

**3. Table of Instrument, List of Equipment  
and Drawings for MSF Test Plant**

**Table of Instrument for MSF Test Plant**

Working Item Measurement Place & Item	Local Indicator	Recorder	Control	Alarm	Emergency Working
1. Flow Measurement					
[1] Raw Seawater	○	○			
[2] Make-up Water	○	○	○		
[3] Recirculation Brine	○	○	○		
[4] Distillate Water	○	○			
[5] Condensate Water	○	○			
2. Flow Confirmation					
[1] Cooling Seawater to Ejector Condenser	○		○	○	Ejector driven steam stop, Annunciator
[2] Sulfuric Acid	○		○	○	Annunciator
[3] Anti-Scale Chemical	○		○	○	Annunciator
[4] Anti-Foam Chemical	○				
[5] Sodium Bisulfite	○				
3. Temperature Measurement					
[1] Raw Seawater		○			
[2] Heat Rej. Outlet Cooling Seawater		○	○		
[3] Ejector Condenser Outlet Cooling Seawater	○				
[4] Final Stage Inlet Make-up Water		○			
[5] Heat Rej. Inlet Recirculation Brine		○			
[6] B/H Inlet Recirculation Brine		○			

Measurement Place & Item	Working Item	Local Indicator	Recorder	Control	Alarm	Emergency Working
[7] B/H Outlet Recirculation Brine			○	○	○	Heating steam stop. Annunciator
[8] B/H Inlet Steam		○				
[9] B/H Shell Steam			○			
4. Boss for Temperature Measurement						
[1] Each Stage Brine		○				
[2] Flash Chamber of Each Stage		○				
5. Pressure Measurement						
[1] Raw Seawater		○				
[2] Each Pump Outlet		○				
[3] 1st Stage Inlet Brine		○				
[4] 1st Stage Steam Chamber		○				
[5] 6th Stage Steam Chamber		○	○			
[6] Ejector Condenser Inlet Seawater		○				
[7] Ejector Driving Steam		○				
[8] B/H Heating Steam		○		○		
[9] B/H Shell Steam		○				
[10] Flash Tank		○				
[11] Boiler Steam		○	○			
[12] Flameless of Boiler					○	Annunciator

Working Item Measurement Place & Item	Local Indicator	Recorder	Control	Alarm	Emergency Working
6. Level Measurement					
[1] Each Stage Brine	○				
[2] 6th Stage Brine	○		○	○	Annunciator
[3] Each Stage Distillate	○				
[4] Brine Heater	○		○		
[5] Decarbonator	○		○		
[6] Deaerator	○		○	○	Annunciator
[7] Flash Tank	○		○		
[8] Sulfuric Acid Tank	○				
[9] Anti-Scale Chemical Tank	○				
[10] Anti-Foam Chemical Tank	○				
[11] Sodium Bisulfite Tank	○				
[12] Water Tank	○				
[13] Oil Tank	○				
7. pH Measurement					
[1] Make-up Water	○	○		○	Annunciator
[2] Recirculation Brine	○	○		○	Annunciator
8. Concentration Measurement					
[1] Product Water	○	○		○	Annunciator
[2] Condensate	○	○		○	Annunciator
[3] DO for Brine and Make-up Water	○	○		○	Annunciator

**List of Equipment for 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 <sup>3</sup> /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 mm $\phi$ 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 mm $\phi$ 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 Type Material	Two stage jet steam ejectors Mixing chamber : SUS 304 Nozzle : SUS 304 Diffuser : SUS 304	1 set
3-2	Ejector Condenser Type Material	Shell & Tube Shell : SUS 316 Tube 16 mm $\phi$ x0.4t : Titanium Tube sheet : Titanium Water-box : C.S. + Neoprene rubber lining [3t] Tube support : SUS 316	1 set
4	Deaerator and Decarbonator		
4-1	Deaerator Type Performance Capacity Material	Vertical cylinder DO concentration : 20 ppb or less 8 m <sup>3</sup> /h Shell : C.S. + Neoprene rubber lining [3t] Internal parts : SUS 316. FRP	1 set
4-2	Decarbonator Type Performance Capacity Material	Spray tray type Decarbonation efficiency : 80% or more 8 m <sup>3</sup> /h Shell : C.S. + Neoprene rubber lining [3t] Internal parts : SUS 316	1 set

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 Mf'R  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 Mf'R  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 Mf'R  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 $\phi$ 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 $\phi$ 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 $\phi$ 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 $\phi$ x 60 Hz AC 110V x 1 $\phi$ 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 $\phi$ 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 set 1 - 5V DC input 4 sets 1 - 5V DC input 2 sets 1 - 5V DC input 7 sets 1 - 5V DC input 1 set 1 - 5V DC input 2 sets 1 - 5V DC input 3 sets (Upper or lower set point) 1 - 5V DC input 4 sets (Upper or lower alarm) 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	The transmitters complying with the requirements shown in "Table of Instrument" shall be provided.	1 set
	Differential pressure transmitter	4 – 20 mA DC output	5 sets
	Pressure transmitter		3 sets
	Pneumatic level controller	0.2 – 1.0 kg/cm <sup>2</sup> , displacement type	3 sets
	Level transmitter	4 – 20 mA DC output	2 sets
	Conductivity meter	4 – 20 mA DC output, direct mounted	2 sets
	pH meter	4 – 20 mA DC output	2 sets
	Orifice plate	Flange tap or ring tap, SUS 316	5 sets
	Thermal resistance	Pt 100, 3 wire type	7 sets
	Local pressure gauge	Dial type 100 $\phi$ , bourdon tube	17 sets
	Local thermometer	Glass type, attached thermowell	17 sets
	Level gauge	Glass type	5 sets
	Level gauge	Float type	1 set
Differential pressure transmitter	4 – 20 mA DC output	3 sets	
Dissolved oxygen meter	Range 0 – 0.2/1/5/20 ppm	2 sets	

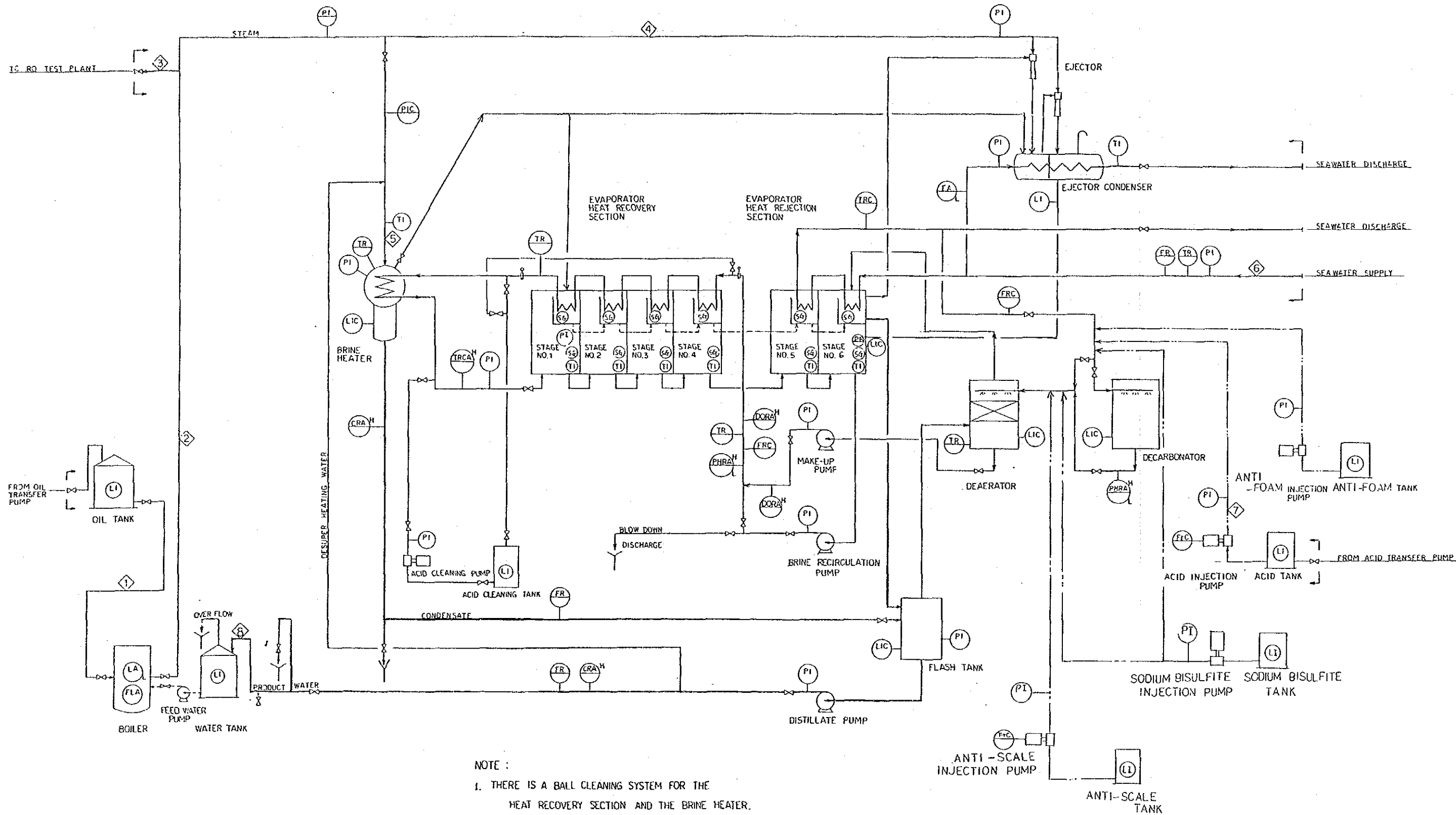
Item No.	Equipment Name	Specification	Q'ty
6-6	Control valve		1 set
	Flow C/V for desuperheater	Globe valve, serial control,	each 1 set
	Pressure C/V for B/H steam	attached positioner, SCPH/SUS 316	
	Temperature C/V for brine		
	Level C/V for brine	Globe valve, serial control, attached positioner, SCS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

Item No.	Equipment Name	Specification	Q'ty
6-6 (cont'd)	Flow C/V for make-up  Level C/V for flash tank  Level C/V for decarbonator  Pressure C/V for acid injection  Pressure C/V for chemical dosing	Globe valve, serial control, attached positioner, SCS 14/SUS 316  Globe valve, serial control, attached positioner, SCS 14/SUS 316  Globe valve, serial control, attached positioner, SCS 14/SUS 316  1 set  1 set  1 set  1 set  4 sets	
7	Piping           Material	* Intra-skid piping shall be provided for MSF test plant.  * Assembled products or sub-assemblies shall be provided as the interconnecting piping among the boiler, feedwater tank, fuel tank and MSF test plant skid.  Seawater & brine line : Cu-Ni, FRP, Rubber lining Distillate line : SUS Vent line : SUS Others : Mf'R St'd.	
8  8-1	Tanks and Mixers  Sulfuric acid tank	Capacity : 100 ltr. Material : SUS 316	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 <sup>2</sup>	
	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 <sup>3</sup> Material : CS	1 set
	Oil heater	Electric system	1 set
	Insulation		1 set
9-3	Boiler feed tank	Capacity : 3 m <sup>3</sup> Material : CS, resine coating	1 set
9-4	Boiler feed water pump		1 set
	Type	Horizontal centrifugal	
	Capacity	1.3 m <sup>3</sup> /h	
	Head	Surplus 10% or more determined by Mf'R	
	NPSH	0.5 m [NPSHav – NPSHreq]	
	Material	Mf'R St'd.	
9-5	Accessories	Chemical injection system, etc.	1 set
10	Spare parts	For one year	1 set

NO	DESCRIPTION	REV	DATE	APPROV



NOTE :  
1. THERE IS A BALL CLEANING SYSTEM FOR THE  
HEAT RECOVERY SECTION AND THE BRINE HEATER.

MASS BALANCE TABLE (pH CONTROL)

NO	①	②	③	④	⑤	⑥	⑦	⑧
LIQUID	HEAVY OIL	STEAM	→	→	→	SEAWATER	H <sub>2</sub> SO <sub>4</sub>	DISTILLATE
TEMP	BUNKER C	8 KG/m <sup>2</sup> G SOL			127 °C sat.	OVER 23 KG/m <sup>2</sup> G	(98 wt %)	
PRESS		555 KG/H			333 KG/H	23400 KG/H	0.52 KG/H	1100 KG/H
FLOW	45 L/H		180 KG/H	50 KG/H				

PROJECT: JAPAN-SAUDI ARABIA RESEARCH PROJECT OF  
SEA WATER DESALINATION

TITLE: MSF TEST PLANT  
FLOW DIAGRAM

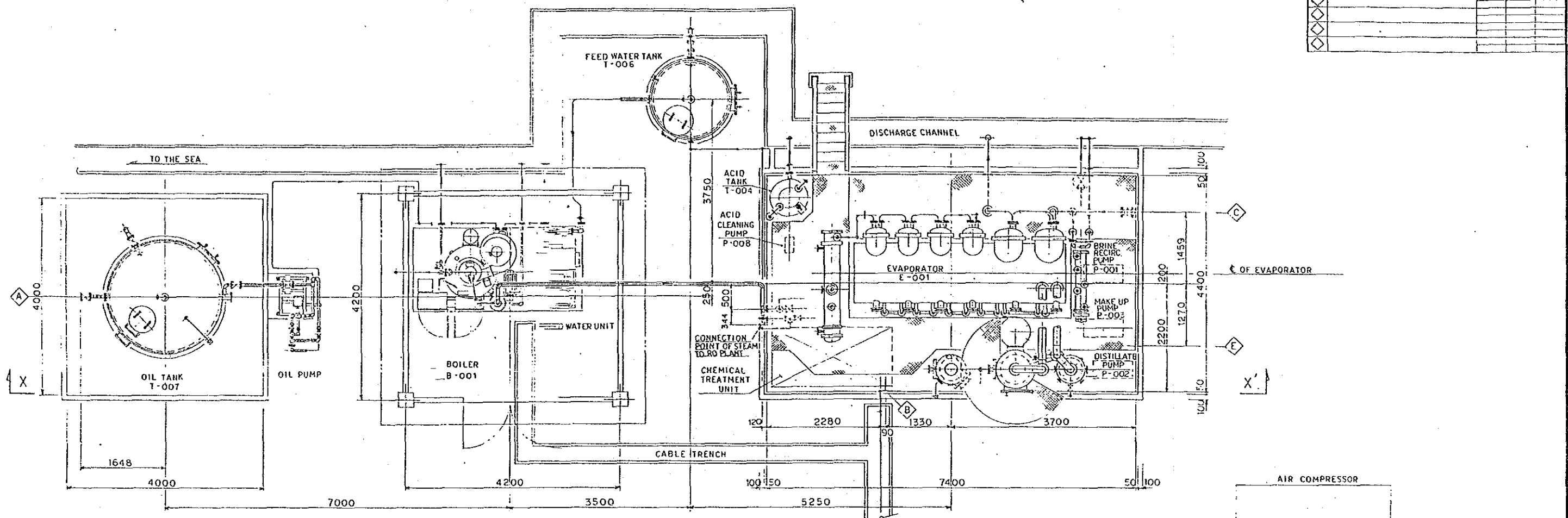
DATE:                      SCALE: NONE

DRAWING NO.: SAJ - R3001

JAPAN INTERNATIONAL COOPERATION AGENCY

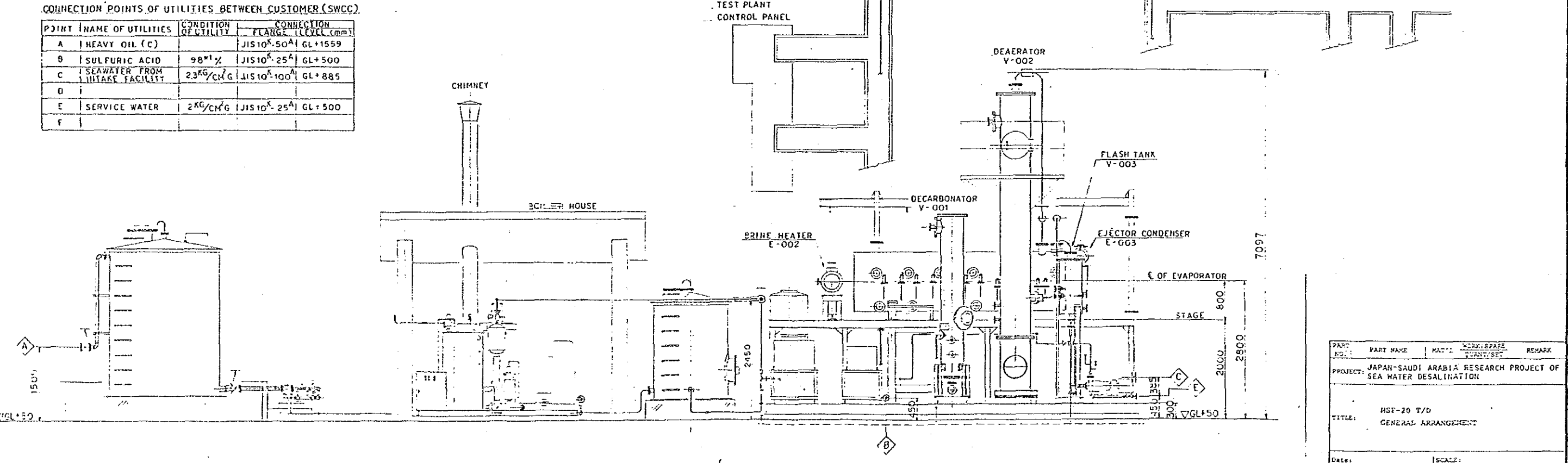


REVISIONS				
NO	DESCRIPTION	REV'D	CHECK'D	APPRO'D



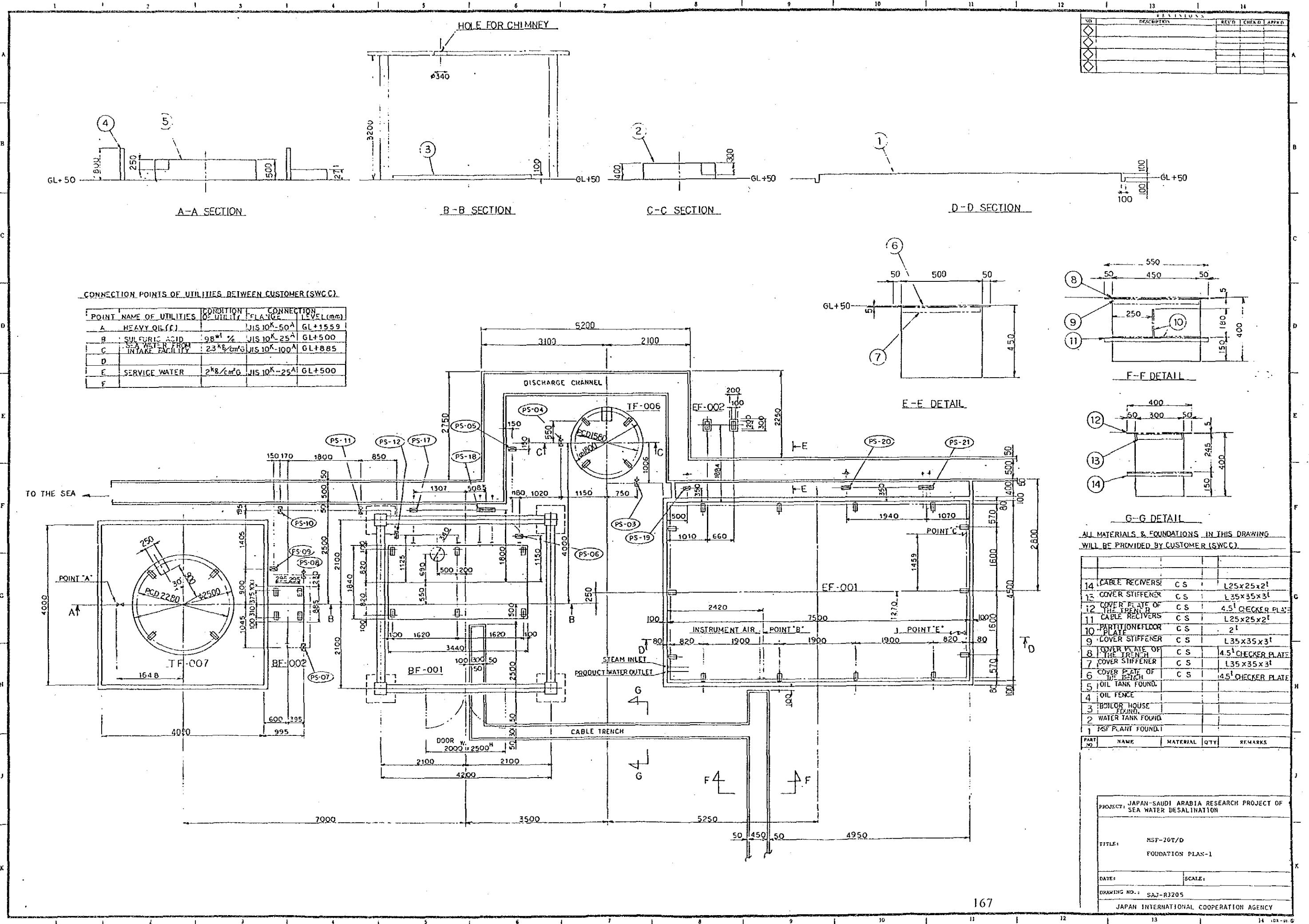
CONNECTION POINTS OF UTILITIES BETWEEN CUSTOMER (SWCC)

POINT	NAME OF UTILITIES	CONDITION OF UTILITY	CONNECTION FLANGES (mm)	CONNECTION (mm)
A	HEAVY OIL (C)		JIS10 <sup>K</sup> -50 <sup>A</sup>	GL+1559
B	SULFURIC ACID	98 <sup>wt</sup> %	JIS10 <sup>K</sup> -25 <sup>A</sup>	GL+500
C	SEAWATER FROM INTAKE FACILITY	23 <sup>KG</sup> /CM <sup>3</sup> G	JIS10 <sup>K</sup> -100 <sup>A</sup>	GL+885
D				
E	SERVICE WATER	2 <sup>KG</sup> /CM <sup>3</sup> G	JIS10 <sup>K</sup> -25 <sup>A</sup>	GL+500
F				



VIEW X ~ X'

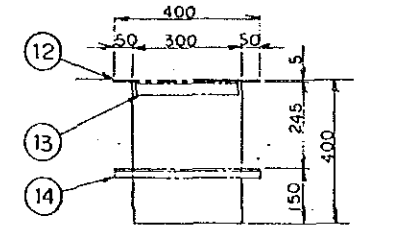
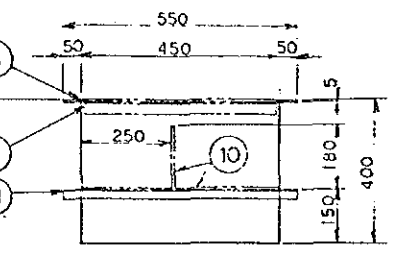
PART NO.	PART NAME	MAT'L	WORKSPACE	REMARK
PROJECT: JAPAN-SAUDI ARABIA RESEARCH PROJECT OF SEA WATER DESALINATION				
TITLE: HSE-20 T/D GENERAL ARRANGEMENT				
Date:		SCALE:		
DRAWING NO.: SAJ-R3201				
JAPAN INTERNATIONAL COOPERATION AGENCY				



NO.	DESCRIPTION	REV'D	CHECK'D	APPROV'D

CONNECTION POINTS OF UTILITIES BETWEEN CUSTOMER (SWCC)

POINT	NAME OF UTILITIES	CONDITION OF UTILITY	FLANGE CONNECTION	LEVEL (mm)
A	HEAVY OIL (C)		JIS 10K-50A	GL+1559
B	SULFURIC ACID	98% 1/2	JIS 10K-25A	GL+500
C	SEA WATER FROM INTAKE FACILITY	23kg/cm <sup>2</sup> G	JIS 10K-100A	GL+885
D				
E	SERVICE WATER	2kg/cm <sup>2</sup> G	JIS 10K-25A	GL+500
F				



ALL MATERIALS & FOUNDATIONS IN THIS DRAWING WILL BE PROVIDED BY CUSTOMER (SWCC).

NO.	DESCRIPTION	MATERIAL	QTY	REMARKS
14	CABLE RECVERS	C S	L25x25x2 <sup>t</sup>	
13	COVER STIFFENER	C S	L35x35x3 <sup>t</sup>	
12	COVER PLATE OF THE TRENCH	C S	4.5 <sup>t</sup> CHECKER PLATE	
11	CABLE RECVERS	C S	L25x25x2 <sup>t</sup>	
10	PARTITION FLOOR PLATE	C S	2 <sup>t</sup>	
9	COVER STIFFENER	C S	L35x35x3 <sup>t</sup>	
8	COVER PLATE OF THE TRENCH	C S	4.5 <sup>t</sup> CHECKER PLATE	
7	COVER STIFFENER	C S	L35x35x3 <sup>t</sup>	
6	COVER PLATE OF THE TRENCH	C S	4.5 <sup>t</sup> CHECKER PLATE	
5	OIL TANK FOUND.			
4	OIL FENCE			
3	BOILER HOUSE FOUND.			
2	WATER TANK FOUND.			
1	MSF PLANT FOUND.			

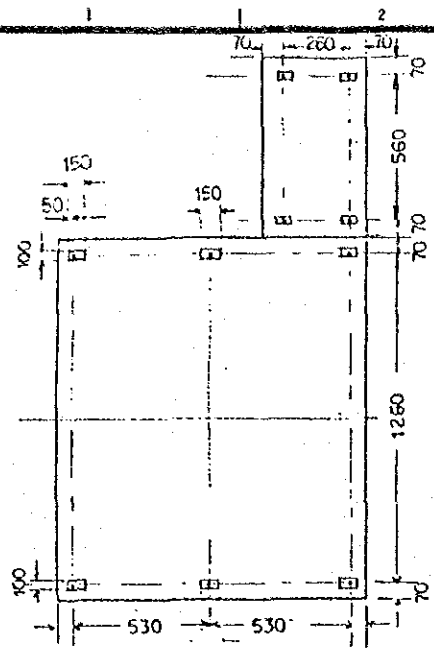
PROJECT: JAPAN-SAUDI ARABIA RESEARCH PROJECT OF SEA WATER DESALINATION

TITLE: MSF-20T/D  
FOUNDATION PLAN-1

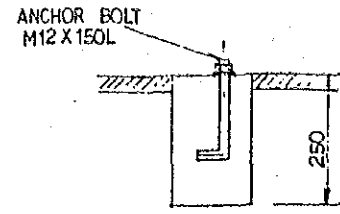
DATE: \_\_\_\_\_ SCALE: \_\_\_\_\_

DRAWING NO.: SAJ-R3205

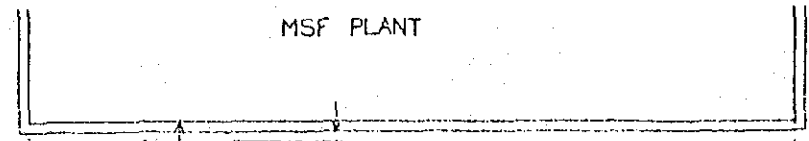
JAPAN INTERNATIONAL COOPERATION AGENCY



PANEL FOUNDATION DETAIL

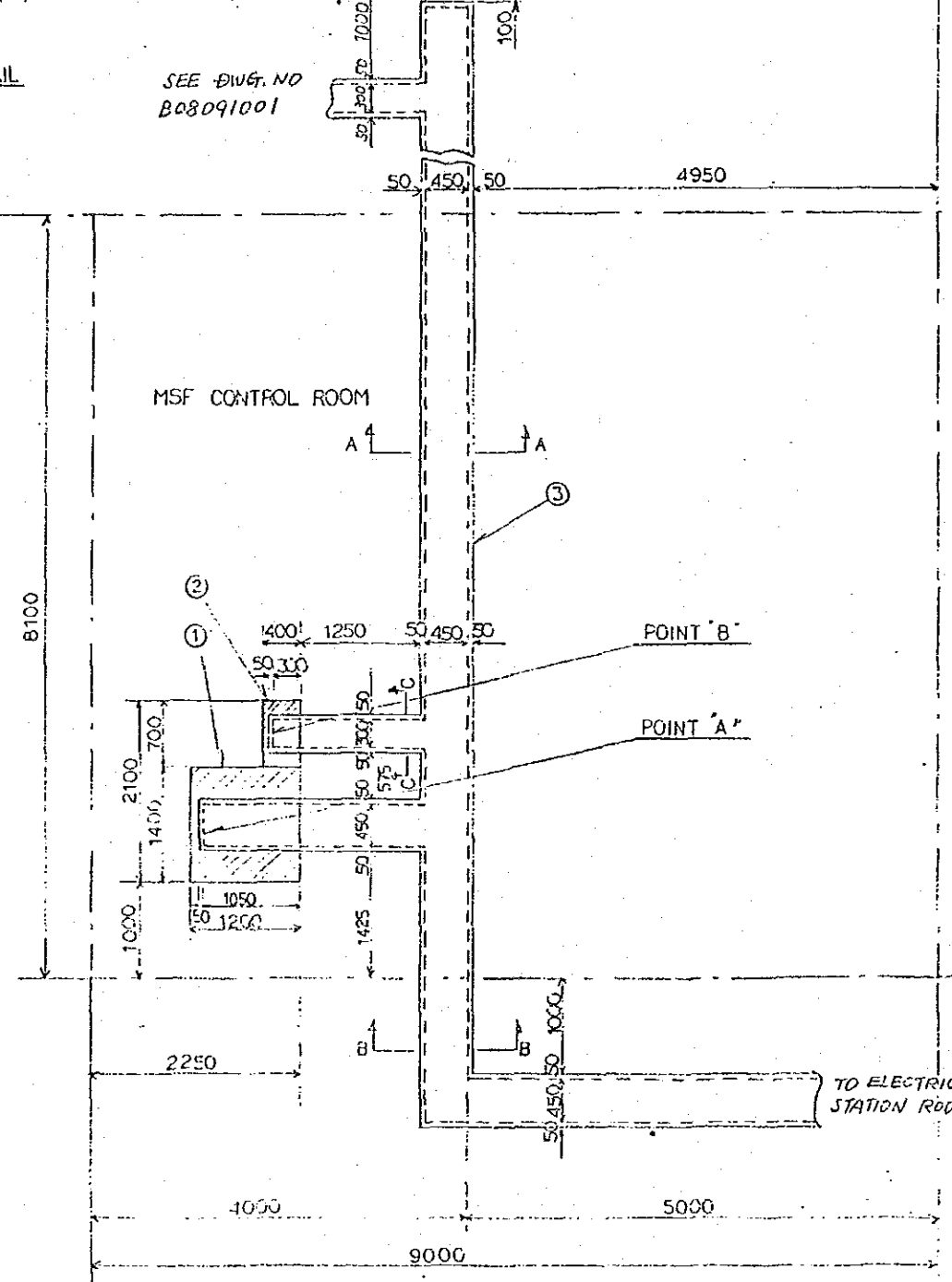


SEE DWG. NO  
B08091001



MSF PLANT

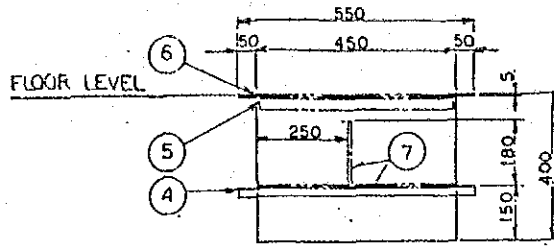
MSF CONTROL ROOM



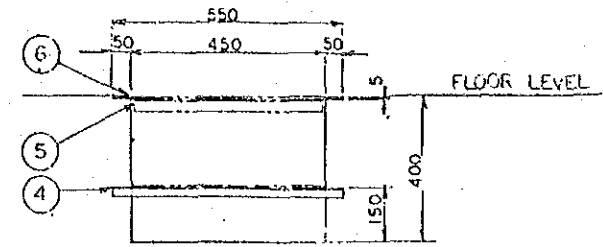
POINT 'B'

POINT 'A'

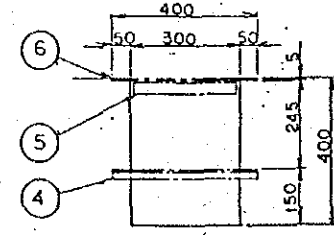
TO ELECTRICAL  
STATION ROOM



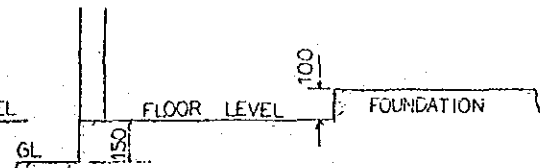
A-A DETAIL



B-B DETAIL



C-C DETAIL



LEVEL OF FOUNDATION

CONNECTION POINT OF  
ELECTRIC POWER

POINT	V x φ x Hz
A	110 x 1 x 60
B	220 x 3 x 60

PART NO.	NAME	MATERIAL	QTY	REMARKS
7	PARTITION AND FLOOR PLATE	CS	21	
6	COVER PLATE ON THE TRENCH	CS	45	45° CHECKER PLATE
5	COVER STIFFENER	CS	135	135 x 35 x 3
4	CABLE RECEIVERS	CS	125	125 x 25 x 2
3	CABLE TRENCH COVER AND CABLE RECEIVERS			
2	FOUNDATION OF MSF CONTROL ROOM		1	FLOOR LEVEL + 100mm
1	FOUNDATION OF MSF CONTROL PANEL		1	FLOOR LEVEL + 100mm

PROJECT: JAPAN-SAUDI ARABIA RESEARCH PROJECT OF  
SEA WATER DESALINATION

TITLE: MSF-20T/D  
FOUDATION PLAN-2

DATE: SCALE:

DRAWING NO.: SAJ-R3233

JAPAN INTERNATIONAL COOPERATION AGENCY

NO	DESCRIPTION	REV'D	CHECK'D	APPRO'D

REVISIONS



PROJECT: JAPAN-SAUDI ARABIA RESEARCH PROJECT OF  
SEA WATER DESALINATION

TITLE: MSF-20T/D  
LOADING DATA

DATE: SCALE:

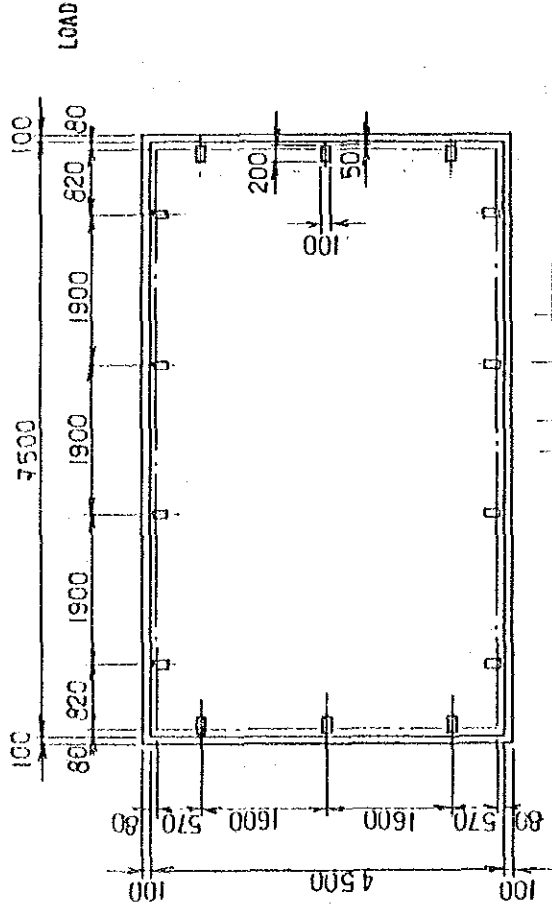
DRAWING NO.: SAJ-R3206

JAPAN INTERNATIONAL COOPERATION AGENCY

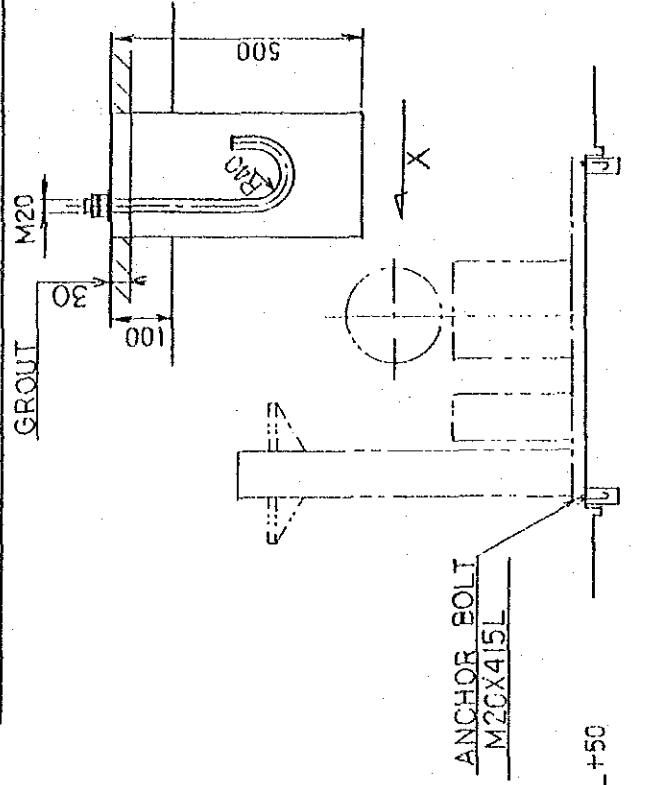
LOADING DATA

SERVICE : SKID OF SEA WATER DESALINATION  
 FOUNDATION NO. EF - 001  
 (Refer to FOUNDATION PLAN  
 DWG. No. B08091001)

WEIGHT  
 EMPTY : 17.000 kG  
 OPERATION : 18.000 kG  
 FULL OF WATER : 25.000 kG



	X-AXIS		Y-AXIS	
	OPERATION	FULL OF WATER	OPERATION	FULL OF WATER
WIND	2900 kG	2900 kG	1500 kG	1500 kG
SEISMIC	2370 kG	3290 kG	2370 kG	3290 kG

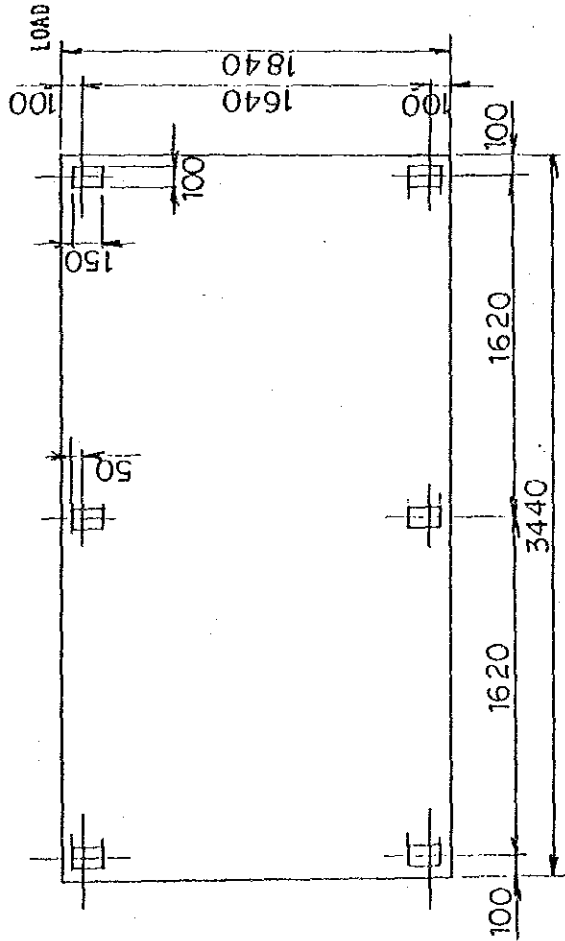


GL+50

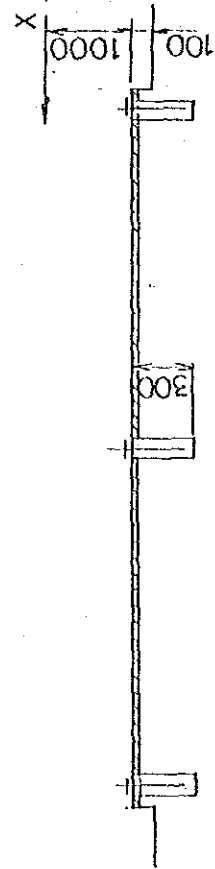
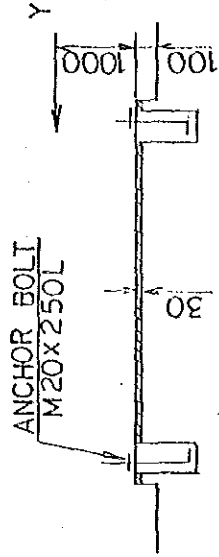
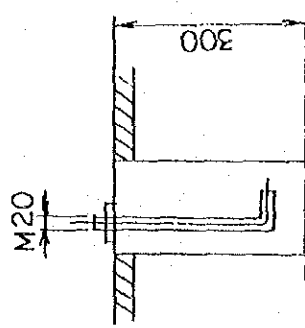
**LOADING DATA**

SERVICE : BOILER  
 FOUNDATION NO. BF-001  
 (Refer to FOUNDATION PLAN  
 DWG. No. 808091001)

WEIGHT  
 EMPTY : 2,000kg  
 OPERATION : 2,200kg  
 FULL OF WATER : 2,300kg



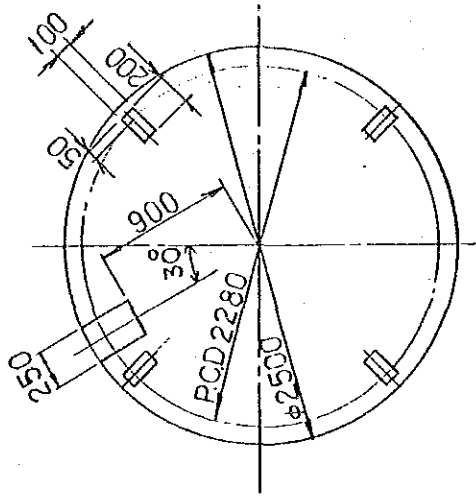
	X-AXIS		Y-AXIS	
	OPERATION	FULL OF WATER	OPERATION	FULL OF WATER
WIND	220kg	220kg	220kg	220kg
SEISMIC	293kg	306kg	293kg	306kg



**LOADING DATA**

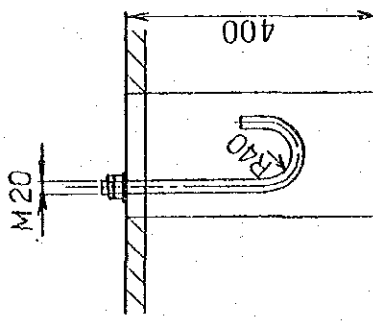
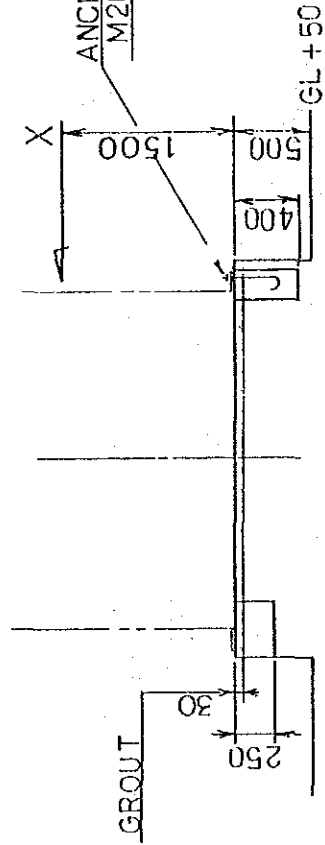
SERVICE : OIL TANK  
 FOUNDATION NO. TF-007  
 (Refer to FOUNDATION PLAN  
 DWG. No. B08091001)

WEIGHT  
 EMPTY : 2,400 kg  
 OPERATION : 13,000 kg  
 FULL OF WATER : 13,000 kg



LOAD

	X-AXIS		Y-AXIS	
	OPERATION	FULL OF WATER	OPERATION	FULL OF WATER
WIND	580 kg	580 kg	-	-
SEISHIC	1710 kg	1710 kg	-	-

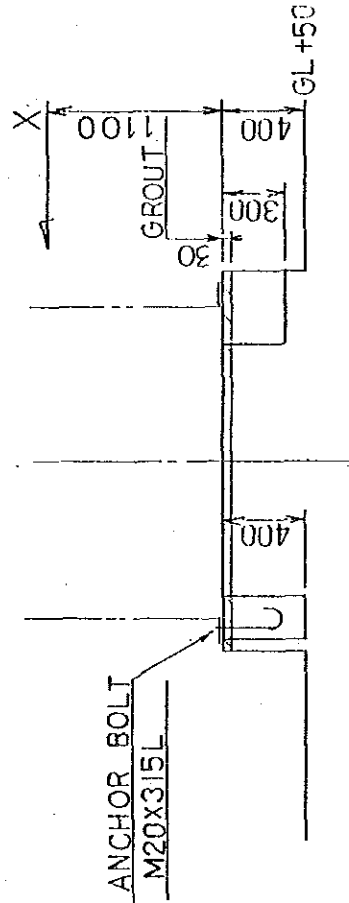
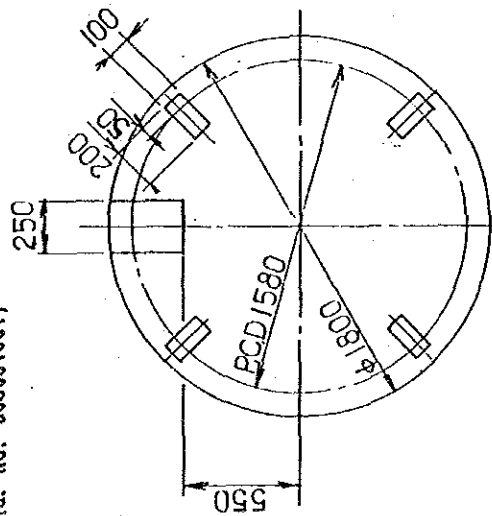




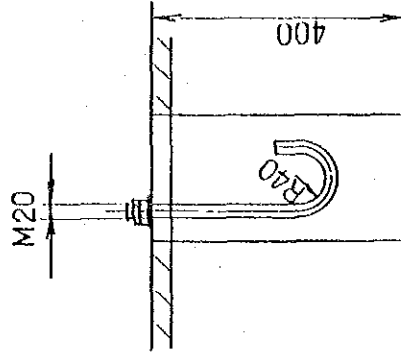
**LOADING DATA**

SERVICE : FEED WATER TANK  
FOUNDATION NO. TF - 006  
 (Refer to FOUNDATION PLAN  
 Dwg. No. 808091001)

WEIGHT  
EMPTY : 1,100 kG  
OPERATION : 4,200 kG  
FULL OF WATER : 4,200 kG



	X-AXIS		Y-AXIS	
	OPERATION	FULL OF WATER	OPERATION	FULL OF WATER
WIND	300 kG	300 kG	-	-
SEISMIC	560 kG	560 kG	-	-



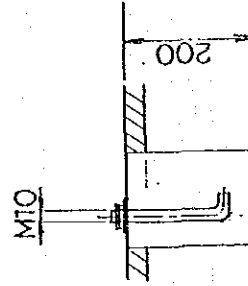
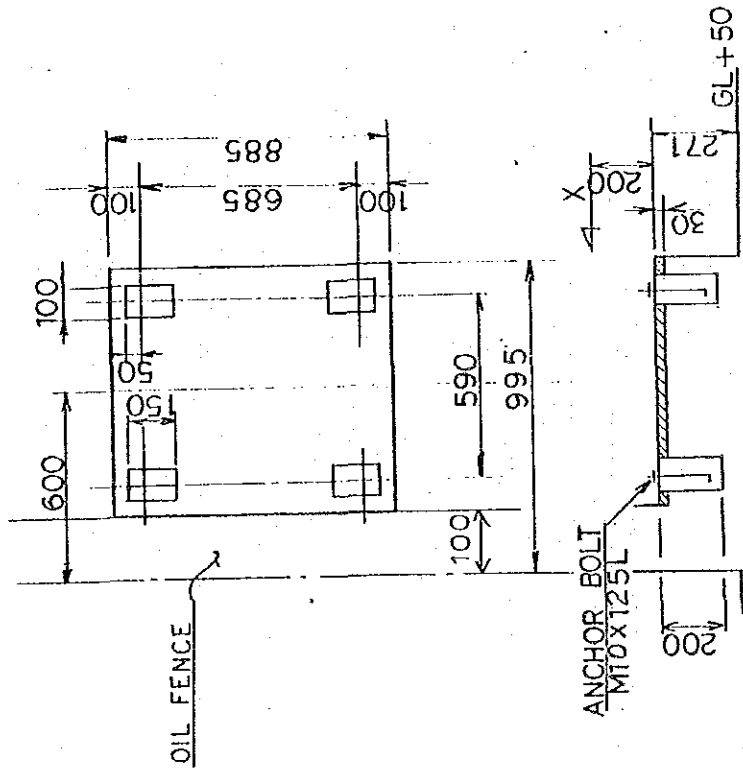
**LOADING DATA**

SERVICE : OIL BOOSTER PUMP  
 FOUNDATION NO. BF-002  
 (Refer to FOUNDATION PLAN  
 DWG. No. B08091001)

HEIGHT                      EMPTY :    100k8  
 OPERATION :    200k8  
 FULL OF WATER : 200k8

	X-AXIS		Y-AXIS	
	OPERATION	FULL OF WATER	OPERATION	FULL OF WATER
WIND	20k8	20k8	—	—
SEISMIC	27k8	27k8	—	—

LOAD



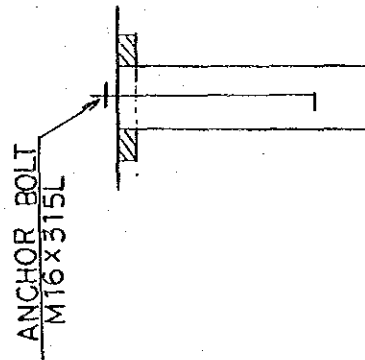
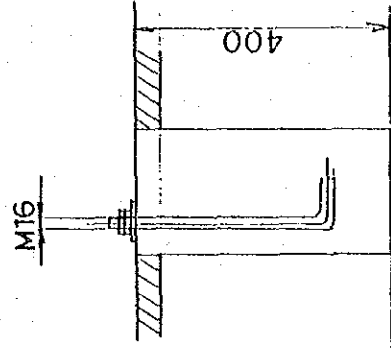
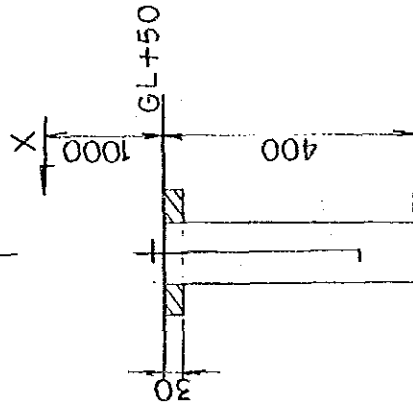
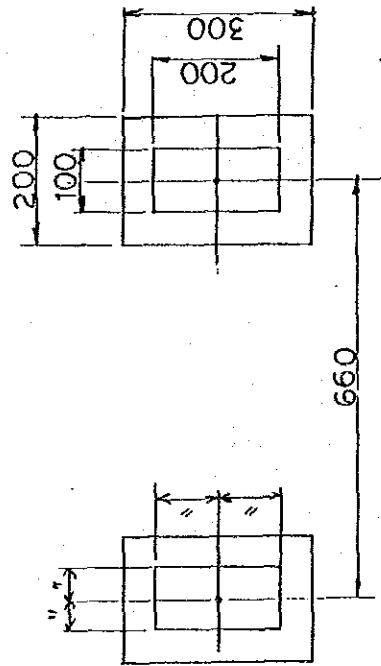
**LOADING DATA**

SERVICE : STAIR WAY  
 FOUNDATION NO. EF-002  
 (Refer to FOUNDATION PLAN  
 DNG. No. 808091001)

HEIGHT : 200kg  
 OPERATION : 200kg  
 FULL OF WATER : —

LOAD

	X-AXIS		Y-AXIS	
	OPERATION	FULL OF WATER	OPERATION	FULL OF WATER
WIND	20kg	—	—	—
SEISMIC	27kg	—	—	—



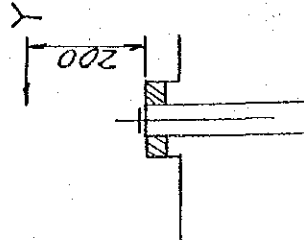
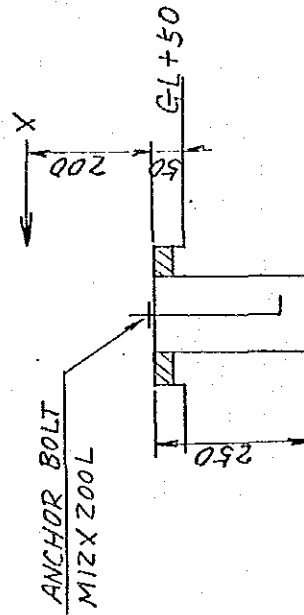
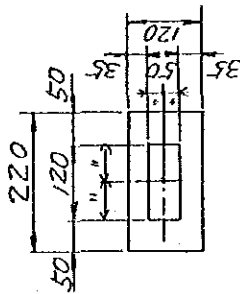
LOADING DATA

SERVICE : PIPING  
 FOUNDATION NO. PS-03~06.17.19  
 (Refer to FOUNDATION PLAN  
 ENG. No. B08091001)

WEIGHT  
 EMPTY : 80kg  
 OPERATION : 100kg  
 FULL OF WATER : 100kg

LOAD

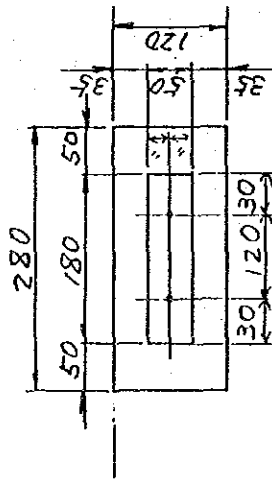
	X-AXIS		Y-AXIS	
	OPERATION	FULL OF WATER	OPERATION	FULL OF WATER
WIND	10kg	10kg	10kg	10kg
SEISMIC	14kg	14kg	14kg	14kg



LOADING DATA

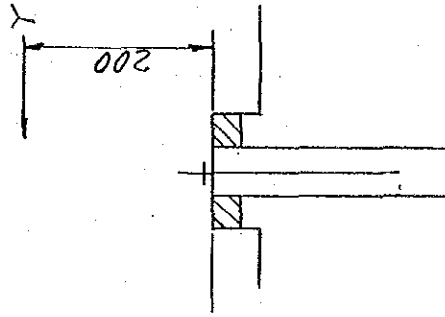
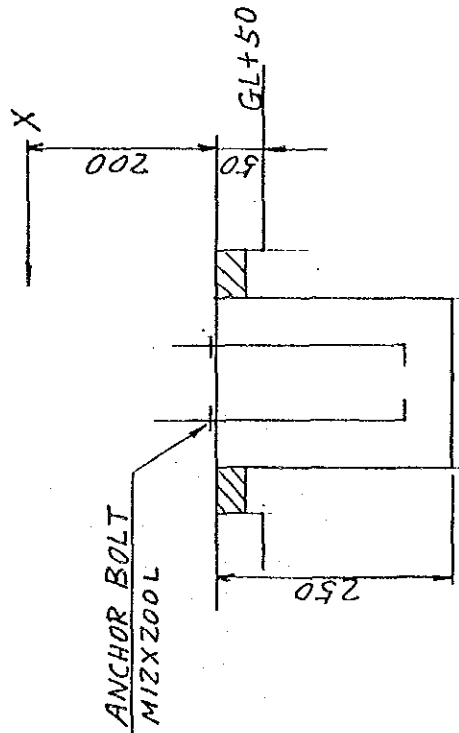
SERVICE : PIPING  
 FOUNDATION NO. PS-07-12  
 (Refer to FOUNDATION PLAN  
 DWG. No. B08091001)

WEIGHT  
 EMPTY : 50kg  
 OPERATION : 80kg  
 FULL OF WATER : 80kg



	X-AXIS		Y-AXIS	
	OPERATION	FULL OF WATER	OPERATION	FULL OF WATER
WIND	8kg	8kg	8kg	8kg
SEISMIC	11kg	11kg	11kg	11kg

LOAD



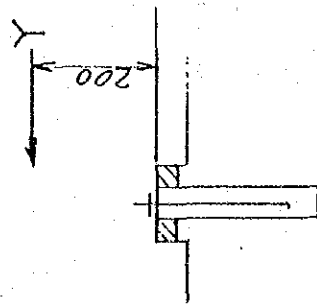
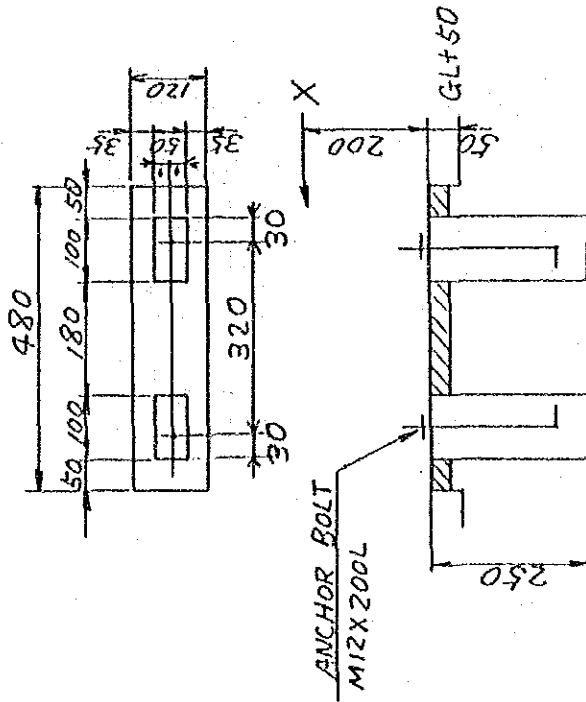
LOADING DATA

SERVICE : PIPING  
 FOUNDATION NO. PS-18  
 (Refer to FOUNDATION PLAN  
 DWG. No. 808091001)

HEIGHT  
 EMPTY : 80kg  
 OPERATION : 100kg  
 FULL OF WATER : 100kg

LOAD

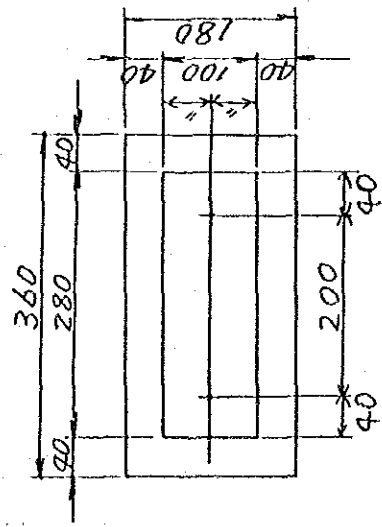
	X-AXIS		Y-AXIS	
	OPERATION	FULL OF WATER	OPERATION	FULL OF WATER
WIND	10kg	10kg	10kg	10kg
SEISMIC	14kg	10kg	10kg	10kg



LOADING DATA

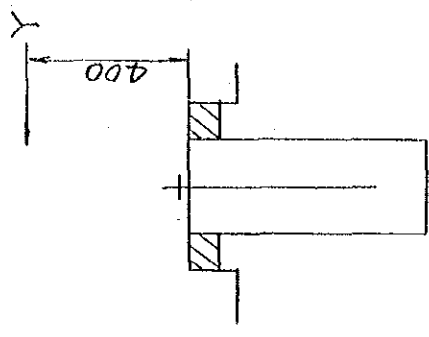
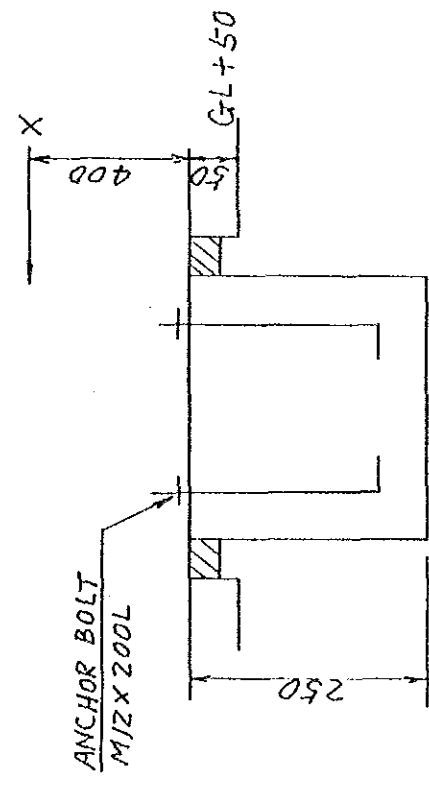
SERVICE : PIPING  
 FOUNDATION NO. PS-20.21  
 (Refer to FOUNDATION PLAN)  
 DWG. No. 808091001)

HEIGHT  
 EMPTY : 80 kg  
 OPERATION : 100 kg  
 FULL OF WATER : 100 kg



	X-AXIS		Y-AXIS	
	OPERATION	FULL OF WATER	OPERATION	FULL OF WATER
WIND	10 kg	10 kg	10 kg	10 kg
SEISMIC	14 kg	14 kg	14 kg	14 kg

LOAD







**4. List of Laboratory Equipment and  
Utility Consumption List**



### List of Laboratory Equipment

#### 1. Equipment for Corrosion Test

Item No.	Description	Q'ty	Remarks
1-1	AC impedance system (1) Body (2) Corrosion Cell Kid (3) Flat Sample Holder (4) Standard Sample	1 set (1) (1) (1) (1)	For laboratory use; measures the corrosion rates of the test pieces of heat transfer tubes for the MSF test plant.
1-2	Corraters (1) Probe (2) Controlling corraters (6 channels)	1 set (6) (1)	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, B <sub>5</sub> TF
1-3	Electrometer (1) Body (2) Electrode	3 sets (3) (10)	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) Camera (2) Illuminator with stand	1 set (1) (1)	Photographs the status of corrosion on specimens
1-7	Photographic enlarger (1) Enlarger (2) Color analyzer (3) Lens for enlarger (4) Negative carrier (holder)	1 set (1) (1) (3) (1)	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 and let them be photographed.
1-9	Roughness meter	1 set	Analyzes the roughness of specimen surfaces before and after corrosion testing, and evaluate the status of corrosion.

Item No.	Description	Q'ty	Remarks
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) (1)	For metal grinding in preparation for observation by the metallurgical microscope.
1-12	Spot welder	1 set	Electric spot welder for use in the laboratory
1-13	Electropolishing equipment (1) Power supply unit (2) Electropolishing unit (3) Transcopy	1 set (1) (1) (1)	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) Dual monochrometer system (2) High frequency unit (3) Microprocessor (4) Graphic printer	1 set (1) (1) (1) (1)	Microchemical analysis of the seawater ingredients scale and corrosion products (Ca, Mg, Fe, Cu, etc.)
2-2	Spectrophotometer (1) Laboratory type (2) Portable type	2 sets (1) (1)	Colorimetric analysis of the seawater ingredients, scale and corrosion products (Fe, Cu, SiO <sub>2</sub> , SO <sub>4</sub> <sup>2-</sup> , Cl <sup>-</sup> , etc.)
2-3	X-ray diffractometer with x-y plotter	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 (1) Laboratory type (2) 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 with recorder.
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 for 25 test items.
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	X-ray fluorescence analyser	1 set	Elementary analysis of the scale inside heat transfer tubes and corrosion products.
2-16	Infrared spectrophotometer	1 set	

### 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	Products 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 <sup>-4</sup> 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	Exclusive use of the atomic absorption spectrophotometer, Max. rated pressure 6 kg/cm <sup>2</sup>
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 and and spectrophotometer.
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	7 sets	Pressure reducing mechanism consists of two stages.
	(1) for N <sub>2</sub>	(5)	
	(2) for H <sub>2</sub>	(2)	
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
4-2	(4) Flask, volumetric Capacity: 10, 25, 50, 100, 250, 500, 1000 mL	6 each	Implements for water and chemical analysis
	(5) Flask, volumetric, amber Capacity: 10, 25, 50, 100, 250, 500, 1000 mL	3 each	
4-3	Pipets (1) Pipet, volumetric Capacity: 0.5, 1, 2, 20, 25, 50 mL Capacity: 5, 10 mL (2) Pipet, graduated Capacity: 1, 2, 5 10, 25 mL (3) Pipet, automatic Minimum graduation 0.1 mL Capacity: 5 mL Minimum graduation 0.1 mL Capacity: 10 mL	6 each  12 each  6 each  2  2	
4-4	Burets (1) Buret, plain, teflon plug Minimum graduation 0.05 mL Capacity: 5 mL Minimum graduation 0.05 mL Capacity: 10 mL Minimum graduation 0.1 mL Capacity: 25 mL	3  3  2	

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

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

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 ml	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	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	Implements for water and chemical analysis
	(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	
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	6	Implements for water and chemical analysis
	Temperature range: 0 – 360°C	6	
4-27	Transformer, variable, total capacity: 1 kW	3	
4-28	Boring apparatus		
	(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, 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)	10 m	
	(2) Asbestos, band, 5 cm width, high quality (AAA)	10 m	
	(3) Asbestos, yarn, 6 mm high quality (AAA)	10 m	
4-34	Pinch cock, middle type	12	
4-35	Screw cocks		
	(1) Large type (5cm)	12	
	(2) Middle type (3 cm)	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 (2) Tongs, for crucible, 240 mm long (3) Tongs, for crucible 600 mm long (4) Tongs, for breaker, 290 mm long (5) Tongs, for platinum crucible, with platinum shoes, 210 mm long	 3 2 2 2 1		
4-38	Forceps (1) Forceps, general use, 125 mm long (2) Forceps, general use, 150 mm long (3) Forceps, general use, 300 mm long (4) Forceps, teflon coating, 180 mm long	 12 12 6 3		
4-39	Spoons (1) Spoon, general use, 150 mm long (2) Spoon, general use, 180 mm long (3) Spoon, with spatula, 150 mm long	 12 12 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	12	
	(2) Clamp, versatile, medium size	12	
	(3) Clamp, versatile, large size	24	
	(4) Clamp holder, regular type	48	
4-42	Supports		
	(1) Support stand, tripod base, 60 cm high	6	
	(2) Support stand, tripod base, 90 cm high	6	
	(3) Support, for two funnel	2	
	(4) Support, with buret holder, porcelain base	6	
	(5) Support, test tube	2	
	(6) Support, pipet	3	
4-43	Rings		
	(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	

Item No.	Description	Q'ty	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 $\phi$
5-8	Band sawing machine	1 set	Max. cutting 260 mm, Processing length: 395 mm
5-9	Universal swivelling branch vice	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	

Utility Consumption List

Item No.	Description	Q'ty	Electricity (kW)			Water (ℓ/min.)	Remarks
			110V (1φ)	220V (1φ)	220V (3φ)		
1-1	AC Impedance System	1 set					
	Potentiostat/Galvanostat	(1)	0.35				
	Lock-In Amplifier	(1)	0.13				
	Computer	(1)	0.08				
	Monitor	(1)	0.026				
	Printer	(1)	0.07				
1-2	Corrater	1 set	0.05				
1-3	Electrometer	3 sets	0.6 (0.2/set)				
1-4	Tester (Volt-ohm meter)	2 sets	Dry Cell UM-3:2 pcs 006P:1pc.				
1-5	Recorder	1 set					
	(1)	(1)	0.050				
	(2)	(1)	0.058				
1-6	Camera	1 set	Mercury Battery HD1.35V: 1 pc.				
	Optional Accessory Copy Stand	1 set	1.0				
1-7	Photographic Enlarger	1 set	0.15				
	Optional Accessory Color Analyzer	1 set	0.008				
1-8	Metallurgical Microscope	1 set	0.06				
1-9	Roughness Meter	1 set	0.05				
1-10	Mounting Press	1 set	1.02			6 (for Acryl resin use)	
1-11	Wet Grinder and Polisher	1 set					
	(1) Wet Grinder	(1)				3	
	(2) Polisher	(1)	2.0			6	

Item No.	Description	Q'ty	Electricity (kW)			Water (ℓ/min.)	Remarks
			110V (1φ)	220V (1φ)	220V (3φ)		
1-12	Spot Welder	1 set		0.22			
1-13	Electropolishing Equip.	1 set		0.33			
1-14	Dryer	1 set	1.06				
1-15	Precision Cutter	1 set			1.9	30 (In case of circulating)	
1-16	Plastic Desiccator	4 sets	0.128 (0.032/set)				
1-17	Immersion Corrosion Testing Equipment	2 sets	1.0 (0.5/set)			4 (2/set)	
1-18	Zero Shunt Ammeter	1 set	0.2				
1-19	DOS Tester	1 set	0.02 Battery 12V 5.7A/H:1 pc.				

Item No.	Description	Q'ty	Electricity (kW)			Water (ℓ/min.)	Remarks
			110V (1φ)	220V (1φ)	220V (3φ)		
2-1	Inductive Coupled Plasma Emission Spectrophotometer	1 set	1.0		5.0 (More than 2 kg/cm <sup>2</sup> ) (Below 30°C)	0.5	Ar: 18ℓ/min. Duct Fan: 15-20m <sup>3</sup> /min.
2-2	Spectrophotometer						
	(1)	1 set	0.4				
	(2)	1 set	0.1				
2-3	X-ray Diffractometer with X-Y Plotter	1 set	2.0		6.0	30 (In case of circulating)	
2-4	Electrical Conductivity Meter	2 sets	0.024 (0.012/set)				
2-5	pH Meter						
	(1) Table Top Type	2 sets	0.040 (0.020/set)				
	(2) Portable Type	1 set	0.01				
			Dry Cell SUM-3: 6 pcs.				
2-6	Automatic Titrator	1 set	0.1				
2-8	Portable Water Analysis Kit	1 set	0.006				
2-9	Scale Deposition Testing Equipment	2 sets	2.6 (1.3/set)			2	
2-10	Turbidity Meter	1 set	0.04				
2-11	Oil Content Determination App.	1 set	0.05				
	Optional Accessory Solvent Reclaimer	1 set					Recycle Fluoro chlorocarbon

Item No.	Description	Q'ty	Electricity (kW)			Water (ℓ/min.)	Remarks
			110V (1φ)	220V (1φ)	220V (3φ)		
2-12	DO Meter	1 set	Ni-Cd Battery 1.2V:6 pcs. Dry Cell UM-3D: 4 pcs. 0.0015 (For charge)				
2-13	ORP Meter	1 set	0.001				
2-14	Micro Biological Examination Kit	1 set	0.05				
2-15	Electron Probe Micro Ana.	1 set	5.0			2-4 (0.5–2kg/cm <sup>2</sup> ) (10°C–25°C)	PR Gas: 0.01ℓ/min.
2-16	Infrared Spectrophotometer	1 set	0.3				
3-1	Analytical Balance Max. 162 g	2 sets	0.02 (0.01/set)				
3-2	Chemical Balance Direct Reading, Max. 3.6 kg	2 sets	0.012 (0.006/set)				
3-4	Water Purification App.	2 sets	3.0 (1.5/set)			4 (2/set)	
3-5	Drying Oven for Glass-ware	2 sets	2.2 (1.1/set)				
3-6	Drying Oven for Chemical	1 set	1.8				
3-7	Muffle Furnace	1 set	1.8				
3-8	Vacuum Pump (1)	1 set	0.4				
3-9	Vacuum Pump (2)	1 set	0.02				
3-10	Air Compressor, Tank	1 set	0.4				

Item No.	Description	Q'ty	Electricity (kW)			Water (ℓ/min.)	Remarks
			110V (1φ)	220V (1φ)	220V (3φ)		
3-11	Magnetic Stirrer	2 sets	0.02 (0.01/set)				
3-12	Magnetic Stirrer, with Hot Plate	1 set	0.25				
3-13	Water Bath, General Type	1 set	1.3			9	
3-14	Refrigerator	1 set	0.13				
3-15	Water Circulating Pump (Handy type)	2 sets	0.2 (0.1/set)			11 (In case of circulating)	
3-16	Stop Watch	2 pcs.	Battery 2 pcs. (Battery 1 pc./set)				
3-17	Hot Plate	1 set	0.35				
3-18	Air Pump (Handy type)	2 sets	0.54 (0.27/set)				
3-20	Constant Temperature Bath	2 sets	4.4 (2.2/set)			40	
3-21	Calculator	3 sets	Battery LR-44: 9 pcs. (3 pcs./set)				
3-22	Digital Thermometer	2 sets	Dry Cell UM-2:4pcs. (2pcs./set)				
3-24	Vacuum Evaporator	1 set	0.015			2	
	Optional Accessory Water Bath	1 set	0.75				



Item No.	Description	Q'ty	Electricity (kW)			Water (l/min.)	Remarks
			110V (1 $\phi$ )	220V (1 $\phi$ )	220V (3 $\phi$ )		
5-1	Precision Lathe	1 set			5.54		
5-2	Bench Drilling	1 set			0.4		
5-3	Electric Bench Grinder	1 set			1.77		
5-4	Cutter	1 set			2.2		
5-5	Electric Drill	2 sets		1.72 (0.86/set)			
5-7	Hack Sawing Machine	1 set			1.5		
5-8	Band Sawing Machine	1 set			2.0		
5-19	Electric Soldering Iron	1 set	0.31				
5-34	Gas Cutter	1 set				C <sub>2</sub> H <sub>2</sub> : 6l/min. O <sub>2</sub> : 26l/min.	
5-36	Expander Model:	1 set	1.5				
6-1	Dissolved Oxygen Measurement System	1 set	0.05				
6-2	Salt Meter	1 set	Dry Cell 0.06P(9V): 1 pc.				





