

3.2 List of Laboratory Equipment stored in Yanbu

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1. Equipment for Corrosion Test

Item No.	Description	Q'ty	Remarks
1-1	AC impedance system	1 set	For laboratory use; measures the corrosion rates of the test pieces of heat transfer tubes for the MSF test plant.
1-2	Corrater	1 set	For process use; measures the corrosion rates of Probe metals mounted in the water box of the MSF test plant, and evaluates the corrosion of the metals by hot brine. Probe material; Cu-Ni, BsTF
1-3	Electrometer	3 sets	Measures the electrode potential to determine the corrosion behaviors of metals.
1-4	Tester (volt-ohm meter)	2 sets	For electric test purposes
1-5	Recorder (include charts)		For multi-purpose applications using multi-point recording and wide range functions.
1-6	Camera	1 set	Photographs the status of corrosion on specimens
1-7	Photographic enlarger	1 set	For enlargement of photographs
1-8	Metallurgical microscope (1) Metallurgical microscope (2) Polaroid camera	1 set (1) (1)	Observes microstructures and corroded portions of metallic specimens
1-9	Roughness meter	1 set	Analyzes the roughness of specimen surfaces before and after corrosion testing
1-10	Mounting press	1 set	A small heating press for embedding metallic materials into plastic resin for the purpose of microscopic observation.
1-11	Wet grinder and polisher (1) Wet manual grinder (2) Wet auto polisher	2 sets (1) (3)	For metal grinding in preparation for observation by the metallurgical microscope.

Item No.	Description	Q'ty	Remarks
1-12	Spot welder	1 set	Electric spot welder for use in the laboratory
1-13	Electropolishing equipment	1 set	For electrotic polishing of metallic materials for microscopic observation
1-14	Dryer	1 set	For hot air drying of metal specimens
1-15	Precision cutter	1 set	Cuts metallic materials for microscopic observation and corrosion testing.
1-16	Plastic desiccator	4 sets	Stores the camera, metallurgical microscope parts and metallic specimens.
1-17	Immersion corrosion testing equipment	2 sets	For corrosion tests in the laboratory in compliance with ASTM G-31
1-18	Zero shunt ammeter	1 set	Measures short-circuit currents between different metals in electrolytic solutions.
1-19	DOS tester (Degree of sensitization)	1 set	Measures the sensitivity to inter-granular corrosion of austenite stainless steels in laboratory and field.

2. Equipment for Water and Chemical Analysis

Item No.	Description	Q'ty	Remarks
2-1	I.C.P. emission spectrophotometer	1 set	Microchemical analysis of the seawater ingredients scale and corrosion products (Ca, Mg, Fe, Cu, etc.)
2-2	Spectrophotometer (a) Precision type (b) Conventional type	2 sets (1) (1)	Colorimetric analysis of the seawater ingredients, scale and corrosion products
2-3	X-ray diffractometer	1 set	Analyzes the crystal structure of various scale and corrosion products.
2-4	Electrical conductivity meter	2 sets	Measures electrical conductivity of seawater and product water.
2-5	pH meter (a) Laboratory type (b) Portable type	3 sets (2) (1)	Measures pH values of seawater and product water.
2-6	Automatic titrater	1 set	Automatic titration equipment capable of controlling titration process
2-7	Residual chlorine meter	1 set	Measures residual chlorine in seawater and product water.
2-8	Portable water analysis kit	1 set	Capable of making simplified chemical analysis of seawater and product water
2-9	Scale deposition testing equipment	2 sets	Reactor for scale deposition test in the laboratory
2-10	Turbidity meter	1 set	Checks the amount of colloids, microbes, scale deposits and corrosion products in seawater.

Item No.	Description	Q'ty	Remarks
2-11	Oil content determination app.	1 set	Measures oil content in seawater.
2-12	DO meter	1 set	Measures the dissolved oxygen level in the pre-treated and concentrated seawater in the RO test plant.
2-13	ORP meter	1 set	Measures the oxidation reduction potential of seawater and product water.
2-14	Microbiological examination kit	1 set	Tests seawater and product water for colibacilli and other bacterial contamination.
2-15	Electron probe micro analyzer	1 set	Electron microscopic observation and X-ray micro analysis of scale, corrosion products etc.
2-16	Infrared spectrophotometer	1 set	Analyses chemical structure of chemical substance

3. General Equipment

Item No.	Description	Q'ty	Remarks
3-1	Analytical balance, max. 162 g.	2 sets	Electronic precision balance for chemical analysis and corrosion study. Increment 0.1 mg
3-2	Chemical balance direct reading, max. 2.1 kg	2 sets	Balance for chemical analysis, Increment 0.01 g
3-3	Balance, max. 20 kg	1 set	Rough balance for chemical analysis Increment 2 g
3-4	Water purification app.	2 sets	Produces purified water for test use at 1.8 l/h
3-5	Drying oven for glassware, 45 x 45 x 45 cm	2 sets	Constant temperature blast dryer, Operating temp. 40–200°C, Accuracy ±1°C
3-6	Drying oven for chemical, 45 x 45 x 45 cm	1 set	Operates on a forced draft system, Operating max. temp. 200°C, Accuracy ±0.1°C
3-7	Muffle furnace, max. 14 x 14 x 25 cm	1 set	Electric furnace; Operating max. temp. 1150°C, Accuracy ±5°C
3-8	Vacuum pump (1) For high vacuum environment	1 set (1)	For laboratory use; Discharge rate 13 l/min, Vacuum degree 10 ⁻⁴ mmHg.
3-9	Vacuum pump (2) For low vacuum environment	1 set (1)	For laboratory use; Discharge rate 13 l/min, Vacuum degree 350 mmHg.
3-10	Air compressor, tank capacity 16 l	1 set	
3-11	Magnetic stirrer	2 sets	Stirrer for titration, Capacity 100 – 5000 ml
3-12	Magnetic stirrer, with hot plate	1 set	Stirrer for titration, Capacity 100 – 3000 ml

Item No.	Description	Q'ty	Remarks
3-13	Water bath, general type	1 set	Constant temperature bath using water.
3-14	Refrigerator	1 set	For laboratory use, Capacity 205 l, Store chemicals that must be kept at low temperature.
3-15	Water circulating pump (Handy type)	2 sets	Displacement 7 – 9l/min.
3-16	Stop watch	2 sets	Digital indication, triple scales.
3-17	Hot plate	1 set	Operating temp. 50 - 200°C
3-18	Air pump (Handy type)	2 sets	Covers both the domains of pressure and reduced pressure. Applicable to pressure reduction filtration, pressurized filtration, air sampling
3-19	Gas flow meter	3 sets	Precision portable gas flow meter.
3-20	Constant temperature bath	2 sets	Precision constant temperature water bath
3-21	Calculator	3 sets	Hand-held type
3-22	Thermometer (Thermister system)	2 sets	Operating range: 0 – 150/140 – 300°C
3-23	Pressure regulator (1) for N ₂ (2) for H ₂	7 sets (5) (2)	Pressure reducing mechanism consists of two stages.
3-24	Vacuum evaporator	1 set	Capacity 1,000 ml, Cooling device is an upright and dual-hose type.

4. Glassware and Others

Item No.	Description	Q'ty	Remarks
4-1	<p>Beakers</p> <p>(1) Beaker, hard glass, standard type Capacity: 50, 100, 200, 300ml Capacity: 500, 1000, 2000 ml</p> <p>(2) Beaker, hard glass, tall type Capacity: 500 ml</p> <p>(3) Beaker, hard glass, conical type Capacity: 300 ml</p> <p>(4) Beaker, silicate glass Capacity: 500 ml</p> <p>(5) Beaker, stainless steel with handle Capacity: 2,000 ml</p> <p>(6) Beaker, polyethylene with handle Capacity: 500, 1000 ml</p>	<p>12 each</p> <p>6 each</p> <p>6</p> <p>6</p> <p>3</p> <p>2</p> <p>2 each</p>	<p>Implements for water and chemical analysis</p>
4-2	<p>Flasks</p> <p>(1) Flask, erlenmeyer, unstoppered Capacity: 20, 50, 100 ml Capacity: 100, 500 ml Capacity: 300 ml</p> <p>(2) Flask, with interchangeable stopper Capacity: 50, 100, 300, 500ml</p> <p>(3) Flask, iodine Capacity: 300 ml</p>	<p>6 each</p> <p>12 each</p> <p>24</p> <p>6 each</p> <p>2</p>	

Item No.	Description	Q'ty	Remarks
4-4	<p>(1) Minimum graduation 0.1 ml Capacity: 50 ml</p> <p>(2) Buret, blue line, teflon plug Minimum graduation 0.1 ml Capacity: 50 ml</p> <p>(3) Buret, amber, teflon plug Minimum graduation 0.1 ml Capacity: 50 ml</p> <p>(4) Buret, micro, plain, teflon plug with stand Capacity: 1, 2 ml 5, 10 ml</p> <p>(5) Buret, automatic, plain, teflon plug with bulb and reservoir Minimum graduation 0.1 ml Capacity: 10 ml 25, 50 ml</p> <p>(6) Buret, automatic, amber, teflon plug with bulb and reservoir Minimum graduation 0.1 ml Capacity: 25, 50 ml</p>	<p>2</p> <p>2</p> <p>2</p> <p>2 each</p> <p>3 each</p> <p>3 each</p>	<p>Implements for water and chemical analysis</p>
4-5	<p>Bottles</p> <p>(1) Bottle, plastic with screw cap Capacity: 250, 500, 1000 ml</p>	<p>18 each</p>	

Item No.	Description	Q'ty	Remarks
4-5	<p>(2) Bottle, for reagent, narrow mouth with stopper Capacity: 250, 500, 1000 ml</p> <p>(3) Bottle, for reagent, amber, narrow mouth with stopper Capacity: 250, 500, 1000 ml</p> <p>(4) Bottle, for reagent, wide mouth with stopper Capacity: 120 ml</p> <p>(5) Bottle, for reagent, amber, wide mouth with stopper Capacity: 120 ml Capacity: 250, 500 ml</p> <p>(6) Bottle, dripping type Capacity: 120 ml</p> <p>(7) Bottle, dripping type, amber Capacity: 120 ml</p> <p>(8) Bottle, filtering, Buchner type Capacity: 300 ml 500 ml 1000 ml</p> <p>(9) Bottle, washing, polyethylene Capacity: 500 ml</p> <p>(10) Bottle, polyethylene with stopcock Capacity: 30 ml</p> <p>(11) Bottle, gas washing (a) Dressel type Capacity: 250 ml</p>	<p>24 each</p> <p>12 each</p> <p>6</p> <p>6</p> <p>3 each</p> <p>6</p> <p>6</p> <p>6 each</p> <p>3</p> <p>12</p> <p>2</p> <p>6</p>	<p>Implements for water and chemical analysis</p>

Item No.	Description	Q'ty	Remarks
4-5	(11) (b) Fritted disc type Capacity: 250 ml (12) Bottle, weighing 40 mm (high) x 20 mm (diameter) 60 mm (high) x 30 mm (diameter)	 6 6 6	 Implements for water and chemical analysis
4-6	Cylinders (1) Cylinder, glass, graduated, stopper Capacity: 25, 50, 100, 250, 500, 1000 ml Capacity: 2000 ml (2) Cylinder, glass, graduated, unstoppered Capacity: 5, 10, 10 (cone type), 100, 250, 500, 1000 ml Capacity: 2000 ml	 12 each 3 6 each 3	
4-7	Condensers (1) Condenser, Liebig type Length: 300 mm (2) Condenser, Dimroth type Length: 300 mm (3) Condenser, Graham type Length: 300 mm	 2 2 2	
4-8	Crucibles and dishes (1) Crucible, porcelain with cover (B-type) Capacity: 30 ml	 6	

Item No.	Description	Q'ty	Remarks
4-8	(2) Crucible, porcelain, Gooch type 40 mm diameter with 24 mm inlet board Capacity: 35 ml (3) Dish, evaporating Diameter: 85 mm, Capacity: 100 ml Diameter: 120 mm, Capacity: 260 ml (4) Crucible, platinum Capacity: 30 ml	 6 6 6 1	Implements for water and chemical analysis
4-9	Funnels (1) Funnel, separatory, with teflon plug Capacity: 100, 300, 500, 1000 ml (2) Funnel, filtering ID at top: 75 mm ID at top: 120 mm ID at top: 210 mm ID at top: 75 mm (long stem) (3) Funnel, Buchner type, porcelain ID at top: 118 mm (4) Funnel, Buchner type, fritted glass disc ID at top: 70 mm (5) Funnel with fritted disc JIS No.1, Capacity: 30 ml JIS No. 2, Capacity: 30 ml JIS No. 3, Capacity: 30 ml	 6 each 12 6 3 3 3 2 3 3 3	

Item No.	Description	Q'ty	Remarks
4-9	(5) JIS No.4, Capacity: 30 ml	3	Implements for water and chemical analysis
	Stem for above	3	
4-10	Desiccators with perforated porcelain plate		
	(1) Desiccator, Scheibler type with perforated, porcelain plate		
	Diameter, inside 150 mm	3	
	Diameter, inside 300 mm	2	
	(2) Desiccator, vacuum type with stopcock		
	Diameter, inside 300 mm	2	
	(3) Desiccator, Scheibler type, amber, Diameter, inside 150 mm	2	
4-11	Test tubes		
	Hard glass 200(L) x 21(D) mm	50	
	Hard glass 150(L) x 12(D) mm	50	
4-12	Watch glasses		
	Diameter: 75, 120 mm	18 each	
4-13	Glass tubings		
	(1) 1,500 mm length, 6 mm OD, glass rod	5	
	(2) 1,500 mm length, 1 mm ID capillary, hard glass	3	
	(3) 1,500 mm length, 2 mm ID 6 - 7 mm OD, hard glass	3	
	(4) 1,500 mm length, 4 mm ID medium wall, hard glass	15	

Item No.	Description	Q'ty	Remarks	
4-13	(5) 1,500 mm length, 6 mm ID medium wall, hard glass	15	Implements for water and chemical analysis	
	(6) 1,500 mm length, 8 mm ID medium wall, hard glass	15		
	(7) 1,500 mm length, 11.6 mm ID medium wall hard glass	5		
	(8) 1,500 mm length, 15.6 mm ID medium wall, hard glass	3		
	(9) 1,500 mm length, 19 mm ID medium wall, hard glass	3		
	(10) 1,500 mm length, 25 mm ID medium wall, hard glass	2		
4-14	Glass stopcocks, interchangeable plug for liquid			
	(1) Straight type, arms 6 mm OD	6		
	(2) Straight type, arms 7.5 mm OD	6		
	(3) Three way type, arms 7.5 mm OD	3		
4-15	Tubes, connecting, T-shaped, glass Arms 7.5 mm OD	6		
4-16	Tubes, connecting Y-shaped, glass Arms 7.5 mm OD	6		

Item No.	Description	Q'ty	Remarks
4-17	Filter pumps (aspirator) Length: 300 -- 350 mm	6	Implements for water and chemical analysis
4-18	Glass stopcock for gas		
	(1) Stopcocks, high vacuum oblique bore		
	Arms 8 mm OD	3	
	Arms 12 mm OD	3	
	Arms 15 mm OD	3	
	(2) Stopcock, high vacuum, three way bore		
	Arms 8 mm OD	2	
	Arms 12 mm OD	2	
4-19	Drying tubes, U-shape with side arms and stoppers Height of tube, 150 mm	3	
4-20	Stoppers, cork		
	Size Top Diameter mm/ No. Bottom Diameter mm		
	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	

Item No.	Description	Q'ty	Remarks
4-21	Stoppers, rubber Size Top Diameter mm/ No. Bottom Diameter mm 03 11/ 9 01 14/10 0 15/12 1 16/12 2 18/14 3 19/15 4 20/16 5 22/19 6 23/20 7 25/21 8 28/23 9 30/25 10 32/28 12 37/32 14 41/37 16 46/40 18 52/46 20 58/51 25 74/68 30 90/84	20 20 20 20 20 20 20 20 20 20 20 10 10 10 10 10 10 10 10 10	Implements for water and chemical analysis
4-22	Stoppers, silicone Size Top Diameter mm/ No. Bottom Diameter mm 3 19/15 8 28/23	20 10	
4-23	Tubings (1) Tubing, rubber, red 3mm(ID)x4.6mm(OD) 5mm(ID)x7mm(OD) 8mm(ID)x11.6mm(OD) 12mm(ID)x17.0mm(OD)	10 m 20 m 50 m 50 m	

Item No.	Description	Q'ty	Remarks
4-23	(2) Tubing, rubber for gas burner 8mm(ID)x12mm(OD) 50 m (3) Tubing, rubber for vacuum 4.5mm(ID)x15mm(OD) 30 m 6mm(ID)x21mm(OD) 10 m 9mm(ID)x24mm(OD) 10m (4) Tubing, rubber for high pressure 8mm(ID)x18mm(OD) 10 m (5) Tubing, synthetic rubber 5mm(ID)x7mm(OD) 10 m 7mm(ID)x10mm(OD) 10 m 10mm(ID)x14.6mm(OD) 10 m (6) Tubing, silicone 6mm(ID)x8mm(OD) 10 m 8mm(ID)x12mm(OD) 10 m 12mm(ID)x15mm(OD) 10 m (7) Tubing, polyvinyl chloride 3mm(ID)x5mm(OD) 10 m 6mm(ID)x8mm(OD) 50 m 8mm(ID)x11mm(OD) 30 m 10mm(ID)x13mm(OD) 30 m 15mm(ID)x19mm(OD) 20 m 18mm(ID)x22mm(OD) 10 m 25mm(ID)x30mm(OD) 10 m		Implements for water and chemical analysis
4-24	Bucket, polyethylene Capacity: 10 l	12	
4-25	Siphone, polyethylene, small type	6	
4-26	Thermometers, general use Temperature range: 0 - 100°C	12	

Item No.	Description	Q'ty	Remarks
4-26	Temperature range: 0 – 250°C Temperature range: 0 – 360°C	6 6	Implements for water and chemical analysis
4-27	Transformer, variable, total capacity: 1 kW	3	
4-28	Boring apparatus (1) Borer, for cork, set (2) Borer, for rubber, set (3) Cork borer sharpener	3 3 2	
4-29	Cork press, rotary	1	
4-30	Tripod, iron, 12 cm OD	6	
4-31	Triangle, with clay pipe stem	12	
4-32	Asbestos wire gauze 18 cm x 18 cm square	50	
4-33	Asbestos (1) Asbestos, band, 3.2 cm width, high quality (AAA) (2) Asbestos, band, 5 cm width, high quality (AAA) (3) Asbestos, yarn, 6 mm high quality (AAA)	10 m 10 m 10 m	
4-34	Pinch cock, middle type	12	
4-35	Screw cocks (1) Large type (5cm) (2) Middle type (3 cm)	12 12	

Item No.	Description	Q'ty	Remarks
4-36	Mortars (1) Mortar and pestle, porcelain, 150 mm OD (2) Mortar and pestle, agate, 150 mm OD	3 2	Implements for water and chemical analysis
4-37	Tongs		
	(1) Tongs, for crucible, 180 mm long	3	
	(2) Tongs, for crucible, 240 mm long	2	
	(3) Tongs, for crucible 600 mm long	2	
	(4) Tongs, for breaker, 290 mm long	2	
	(5) Tongs, for platinum crucible, with platinum shoes, 210 mm long	1	
4-38	Forceps		
	(1) Forceps, general use, 125 mm long	12	
	(2) Forceps, general use, 150 mm long	12	
	(3) Forceps, general use, 300 mm long	6	
	(4) Forceps, teflon coating, 180 mm long	3	
4-39	Spoons		
	(1) Spoon, general use, 150 mm long	12	
	(2) Spoon, general use, 180 mm long	12	
	(3) Spoon, with spatula, 150 mm long	6	

Item No.	Description	Q'ty	Remarks
4-39	(4) Spoon, with spatula, 180 mm long	6	Implements for water and chemical analysis
4-40	Spatula, stainless steel, 210 mm long	6	
4-41	Clamps (1) Clamp, versatile, small size (2) Clamp, versatile, medium size (3) Clamp, versatile, large size (4) Clamp holder, regular type	12 12 24 48	
4-42	Supports (1) Support stand, tripod base, 60 cm high (2) Support stand, tripod base, 90 cm high (3) Support, for two funnel (4) Support, with buret holder, porcelain base (5) Support, test tube (6) Support, pipet	6 6 2 6 2 3	
4-43	Rings (1) Ring support, cast iron with clamp, small size (2) Ring support, cast iron with clamp, medium size (3) Ring support, cast iron with clamp, large size	6 12 6	

Item No.	Description	Qty	Remarks
4-44	Gas burners (1) Gas burner, standard type (2) Gas burner, Meker type	12 3	Implements for water and chemical analysis
4-45	Blower, rubber (spray)	12	
4-46	Pipet filler, rubber	6	
4-47	Papers		
	(1) Paper, filtering, qualitative No.1 12.5 cm (diameter)	600	
	(2) Paper, filtering, qualitative No.1 18.5 cm (diameter)	600	
	(3) Paper, filtering, qualitative No.2 12.5 cm (diameter)	600	
	(4) Paper, filtering, qualitative No.5A 12.5 cm (diameter)	600	
	(5) Paper, filtering, qualitative No.5B 12.5 cm (diameter)	600	
	(6) Paper, filtering, qualitative No.5C 12.5 cm (diameter)	600	
	(7) Paper, filtering, oil, 800 x 300 mm square	200	
	(8) Paper, paraffin, pack of 50 sheets	6 packs	
	(9) Paper, for pH test, pH range 0.4 – 13.6	6 sets	

Item No.	Description	Q'ty	Remarks
4-48	Emery papers (1) Fine (2) Medium (3) Coarse	12 sheets 12 sheets 12 sheets	Implements for water and chemical analysis
4-49	Brushes (1) Brush, for test tube (2) Brush, for burette (3) Brush, for flask, Middle type (4) Brush, for flask, large type (5) Brush, for pipette (6) Brush, for beaker	6 6 6 6 6 3	
4-50	Vessel, evacuated with case capacity 1 l	3	
4-51	Platinum dish 150 ml	1	
4-52	Bottle, DO measuring, Winkler type, 10 ml	5	
4-53	Electric tool set	2	

5. Machines and Tools

Item No.	Description	Q'ty	Remarks
5-1	Precision lathe	1 set	High-speed processing, Floor area 1203 x 2468 mm Net weight 2300 kg
5-2	Bench drilling	1 set	Max. drilling 23 mm
5-3	Electric bench grinder	1 set	Grindstone diameter 305 mm
5-4	Cutter	1 set	Grindstone diameter 405 mm
5-5	Electric drill	2 sets	Max. drilling 20 mm
5-6	Hand lever shear	1 set	Processing thickness 1.6 mm, Processing length 1 m
5-7	Hack sawing machine	1 set	Max. cutting 250 mm ϕ
5-8	Band sawing machine	1 set	Max. cutting 260 mm, Processing length: 395 mm
5-9	Universal swivelling branch vise	1 set	Max. opening 165 mm, Depth of jaws 32 mm
5-10	Cast anvil	1 set	Size 560L x 150D x 290H
5-11	Hack-saw frame	1 set	Saw blade 250 mm
5-12	File each size	1 set	Type: Flat, Half-round, Round, Square, Three square Size: 150, 250 mm
5-13	Calipers	1 set	Size: 150, 200, 250, 300, 350 mm
5-14	steel tape measure	1 set	Size: 2, 3.5, 5, 30 m
5-15	Steel rule	1 set	Size: 150, 300, 600 mm
5-16	Vernier calipers	1 set	Size: 150, 300, 600, 1000 mm

Item No.	Description	Q'ty	Remarks
5-17	Micrometer (All kinds)	1 set	For external micrometer: 0~25, 25~50, 50~75, 75~100 mm For inside micrometer: 5~30, 25~50, 50~75, 75~100 mm
5-18	Adjustable tap wrench	1 set	Size: 1 ~ 6, 1~10, 4~13, 6~20, 10~25 mm
5-19	Electric soldering iron	1 set	Rating: 30, 40, 60, 80, 100W
5-20	Spanner	1 set	A, B type, ISO type
5-21	Adjustable angle wrench	1 set	Size: 150, 200, 250, 300, 375 mm
5-22	Water pump pliers	1 set	Size: 250, 300 mm
5-23	Side cutting pliers	1 set	Size: 150, 175, 200 mm
5-24	Radio pliers	1 set	Size: 150, 175 mm
5-25	Diagonal cutting nippers	1 set	Size: 150, 152 mm
5-26	Figure and letter punch	1 set	The figure punch set includes 9 punches and the alphabet set consist of 26 punches Size: 2, 3, 4, 5, 6, 8 mm
5-27	Wire stripper	1 set	A type, B type
5-28	Hammer	1 set	Size: 0.225, 0.45, 0.9, 1.3, 1.8, 2.2, 2.7, 3.6 kg
5-29	Plastic hammer	1 set	Size: 0.2, 0.3 0.5, 0.8, 1.0 kg
5-30	Tinners scissors	1 set	Size: 210, 240, 300 mm
5-31	Oil gun	1 set	Size: 160, 540 ml
5-32	Screw drivers (All kinds)	1 set	With wood handles type: 100, 150, 200, 250 mm With plastic handles type: 100, 150, 200 mm

Item No.	Description	Q'ty	Remarks
5-33	Box spanner	1 set	A type, B type, ISO type
5-34	Gas cutter	1 set	Portable gas cutter kit
5-35	Tube puller	1 set	For MSF test plant
5-36	Expander	1 set	For MSF test plant
6.	Process Analyzer		
6-1	Dissolved oxygen meter	1 set	Range: 0~50/0~100/0~200 ppb
6-2	Salt meter	1 set	
7.	Standards		
7-1	Standard data booklet	1 set	

3.3 List of Equipment for Test Plants stored in Yanbu

3.3 List of Equipment for Test Plants stored in Yanbu

(1) RO Test plant

Sea Water Pretreatment Equipment Section-100

Item	Equipment Name	Specification	Q'ty
T-101	Seawater intake tank Material Capacity Accessories	Vertical, cylindrical, and closed type Polyethylene 3 m ³ Level indicator, overflow pipe, drain valve, ladder, manholes, anchor bolts, etc.	1 set
T-102	Filtered sea water tank Capacity	Same as T-101 15 m ³	1 set
F-101AB	Filter Material Media Accessories	Pressured dual media layer filter Steel inside of filter lining with rubber sheet Gravel-Sand-Anthracite Manhole, nozzles, piping, sight glass, etc.	2 sets
P-101	Sea water pump Material Motor Accessories	Volute centrifugal pump SCS14/SUS316 Outside, 220V x 3 ϕ x 60 Hz x 3.7 kW, TEFC, insulation class JIS E Common bed, coupling etc.	1 set
P-102	Back washing pump Motor	Pumps type and material is same as P-101. Outside, 220V x 3 ϕ x 60 Hz x 1.5 kW, TEFC, insulation class JIS E	1 set
P-103	Back washing air blower Material Motor Accessories	Roots blower, three blade helical Cast iron Outside 220V x 3 ϕ x 60Hz x 1.5 kW, TEFC, insulation class JIS E Common bed, V belt/pulley, silent cleaner, relief valve etc.	1 set
P-105	Waste pump Material Motor	Volute centrifugal pump SCS-14/SUS-316 Outside, 220V x 3 ϕ x 60 Hz x 1.5 kW, TEFC, insulation class JIS E	1 set

Item	Equipment Name	Specification	Q'ty
UV- 101	UV sterilizer Capacity Material Accessories	Ultra violet ray type 7.5 m ³ /h Hard glass, SUS 316 Setting bed, controller, etc.	1 set
FI- 101 - 103	Flow indicator Material	Rotor-meter type For sea water feed, back washing, back washing air SUS 316 or plastic	3 sets
PI- 101 - 106	Pressure indicator Material Piping & valve Material Valve Automatic valve	Bourdon tube type SUS 316, plastic Class JIS 10K type Plastic pipe & fitting JIS 10K type gate, ball valve plastic made JIS 10K air torque cylinder type diaphragm Valve (PVC) Steam pressure regulating valve (PVC) Heated steam automatic shut down valve (TASV) Cast iron line with rubber made sample valve, etc. Strainer, Steam trap, etc.	8 sets 1 set
	Indicator board Material	Pressure & flow indicators setting Steel	1 set
	Skid Accessories	Shape steel made Anchor bolt, others Note: Instruments such as LSA-101, 102, 103 AB etc. are listed in Section 700.	1 set
P-401	Air compressor Discharge pressure Motor Accessories	Oilless baby compressor 7 kg/cm ² , automatic pressure control Outside, 220V x 3φ x 60Hz x 4P x 3.7 kW, TEFC, insulation Class JIS E Bed, V belt/pulley, air receiver, safety valve, etc.	1 set

Fouling Index Automatic Indicating Recorder

Item	Equipment Name	Specification	Q'ty
FIR-101	FI meter Sampling & measuring part Controlling part Power source	Automatic sampling, measuring, indicating and recorder for filtered seawater fouling index Automatic operation Digital printer, sequence controller 110V x 1 ϕ x 60Hz x 0.5 kW	1 set

Chemical Feeder Section-500

Item	Equipment Name	Specification	Q'ty
T-501	Sodium hypochlorite solution tank (NaHClO) Material Accessories	Square type 200 l capacity Plastic Level indicator, etc.	1 set
T-502	Ferric chloride solution tank (FeCl ₃)	Same as T-501	1 set
T-503	Sulfuric acid solution tank (H ₂ SO ₄)	Same as T-501	1 set
T-504	Sodium bisulfite solution tank	Same as T-501	1 set
P-501AB	Sodium hypochlorite injection pump Accessories Motor	Constant flow injection diaphragm pump Pump bed, pump cover, etc. 220V x 3φ x 60Hz x 0.03 kW, Tropical insulation treated	2 sets
P-502	Ferric chloride injection pump	Same as P-501	1 set
503AB	Sulphuric acid	Same as P-501. Note: P-503B pump operation (ON-OFF) is controlled by PHRA-301.	2 sets
504ABC	Sodium bisulfate injection pump	Same as P-501. Note: 1) P-504C pump operation is controlled by ORPA-201 and timer program. 2) P-504AB pumps inject 40 ppm SBS for normal operation, P-504C inject 500 ppm SBS for shock treatment.	3 sets

Item	Equipment Name	Specification	Q'ty
FIR-101	Piping & valve	Pump suction valve (non-return with strainer) Pump delivery valve (non-return with siphon protector) Braid hose, hose band, etc.	1 set
	Mixing bar Material	For chemical tank PVC	4 sets
	Skid Accessories	Shape steel made Anchor bolts, others Note: 5 tanks (one is S/P tank) and 8 pumps shall be installed and mounted on the same skid.	1 set

Spiral wound type Reverse Osmosis Equipment Section-200

Item	Equipment Name	Specification	Q'ty
T-201	Feed tank Material Capacity Accessories	Vertical, cylindrical, closed type Polyethylene 1.5 m ³ Level indicator, nozzles, overflow pipe, drain valve, manhole, bolt-tap, anchor bolt, etc.	1 set
T-202	Permeate tank Capacity Accessories	Vertical, cylindrical, closed type and polyethylene make. 1.0 m ³ Level indicator, nozzles, overflow pipe, drain valve, anchor bolt, etc.	1 set
P-201	Feed water supply pump Material Motor Accessories	Centrifugal pump SCS-14 Outside, 220V x 3 ϕ x 60Hz x 1.5kW, TEFC, insulation class E Common bed, coupling, etc.	1 set
P-202	Booster pump Material Motor Accessories	Centrifugal pump SCS-14 220V x 3 ϕ x 60Hz x 3.7 kW Common bed, coupling, etc.	1 set
P-203	High pressure pump Material Motor Accessories	Variable flow 20 - 100%, triplex plunger pump SCS-14/SUS-316 Plunger: Ceramic coating 220V x 3 ϕ x 60Hz x 300 - 1,375 rpm x 15 kW, VS motor, TEFC, insulation class E Common bed, driving system, relief valve, accumulator, etc.	1 set
HE-201	Feed preheater Capacity Design pressure Material	Plate type heat exchanger 45,000 Kcal/h 5 kg/cm ² Heating surface; titanium or equivalent equal	1 set

Item	Equipment Name	Specification	Q'ty
HE-202	Feed heater Capacity Material Design pressure	Plate type Steam supply : max. 90 kg/hr : saturated steam of 8 kg/cm ² /g Supply water temperature is to be automatic- controlled up to max. 50°C Titanium or equivalent equal 5 kg/cm ²	1 set
UV-201	UV sterilizer Capacity Material Design pressure Accessories	Ultra violet ray type 3.5 m ³ /hr Hard glass, SUS 316 5 kg/cm ² Setting bed, controller, etc.	1 set
F-201AB	Safety filter Capacity Material Design pressure	Cartridge filter type 3.5 m ³ /h x 20 micron Filter element: polypropylene Housing: Polycarbonate 5 kg/cm ²	2 sets
RO-201 ABC	RO membrane module RO membrane element RO vessel Accessories	Spiral wound type 8"φ x 6 elements FRP made 2 elements x 3 vessels Max. applied pressure x temperature 70 kg/cm ² x 50°C RO element/Vessel parts	1 set
FI- 201 - 202	Flow indicator for permeate, brine Material	Rotor meter type panel mounted Taper tube-hard glass Other: SUS 316 or plastic	2 sets
PI- 201 - 206	Pressure indicator Material	Bourdon tube type panel mounted D model SUS 316/plastic case Note: PI-204, 205 are vibro-isolating type	6 sets

Item	Equipment Name	Specification	Q'ty
TI- 201 - 204	Thermometer	Local mounted scale 0 - 100°C with protecting tube, SUS 316 made	4 sets
PSA-201	Pressure switch	Bellows or bourdon tube type	1 set
	Material	SUS 316	
	Setting pressure	0 - 3 kg/cm ²	1 set
	Indicator board	Steel plate is stainless steel.	1 set
		Mount pressure, flow indicators, pressure switch and name plate, etc.	
	Piping & valve	High pressure side;	1 set
		Stainless steel pipe SUS-316 TP, high pressure rubber hose, victaulic coupling, flange and fitting, valve	
	Valve: 600 lbs. type stainless steel made		
	Low pressure side;		
	Plastic pipe, rubber, plastic hose, JIS 10K flange and fitting,		
	Valve: JIS 10K plastic made ball, globe, gate valve, etc.		
	Sampling valve: Stainless steel, plastic made		
	Automatic control valve, Diaphragm valve, drain trap, etc.		
Skid	Shape steel made	1 set	
Accessories	Anchor bolt, others		
	Note: Instrument such as TC-201, TR-201, ORPA-201, CR-201, LSA-201, TA-201, etc. are listed in SECT-700.		
Special parts	Setting parts for other foreign spiral wound RO module	1 set	
	Note: Other module (RO element) is U.S.A. UOP Fluid System model TFC-1501 PA		

Hollow fiber type Reverse Osmosis Equipment Section-300

Item	Equipment Name	Specification	Q'ty
T-301	Feed tank Material Capacity Accessories	Vertical, cylindrical closed type Polyethylene 1.5 m ³ Level indicator, nozzles, overflow pipe, drain valve, manhole, ladder, ball-tap, anchor bolt, etc.	1 set
T-302	Permeate tank	Same as T-202 Note: Without ball-tap	1 set
P-301	Feed water supply pump Material Motor Accessories	Centrifugal pump SCS-14 Outside 220V x 3 ϕ x 60Hz x 1.5 kW, TEFC, insulation class E Common bed, coupling, etc.	1 set
P-302	Booster pump Material Motor Accessories	Centrifugal pump SCS-14 220V x 3 ϕ x 60Hz x 3.7 kW Common bed, coupling, etc.	1 set
P-303	High pressure pump Material Motor Accessories	Variable flow 20 – 100%, triplex plunger pump SCS-14/SUS-316 Plunger: Ceramic coating 220V x 3 ϕ x 60Hz x 300 – 1,375 rpm x 15 kW, VS motor, TEFC, insulation class E Common bed, driving system, relief valve, accumulator, etc.	1 set
HE-301	Feed preheater	Same with HE-201	1 set
HE-302	Feed heater	Same with HE-202	1 set

Item	Equipment Name	Specification	Q'ty
UV-301	UV Sterilizer Capacity Material Design pressure Accessories	Ultra violet ray type 3.5 m ³ /hr Hard glass and stainless steel 5 kg/cm ² Setting bed, controller, etc.	1 set
F-301AB	Safety Filter Capacity Material Design pressure	Cartridge filter type 3.5 m ³ /h x 10 micron meter Filter element: Polypropylene Housing: Polycarbonate 5 kg/cm ²	2 sets
RO-301AB	RO membrane module	RO membrane module: Hollow fiber type 2 elements (8"φ) x 1 module 1 element(8"φ) x 1 module Max. applied pressure x temperature 65 kg/cm ² x 50°C	1 set
FI- 301 - 302	Flow indicator Material	Rotor meter type panel mounted For permeate, brine Taper tube: Hard glass Other: Stainless steel or plastic	2 sets
PI- 301 - 306	Pressure indicator Material	Bourdon tube type panel mounted model D Stainless steel/plastic case Note: PI-304 – 305 are vibro-isolating type	6 sets
TI- 301 - 304	Thermometer	Local mounted scale 0 – 100°C with protecting tube SUS-316 made	4 sets
PSA-301	Pressure switch Material Setting pressure Indicator board	Bellows or bourdon tube type Stainless steel 0 – 3 kg/cm ² Steel plate or stainless steel. Mounted pressure, flow indicators, pressure switch and name plate, etc.	2 sets 1 set

Item	Equipment Name	Specification	Q'ty
PSA-301 (Cont'd.)	Piping & Valve	<p>High pressure side; SUS-316 TP, high pressure rubber hose, victaulic coupling, flange and fitting Valve: 600 lbs. type stainless steel made</p> <p>Low pressure side; Plastic pipe, rubber and plastic hose, JIS 10K flange and fitting Valve: JIS 10K type plastic made ball, glove, gate valve, etc.</p> <p>Automatic control valve (CV), diaphragm valve, drain trap, etc.</p>	1 set
	Skid Size Accessories	<p>Shape steel made Approx. 3,000 L x 2,000 W mm Anchor bolt, others Note: Instruments such as TC-301, TR-301, PHRA-301, CR-301, LSA-301, TA-301 are listed in SECT. 700.</p>	1 set
	Special parts	<p>Setting parts for other foreign hollow fiber type RO module. Note: Other module is U.S.A. DuPont Permasep B-10 model 6840-060 x 1 module.</p>	1 set

Item	Equipment Name	Specification	Q'ty
TC- 201 - 301	Temperature controller	Temperature indicating-controlling instrument using air pressure	2 sets
ORPA-201	Oxidation reduction potential with alarm	Electrode type with alarm (range: -700 - 700mV) Sensor, electrode holder, Special cable	1 set 1 each 1 set
PHIA-301	pH recorder with alarm	Glass electrode type recorder with alarm (range 0 - 14 pH) Electrode, electrode holder Special cable	1 set 1 each 1 set
CR- 201 - 301	Conductivity recorder	2-pen conductivity recorder (range: 0 - 1,000 μ S/cm) Electrode Special cable	1 set 2 sets 1 set
LSA-101 -201 -301 -103AB	Level switch	Conductivity type level switch	6 sets
TA- 201 - 301	Temperature switch		1 set

Piping and Wiring Materials

Item	Equipment Name	Specification	Q'ty
	Scope of Supply for piping and wiring materials inside of battery limit shown in flow sheet and plot plan of this test plant.		
	Piping material	Sea water intake pipe Waste, steam and concentrate discharge pipe, sea water, filtered water, product concentrate, etc.	1 set
	Material	Pipes between each equipment and tank. Chemical injection pipe 10 - 80 mm ϕ plastic pipe (pvc) and fitting JIS 10K class plastic flange. 15 - 25 mm ϕ SGP & SUS-316 pipe & fitting, JIS 10K class 8 mm ϕ plastic braid hose, vinyl hose, hose hand, pipe fitting, etc.	
	Valve	JIS 10K class, BC or FC, PVC Globe, ball, check valves, Sampling valve, etc.	1 set
	Other	Drain trap, strainer, etc.	1 set
	Wiring material	Wiring material between control panel and electrical equipment and instruments.	1 set
	Pneumatic pipe air set		
	Power cable	CV cable type	
	Control cable	CVV cable type	
	Instrument cable	CVV cable type and special type	
	Wiring pipe	Steel pipe for wiring	
	Flexible wiring pipe	Flexible wiring pipe covered with vinyl	
	Supporting material, etc.	Hard vinyl pipe & fitting	

Apparatus and tool for Operation and Maintenance

Item	Equipment Name	Specification	Q'ty
	Apparatus	Portable measuring instruments and mess cylinder, sampling bottle, etc. for daily operation and maintenance.	1 set
	Portable fouling index meter	Pressure water vessel, FI filter, baby compressor, etc.	1 set
		Portable pH meter	1 set
		Portable conductivity meter	1 set
		Portable dissolved oxygen meter	1 set
		Portable residual chlorine meter	1 set
		Thermometer 0 – 100°C	2 sets
		Mess-cylinder, bottle, filter paper, etc.	1 set
	Tools	Tools for daily operation and maintenance	1 set
	Ordinary tool	Spanner, pench, hammer, driver, metal saw etc. and tool box.	
		Waste cloth, fitting material for piping, glue, seal gasket, maintenance paint, etc.	
		Buckets	
	Special tool	Special tool for overhaul and fabrication of pump and RO module.	
	Spare parts and reagent	For one year operation	1 set

Chemical for Operation and Maintenance

Item	Equipment Name	Specification	Q'ty
	Chemicals for one year operation and maintenance	Note: Not include chemicals (Sulfuric acid, sodium hypochlorite)	1 set
	Ferric chloride	34% conc. FeCl ₃ drum can	800 kg
	Sodium bisulfite	95% more conc. S.B.S. vinyl bag	2,400 kg
	Sodium hexametaphosphate	98% more conc. S.H.M.P. vinyl bag	200 kg
	Citric acid	98% citric acid vinyl bag	120 kg
	Ammonia	25% ammonia 20ℓ plastic bottle	60 ℓ
	Formaline	34% Formaldehyde 20 ℓ plastic bottle	100 kg
	Membrane treatment agent		1 set

(2) MSF Test Plant

Item No.	Equipment Name	Specification	Q'ty
1	Evaporator Type Capacity No. of stage Operating system Scale control system Performance ratio Material	Cross tube type multi stage distillation 20 m ³ /D [in operation under pH control rated output] Heat recovery section: 4 stages Heat rejection section: 2 stages Brine recirculation system [also operative as once-through system] pH control system [also operative as chemical injection system] 2.5 [rated output, pH control operation] Plate & partition : 90/10 Cu-Ni Tube 16 mmφ x 1t : 90/10 Cu-Ni Tube sheet : 90/10 Cu-Ni Internal parts : 90/10 Cu-Ni Demister : SUS 316 Connection pipe between water-box : 90/10 Cu-Ni Pipe for brine loopseal : 90/10 Cu-Ni Pipe for distillate loopseal : 90/10 Cu-Ni	1 set
2	Brine Heater Type Material	Shell & tube Shell : Carbon steel Tube 16 mmφ x 0.5t : Titanium Tube sheet : 90/10 Cu-Ni Water box [with Anode] : 90/10 Cu-Ni	1 set

Item No.	Equipment Name	Specification	Q'ty
3	Vacuum System		1 set
3-1	Ejector		1 set
	Type	Two stage jet steam ejectors	
	Material	Mixing chamber : SUS 304	
		Nozzle : SUS 304	
		Diffuser : SUS 304	
3-2	Ejector Condenser		1 set
	Type	Shell & Tube	
	Material	Shell : SUS 316	
		Tube 16 mm ϕ x0.4t : Titanium	
		Tube sheet : Titanium	
		Water-box : C.S. + Neoprene rubber lining [3t]	
		Tube support : SUS 316	
4	Deaerator and Decarbonator		
4-1	Deaerator		1 set
	Type	Vertical cylinder	
	Performance	DO concentration : 20 ppb or less	
	Capacity	8 m ³ /h	
	Material	Shell : C.S. + Neoprene rubber lining [3t]	
		Internal parts : SUS 316. FRP	
4-2	Decarbonator		1 set
	Type	Spray tray type	
	Performance	Decarbonation efficiency : 80% or more	
	Capacity	8 m ³ /h	
	Material	Shell : C.S. + Neoprene rubber lining [3t]	
		Internal parts : SUS 316	

Item No.	Equipment Name	Specification	Q'ty
5.	Pump & Motor		
5-1	Brine recirc. pump Type Capacity) Head) NPSH Material	Horizontal centrifugal Surplus 10% or more determined by MFR 0.5 m [NPSHav – NPSHreq] Casing, impeller : SCS 14 Shaft : SUS 316	2 sets [1 set is spare of warehouse]
5-2	Make-up pump Type Capacity) Head) NPSH Material	Horizontal centrifugal Surplus 10% or more determined by MFR 0.5 m [NPSHav – NPSHreq] Casing, impeller : SCS 14 Shaft : SUS 316	2 sets [1 set is spare of warehouse]
5-3	Distillate pump Type Capacity) Head) NPSH Material	Horizontal centrifugal Surplus 10% or more determined by MFR 0.5 m [NPSHav – NPSHreq] Casing, impeller : SCS 13 Shaft : SUS 304	2 sets [1 set is spare of warehouse]
5-4	Acid injection pump Type Capacity) Head) Material	Controlled volume, diaphragm 10 m ltr/min. 70 mAq Diaphragm : Teflon Body : SCS 14	2 sets [1 set is spare of warehouse]

Item No.	Equipment Name	Specification	Q'ty
5-5	Anti-scale chemical injection pump Type Capacity Head Material	Controlled volume, diaphragm 10 m ltr/min 70 mAq Mf'R St'd	2 sets [1 set is spare of warehouse]
5-6	Anti-foam injection pump Type Capacity Head Material	Controlled volume, diaphragm 5 m ltr/min. 70 mAq Mf'R St'd	2 sets [1 set is spare of warehouse]
5-7	Sodium bisulfite injection pump Type Capacity Head Material	Controlled volume, diaphragm 5 m ltr/min 70 mAq Mf'R St'd	2 sets [1 set is spare of warehouse]
5-8	Acid cleaning pump Type Capacity Head Material	Centrifugal 30 ltr/min 20 mAq Mf'R St'd. [liquid end nonmetallic]	1 set
5-9	Motor for recirc. brine pump	TEFC, insulation class JIS B AC 220V x 3 ϕ x 60 Hz, 2p, 5.5 kW	2 sets [1 set is spare of warehouse]
5-10	Motor for make-up pump	TEFC, insulation class JIS B AC 220V x 3 ϕ x 60 Hz, 2p, 5.5 kW	2 sets [1 set is spare of warehouse]

Item No.	Equipment Name	Specification	Q'ty
5-11	Motor for distillate pump	TEFC, insulation class JIS B AC 220V x 3 ϕ x 60 Hz, 2p, 3.7 kW	2 sets [1 set is spare of warehouse]
5-12	Motor for acid injection pump	Insulation class JIS B	"
5-13	Motor for anti-scale chemical injection pump	Insulation class JIS B	"
5-14	Motor for anti-foam injection pump	Insulation class JIS B	"
5-15	Motor for sodium bisulfite injection pump	Insulation class JIS B	"
5-16	Motor for acid cleaning pump	Insulation class JIS B	1 set
6	Electric Instrumentation		
6-1	Motor control panel	Indoor type, self-standing Size: 700 [W]x 2,000 [H]x 400 [D] Power supply: AC 220V x 3 ϕ x 60 Hz AC 110V x 1 ϕ x 60 Hz [for control] Breaker : NFB Start method : Direct online Spare parts Overcurrent circuit: 3 elements Earth : Earth trip Stop lamp : Supply instrument panel Control switch : Supply on central panel & local	1 set

Item No.	Equipment Name	Specification	Q'ty
6-2	Instrument panel Recorder Adjuster Annunciator Push button Lamp	Indoor type, self-standing Size: 1400(W) x 2000(H) x 1200(D) Power supply: AC 110V x 1 ϕ x 60 Hz Design condition: temperature : 40°C relative humidity : 60% Same as 6-4	1 set
6-3	Electric instrumentation work materials	Wiring materials shall be provided for use in the test plant site: between the plant and instrument panel, motor control panel.	1 set
6-4	Panel instruments 6 point type recorder 2 pen type recorder 3 pen type recorder Indicator Indicator Ratio bias setter 2 point process alarm 1 point process alarm Annunciator	The instruments complying with the requirements shown in "Table of Instrument" shall be provided 1 - 5V resistance thermometer input 1 - 5V DC input 1 - 5V DC input 1 - 5V DC input 1 - 5V DC input 1 - 5V DC input 1 - 5V DC input 1 - 5V DC input 1 - 5V DC input 1 - 5V DC input Abnormal on light, test push button, acknowledge push button, reset push button, push button lamp, R/V converter trans., distributor	1 set

Item No.	Equipment Name	Specification	Q'ty
6-5	Local transmitters	<p>The transmitters complying with the requirements shown in "Table of Instrument" shall be provided.</p> <p>Differential pressure transmitter 4 – 20 mA DC output 5 sets</p> <p>Pressure transmitter 3 sets</p> <p>Pneumatic level controller 0.2 – 1.0 kg/cm², displacement type 3 sets</p> <p>Level transmitter 4 – 20 mA DC output 2 sets</p> <p>Conductivity meter 4 – 20 mA DC output, direct mounted 2 sets</p> <p>pH meter 4 – 20 mA DC output 2 sets</p> <p>Orifice plate Flange tap or ring tap, SUS 316 5 sets</p> <p>Thermal resistance Pt 100, 3 wire type 7 sets</p> <p>Local pressure gauge Dial type 100 φ, bourdon tube 17 sets</p> <p>Local thermometer Glass type, attached thermowell 17 sets</p> <p>Level gauge Glass type 5 sets</p> <p>Level gauge Float type 1 set</p> <p>Differential pressure transmitter 4 – 20 mA DC output 3 sets</p> <p>Dissolved oxygen meter Range 0 – 0.2/1/5/20 ppm 2 sets</p>	1 set

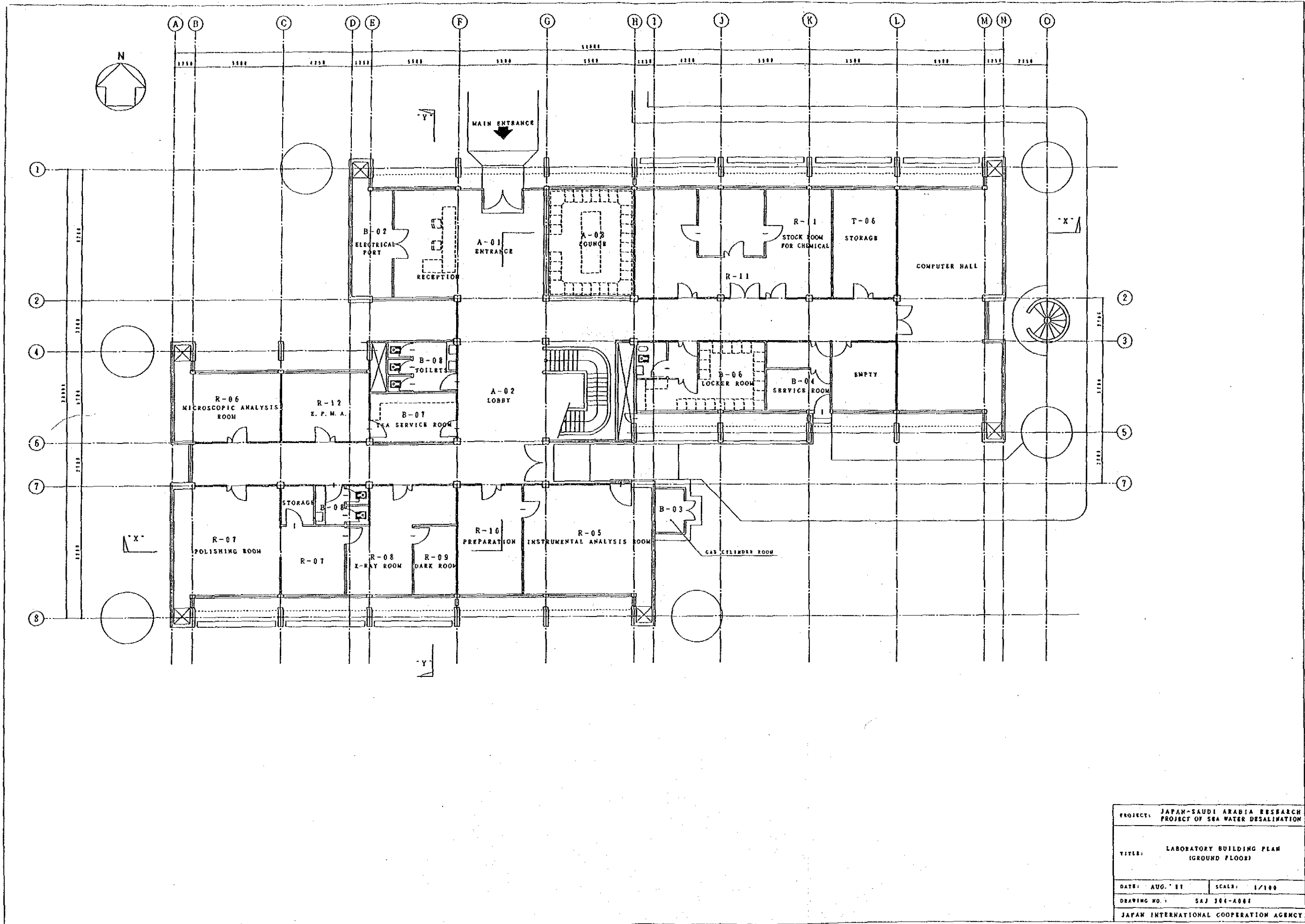
Item No.	Equipment Name	Specification	Q'ty
6-6	Control valve Flow C/V for desuperheater Pressure C/V for B/H steam Temperature C/V for brine Level C/V for brine 3-way valve for distillate online and distillate damp Flow C/V for seawater Level C/V for deaerator ON-OFF valve for ejector steam Flow C/V for brine Level C/V for B/H condensate	Globe valve, serial control, attached positioner, SCPH/SUS 316 each 1 set Globe valve, serial control, attached positioner, SCS 14/SUS 316 1 set Ball valve, SCS 14/SUS 316 1 set Butterfly valve, serial control, attached positioner, FC20+ rubber lining/SUS 316 1 set Globe valve, serial control, attached positioner, SCS 14/SUS 316 1 set Globe valve, ON-OFF control, electromagnetic valve, SCPH 1 set Globe valve, serial control, attached positioner, SCS 14/SUS 316 1 set Globe valve, serial control, attached positioner, SCPH/SUS 316 1 set	1 set

Item No.	Equipment Name	Specification	Q'ty
8-2	Anti-scale chemical tank	Capacity : 100 ltr. Material : SUS 316	1 set
8-3	Anti-foam chemical tank	Capacity : 25 ltr. Material : SUS 316	1 set
8-4	Sodium bisulfite tank	Capacity : 25 ltr. Material : SUS 316	1 set
8-5	Flash tank	Capacity : 150 ltr. Material : SUS 304	1 set
8-6	Acid cleaning tank	Capacity : 300 ltr. Material : Polyethylene	1 set
8-7	Sulfuric acid mixer	Material : FRP	1 set
8-8	Anti-scale chemical mixer	Material : SUS 316	1 set
8-9	Anti-foam chemical mixer	Material : SUS 316 Manual type	1 set
8-10	Sodium bisulfite mixer	Material : SUS 316 manual type	1 set
8-11	Seawater strainer	Material : BC3, SGP + Rubber lining	1 set
8-12	Frames, platforms and baseplates	* Appropriate frames, platforms and base- plates shall be provided to facilitate operation. * A lifting device shall be installed to take out the brine heater and evaporator tube bundle.	1 set
8-13	Ball cleaning system	The tube of brine heater and the recovery section shall be cleaned with sponge balls during operation.	1 set

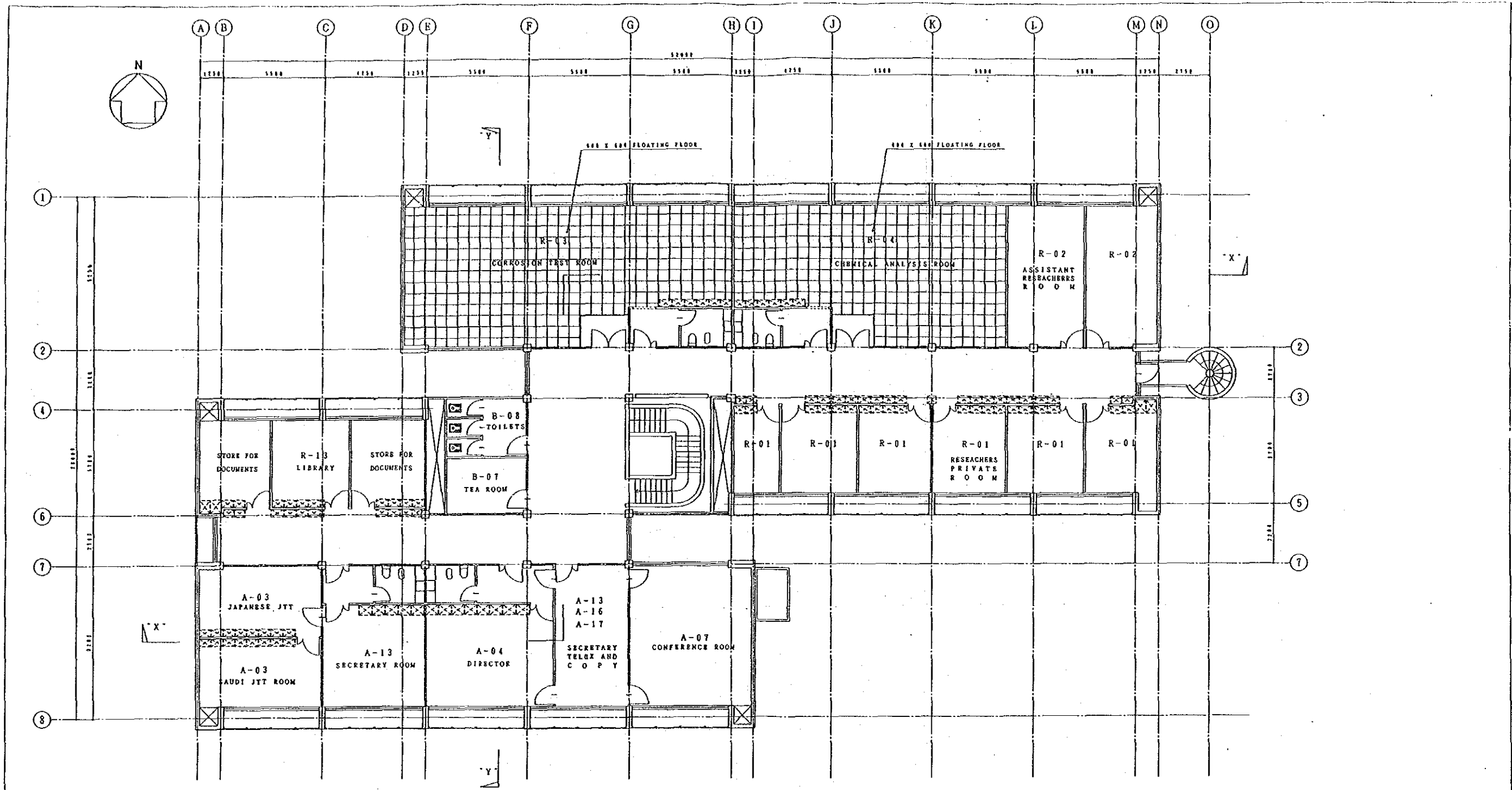
Item No.	Equipment Name	Specification	Q'ty
9	Boiler system	Indoor type	
9-1	Boiler		1 set
	Type	Once-through, water tube type	
	Equivalent evaporation	1,000 kg/h	
	Max. steam press.	10 kg/cm ²	
	Efficiency	85% or more	
	Oil consumption	68.7 ltr/h [A heavy oil bunker C]	
	Oil heater	Electric system	1 set
	Insulation		1 set
9-2	Fuel tank	Capacity : 10 m ³ Material : CS	1 set
	Oil heater	Electric system	1 set
	Insulation		1 set
9-3	Boiler feed tank	Capacity : 3 m ³ Material : CS, resine coating	1 set
9-4	Boiler feed water pump		1 set
	Type	Horizontal centrifugal	
	Capacity	1.3 m ³ /h	
	Head	Surplus 10% or more determined by MfR	
	NPSH	0.5 m [NPSHav – NPSHreq]	
	Material	MfR St'd.	
9-5	Accessories	Chemical injection system, etc.	1 set
10	Spare parts	For one year	1 set

4. Major Drawings for the Research Center

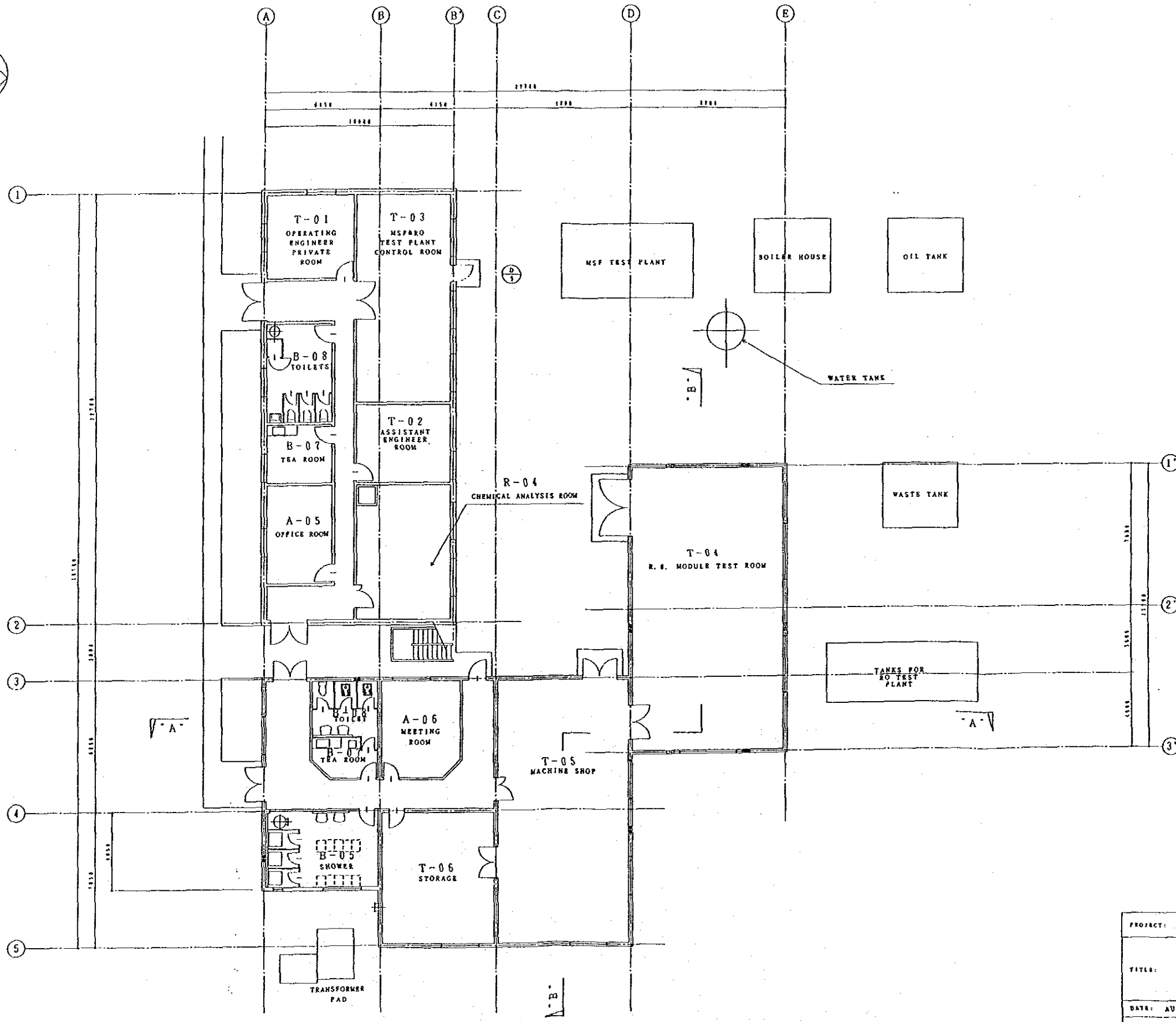
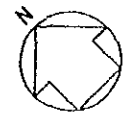
- * Laboratory building plan (ground floor)
- * Laboratory building plan (first floor)
- * Test plant building plan
- * Laboratory equipment lay-out (Laboratory bldg. ground fl.)
- * Laboratory equipment lay-out (laboratory bldg. 1st fl.)
- * Laboratory equipment lay-out (new bldg.)
- * Laboratory equipment lay-out (existing control room)
- * Plot plan of MSF & RO Test Plant
- * Test plant plot plan



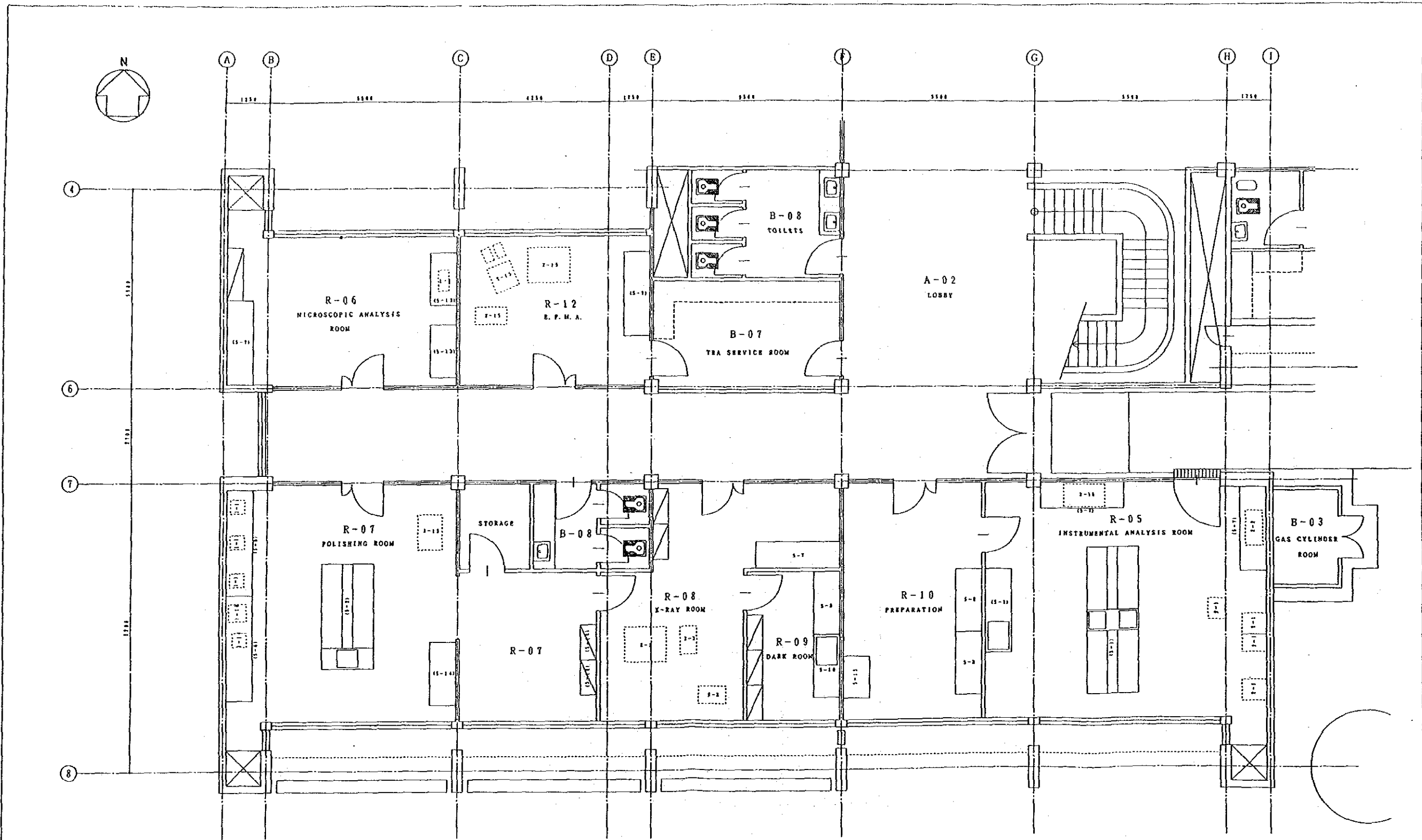
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JAPAN INTERNATIONAL COOPERATION AGENCY	



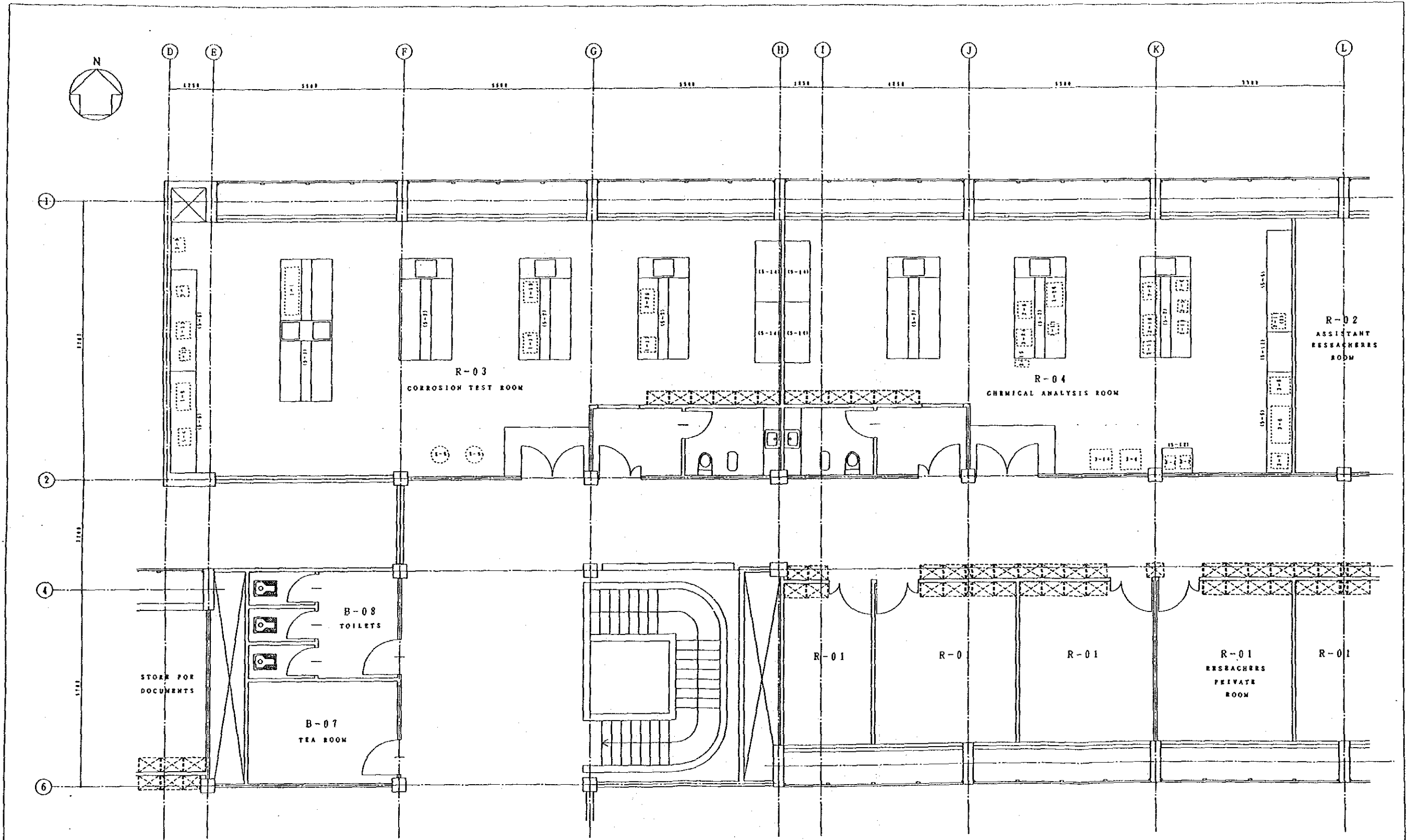
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DATE: AUG. '81	SCALE: 1:100
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JAPAN INTERNATIONAL COOPERATION AGENCY	



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JAPAN INTERNATIONAL COOPERATION AGENCY	



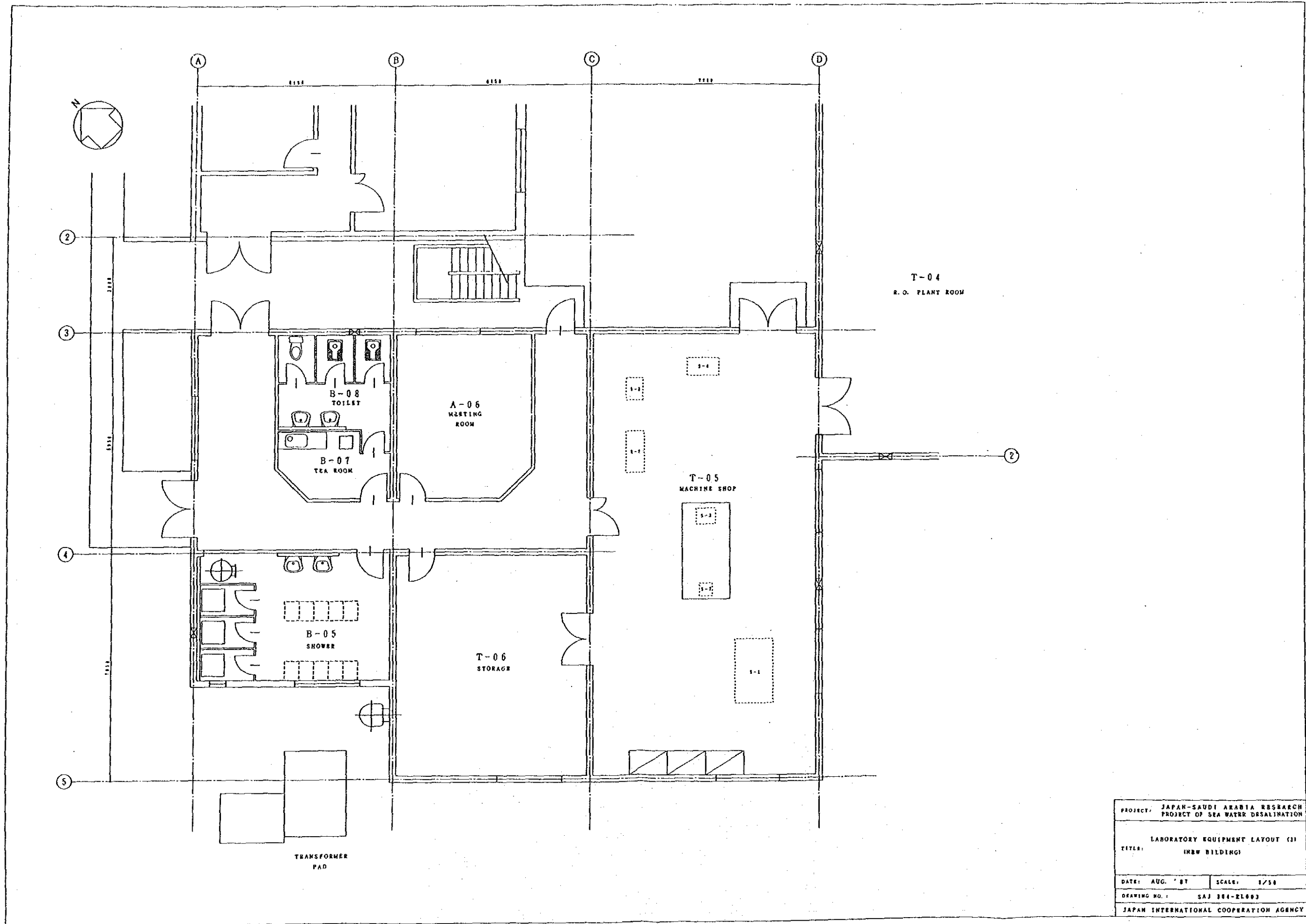
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PROJECT OF SEA WATER DESALINATION

TITLE: LABORATORY EQUIPMENT LAYOUT (S)
(LABORATORY BUILDING FIRST FLOOR)

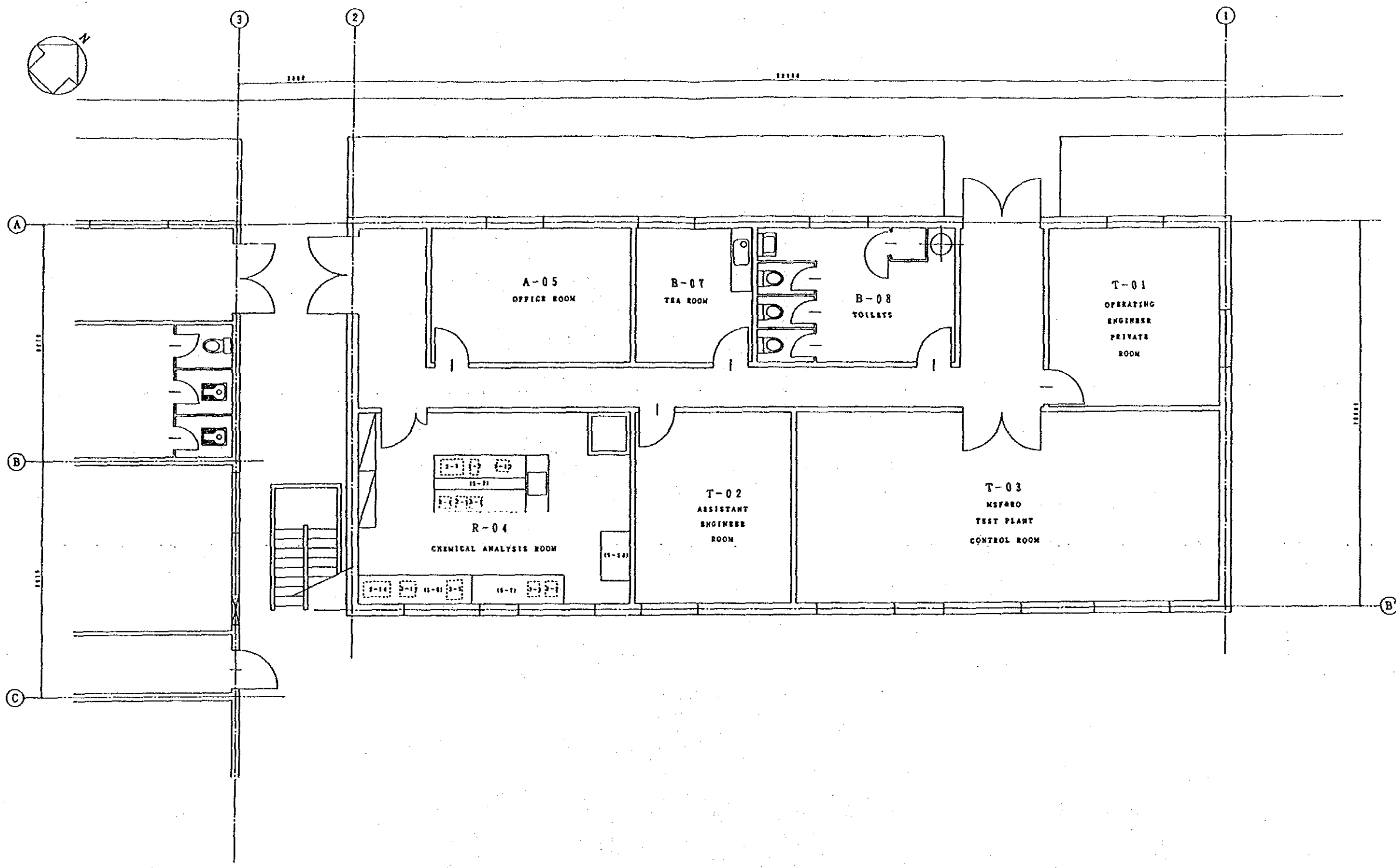
DATE: AUG. '87 SCALE: 1/50

DRAWING NO.: SAJ 304-BL002

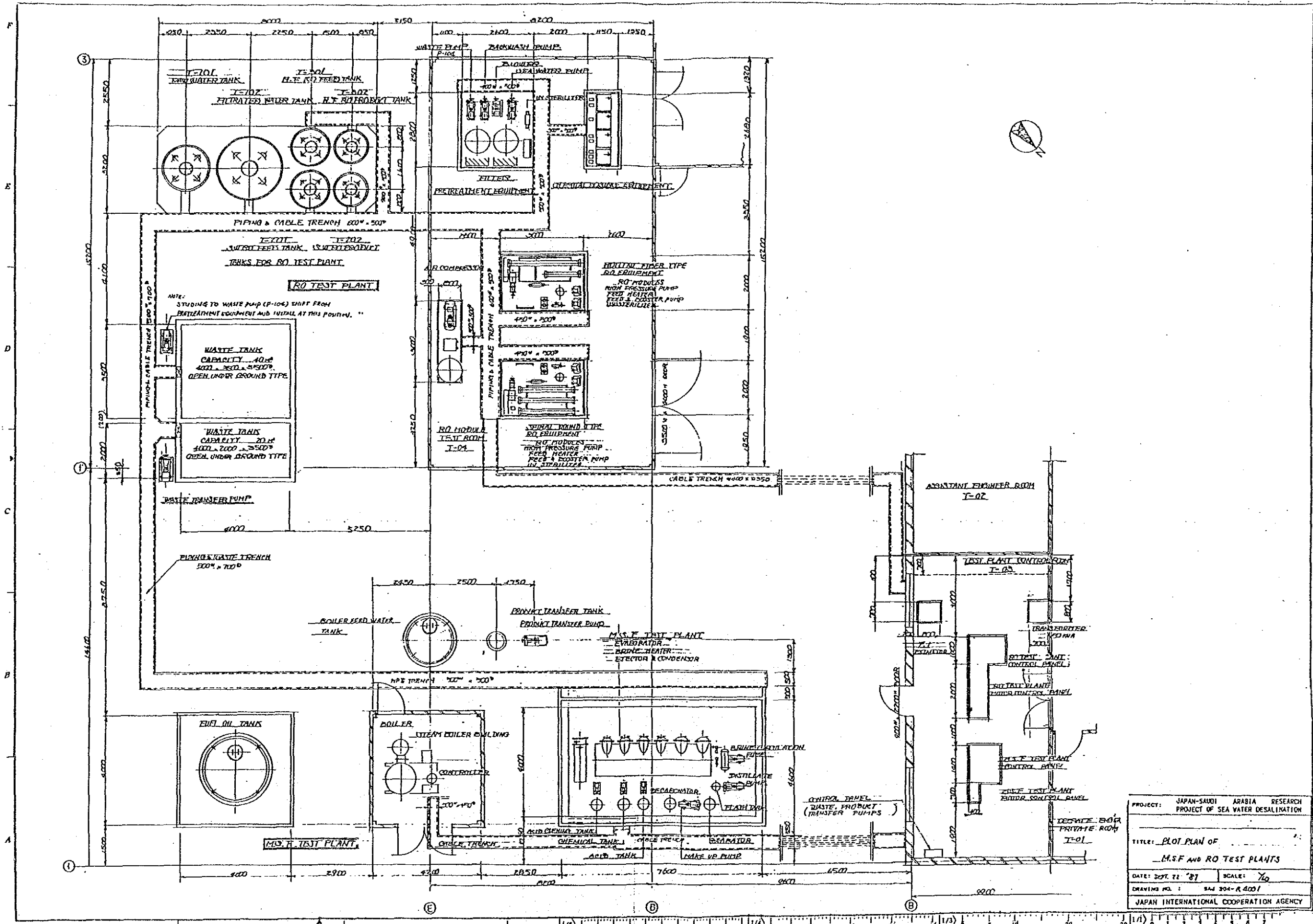
JAPAN INTERNATIONAL COOPERATION AGENCY



PROJECT: JAPAN-SAUDI ARABIA RESEARCH PROJECT OF SEA WATER DESALINATION	
TITLE: LABORATORY EQUIPMENT LAYOUT (I) (NEW BUILDING)	
DATE: AUG. '87	SCALE: 1/50
DRAWING NO.: SAJ 304-2L003	
JAPAN INTERNATIONAL COOPERATION AGENCY	



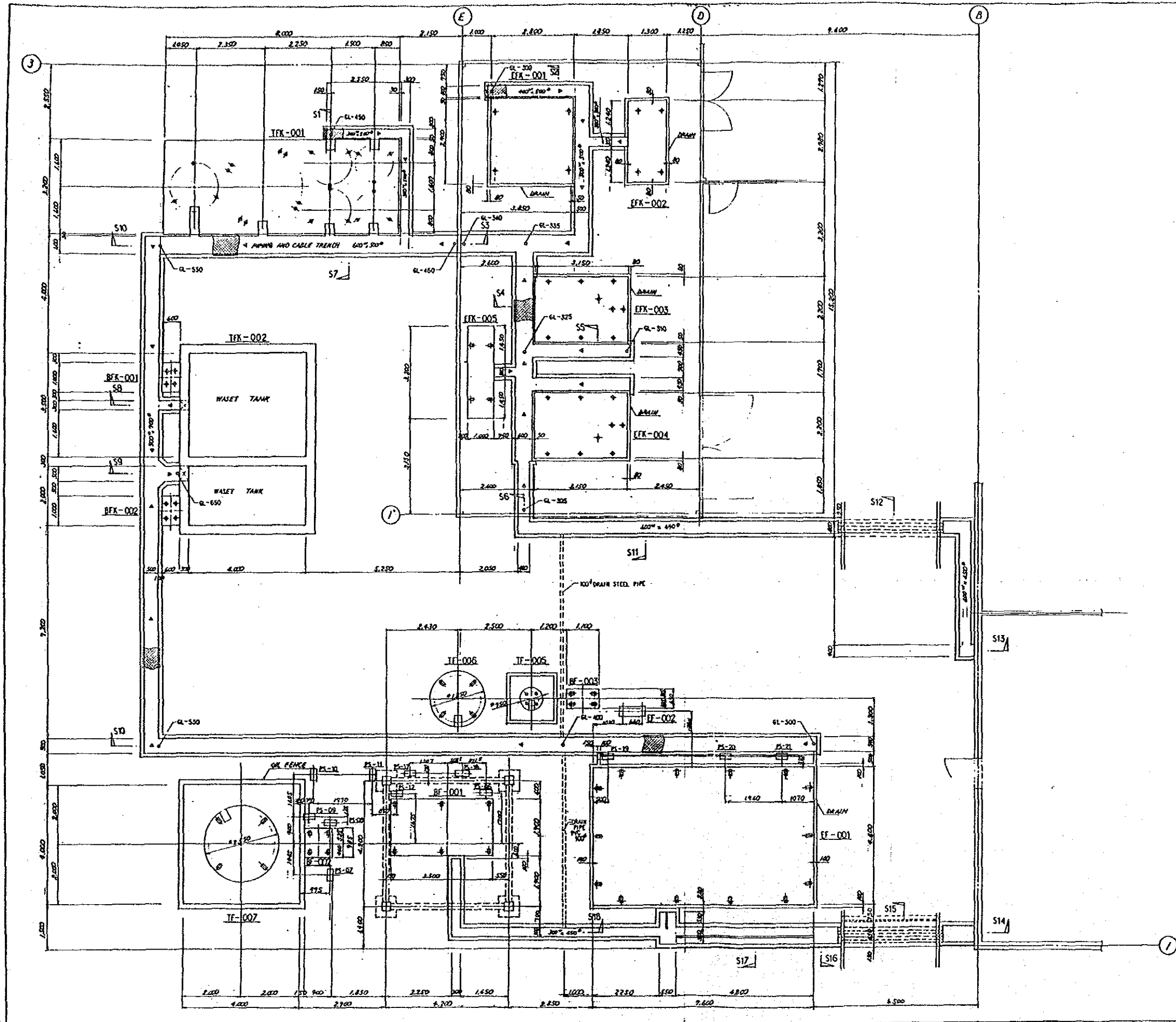
PROJECT: JAPAN-SAUDI ARABIA RESEARCH PROJECT OF SEA WATER DESALINATION	
TITLE: LABORATORY EQUIPMENT LAYOUT (1) (EXISTING CONTROL ROOM)	
DATE: AUG. '67	SCALE: 1/50
DRAWING NO.: SAI 384-51864	
JAPAN INTERNATIONAL COOPERATION AGENCY	



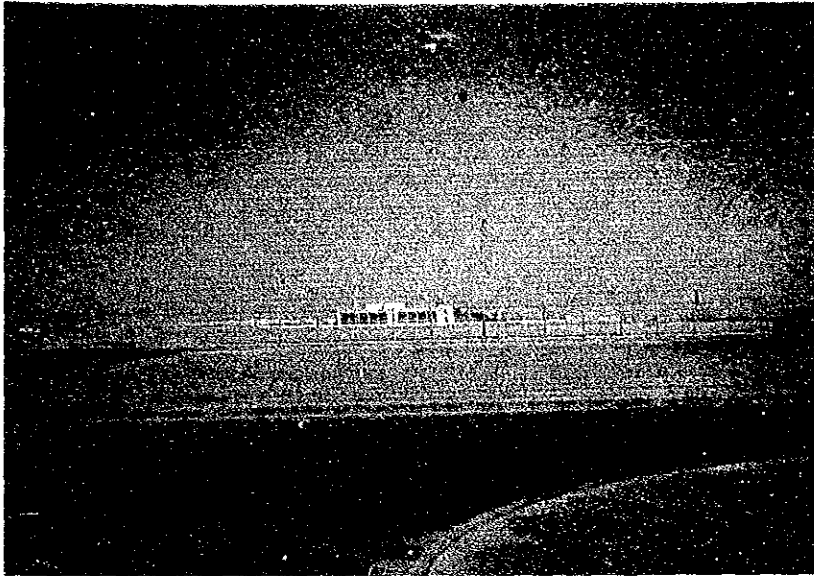
PROJECT:	JAPAN-SAUDI ARABIA RESEARCH PROJECT OF SEA WATER DESALINATION
TITLE:	PLOT PLAN OF M.S.F. AND RO TEST PLANTS
DATE:	NOV. 22 '87
SCALE:	1/50
DRAWING NO.:	SAJ 304-R.4001
JAPAN INTERNATIONAL COOPERATION AGENCY	

LEGEND

- ▽ GRADIENT OF TRENCH WAY
- ∠ LEVEL OF TRENCH WAY
- AS SYMBOL OF TRENCH DETAIL (REFER TO SAJ 304-J002)

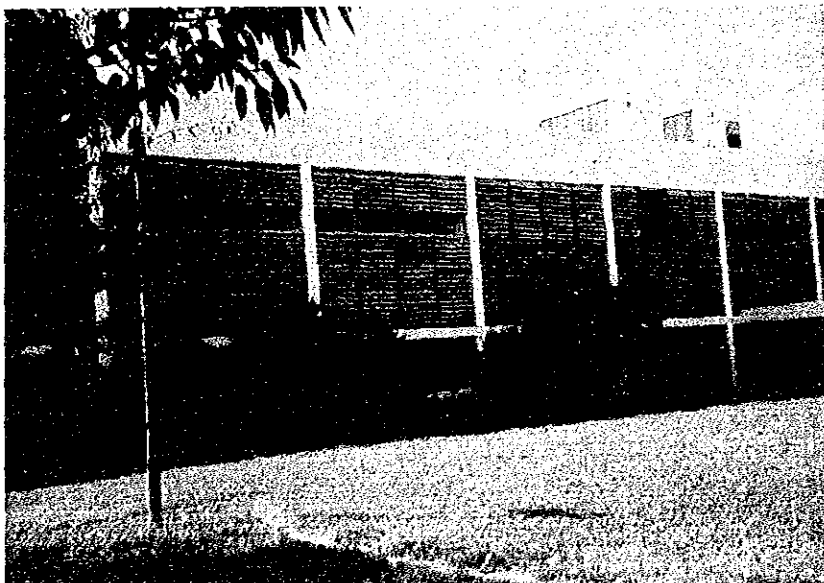
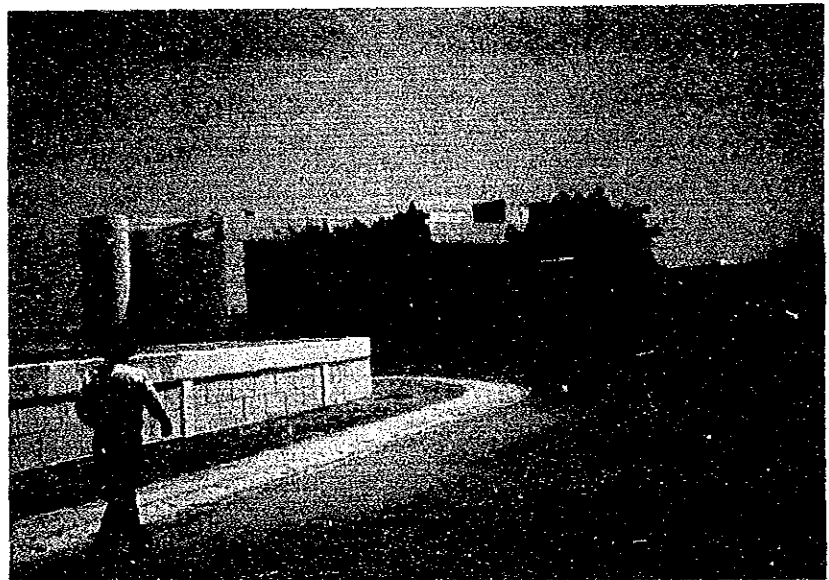


5. Photographs

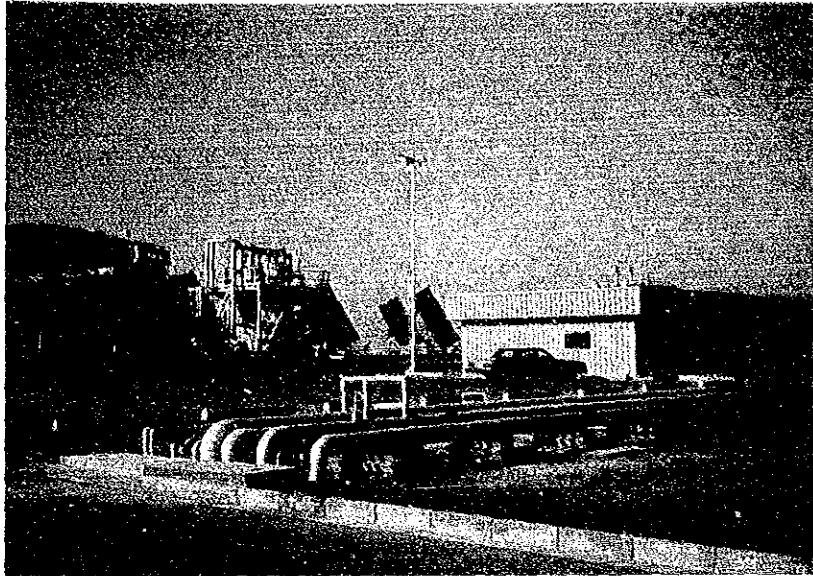


View of Existing Administration Building from Yanbu-Medina Power & Desalination Plant

View of Existing Administration Buildings from the gate

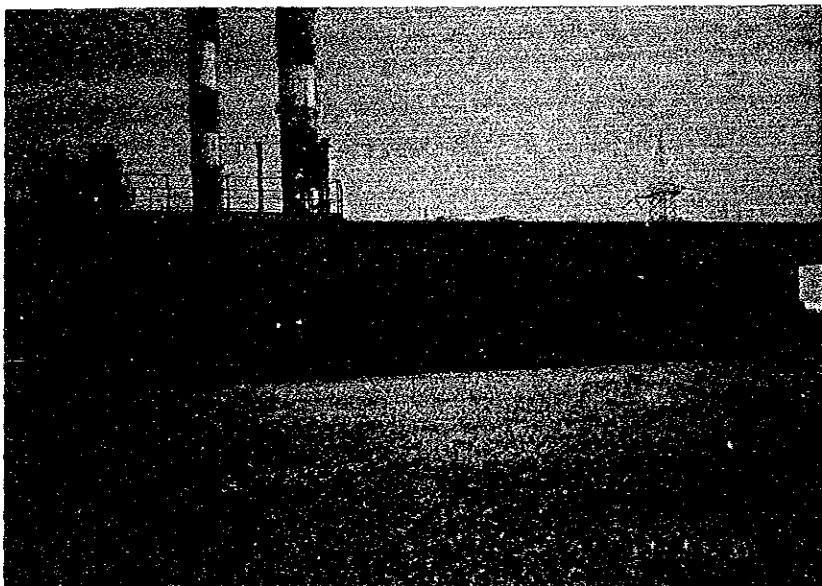
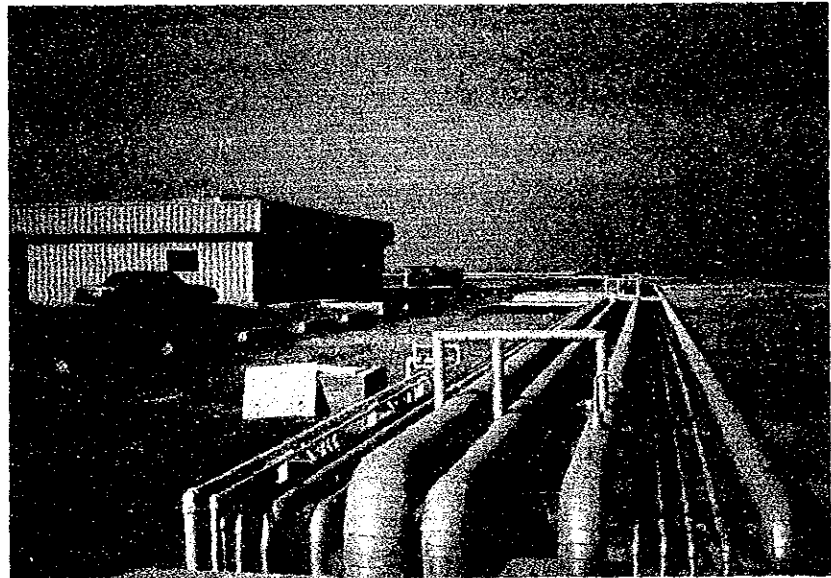


Near view of Existing Administration Building



Existing Control Room
for solar energy desalination
pilot plant

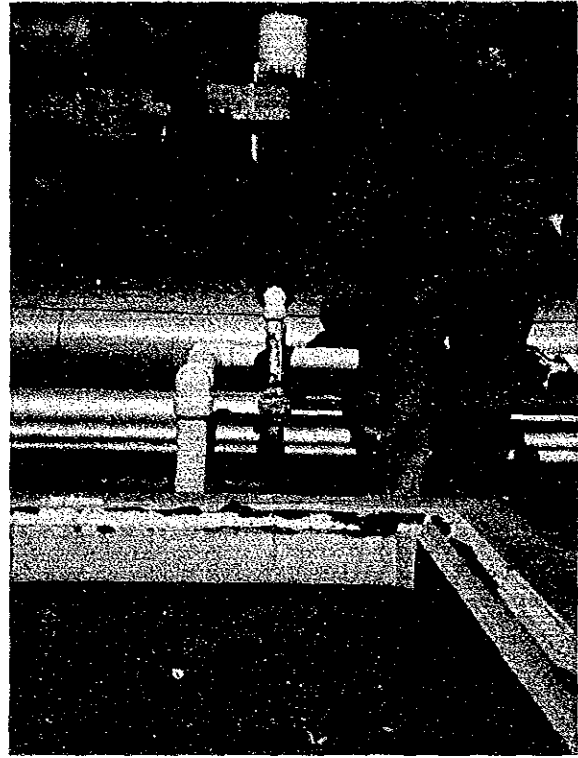
Pipeyard in front of the above
Control Room.
Utilities for Test Plant are
partly branched from these
pipelines.



Space for installation of
Test Plant



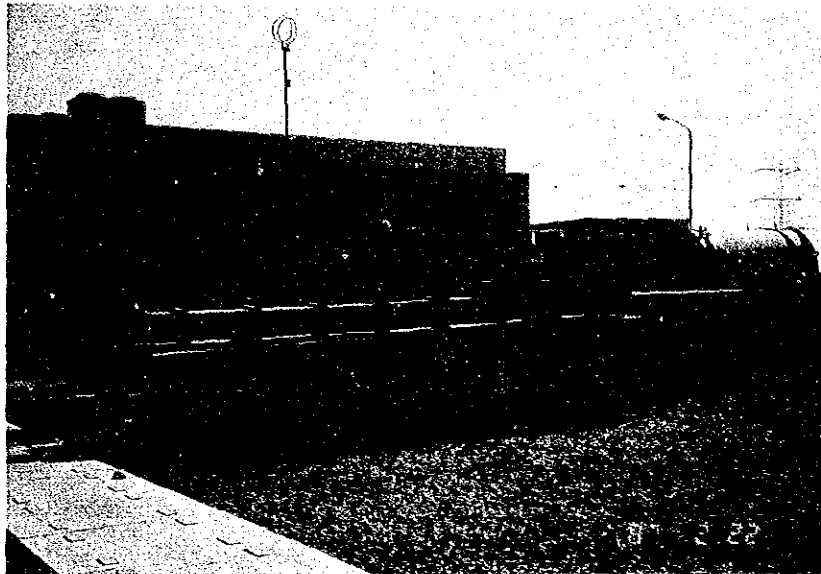
Foundations of dismantled pilot plant in the Test Plant area



Connection points for ancillary facilities of the Test Plant, Fuel oil line, Product Water line.

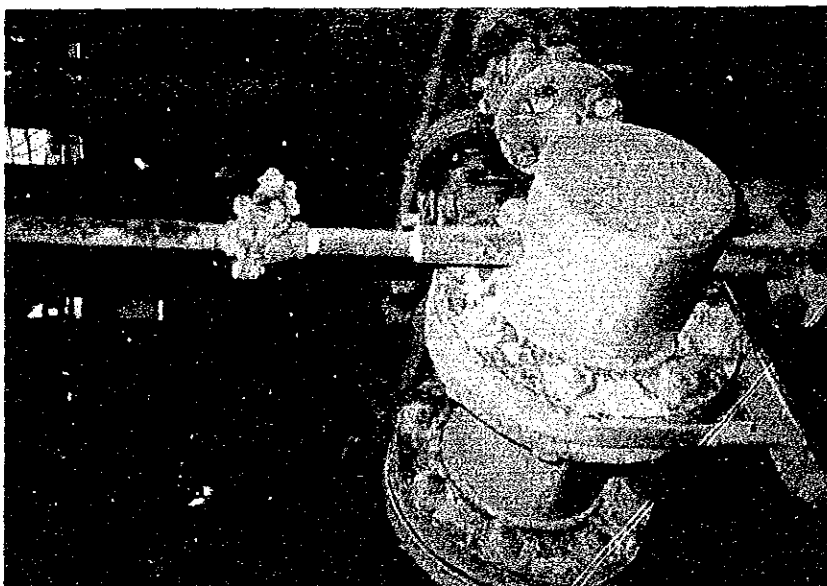


Seawater Intake Pipeline for Yanbu Desalination Plant along which a new small unsterilized seawater intake pipeline are set.



Test Plant stored in Yanbu-Medina Power & Desalination Plant

Present state of equipment for the Test Plant
(1) Control valves



Present state of equipment for the Test Plant
(2) Pipelines

JICA