its commitments stipulated above because of force majeure which could not be avoided, its commitments shall be suspended until the finality of force majeure where it shall be able to carry out its commitments.

12-2 Force Majeure, include acts of God, acts of public enemy, wars, civil disturbances and other similar events not caused by nor within the control of each party.

12-3 During the period of suspension of the performance caused by force majeure, SWCC may pay costs of Japanese or otherwise experts, instructors and employees. In this case, they shall continue their work in the Kingdom of Saudi Arabia.

12-4 In the event of suspension of the performance caused by force majeure SWCC and JICA shall consult and endeavor to overcome any difficulties caused by force majeure.

Article 13

Amendment, renewal or termination.

This contract may be amended, renewed or terminated by SWCC and JICA agreement in writing.

Article 14

Settlement of disputes:

SWCC and JICA upon request of any of them shall endeavor to resolve amicably in a spirit of cooperation and trust any disputes or misunderstanding that may arise as a result of this contract.

Article 15

Correspondence.

Notices and correspondence exchanged between SWCC and JICA shall be by registered mail or telex or hand carried in return of receipt on the below written addresses:-

SWCC:

The Saline Water Conversion Corporation  
Airport Street - P.O.Box  
Riyadh, Kingdom of Saudi Arabia.

JICA;

The Japan International Cooperation Agency,

This contract was concluded in three original copies in Arabic and English languages, each party received a copy of them, the third copy shall be kept in the center for reference.

For/SKCC

For/JICA

