BOILER SAMPLE TUBE TEST REPORT

NATIONAL POWER CORPORATION

MALAYA THERMAL POWER PLANT

UNIT NO. 1 BOILER WATERWALL

JANUARY 1995

WEST JAPAN ENGINEERING CONSULTANTS, INC.

KYUDEN INDUSTRIES CO. INC.

1. Introduction

This is a report on the results of the evaluation of the deterioration of the waterwall tubes of Malaya Unit No. 1.

2. Sample Tube

Waterwall tube: 900 mm (300 mm for deterioration tests, 600 mm for dissolution tests)

3. Test Items and Methods

(1) Appearance

Upon receipt, the sample tube was visually inspected, and checked for any deformations in the tube shape and any scale discoloration. The appearances were photographed for recording purposes.

(2) Dimension

Outer diameter and wall thickness of sample tube were measured to check for any decrease in the wall thickness or for any deformation.

(3) Cross section microstructure

The microstructure in the circumferential section was examined on the furnace side and furnace-wall side, and was checked for any structural change due to overheating, etc. Photographs were taken for recording purposes.

(4) Hardness measurement

The hardness at the center of tube wall thickness in the circumferential section was measured at 8 points.

(5) Thickness of interior surface scale

Thickness of the interior surface scale was measured on the furnace side and furnace-wall side

in the circumferential section using an optical microscope, and photographs were taken for recording purposes.

(6) Amount of interior surface scale buildup

Scale built up on the interior surface on the furnace side and furnace-wall side was removed by acid cleaning and the amount of scale was found by measuring the weight difference before and after scale removal.

(7) Composition analysis of interior surface scale

Composition of the interior surface scale was analyzed by chemical analysis and X-ray diffraction.

(8) Dissolution test of interior surface scale

Dissolution test with hydrochloric acid (circulation method) was conducted. Schematic diagram of the scale dissolution test equipment is provided in Fig. 9. Acid solution (hydrochloric acid) at 60°C was circulated through the 300 mm long sample tube, and the concentration of the eluted Fe ion was measured hourly until saturation was reached.

4. Test Results

(1) Appearance

Fig. 2 and Fig. 3 show the appearance.
The T. P. No. 1 and No. 2 had, on their furnace side surface, roughly 0.2 mm of dark-gray hard scale with approx. 0.2 mm adhesion of whitish gray ash on top of the scale. Their furnace-wall side surfaces had roughly 0.1 mm of dark-gray hard scale with a 0.2 ~ 0.5 mm adhesion of reddish brown powdery scale on the top.

(2) Dimensional check

Fig. 4 and Table 1 show the dimensional check results.
The outer diameter was 37.2 mm in all the four directions measured. The wall thickness was 5.0 ~ 5.3 mm and neither conspicuous unevenness in the thickness nor swelling was noted.

(3) Cross-section microstructure

The cross-section microstructure on the furnace side and furnace-wall side are shown in Fig. 5 and Fig. 6 respectively.

Both the furnace and furnace-wall sides had ferrite-perlite structure with no indication of structural changes caused by overheating, etc. However, a decarburized layer was noted roughly 0.10 mm deep from the interior surface on the furnace side and roughly 0.07 mm from the furnace-wall side interior surface.

(4) Hardness test

The hardness test results are shown in Table 2. The hardness level was within the range of Hv 133 ~ 141, with Hv 133 ~ 136 on the furnace side and Hv 137 ~ 141 on the furnace-wall side. The values on the furnace side were slightly lower.

(5) Thickness of interior surface scale

Fig. 7 shows the thickness measurement results of the interior surface scale.

The thickest part of the scale was 0.11 mm on the furnace side and 0.05 mm on the furnace-wall side, with the mean thickness 0.095 mm on the furnace side and 0.038 mm on the furnace-wall side. The scale was thicker on the furnace side than on the furnace-wall side.

(6) Measurement of the degree of interior surface scale

Table 3 shows the measurement results of the amount of interior surface scale.

The scale buildup was 70 mg/cm^2 on the furnace side and 49 mg/cm^2 on the furnace-wall side. A larger amount of scale was noted on the furnace side than on the furnace-wall side.

(7) Composition analysis of interior surface scale

Table 4 shows the results of chemical analysis for the interior surface scale composition, and Fig. 8 shows the results of component identification by X-ray diffraction.

The chemical composition of the interior surface scale was Fe 66.3%, Cu 0.02%, Ni 0.02%, Al 1.38%, Zn 0.14%, Ca 0.08%, Mg 0.02%, Si 0.15%, and insoluble matter in acid 2.17%, of which Fe was the principal component. The X-ray diffraction identified Fe_3O_4.

(8) Interior surface scale dissolution tests

1) Study of concentration for test solution

The amount of the interior surface scale measured this time was 70 mg/cm^2 on the furnace side. If it is assumed to be mostly composed of Fe_3O_4 , the Fe will be:

Fe = 70 (mg/cm^2) x (1/1.38) = 50.7 (mg/cm^2).

If the chemical cleaning solution ratio for the test is 2.5 mℓ/cm^2, the eluted Fe is considered to be:

50.7 (mg/cm^2) x 1000 x [1/2.5(mℓ/cm^2)] = 20,280 (mg/ℓ).

Since an Fe elution of 5,740 mg/ℓ is possible with the 1% acid solution of conventionally used hydrochloric acid of single component solution, solution specification of hydrochloric acid concentration of

$$20,280\,(mg/\ell) \div 5,740\left(\frac{mg/\ell}{\%}\right) = 3.5\,(\%)$$

would be applicable. By taking an allowance for residual acid concentration into account so as to secure 2.0 ~ 2.5% post-test concentration, it was decided to change the solution specification for [Test No.2] after the scale behavior checking with a test using 5% hydrochloric acid concentration [Test No. 1].

2) Scale dissolution test results

Table 5 shows the test conditions and results, Fig. 10 shows the change in the eluted Fe ion concentration with the passage of time, and Photo 1 shows the interior surface status of the specimen after the respective tests.

a. Test No. 1

The test was carried out by using a solution of 5.0% concentration of hydrochloric acid. After one hour from the start of the test, the eluted Fe ion concentration was 14,025 ppm. Thereafter the value gradually rose, and reached saturation point at 15,675 ppm in three hours from the start. Then the internal surface of the tube was checked to confirm that the scale had been completely removed.

b. Test No. 2

Since the scale was confirmed to have been completely removed with use of the solution of 5.0% hydrochloric acid concentration specification, another test was conducted with the solution for which the hydrochloric acid concentration was changed to 3.5%.

In an hour after starting the test, the eluted Fe ion concentration was 11,550 ppm. Thereafter the value gradually rose, and reached the saturation point at 14,850 ppm in three hours from the start. Then the internal surface of the tube was checked to confirm that the scale had been completely removed.

5. Summary

(1) No discoloration or deformation was observed on the furnace side or the furnace-wall side.

(2) In the dimensional check, no uneven thickness or swelling was found.

(3) The structures were ferrite perlite with no indication of structural change caused by overheating, etc. A decarburized layer roughly 0.1 mm deep was noted on the interior surfaces of the tubes.

(4) The hardness level was within the range of Hv 133 ~ 141, and the values on the furnace side were slightly lower.

(5) The mean thickness of interior surface scale was 0.095 mm on the furnace side and 0.038 mm on the furnace-wall side. The amount of interior surface scale was 70 mg/cm^2 on the furnace side and 49 mg/cm^2 on the furnace-wall side. In both measurements, higher values were indicated on the furnace side where the tube wall temperature is high.

(6) The results of the composition analysis for the interior surface scale showed that Fe was the primary component, and other components (metallic components such as Cu, Ni, Al, and Zn, and hardness components in boiler water such as Ca, Mg, and Si) were of mere trace quantity.

(7) In the result of the interior surface scale could be completely removed with a solution of 5% and 3.5% hydrochloric acid concentration.

A summary of the results is that the sample tube showed no discoloration due to overheating or reduced tube wall thickness due to corrosion, and their structures were ferrite perlite with no indication of structural changes due to overheating, etc.

On the interior surface of the tubes, a decarburized layer, assumed to have occurred during manufacturing, was noted. The hardness value was slightly lower on the furnace side, which seems to indicate a tendency towards softening.

In the composition of the interior surface scale caused by overheating or corrosion of the tube material, the amount of impure elements was minimal and the Fe_3O_4 was dominant. Although conspicuous deterioration was not found with the tube sample this time, we recommend that a sample tube test be implemented systematically to ascertain the status of the tube materials changing with the passage of time and to use the results for water quality management.

Furthermore, since the scale amount is anticipated to increase, we recommend that dissolution tests be conducted again when the boilers are chemically cleaned.

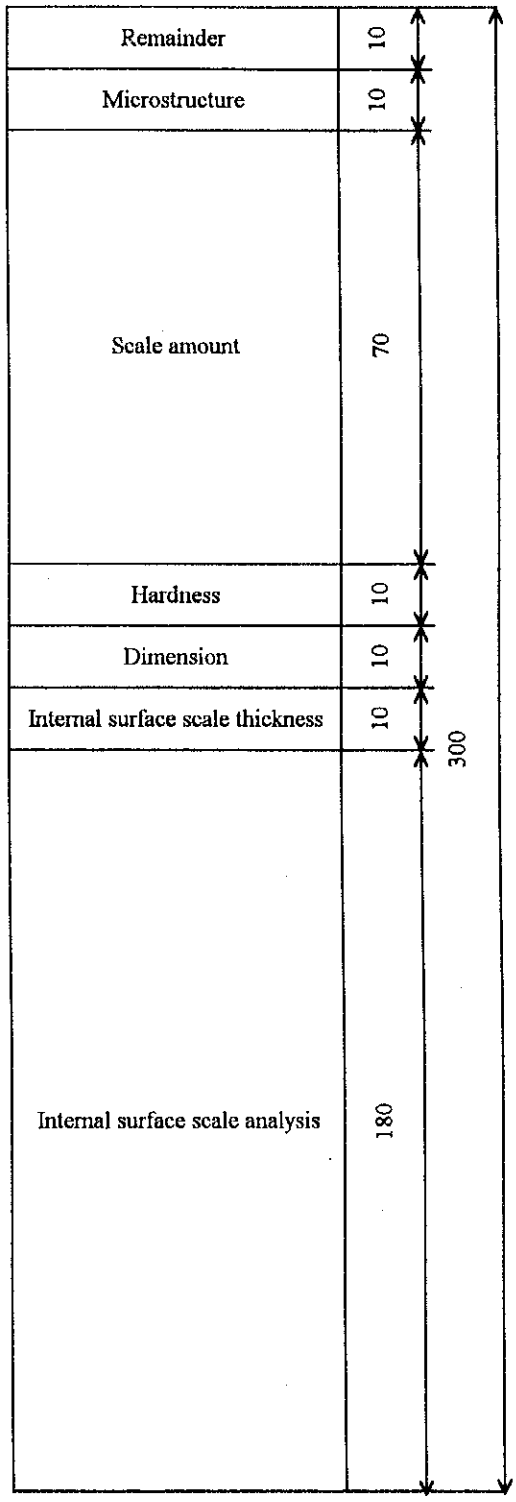
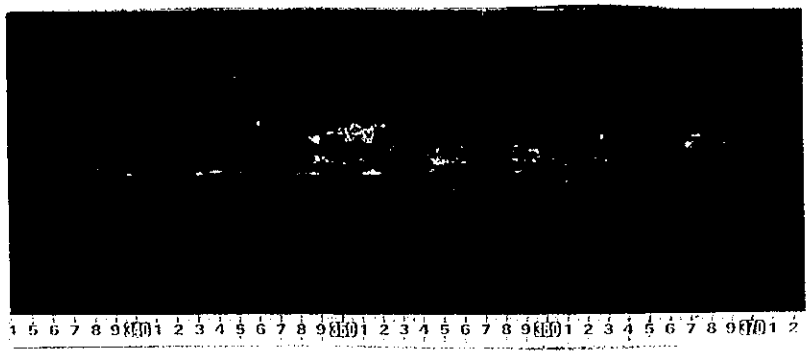


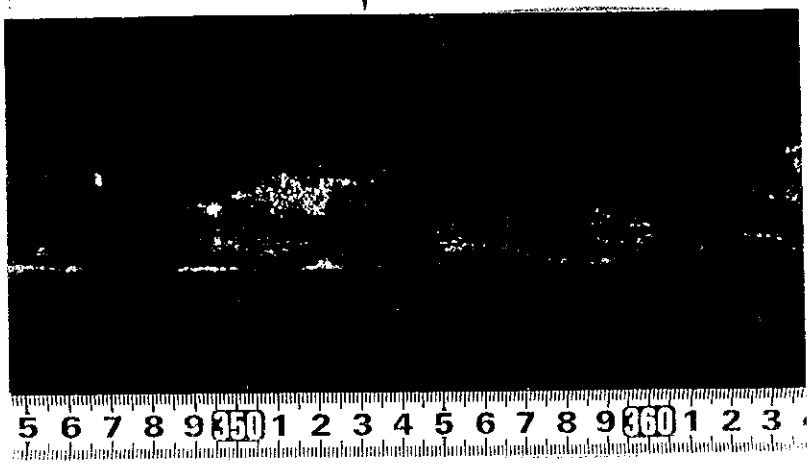
Fig. 1 Specimen Allocation in the Sample Tube

Overall view



Furnace side

Enlarged



Overall view

Furnace-wall side

Enlarged

Fig. 2 T. P. No. 1 Appearances

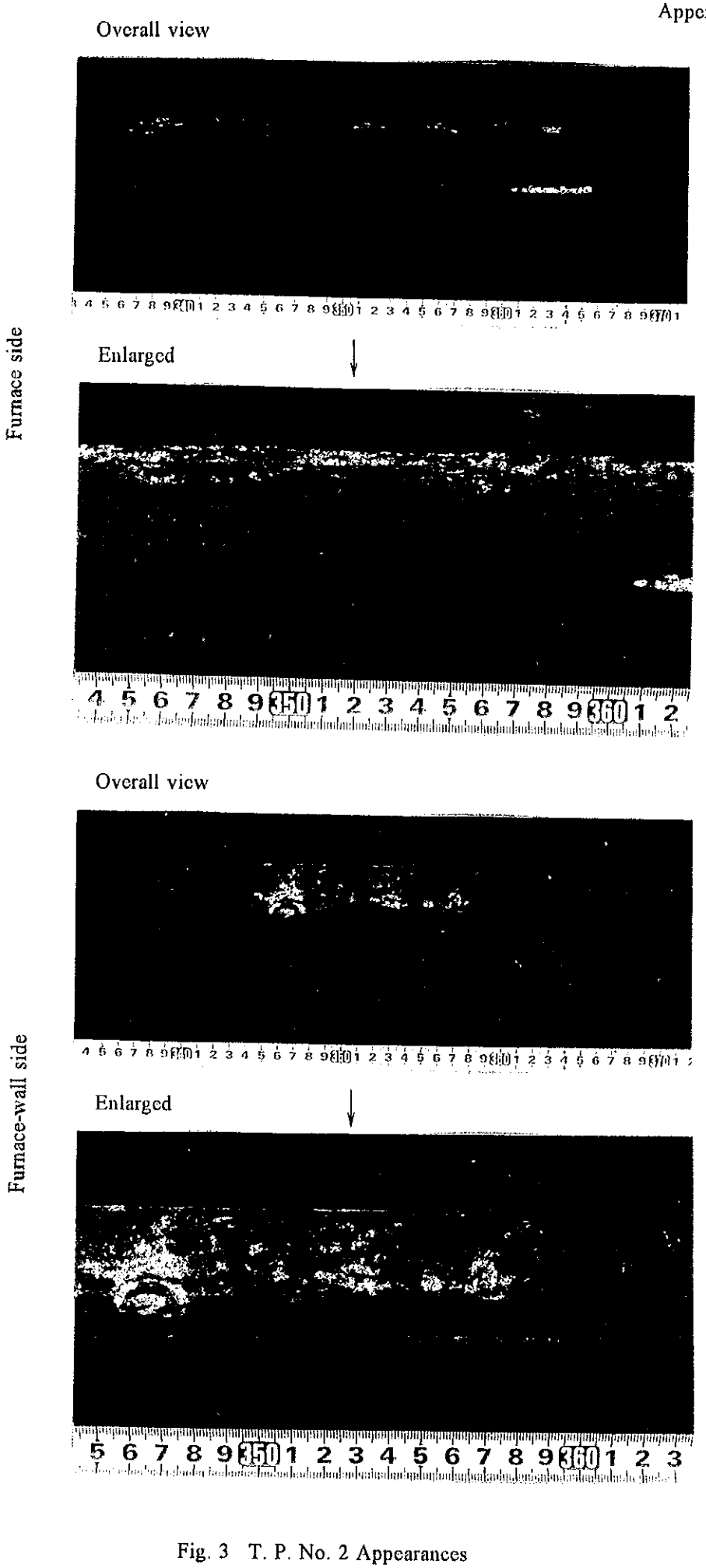
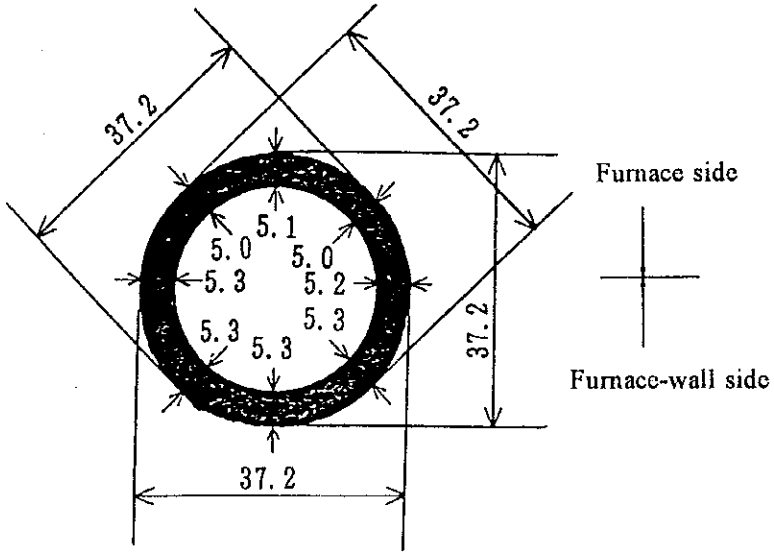
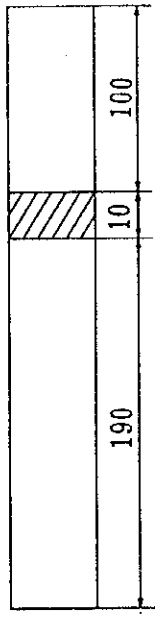


Fig. 3 T. P. No. 2 Appearances



No variation of thickness, swelling, etc. was found.

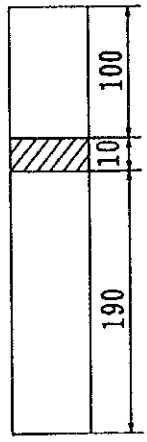


Sampled location of specimen (▨)

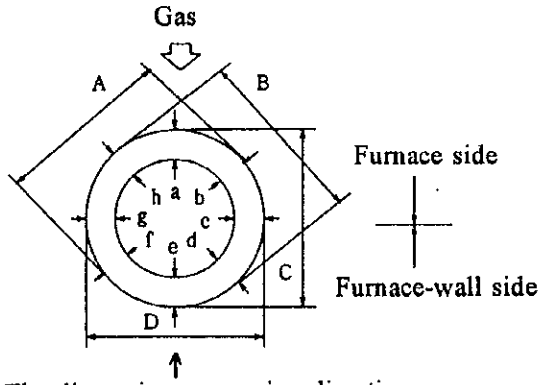
Fig. 4 T. P. No. 1 Dimensional Check Results (mm)

Table 1 T. P. No. 1 Dimensional Check Results (mm)

Check Items	Measuring Directions	Measured Values
Outer Diameter	A	37.2
	B	37.2
	C	37.2
	D	37.2
Wall Thickness	a	5.1
	b	5.0
	c	5.2
	d	5.3
	e	5.3
	f	5.3
	g	5.3
	h	5.0



Sampled location of specimen (marked by ▨)



The dimension measuring directions

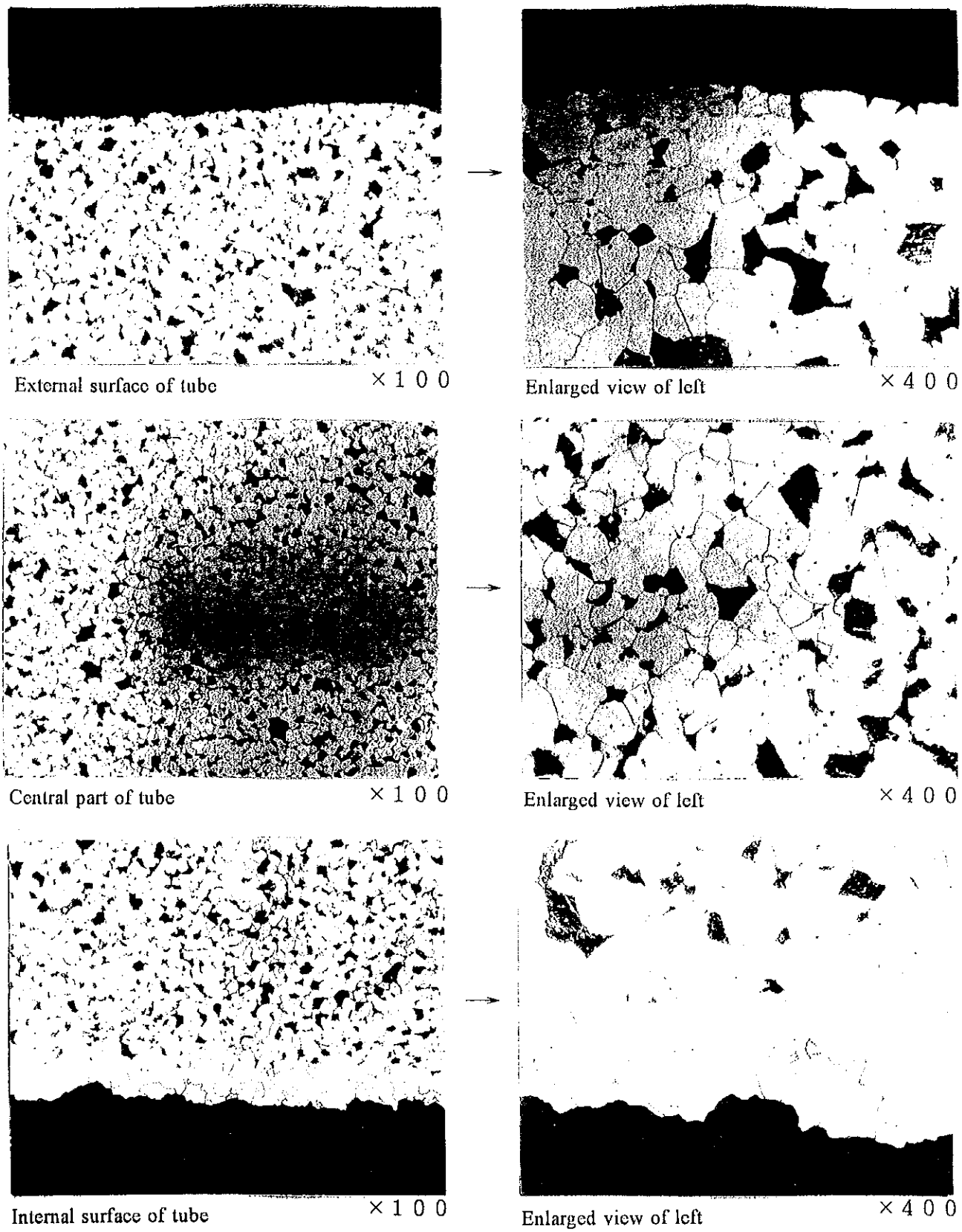


Fig. 5 Cross-section Microstructure on Furnace Side

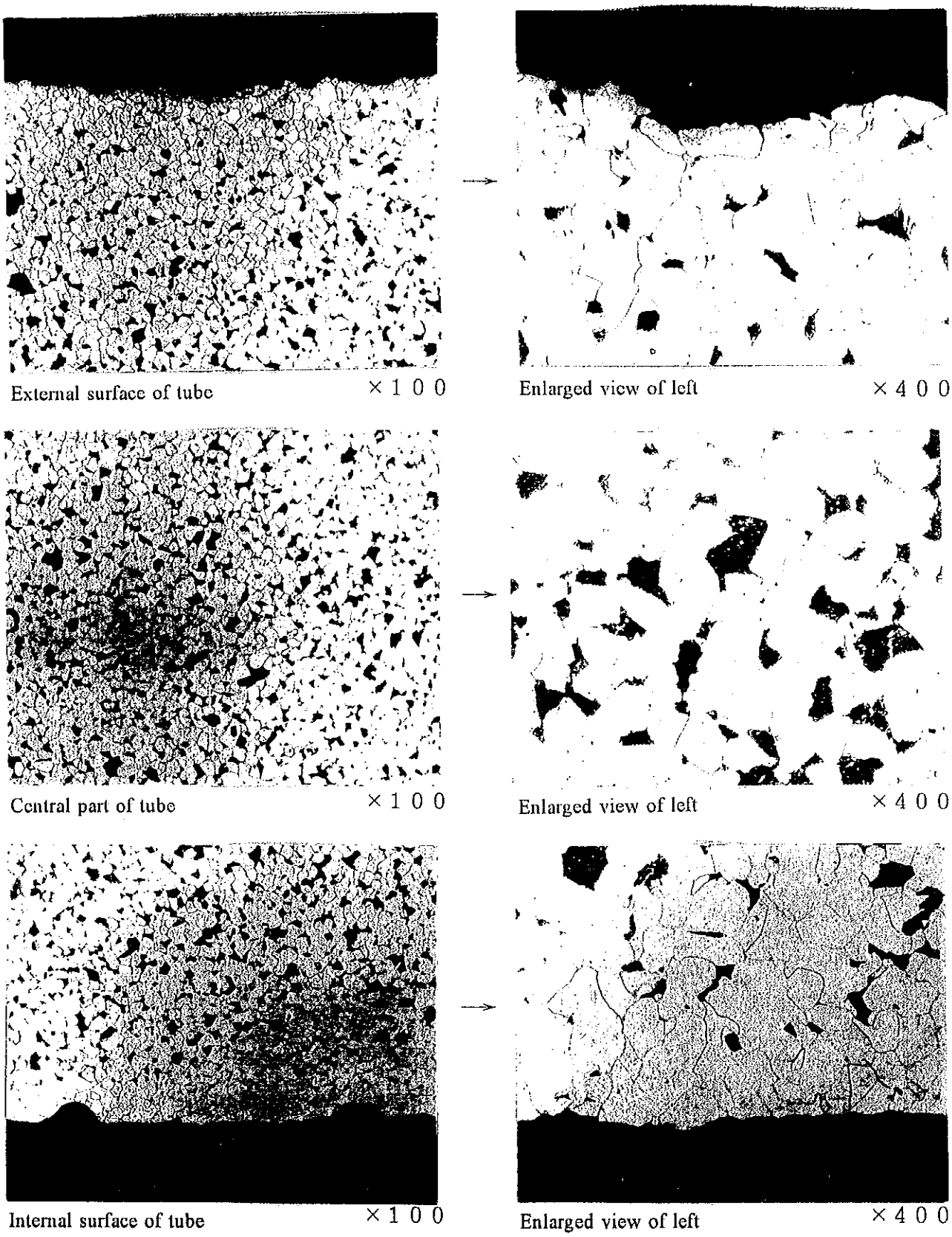
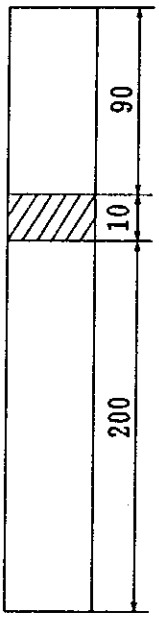


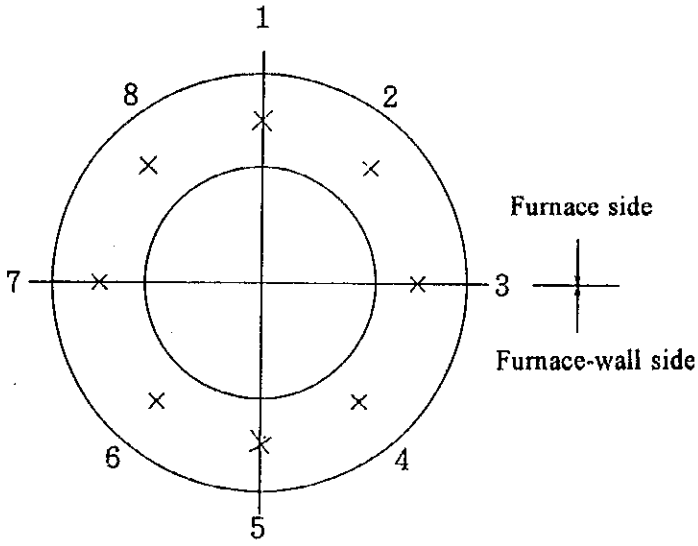
Fig. 6 Cross-section Microstructure on Furnace-wall Side

Table 2 Hardness Test Results (Hv)

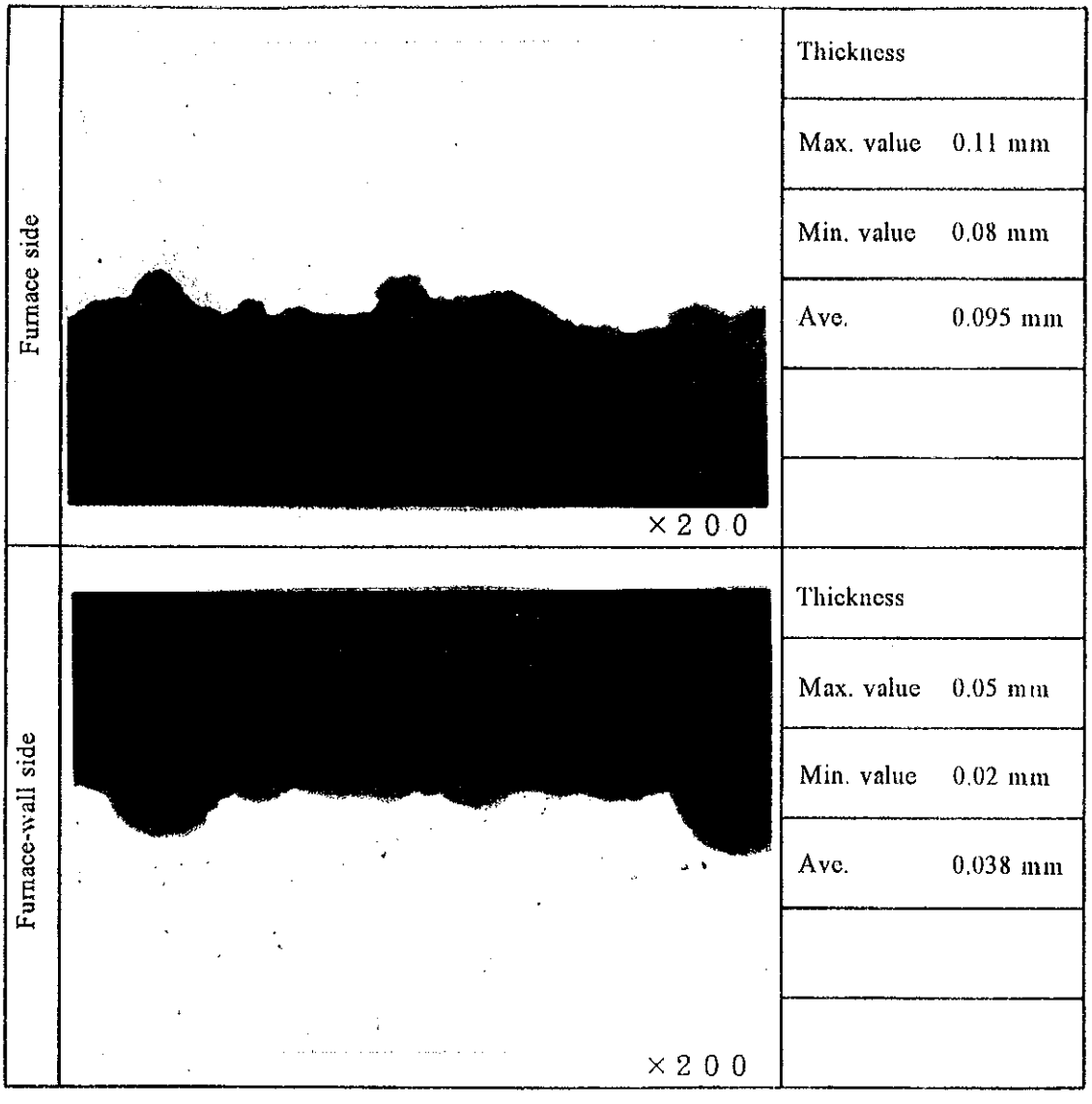
Measuring points	1	2	3	4	5	6	7	8
Measured value	133	134	135	141	138	137	134	136

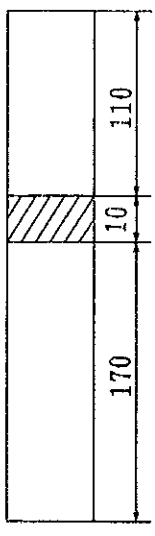


Sampled location of specimen

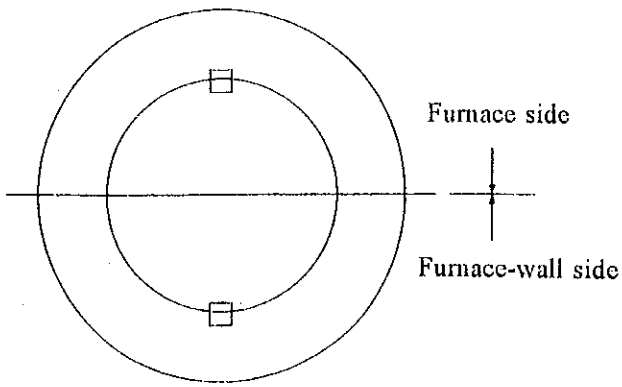


Measuring points x (center of the wall thickness)





Sampled location of specimen

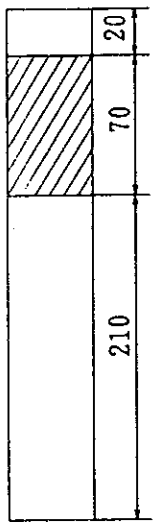


Measuring points

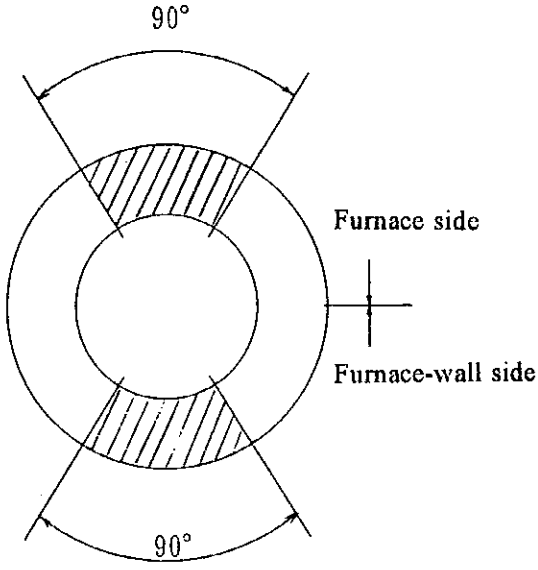
Fig. 7 Thickness Measurement Results of Interior Surface Scale (mm)

Table 3 Interior Surface Scale Measurement (mg/cm^2)

Furnace side	Furnace-wall side
70	49



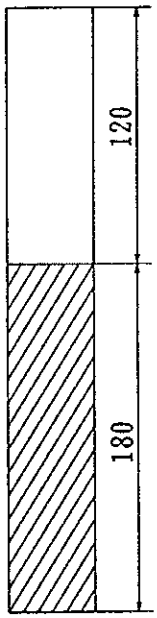
Sampled location of specimen



Measuring points

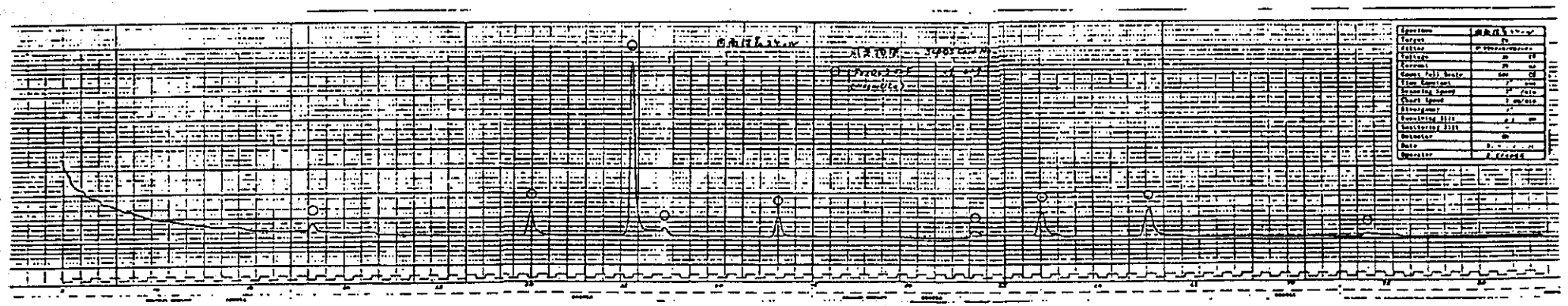
Table 4 Chemical Analysis Result of Scale Composition (%)

Scale composition	Fe	Cu	Ni	Al	Zn	Ca	Mg	Si	Unsolvable elements
%	66.3	0.02	0.02	1.38	0.14	0.08	0.02	0.15	2.17



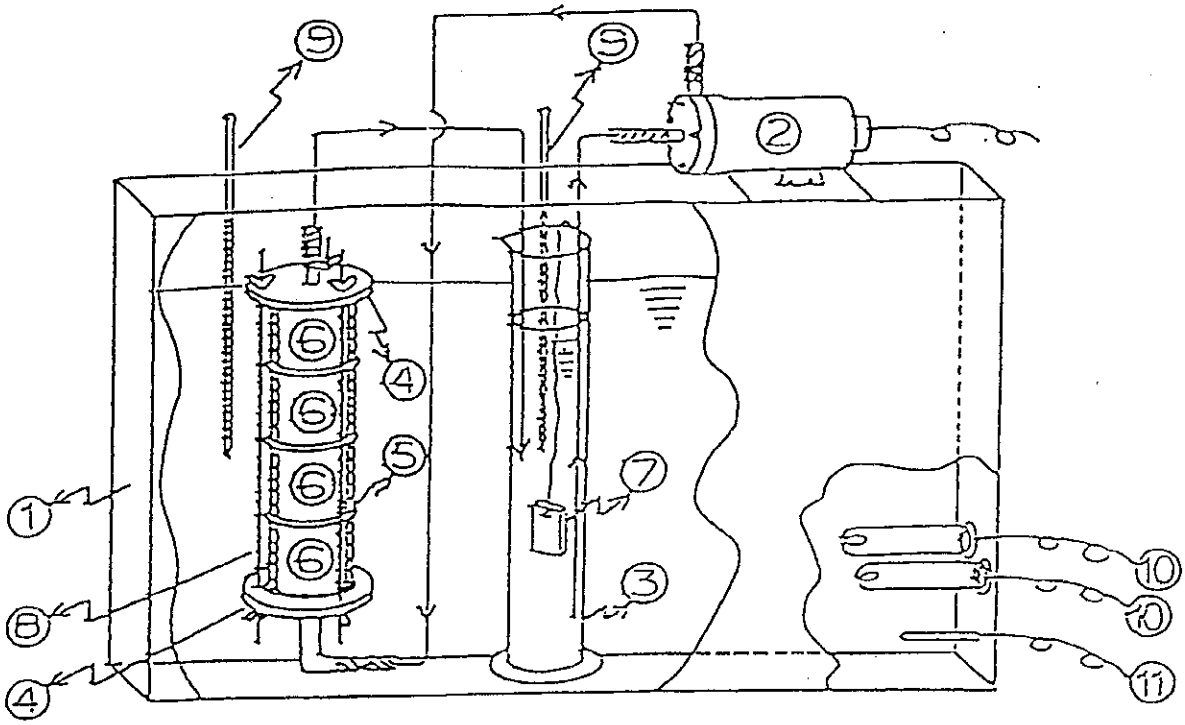
Sampled location of specimen

Identified substance Fe_3O_4



Specimen	Scale on interior surface
Target	Cu
Filter	Graphite monochromator
Voltage	30 KV
Current	20 mA
Count Full Scale	500 CS
Time Constant	2° sec
Scanning Speed	2° /min
Chart Speed	2 cm/min
Divergency	1°
Receiving Slit	0.3 mm
Scattering Slit	-
Detector	GM
Date	H. 7. 1. 11
Operator	O. SAKODA

Fig. 8 Component Identification of Internal Surface Scale by X-ray Diffraction



(1)	Constant-temperature bath	(6)	Specimen
(2)	Circulating pump	(7)	Test piece
(3)	Circulation tank	(8)	Connecting rod
(4)	Flange	(9)	Thermometer
(5)	Gasket	(10)	Heater
		(11)	Thermostat

Fig. 9 Outline of Dissolution Test Equipment

Table 5 Scale Dissolution Test Conditions and Results

Specifications \ Test No.	1	2
Test conditions		
Hydrochloric acid (%)	5.0	3.5
Ibit 2S (%) 0.3	0.3	
Swellin S (%)	0.2	0.2
Processing temperature (°C)	60	60
Test solution ratio (mℓ/cm^2)	2.5	2.5
Circulating speed inside tube (m/s)	0.3 ~ 0.4	0.3 ~ 0.4
Fe ion elution (mg/ℓ)		
After 1 hour	14,025	11,550
After 2 hours	15,125	14,300
After 3 hours	15,675	14,850
After 4 hours	15,675	14,850
Residual acid content (%)	1.6	0.2
Sludge amount (mg/cm^2)	0.56	1.56
Scale removal status	complete removal	complete removal

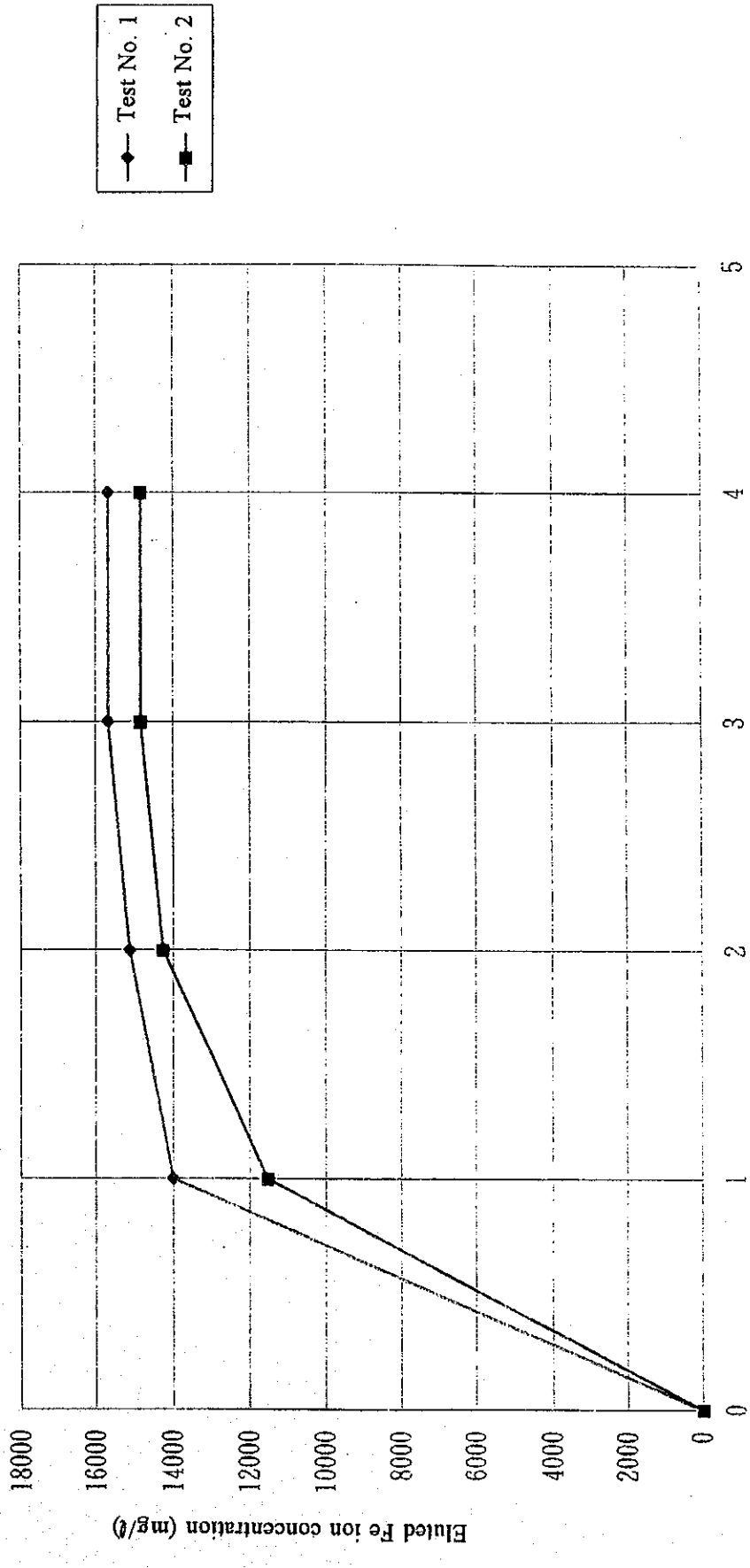
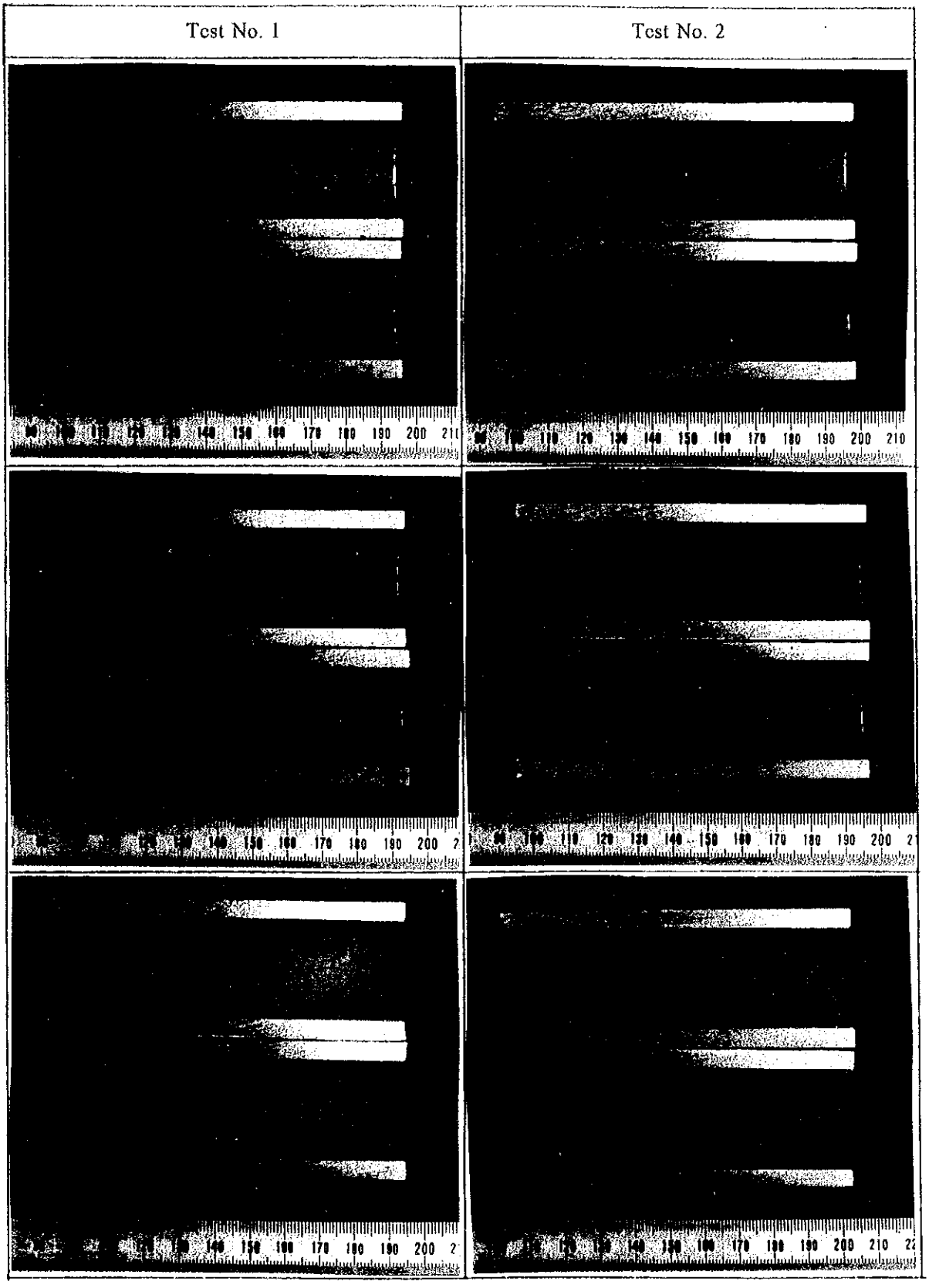
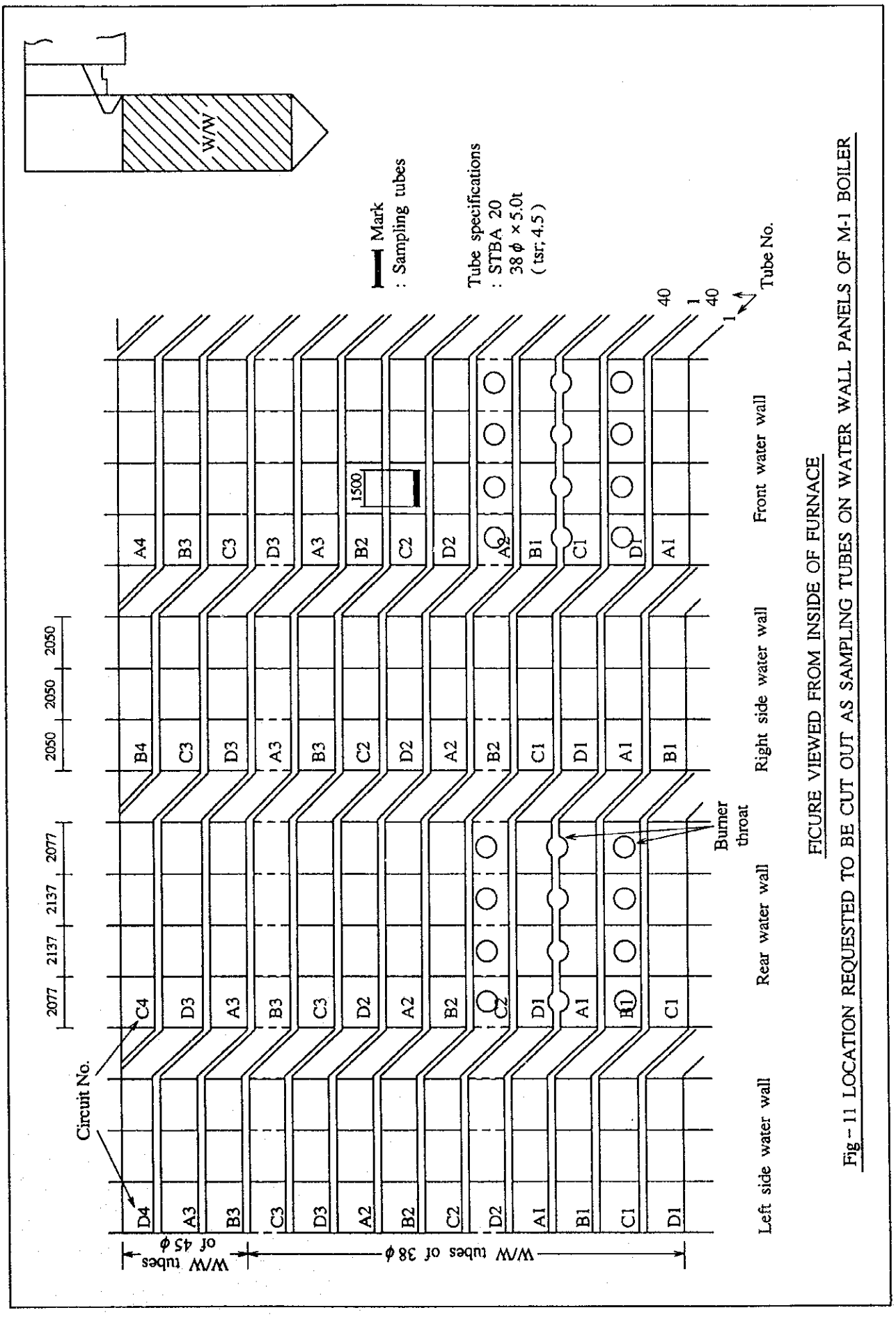


Fig. 10 Eluted Fe Ion Concentration with the Passage of Time

Photo 1 Status of Internal Surface of Tubes after Dissolution Test





FICURE VIEWED FROM INSIDE OF FURNACE

Fig - 11 LOCATION REQUESTED TO BE CUT OUT AS SAMPLING TUBES ON WATER WALL PANELS OF M-1 BOILER

TECHNOLOGY FOR ASSESSMENT OF REMAINING LIFE

I. GENERAL DESCRIPTION

1. Objective

The objective of remaining life assessment will be considered as follows;

(1) To assure the reliable operation of power plant

(2) To establish/enrich "preventive maintenance" system

(3) To determine critical equipment/components which shall be taken necessary measures at the coming major periodic overhaul or rehabilitation.

(4) To prepare the suitable examination method of those components

(5) To assess actual conditions of equipment/components

(6) To find out ideas or methods of elongation of power plant's life span.

2. Assessment of Remaining Life

(1) Timing for Remaining Life Assessment (R. L. A.)

(a) Standard timing for R. L. A. in japan is;

- Total operation hour reaches 100,000 hours or
- Total number of start reaches 2,500

(b) Applicable Timing for R. L. A.

It is recommendable for those power plants operating for a long time without any R. L. A. to implement inspection in the earliest chance, because the results of these inspections will be essential to draw up the prescriptions for preventive maintenance necessary for safe and reliable operation after rehabilitation.
The timing applicable for such power plants mentioned above will be only in the time of plant overhaul.

(2) Facilities/components to be inspected for R. L. A.

In general, all major facilities of the plant should be inspected in view of detecting aged deterioration, if not implemented any R. L. A. up to the date. However, from technical and economic view points, it is practical and recommendable way to limit to critical equipment such as boiler, turbine, generator, etc.
The critical parts of major equipment are considered as follows;

Boiler	:	Pressure parts such as drum, SH/RH tubes, water wall tubes and headers
Turbine	:	HP/IP casing and rotor, LP rotor and its long blades, Major Valves (MSV, CV, RSV, ICV)
Major Pipes	:	Main steam pipe, Reheat steam pipe

Generator : Stator/rotor coil and rotor shaft

(3) Facilities/components to be inspected by non-destructive inspection

There are some facilities/components that should be inspected by non-destructive inspection to assure the reliable operation before R. L. A. This inspection will give their present conditions of deterioration and be needed for R. l. A.

3. Critical Equipment/components to be Examined

In this article, the critical equipment/components and their examination method are shown as follows: (in Table 3)

Table 3-1 Major Equipment and Components (For reference)

	Unit A		Unit B	
Equipment	Components	Parts	Components	Parts
Boiler	Furnace	Wall tubes	Same as Unit No. 1	
	High Temp. Superheater and Reheater (Upper part)	Outlet header tube nozzles		
		Tubes		
		Dissimilar weld joint of tubes		
	Type	Drum type	Type	Drum type
Turbine	HP/IP rotor	Center bore Heat groove Blade groove	HP/IP rotor	Outer surface
		Moving Blade Governing stage HP. 1st & 2nd IP. 1st & 2nd		Moving Blade HP. IP.
	LP rotor	Center bore Blade groove L-0, L-1	HP/IP Inner casing and Outer casing	Inner surface
	Type	WH type	Type	Simense Type
Equipment	Components	Parts	Components	Parts
Generator	Stator	Coil (*1)(*2)	Stator	Coil (*2)
	Rotor	NA	Rotor	NA
	Manufacturer	Mitsubishi Electric Co.	Manufacturer	Fuji Electric Co.

(*1) No special examination is carried out, but remaining life will be assessed by the operation hours and number of start/stops.

(*2) Coil insulation precise examination
This is considered as ageing deterioration examination and not included here in this remaining life assessment. However, WEST JEC recommends to do this examination, if the stator coils are not rewound in the rehabilitation.

NA = Not applied

MALAYA THERMAL POWER PLANT

LIST OF MMP PROCEDURES

TABLE OF CONTENTS

*: Under preparation

MALAYA THERMAL POWER PLANT
MECHANICAL MAINTENANCE PROCEDURES
(MYTP/MMP)

PROCEDURE NO.	TITLE	
MMP - 01	VALVE PACKING REPLACEMENT	
- 02	COUPLING ALIGNMENT OF ROTATING EQUIPMENT	
- 03	TANK AND VESSEL ENTRY, INSPECTION, REPAIR AND CLOSURE	
- 04	LIMITORQUE OPERATOR, REMOVAL OVERHAUL AND INSTALLATION	
- 05	LUBRICATION, INSPECTION OF MECHANICAL EQUIPMENT	*
- 06	MAINTENANCE OF RELIEF VALVE	
- 07	GENERAL WELDING PROCEDURE (PIPING)	*
- 08	GENERAL WELDING PROCEDURE STRUCTURAL	
- 09	MYTP #1 BOILER FEEDWATER PUMPS	*
- 10	DISASSEMBLY AND REASSEMBLY OF MYTP #2 CIRCULATING WATER PUMPS	
- 11	MYTP #1 VERTICAL CIRCULATING WATER PUMPS	
- 12	MAINTENANCE OF MYTP #2 CONDENSATE PUMPS TYPE TSM-VB6	
- 13	MYTP #1 M-BFP, TYPE HDG55N	*
- 14	MAINTENANCE OF MOTOR DRIVEN CENTRIFUGAL FIRE SERVICE BOOSTER PUMP	*
- 15	MAINTENANCE OF MOTOR DRIVEN CENTRIFUGAL FIRE SERVICE BOOSTER PUMP	*
- 16	INSPECTION & CLEANING OF FUEL OIL STRAINER	*

* Under preparation

MALAYA THERMAL POWER PLANT
ELECTRICAL MAINTENANCE PROCEDURES
(MYTP/MMP)

PROCEDURE NO.	TITLE	
EMP- 01	GENERAL INSULATION RESISTANCE	
- 02	LUBRICATION OF ELECTRICAL MOTOR BEARINGS	
- 03	MOTOR OPERATED VALVES MAINTENANCE/TESTING	
- 04	ROUTINE MAINTENANCE AND OVERHAUL OF DC MOTORS	
- 05	DC HI-SPOT TESTING	
- 06	AC HI-SPOT TESTING	
- 07	PREVENTIVE MAINTENANCE AND INSPECTION OF AC MOTORS	
- 08	BATTERY PERFORMANCE TEST	
- 09	INSPECTION AND MAINTENANCE OF BATTERY	
- 10	MYTP #2 480 V SWITCHGEAR	
- 11	AMMETER & VOLTMETER CALIBRATION	
- 12	INSPECTION AND MAINTENANCE OF TYPE FA2-N GAS CIRCUIT BREAKER	
- 13	TRANSFORMER TURNS RATIO TEST	*
- 14	INSPECTION AND MAINTENANCE OF TRANSFORMER	
- 15	INSPECTION AND MAINTENANCE OF GENERATOR	*
- 18	CONTACT RESISTANCE TESTING	
- 20	INSPECTION AND MAINTENANCE OF 480 VOLTS MCC	

* Under preparation

MALAYA THERMAL POWER PLANT
INSTRUMENT AND CONTROL PROCEDURE (ICF)
(MYTP/MMP)

PROCEDURE NO.	TITLE
ICP - 01	GENERIC CALIBRATION OF INDICATORS
- 02	GENERIC CALIBRATION OF INSTRUMENTATION SWITCHES
- 03	CALIBRATION FOR LOCAL TEMPERATURE INDICATORS
- 04	GENERIC CALIBRATION OF RECORDERS
- 05	CALIBRATION OF PRESSURE INDICATORS OR PRESSURE GAUGES
- 06	CALIBRATION OF PRESSURE SWITCHES
- 07	GENERIC CALIBRATION OF CONTROL VALVE AND POSITIONER
- 08	CALIBRATION OF PNEUMATICALLY ACTUATED VALVE

MALAYA THERMAL POWER PLANT
RESULT TESTING PROCEDURES
(MYTP/MMP)

PROCEDURE NO.	TITLE	
RTP - 01	BOILER PERFORMANCE TEST	
- 02	BOILER EFFICIENCY TEST (HEAT LOSS METHOD)	
- 03	BOILER CIRCUIT DROP TEST	*
- 04	BOILER SYSTEM LEAK TEST	*
- 05	BOILER HYDROSTATIC TESTING a Once-Through b Drum-Type	*
- 06	BOILER TUBES ACID TESTING	*
- 07	BOILER STORAGE AND PRESERVATION	*
- 08	BOILER SAFETY VALVE SETTING (JACK METHOD)	*
- 09	HEAT RAT PERFORMANCE TESTING	
- 10	AIR PREHEATER "LJUNGSTROM" PERFORMANCE	
- 11	STEAM COIL AIR HEATER LEAK TEST	*
- 12	TURBINE STAGE EFFICIENCY TESTING	
- 13	FEEDWATER HEATER PERFORMANCE (LOW/HIGH PRESS)	*
- 14	FEEDWATER HEATER LEAK TEST AND TUBES PLUGGING	*
- 15	HOUSE SERVICE CLOSED CYCLE PERFORMANCE	
- 16	TURBINE PROTECTIVE DEVICE TEST a. Siemens Turbine b. Hitachi Turbine	*
- 17	MAIN CONDENSER PERFORMANCE	
- 21	IN-PLACE DYNAMIC BALANCING	

* Under preparation

MALAYA THERMAL POWER PLANT
CHEMICAL ANALYSIS PROCEDURES
(MYTP/MMP)

PROCEDURE NO.	TITLE	
CAP - 01	DETERMINATION OF PHOSPHATE, TITRATION METHODS	
- 02	DETERMINATION OF PHOSPHATE, CALORIMETRIC METHODS	
- 03	DETERMINATION OF COPPER, ZINCON METHOD	
- 04	DETERMINATION OF IRON BY SPECTROPHOTOMETRIC METHOD	
- 05	PREVAILING CONDITION OF THE PLANT TO BE SHUTDOWN	*
- 06	CHEMICAL MANAGEMENT IN NORMAL OPERATION OF BOILER	*
- 07	DEPOSITS - SLAG ANALYSIS	
- 08	ADDITIONAL GUIDELINES FOR NPC POWER PLANT INITIAL START-UP/PRESERVATION	*
- 09	DEMINERALIZE PLANT (REGENERATION PROCEDURE, NEUTRALIZATION)	*
- 10	DETERMINATION OF CHLORIDE, NEPHELOMETRY METHOD (TOTAL RESIDUAL Cl, COLOMETRIC METHOD)	
- 11	HYDRAZINE TEST (IODOMETRIC METHOD)	
- 12	HYDRAZINE, CALORIMETRIC DETERMINATION WITH PARADIMETHYL AMINO BENZALDEHYDE	
- 13	SILICA, SPECTROPHOTOMETRIC DETERMINATION (LOW RANGE/HIGH RANGE COLLOIDAL SILICA PROCEDURE)	
- 14	DISSOLVED OXYGEN DETERMINATION BY INDIGO CARMINE METHOD	
- 15	DISSOLVED OXYGEN DETERMINATION USING CHEMIT KITS	
- 16	DETERMINATION OF SPECIFIC GRAVITY, HYDROMETER METHOD	
- 17	MEASUREMENT OF PH	
- 18	DETERMINATION OF FREE MINERAL ACIDITY	
- 19	MEASUREMENT OF ALKALINITY, PHENOLPHTHALEIN AND TOTAL ALKALINITY	*
- 20	DETERMINATION OF TOTAL SOLID, TOTAL DISSOLVED SOLIDS & TOTAL SUSPENDED SOLIDS (HIGH RANGE)	
- 21	DETERMINATION OF TOTAL HARDNESS (MAGNESIUM AND CALCIUM) BY VOLUMETITRATION	
- 22	STANDARDIZATION OF HYDROCHLORIC SULFURIC ACID, SPECIAL IN	

* Under preparation

MALAYA THERMAL POWER PLANT
CHEMICAL ANALYSIS PROCEDURES
(MYTP/MMP)

PROCEDURE NO.	TITLE	
CAP - 23	STANDARDIZATION OF SODIUM THIOSULFATE 0.1N	
- 24	STANDARDIZATION OF SODIUM HYDROXIDE 0.02 TO 1.ON	
- 25	STANDARDIZATION OF SODIUM POTASSIUM PERMANGANATE 0.1N	
- 26	STANDARDIZATION OF IODINE 0.1N	
- 27	STANDARDIZATION OF IODINE. 0.1N	
- 28	STANDARDIZATION OF HYDROCHLORIC/SULFURIC ACID. 0.02 TO 1.0N	
- 29	DETERMINATION OF CATION CONDUCTIVITY	
- 30	SAL T-SPLITTING (STRONG BASE) ANION RESIN CAPACITY DETERMINATION	
- 31	RESINS, DETERMINATION OF TOTAL CATION EXCHANGER CAPACITY	
- 32	WATER RETENTION OF CAPACITY RESINS	
- 33	ION-EXCHANGE RESINS SCREEN ANALYSIS	
- 34	DETERMINATION OF AVAILABLE CHLORIDE IN SODIUM HYPOCHLORITE SHIPMENTS	
- 35	ANALYSIS OF SODIUM HYDROXIDE (DETERMINATION OF PURITY, TOTAL ALKALINITY AS NaOH)	
- 36	ANALYSIS OF HYDROCHLORIC ACID (DETERMINATION OF PURITY, ACIDITY AS HCl)	
- 37	CORROSION RATE AND DEPOSIT DENSITY TEST	*
- 38	FUEL OIL TANK SAMPLING FOR ANALYSIS (DIESEL FUEL)	*
- 39	SPECIFIC GRAVITY DETERMINATION IN DIESEL FUEL OIL	*
- 40	DETERMINATION OF SPECIFIC GRAVITY	*
- 41	CARBON RESIDUE DETERMINATION IN FUEL OIL	*

* Under preparation

MALAYA THERMAL POWER PLANT
TECHNICAL DOCUMENT CONTROL PROCEDURE
(MYTP/MPP)

PROCEDURE NO.	TITLE
TDC - 1	RECEIVING OF EXTERNAL AND INTERNAL INCOMING DOCUMENTS
- 2	PROCESSING AND DISPATCH OF INTERNALLY INTENDED AND OUTGOING DOCUMENTS
- 3	MYTP RECORDS RETENTION/DISPOSAL
- 4	CLASSIFYING/INDEXING OF DOCUMENTS
- 5	FILLING, SUPPLEMENTING, CORRECTING AND UPDATING OF DOCUMENTS
- 6	CONTROL OF GENERATED DOCUMENTS
- 7	HANDLING OF CONFIDENTIAL AND RESTRICTED DOCUMENTS

Scheduled Maintenance Control List for Boiler and the Relevant Equipment

Scheduled Maintenance Routine List will be drawn up based on this List

Thermal Power Plant, Maintenance Sec. (Mechanical)

Division (Note 1)	Work Criteria No.	Check Sheet No.	Work Division (Note 2)	Inspection Items	Number of Equipment	Frequency (Time/ Month)	First Week						Second Week						Third Week						Fourth Week						Execution Month					
							M.	Tu.	W.	Th.	F.	Sa.	M.	Tu.	W.	Th.	F.	Sa.	M.	Tu.	W.	Th.	F.	Sa.	M.	Tu.	W.	Th.	F.	Sa.	4	5	6	7	8	9
																														10	11	12	1	2	3
			D	Inspection on the Body of Boiler		2		I						II						I						II										
			D	Inspection on the Ancillary Valves, Piping, Valves		1											I						II												
			D	Inspection on Soot Blower Facilities		1																	I					II								
			D	Inspection on Burners and the Surroundings		2		II						I						II						I										
			D	Cleaning Heavy Oil Burner Tips		4	I, II						I, II						I, II						I, II											
O			D	Inspection on Tanks of Heavy/Crude Oil and Light Oil, and the Surroundigns		2									©												©									
			A	Cleaning of High, Low Pressure Heavy/Crude Oil Pump and Strainer Pan		Unit 1: 1 Unit 2: 2															I, II	II															
			D	Inspection of Ancillary Piping, Valves of Fuel Oil Pump		2		I, II												I, II																	
O			D	Inspection on Receiving Equipment of Heavy/Crude Oil		2				©												©															
			D	Inspection on Forced Draft Fan		1			I						II																						
			D	Inspection on Exhaust Gas Mixing Fan		1															I						II										
			D	Inspection on Gas Recirculating Fan		1									©																						
			D	Inspection on Ash Treatment Equipment		4			I, II						I, II						I, II						I, II										
			D	Inspection on Hammering Devices of EP		1						II																		I							
			D	Inspection on Driving Device of EP Damper		1												I						II													
O			D	Inspection on Ammonia Injection Equipment		2				©																			©								
			D	Inspection/Repair on Packing Equipment of Heavy Oil Ash		4					©						©						©						©								
			D	Inspection on and around Air Heater		1								II												I											
			D	Inspection on Driving Device of Air Heater Damper		1						I						II																			
			D	Inspection on Drain Pump of Steam Air Heater		1										II													I								
O			D	Adjustment and Repair of In-Hourse Compressors		1							©																								
O			D	Adjustment and Repair of Soot Blow Compressors		4		©						©						©						©											
			D	Inspection on Drain Disposal Equipment of Soot Blow Compressors		1																								©							
O			D	Inspection on Compressor for Control		1										©																					
			D	Inspection on Steam Converter		1											I													II							
O			D	Oil Treatment for Small Sized Oil Separation Reservoir		2	©												©																		
O			D	Oil Treatment for Large Sized Oil Separation Reservoir		4					©						©						©						©								
O			D	Cleaning of Pump Yard for Oil Delivery		4						©						©						©						©							
			D	Inspection/Maintenance of Explosion-Proof Tools		1						©																									
			D	Main Pipe Inspection		1						I						II																			
			D	Inspection/Repair of Gas Reheating Equipment		1					II																										
			D	Inspection on Cooling, Absorption Equipment for Exhaust Gas Desulfurizer		1				II																											
			D	Inspection on Oxidation Equipment for Desulfurizer		1										II																					
			D	Inspection on Gypsum Separation Equipment		1											II																					
			D	Inspection on Transportation Facilities of Gypsum for Desulfurizer		1																	II														
			D	Inspection on Raw Material Transportation, Storage Equipment for Desulfurizer		1																	II														
			D	Inspection on Adjusting Equipment of Raw Material for Desulfurizer		1																							II								
			D	Inspection on Desulfurizer Pit and Drainage Equipment		1																								II							
			D	Inspection on Water and the relevant Facilities for Desulfurizer		1																								II							

Note 1 : The mark of O will be executed during economy shutdown, too.

Note 2 : Work Division

A : All work will be attended by the personnel of Electric Power Co.
B : The personnel of Electric Power Co. will be present at the beginning, intermediate and end of the work.
C : The personnel of Electric Power Co. will be present at the beginning and end of the work.
D : Without attendance of Electric Power Co.

I ..... No. 1 Unit
II ..... No. 2 Unit
I, II .... No. 1 Unit and No. 2 Unit
© ..... Common Units for No. 1 and No. 2

Scheduled Maintenance Control List for Turbine and the Relevant Equipment

Scheduled Maintenance Routine List will be drawn up based on this List.

Thermal Power Plant, Maintenance Sec. (Mechanical)

Division (Note 1)	Work Criteria No.	Check Sheet No.	Work Division (Note 2)	Inspection Items	Number of Equipment	Frequency (Time/ Month)	First Week						Second Week						Third Week						Fourth Week						Execution Month					
							M.	Tu.	W.	Th.	F.	Sa.	M.	Tu.	W.	Th.	F.	Sa.	M.	Tu.	W.	Th.	F.	Sa.	M.	Tu.	W.	Th.	F.	Sa.	4	5	6	7	8	9
																														10	11	12	1	2	3
O			D	Inspection/Repair of Turbine Body		2	II	I											II	I																
			D	Inspection/Repair of Oiling System		4	II	I					II	I					II	I					II	I										
			D	Inspection/Repair of Main Valves		2	II	I											II	I																
			D	Inspection/Repair of Condenser Body and Auxiliary Valves		2		I, II												I, II																
			D	Inspection/Repair of Circulating Water Pump and its Surroundings		2			I, II												I, II																
			D	Inspection/Repair of Condensate Pump		2			I												I																
			D	Inspection/Repair of Condensate Pump, Condensate Booster Pump		2			II												II																
			D	Inspection/Repair of Ejector, Gland Condenser		1										I																					
			D	Inspection/Repair of Vacuum Pump, Gland Condenser		1										II																					
			D	Inspection/Repair of Feed Water Pump (M.T)		4					I, II						I, II						I, II					I, II								
			D	Inspection/Repair of Feed Water Heater and Deaerator		2											I, II											I, II								
			D	Inspection/Repair of Low Pressure Drain Pump and Drain Tank		2											I, II											I, II								
			D	Inspection/Repair of Demineralized Water Pump, Condensate Transfer Pump		1			I, II																												
			D	Inspection/Repair of Condensate Demineralizer		2									II													II								
O			D	Inspection/Repair of Make-up Water Treatment Equipment		4				I						I						I						I								
			D	Inspection/Repair of Chemicals Feed Pump and Solution Tank		2				I, II												I, II														
			D	Inspection/Repair of Sampling Rack		1				I, II																											
			D	Inspection/Repair of Cooling Water Pump for Bearing		2								I, II													I, II									
			D	Inspection/Repair of Cooling Water Cooler for Seawater Booster Pump		2								I, II													I, II									
			D	Inspection/Repair of Main Piping System		1							II															I								
O			D	Inspection/Repair of Seawater Strainer		No. 1 Unit: 2 No. 2 Unit: 1					I, II					I																					
O			D	Cleaning of Seawater Strainer		1								I																						
			D	Inspection/Repair of Dust Collector		2					II	I											I	II												
O			D	Inspection/Repair of Seawater Electrolysis Equipment		2										I								I												
O			D	Cleaning of Dust Receiver		4					I						I							I						I						
O			D	Inspection/Repair of Iron Ion Dosing Equipment		3					I						I							I												
			D	Inspection/Repair of Deforming Equipment		2					II												II													
O			A	Inspection/Repair of Emergency Diesel Generator		2			I, II												I, II															
			D	Inspection/Repair of Diesel Fire Extinguishing Pump		1									I																					
O			D	Inspection/Repair of Overhead Crane		1															I															
O			D	Inspection/Repair of Motor Driven Hoist		1									I, II																					
			D	Inspection/Repair of Drainage Pump in Turbine Room		2		II			I										II			I												
O			D	Cleaning of Lubrication Stand & its Surroundings and Making up Oil		4	I						I						I						I											
O			D	Inspection/Repair of Waste Water Treatment Equipment		4				I						I						I						I								
O			D	Inspection/Repair of Air Conditioner		2									I													I								
O			D	Inspection/Repair of Vacuum Cleaner		1																							I							
			D	Inspection of Explosion - Proof Tools		1																								II						
			D	Putting Warehouse of Maintenance in Order		1																	II													
			D	Supplement of Oil Catcher		1												II																			
			D	Checking of Fixtures/Equipment		1												II																			

Note 1 : The mark of O will be executed during economy shutdown, too.

Note 2 : Work Division

A : All work will be attended by the personnel of Electric Power Co.

B : The personnel of Electric Power Co. will be present at the beginning, intermediate and end of the work.

C : The personnel of Electric Power Co. will be present at the beginning and end of the work.

D : Without attendance of Electric Power Co.

I . . . . . No. 1 Unit

II . . . . . No. 2 Unit

I, II . . . . No. 1 Unit and No. 2 Unit

Scheduled Maintenance Control List for Electric and the Relevant Equipment (1/2)

Scheduled Maintenance Routine List will be drawn up based on this List.

Thermal Power Plant, Maintenance Sec. (Electrical)

Division (Note 1)	Work Criteria No.	Check Sheet No.	Work Division (Note 2)	Inspection Items	Number of Equipment	Frequency (Time/ Month)	First Week						Second Week						Third Week						Fourth Week						Execution Month					
							M.	Tu.	W.	Th.	F.	Sa.	M.	Tu.	W.	Th.	F.	Sa.	M.	Tu.	W.	Th.	F.	Sa.	M.	Tu.	W.	Th.	F.	Sa.	4	5	6	7	8	9
																														10	11	12	1	2	3
			A	Brushes of Generator (Implemented in the fifth week, too)	8		I, II			I, II			I, II			I, II			I, II			I, II			I, II										
O			D	Cooling Equipment of Generator Stator (Implemented in the fifth week, too)	4			I, II						I, II						I, II						I, II										
O			D	Casing of Generator	1								I, II																							
			A	Measurement of Generator Shaft Voltage	2								I, II												I, II											
			D	Cleaning of Generator Filter	2										I, II												I, II									
O			D	Exciter Panel, Rectifier Panel	2			I, II												I, II																
O			D	Hydrogen Sealing Oil (Implemented in the fifth week, too)	4						I, II						I, II						I, II						I, II						
O			D	Oil Change of Vacuum Pump for Sealing Oil	1									I	II																					
			D	Replacement of Hydrogen Bottle (Implemented in the fifth week, too)	8			I, II			I, II			I, II			I, II			I, II			I, II			I, II			I, II							
O			D	Transformer	2											I, II												I, II								
O			D	Substation Facilities	2		I												I																	
O			A	Insulator Washing, Contamination Meter (Implemented in the fifth week, too)	4						I						I						I						I							
O			D	Diesel Generator	2				I, II												I, II															
			D	EP Facilities (Implemented in the fifth week, too)	2			I	II											I	II															
O			D	Panelboard Switchgear	2										I, II												I, II									
O			D	High Voltage Moter	1					I, II																											
O			D	Low Voltage Moter	1				I, II																												
O			A	Insulation Measurement and Space Heater Current Measurement of Main Equipment	2								I												I											
O			A	Insulation Measurement and Space Heater Current Measurement of Main Equipment (Including Exhaust Gas Desulfurization)	2								II												II											
O			D	Direct Current Power Source Unit		1															I, II															
			D	Equal Charging of Battery		once/ 6 months															I, II										O					
																														O					
O			A	Measurement of Leakage Current of L. A.		once/ 3 months																			I							O			O	
																															O			O	
O			A	Detector Operation of L. A.		once/ 6 months	I																								O					
																														O					
O			D	OF, CV Cable		1											I																			
O			A	Insulation Measurement of Lighting		once/ 3 months													I, II													O			O	
																															O			O	
O			A	Measurement of Grounding Resistance		once/ 6 months													I												O					
																														O					
O			D	Measurement of Illuminance		1														I															
O			D	Overhead Crane		1														I															
O			D	Inspection of BFPT Hoist		1										I, II																			
O			A	Make-Up Water Treatment		1						I																							
O			D	Drainage Pump Inspection for House Service (Underwater Pump)		once/ 3 months			I																							O			O	
																															O			O	
O			D	Waste Water Treatment System		2				I											I															
O			D	Control Panel for Airplane Warning Light		1					II																									
O			A	Pump Station at Sasagawa River		once/ 3 months	I																									O			O	
																															O			O	
O			D	Bagging Equipment		2					I												I													
O			D	Room for High Pressure Gas Bottle		1							I																							

Note 1 : The mark of O will be executed during economy shutdown, too.

Note 2 : Work Division

A : All work will be attended by the personnel of Electric Power Co.
B : The personnel of Electric Power Co. will be present at the beginning, intermediate and end of the work.
C : The personnel of Electric Power Co. will be present at the beginning and end of the work.
D : Without attendance of Electric Power Co.

I . . . . . No. 1 Unit
II . . . . . No. 2 Unit
I, II . . . . No. 1 Unit and No. 2 Unit

Scheduled Maintenance Control List for Electric and the Relevant Equipment (2/2)

Scheduled Maintenance Routine List will be drawn up based on this List.

Thermal Power Plant, Maintenance Sec. (Electrical)

Division (Note 1)	Work Criteria No.	Check Sheet No.	Work Division (Note 2)	Inspection Items	Number of Equipment	Frequency (Time/ Month)	First Week						Second Week						Third Week						Fourth Week						Execution Month					
							M.	Tu.	W.	Th.	F.	Sa.	M.	Tu.	W.	Th.	F.	Sa.	M.	Tu.	W.	Th.	F.	Sa.	M.	Tu.	W.	Th.	F.	Sa.	4	5	6	7	8	9
																														10	11	12	1	2	3
O			D	Air Conditioner		2									I											I									
O			D	Receiving Equipment of Heavy Crude Oil		1										I																			
O			D	Seawater Electrolytic Equipment		2												I												I						
O			D	Condensate Demineralizer		1															II															
O			D	Facilities installed in Service Building		1																				I									
O			D	Electric Anticorrosion Equipment		1																					I, II									
O			D	Low Voltage Moter for Exhaust Gas Desulfurizer No. 1 & No. 2		1						II																								
O			D	Low Voltage Moter of Common Use for Exhaust Gas Desulfurizer (No. 1)		1												II																		
O			D	Low Voltage Motor of Common Use for Exhaust Gas Desulfurizer (No. 2)		1																		II												
O			D	High Voltage Motor for Exhaust Gas Desulfurizer		1																								II						
O			D	Panelboard Switchgear for Exhaust Gas Desulfurizer		1																							II							
O			D	Air Conditioner for Exhaust Gas Desulfrizer, etc.		1																							II							

Note 1 : The mark of O will be executed during economy shutdown, too.

Note 2 : Work Division

A : All work will be attended by the personnel of Electric Power Co.

B : The personnel of Electric Power Co. will be present at the beginning, intermediate and end of the work.

C : The personnel of Electric Power Co. will be present at the beginning and end of the work.

D : Without attendance of Electric Power Co.

I . . . . . No. 1 Unit

II . . . . . No. 2 Unit

I, II . . . . No. 1 Unit and No. 2 Unit

Scheduled Maintenance Control List for Control and the Relevant Equipment (1/2)

Scheduled Maintenance Routine List will be drawn up based on this List

Thermal Power Plant, Maintenance Sec. (Control)

Division (Note 1)	Work Criteria No.	Check Sheet No.	Work Division (Note 2)	Inspection Items	Number of Equipment	Frequency (Time/ Month)	First Week						Second Week						Third Week						Fourth Week						Execution Month					
							M.	Tu.	W.	Th.	F.	Sa.	M.	Tu.	W.	Th.	F.	Sa.	M.	Tu.	W.	Th.	F.	Sa.	M.	Tu.	W.	Th.	F.	Sa.	4	5	6	7	8	9
																														10	11	12	1	2	3
			D	Hydrogen Cooling Equipment for Generator Stator		1														I, II																
O			D	Event Recorder		1																					I								
			A	ABC Control System		1		I																												
			A	APC Control System		1		II																												
			A	Air Dehumidifier System		1				I, II																										
			D	Cleaning Filter of Air Dehumidifier System		once/ 3 months				I, II																						O			O	
																															O			O	
			D	Control Equipment of No. 1 Burner (Disassembled Cleaning is only implemented for equipment with lots of trouble frequency of torch nozzle tips.)		2							I												I										
			D	Control Equipment of No. 2 Burner (Disassemble, Cleaning of Torch, Flame Detector and Igniter)		4	E,C *sg						D,C *sg						B,C *sg						A,C *sg										
			A	Purge of Draft Detecting Pipe		1																				I, II										
			A	Opening & Cleaning of Detection Seat of Detecting Pipe		once/ 3 months																				I, II					O			O		
																														O			O		
			D	Local Control Equipment (Boiler)		1			I, II																											
			D	Local Control Equipment (Turbine)		1																				I, II										
			D	NO_x Control Equipment (Including Blowing of Detection Pipe on the First Week)		2				I												I														
			D	Dust Collector Control Equipment (Rotary Screen)		1														I, II																
O			D	Receiving Equipment for Fuel Oil Tank		1	I																													
O			D	Test of Oil Leakage Detector for Fuel Oil Tank		1	I																													
O			D	Nitrojection Equipment		1					I, II																										
O			D	Detection Equipment for Ammonia Gas		1					I																										
O			D	Make-up Water Treatment, Drainage Neutralization Equipment		1																I														
O			D	Drainage Treatment Equipment		1																							I							
			D	Chemical Feeder		1																								I, II						
			D	PH Meter, Conductivity Meter (Relevant to Central Rack)		1																		I, II												
			D	Replacement of After Cation Resin for Conductivity Meter of Chemical Dosing (Replacement every two months)		once/ 2 months																								I, II						
			D	Analyzer of Dissolved Oxygen, Hydrazine		1		I, II																												
			D	Silica Meter		1																I														
O			D	Boiler for House Service		1																I														
			D	Condensate Demineralizer		1																II														
			D	Seawater Electrolytic Equipment		1																I														
			D	Iron Ion Dosing Equipment		1																	I														
			D	SO_2, NO_X, O_2 Analysis of Exhaust Gas (Implemented in the fifth week, too)		4			I, II					I, II							I, II							I, II								
			D	Inspection of Pretreatment Probe for SO_2, NO_x, O_2 Analyzer of Exhaust Gas		once/ 3 months								I, II																		O			O		
																														O			O		
			D	CO Analyzer		2								I, II														I, II								
			D	Inspection on Probe of CO Meter		once/ 3 months								I, II																		O			O		
																														O			O		
			D	Analyzer of Eco. O_2		Unit No. 1: 2 Unit No. 2: 1								I														I, II								
O			D	Detector for Combustible Gas (No. 2 includes DS)		1									I, II																						
O			-	Analyzer of Sulfur Contents		1									I, II																						
O			D	TV System of Flue Gas Monitoring for House Service		1																		II												

Note 1 : The mark of O will be executed during economy shutdown, too.

Note 2 : Work Division

A : All work will be attended by the personnel of Electric Power Co.
B : The personnel of Electric Power Co. will be present at the beginning, intermediate and end of the work.
C : The personnel of Electric Power Co. will be present at the beginning and end of the work.
D : Without attendance of Electric Power Co.

I ..... No. 1 Unit
II ..... No. 2 Unit
I, II .... No. 1 Unit and No. 2 Unit

* Stage

Scheduled Maintenance Control List for Control and the Relevant Equipment (2/2)

Scheduled Maintenance Routine List will be drawn up based on this List

Thermal Power Plant, Maintenance Sec. (Control)

Division (Note 1)	Work Criteria No.	Check Sheet No.	Work Division (Note 2)	Inspection Items	Number of Equipment	Frequency (Time/ Month)	First Week						Second Week						Third Week						Fourth Week						Execution Month					
							M.	Tu.	W.	Th.	F.	Sa.	M.	Tu.	W.	Th.	F.	Sa.	M.	Tu.	W.	Th.	F.	Sa.	M.	Tu.	W.	Th.	F.	Sa.	4	5	6	7	8	9
																														10	11	12	1	2	3
			D	Monitoring Instrument for Turbine		1																	I, II												
			D	Vibration Monitoring Equipment for Auxiliary Facilities		1				I, II																									
			D	Clock System		1										I																			
			D	No. 1 Satellite Control Panel (Turbine)		once/ 4 months												I													O				O
																																O				
			D	No. 1 Satellite Control Panel (Boiler)		Ditto												I														O				
																														O				O		
			D	No. 2 Satellite Control Panel (Turbine)		Ditto												II																O		
																															O					O
			D	No. 2 Satellite Control Panel (Boiler)		Ditto												II													O				O		
																																O				
			D	Recorder for BTG Panel		1																						I, II								
			D	Recorder for BA Panel		1																							I, II							
O			D	Computer, BSC Equipment		1											II																			
O			D	Small Sized Oil Separation and Reserving Tank		1											I																			
O			D	Insulation Measurement for Electrical Final Control Element (Shutdown Time of Mar. Jun. Sep. Dec.)		once/ 3 months								I, II																			O			O
																																O				O
			D	Checking of Fixture/Equipment, Stock (Prepared in advance)		once/ 2months						I																				O		O		O
																															O		O		O
O			D	Checking of Explosion-Proof Tool		once/ 6 months																													O	
																																		O	
			D	Level Instrument with Purge Set for Exhaust Gas Desulfurizer		1					II																									
			D	Recorder for Exhaust Gas Desulfurizer		1						II																								
			D	PH Meter for Exhaust Gas Desulfurizer (Absorber, Oxidation Equipment)		1								II																					
			D	SO_2 Analyzer for Exhaust Gas Desulfurizer		1															II															

Note 1 : The mark of O will be executed during economy shutdown, too.

Note 2 : Work Division

A : All work will be attended by the personnel of Electric Power Co.
B : The personnel of Electric Power Co. will be present at the beginning, intermediate and end of the work.
C : The personnel of Electric Power Co. will be present at the beginning and end of the work.
D : Without attendance of Electric Power Co.

I . . . . . No. 1 Unit
II . . . . . No. 2 Unit
I, II . . . . No. 1 Unit and No. 2 Unit

Monthly Routine List of Scheduled Maintenance for Mechanical Equipment of Units 1,2 (for Boiler)

Thermal Power Plant
Maintenance Sec.

Week	Unit \ Day	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
1st.Week	Unit 1	1.Oil Treatment for Small Sized Oil Separation Reservoir ⊗Ⓒ 2.Cleaning Heavy Oil Burner Tips	1.Adjustment and Repair of Soot Blow Compressors ⊗Ⓒ 2.Inspection of Ancillary Piping,Valves of Fuel Oil Pump 3.Inspection on the Body of Boiler	1.Inspection on Ash Treatment Equipment 2.Inspection on Forced Draft Fan	1.Inspection on Receiving Equipment of Heavy·Crude Oil (※)Ⓒ 2.Inspection on Ammonia Injection Equipment (※)Ⓒ	1.Oil Treatment for Large Sized Oil Separation Reservoir(※)Ⓒ 2.Inspection and Repair on Packing Equipment of Heavy Oil Ash(※)Ⓒ	1.Cleaning of Pump Yard for Oil Delivery(※)Ⓒ 2.Main Pipe Inspection 3.Inspection on Driving Device of Air Heater Damper
	Unit 2	1.Cleaning Heavy Oil Burner Tips	1.Inspection of Ancillary Piping,Valve of Fuel Oil Pump 2.Inspection on Burners and the Surroundings	1.Inspection on Ash Treatment Equipment	1.Inspection on Cooling Absorption Equipment for Exhaust Gas Desulfurizer	1.Inspection and Repair of Gas Reheating Equipment	1.Inspection on Hammering Devices of EP 2.Inspection and Maintenance of Explosion-Proof Tools
2nd.Week	Unit 1	1.Adjustment and Repair of House Service Compressors 2.Cleaning Heavy Oil Burner Tips	1.Adjustment and Repain of Soot Blow Compressors ⊗Ⓒ 2.Inspection on Burners and the Surroundings	1.Inspection on Tanks of Heavy·Crude Oil and Light Oil,and the Surroundings ⊗Ⓒ 2.Inspection on Ash Treatment Equipment 3.Inspection on Gas Recirculating Fan (※)Ⓒ	1.Inspection on Compressor for Control (※)Ⓒ	1.Oil Treatment for Large Sized Oil Separation Reservoir(※)Ⓒ 2.Inspection on the Ancillary Valves, Piping,Valves 3.Inspection and Repair on Packing Equipment of Heavy Oil Ash(※)Ⓒ	1.Cleaning of Pump Yard for Oil Delivery (※)Ⓒ 2.Inspection on Steam Converter 3.Inspection on Driving Device of EP Damper
	Unit 2	1.Cleaning Heavy Oil Burner Tips	1.Inspection on and around Air Heater 2.Inspection on the Body of Boiler	1.Inspection on Ash Treatment Equipment 2.Inspection on Forced Draft Fan	1.Inspection on Drain Pump of Steam Air Heater 2.Inspection on Oxidation Equipment for Desulfurizer	1.Inspection on Gypsum Separation Equipment	1.Main Pipe Inspection 2.Inspection on Driving Device of Air Heater Damper
3rd.Week	Unit 1	1.Oil Treatment for Small Sized Oil Separation Reservoir ⊗Ⓒ 2.Cleaning Heavy Oil Burner Tips	1.Adjustment and Repair of Soot Blow Compressors ⊗Ⓒ 2.Inspection of Ancillary Piping,Valves of Fuel Oil Pump 3.Inspection on the Body of Boiler	1.Inspection on Ash Treatment Equipment ②Cleaning of High,Low Pressure Heavy·Crude Oil Pump and Strainer Pan 3.Inspection on Exhaust Gas Mixing Fan	1.Inspection on Receiving Equipment of Heavy·Crude Oil(※)Ⓒ 2.Inspection on Soot Blower Facilities	1.Oil Treatment for Large Sized Oil Separation Reservoir(※)Ⓒ 2.Inspection and Repair on Packing Equipment of Heavy Oil Ash(※)Ⓒ	1.Cleaning of Pump Yard for Oil Delivery (※)Ⓒ
	Unit 2	1.Cleaning Heavy Oil Burner Tips	1.Inspection of Ancillary Piping,Valves of Fuel Oil Pump 2.Inspection on Burners and the Surroundings	1.Inspection on Ash Treatment Equipment ②Cleaning of High,Low Pressure Heavy /Crude Oil Pump and Strainer Pan	①Cleaning of High,Low Pressure Heavy /Crude Oil Pump and Strainer Pan 2.Inspection on Transportation Facilities of Gypsum for Desulfurizer	1.Inspection on the Ancillary Valves, Piping,Valves 2.Inspection on Raw Material Transportation, Storage Equipment for Desulfurizer	1.Inspection on Driving Device of EP Damper
4th.Week	Unit 1	1.Cleaning Heavy Oil Burner Tips	1.Adjustment and Repair of Soot Blow Compressors ⊗Ⓒ 2.Inspection on and around Air Heater 3.Inspection on Burners and the Surroundings	1. Inspection on Tanks of Heavy·Crude Oil and Light Oil,and the Surroundings ⊗Ⓒ 2.Inspection on Ash Treatment Equipment	1.Inspection on Ammonia Injection Equipment(※)Ⓒ 2.Inspection on Drain Pump of Steam Air Heater	1.Oil Treatment for Large Sized Oil Separation Reservoir(※)Ⓒ 2.Inspection and Repair on Packing Equipment of Heavy Oil Ash(※)Ⓒ	1.Cleaning of Pump Yard for Oil Delivery (※)Ⓒ 2.Inspection on Hammering Devices of EP
	Unit 2	1.Cleaning Heavy Oil Burner Tips	1.Inspection on the Body of Boiler	1.Inspection on Ash Treatment Equipment 2.Inspection on Exhaust Gas Mixing Fan	1.Inspection on Soot Blower Facilities 2.Inspection on Adjusting Equipment of Raw Material for Desulfurizer	1.Inspection on Desulfurizer Pit and Drainage Equipment	1.Inspection on Steam Converter 2.Inspection on Water and the relevant Facilities for Desulfurizer 3.Inspection on Drain Disposal Equipment of Soot Blow Compressors(※)Ⓒ
5th.Week	Unit 1						
	Unit 2						

Remarks

1.Scheduled Maintenance Work will be implemented in accordance with the attached sheet of maintenance work criteria.
2.Contact with both operation sec. and the person in charge will be kept without fail before and after the work.
3.As a rule,the scheduled maintenance work will be executed after completion of the requested maintenance work.
4.The marked of the underlined part will be also performed during economy shutdown.
5.The marked of ① or ② will be executed in the presence of the personnel of Electric Power Co.
6.Vibration measurement on auxiliary equipment will be executed on 5th week,implemented after the date of 29th.
7.The marked of Ⓒ indicates the work for common facilities regarding unit 1 and unit 2.

Overhaul Inspection manual at the Time of Periodical Examination

Time and Contents of Periodical Inspection for Boiler Facilities (Inspection implemented by Installer)

Notes (*): The inspection means detailed inspection selected checking portion at the approaching time of rapture strength, which is 100,000 hours determined as design criteria of strength of thermal power plant facilities.

Essential Equipment	1. Periodical Inspections based on Standard Periods			2. Initial Periodical Inspection	3. Periodical Inspection after Long-Term Operation	Measures taken in Daily Maintenance	Remarks
	A Inspection	B Inspection	C Inspection				
1. Boiler (1) Steam Drum [To include Flush-Tank for Starting Bypass]	a. On the condition steam-water separation equipment will be removed numbers required, visual inspection inside drum and liquid Penetrant test (hereinafter, referred to PT test) on welding lines inside Drum is to be implemented.	a. If inside welding portion of nozzle stub is not machined smoothly, visual inspection of the inside nozzle stub and PT test shall be performed on the condition steam-water separation equipment will be removed numbers required. b. In case that round-off work is not executed at the edge of welding portion attaching drum internals, visual inspection and PT test for the part shall be implemented.	———	a. To implement periodical inspection based on standard period, A Inspection.	Excluding the following, the case is to be same as periodical inspection based on standard period. a. To "B" inspection of periodical inspection based on standard period, the following are to be added. · When inside welding portion of nozzle stub has been machined smoothly, inspection will be executed on the condition of attaching steam-water separation equipment and welding portions to be inspected is to be performed PT test. b. To "C" inspection of periodical inspection based on standard period, the following are to be added. · When inside welding portion has not been machined smoothly, visual inspection of the inside nozzle stub and PT test are to be implemented on the condition of removing required numbers of steam-water separation equipment	o Water Quality Surveillance o Observance of Temperature Rising Ratio of Boiler Water o Confirmation of Steam Leakage	o Special Precise Inspection executed at the time of Periodical Inspection based on Standard Period is recommendable to be implemented according to the interval described below; · first time after 80,000 hours' operation · second time and later every 8 years or after 60,000 ~ 80,000 hours' operation o As to special precise inspection (*) a. Selecting typical spots out of nozzle stub outside welding and longitudinal, circumferential joints of outside welding, magnetic particle testing (hereinafter, referred to MT) is to be implemented. b. Required numbers of drum internals attached by welding are to be removed and MT is to be implemented welding portion of inside nozzle stub.
(2) Water Drum	(Same as Steam Drum, however, steam-water separation equipment is to be superseded with inside equipment)						

Essential Equipment	1. Periodical Inspections based on Standard Periods			2. Initial Periodical Inspection	3. Periodical Inspection after Long-Term Operation	Measures taken in Daily Maintenance	Remarks
	A Inspection	B Inspection	C Inspection				
(3) Header (A) Furnace Economizer	a. To inspect Header and Header Lifting Ring from the outside b. Selecting typical spots, PT test on Header, welding portion of nozzle stub and support metals are to be implemented. [But, after about six years since commercial operation started] c. Including other Headers, selecting more than two typical ones and inside inspections are to be implemented.	a. Same as mentioned A Inspection b. For the welding portions of Furnace outlet Header and nozzle stub which have not been taken measures of both flexible countermeasures and round-off processing at the end of welding portion, typical points are to be selected and PT test shall be implemented. ———	——— ——— ———	a. To implement periodical inspection based on standard period, A Inspection. Besides, Examination implemented more than six years later from the start of commercial operation is also implemented at the initial periodical inspection.	Excluding the following the case is to be same as periodical inspection based on standard period. a. To "C" inspection of periodical inspection based on standard period, the following is to be added. To inspect Header and Header Lifting Ring from the outside.	· Water Quality Surveillance · Confirmation of Steam Leakage	o In case of inspecting Header and Header Lifting Ring form the outside, header with heat insulating material is not needed to remove the insulating material. o As to special precise inspection o Selecting typical spots out of outside welding of longitudinal, circumferential joints of Header and MT is to be implemented.
(B) Superheater Reheater	Same as described above	a. To inspect Header and Header Lifting Ring from the outside b. Welding portion of nozzle stub which has not been taken measures of both flexible countermeasures and round-off processing at the end of welding portion, typical portions are to be selected and PT test shall be implemented.	——— ———	Same as described above	Same as described above	· Water Quality Surveillance · Confirmation of Steam Leakage · Surveillance of Metal Temperature	Same as described above

Essential Equipment	1. Periodical Inspections based on Standard Periods			2. Initial Periodical Inspection	3. Periodical Inspection after Long-Term Operation	Measures taken in Daily Maintenance	Remarks
	A Inspection	B Inspection	C Inspection				
(4) Tube (A) Evaporation Tube	[In Case of Oil-Fired, Gas-Fired Boiler] a. Visual Inspection is to be executed after setting scaffolds up to the burner level inside furnace. b. PT test is to implemented on the typical spots of welding metal attached with tube	[In Case of Oil-Fired, Gas- Fired boiler] a. Tubes inside furnace are to be inspected from the outside, however, scaffolds will not be required to set up.		a. To implement Periodical inspection based on Standard Period, A inspection	Excluding the following, the case is to be same as periodical inspection based on standard period. a. To "C" inspection of periodical inspection based on standard period, the following is to be added. · To inspect tubes inside furnace from the outside. No need required setting up scaffolds.	· Water Quality Surveillance · Confirmation of Steam Leakage · Surveillance of Metal Temperature	o It is recommendable to take out sample tubes and check them every two years, to inspect and confirm the inside condition
	[In Case of Coal-Fired Boiler] a. Visual Inspection is to be executed after setting scaffolds up to the burner level inside furnace. b. PT test is to implemented on the typical spots of welding metal attached with tube c. Thickness measurement is to be implemented on the typical spots of tubes affected by steam cut	[In Case of Coal-Fired Boiler] a. Tubes inside furnace are to be inspected from the outside, however, scaffolds will not be required to set up. c. In case that measures for erosion have not been applied, thickness test of typical spots of tubes affected by steam cut shall be implemented.	a. Same as described in the relevant to "B" Inspection item.	a. To implement Periodical inspection based on Standard Period, A inspection	To be same as periodical inspection based on standard period.	· Water Quality Surveillance · Confirmation of Steam Leakage · Surveillance of Metal Temperature	o It is recommendable to take out sample tubes and check them every two years, to inspect and confirm the inside condition.

Essential Equipment	1. Periodical Inspections based on Standard Periods			2. Initial Periodical Inspection	3. Periodical Inspection after Long-Term Operation	Measures taken in Daily Maintenance	Remarks
	A Inspection	B Inspection	C Inspection				
(B) Tube of Superheater Reheater, Economizer	[In Case of Oil-Fired Boiler] a. Visual Inspection is to be implemented on Superheater, Reheater and Economizer Tubes b. Thickness measurements will be implemented on the typical spots of Superheater and Reheater Tubes c. PT test is to be executed as to typical spots of dissimilar metal joints without using Inconel series welding rods. d. PT test is to be executed as to typical spots of metal welding attached with tube.	[In Case of Oil-Fired Boiler] a. Same as described in the relevant to "A" Inspection item. ——— ——— ———	——— ——— ——— ———	a. To implement periodical inspection based on Standard Period, A inspection.	Excluding the following, the case is to be same as periodical inspection based on standard period. a. To "C" inspection of periodical inspection based on standard period, the following is to be added. · To implement visual inspection of superheater tubes, reheater tubes and economizer tubes.	· Water Quality Surveillance · Confirmation of Steam Leakage · Surveillance of Metal Temperature	
	[In Case of Gas-Fired Boiler] a. Visual Inspection is to be implemented on Superheater, Reheater and Economizer Tubes b. PT test is to be executed as to typical spots of dissimilar metal joints without using Inconel series welding rods c. PT test is to be executed as to typical spots of metal welding attached with tube	[In Case of Gas-Fired Boiler] a. Same as described in the relevant to "A" Inspection item. ——— ———	——— ——— ———	a. To implement periodical inspection based on standard period, A inspection.	Excluding the following, the case is to be same as periodical inspection based on standard period. a. To "C" inspection of periodical inspection based on standard period, the following is to be added. · To implement visual inspection of superheater tubes, reheater tubes and economizer tubes.	· Water Quality Surveillance · Confirmation of Steam Leakage · Surveillance of Metal Temperature	

Essential Equipment	1. Periodical Inspections based on Standard Periods			2. Initial Periodical Inspection	3. Periodical Inspection after Long-Term Operation	Measures taken in Daily Maintenance	Remarks
	A Inspection	B Inspection	C Inspection				
(B) Tubes of Superheater, Reheater, Economizer	[In Case of Coal-Fired boiler] a. Visual inspection is to be implemented on Superheater Tubes, Reheater and Economizer Tubes b. Thickness measurements will be implemented on the typical spots of Superheater, Reheater and Economizer Tubes. c. PT test is to be executed as to typical spots of dissimilar metal joints without using Inconel series welding rods. d. PT test is to be executed as to typical spots of metal welding attached with tube.	[In Case of Coal-Fired boiler] a. Same as described in the relevant to "A" Inspection item. b. In case of without countermeasures for errosion, visual and feeling with hand inspections will be executed on superheater tubes, reheater tubes and economizer tubes. c. In case of without countermeasures for errosion, thickness measurements will be implemented on the typical spots of Superheater Tubes, Reheater and Economizer Tubes. ———	——— b. Same as described in the relevant to "B" Inspection item. c. Same as described in the relevant to "B" Inspection item. ———	a. To implement periodical inspection based on standard period, A inspection	Excluding the following, the case is to be same as periodical inspection based on standard period. a. To "C" inspection of periodical inspection based on standard period, the following is to be added. · To implement visual inspection of superheater tubes, reheater tubes and economizer tubes.	· Water Quality Surveillance · Confirmation of Steam Leakage · Surveillance of Metal Temperature	
(5) Valves (A) Safety Valve	Such safety valves as of steam drum, superheater, reheater and electrical relief valve are checked as follows; a. To disassemble, to check b. After assembling, to implement working test	a. To implement working test	a. To implement working test	a. To implement periodical inspection based on standard period, A inspection	To be same as periodical inspection based on standard period.	· Confirmation of Steam Leakage · Confirmation by visual inspection from outside	· Working test can be done by using hydraulic jack.
(B) Main Valves [With excessive wear on valve body, valve seat]	a. To disassemble and to check	a. To disassemble and to check	a. To disassemble and to check	a. To implement periodical inspection based on standard period, A inspection	To be same as periodical inspection based on standard period	· Confirmation of Steam Leakage · Confirmation by visual inspection from outside	

Essential Equipment	1. Periodical Inspections based on Standard Periods			2. Initial Periodical Inspection	3. Periodical Inspection after Long-Term Operation	Measures taken in Daily Maintenance	Remarks
	A Inspection	B Inspection	C Inspection				
(6) Boiler Circulation Pump	a. Existence of abnormality on pumps is to be performed by means of pressure, electric current, etc.	a. Same as described in the relevant to "A" Inspection item	———	a. To disassemble more than one unit, and to check b. For the pumps without disassembling, test which can be confirmed of existence of abnormality is to be executed by means of pressure, electric current, etc.	Excluding the following, the case is to be same as periodical inspection based on standard period. a. To "C" inspection of periodical inspection based on standard period, the following is to be added. · Test, which can be confirmed of existence of abnormality, is to be executed by means of pressure, electric current, etc.	· Confirmation of Leakage · Confirmation Vibration, Noise · Confirmation by means of visual inspection from the outside	o It is recommendable to disassemble and to inspect every four years.
(7) Boiler Auxiliary Facilities (A) Water Feed Pump and its Driving Steam Turbine	a. For Water Feed Pump, the test being capable of confirming of abnormality on pumps will be implemented by means of pressure, flow rate, bearing temperature, etc. and for the driving steam turbine, test, which is able to confirm abnormality of steam turbine such as revolution per minute, bearing temperature, will be implemented.	a. Same as described in the relevant to "A" Inspection item	———	a. More than two units are to be disassembled and inspected. As for water feed pump not being disassembled, the test, which is able to confirm abnormality of pump by means of pressure, flow rate, bearing temperature, etc., will be implemented and for the driving steam turbine not being disassembled, the test which is able to confirm abnormality of the steam turbine such as revolution per minute, bearing temperature,etc. will be executed.	Excluding the following, the case is to be same as periodical inspection based on standard period. a. To "C" inspection of periodical inspection based on standard period, the following are to be added. For water feed pump, the test being capable of confirming existence of abnormality of pump by means of pressure, flow rate, bearing temperature, etc. will be executed, and for the driving steam turbine, the test, which is able to confirm abnormality of steam turbine such as revolution per minute, bearing temperature, will be implemented.	· Confirmation of Leakage · Confirmation of Vibration, Noise	o It is recommendable to disassemble and to inspect every four years.

Essential Equipment	1. Periodical Inspections based on Standard Periods			2. Initial Periodical Inspection	3. Periodical Inspection after Long-Term Operation	Measures taken in Daily Maintenance	Remarks
	A Inspection	B Inspection	C Inspection				
(B) Fan [Forced Draft Fan, induced Draft Fan, Gas recirculating Draft Fan, Gas Mixing Draft Fan]	a. Tests being capable of confirming existence of abnormality of fans will be implemented by means of wind pressure, bearing temperature, etc.	a. Same as described in the relevant to "A" Inspection item.	———	a. Opening manhole fully, inside inspection is to be implemented. b. As for lubrication oil equipment, bearing portions, disassembled inspection will be implemented.	Excluding the following, the case is same as periodical inspection based on standard period. a. To "C" inspection of periodical inspection based on standard period, the following is to be added. · Tests being capable of confirming existence of abnormality of the fan will be implemented by means of wind pressure, bearing temperature, etc.	· Confirmation of Vibration, Noise	It is recommendable to disassemble and to inspect every two years.
(C) Air Heater	a. Tests being capable of confirming existence of abnormality of air heater will be implemented by means of air temperature of the inlet and outlet, differential pressure, etc.	a. Same as described in the relevant to "A" Inspection item.	———	a. Rotary Regenerative Air Heater will be inspected, opening manhole fully, on rotor body, heating surface and driving device. b. Steam Air Heater will be inspected the inside after opening manhole fully.	Excluding the following, the case is same as periodical inspection based on standard period. a. To "C" inspection of periodical inspection based on standard period, the following is to be added. · Tests being capable of confirming existence of abnormality of air heater will be implemented by means of air temperature of the inlet and outlet, differential pressure, etc.	· Confirmation of Vibration, Noise	It is recommendable to disassemble and to inspect heating surface every two years.

Essential Equipment	1. Periodical Inspections based on Standard Periods			2. Initial Periodical Inspection	3. Periodical Inspection after Long-Term Operation	Measures taken in Daily Maintenance	Remarks
	A Inspection	B Inspection	C Inspection				
(D) Combustion Equipment a. Burner	a. To disassemble and to check	———	———	a. To implement periodical inspection based on standard period, A inspection.	To be same as periodical inspection based on standard period.	· Confirmation by visual inspection from outside	o Burner Refractory, Diffuser, etc. shall be maintained sufficiently in order to be in use for about three years.
b. Oil Pump [Heavy, Crude Oil Pump Light Oil Pump]	[In Case of Oil-Fired Boiler] a. Tests being capable of confirming existence of abnormality of pumps will be implemented by means of pressure, electric current, etc.	[In Case of Oil-Fired Boiler] a. Same as described in the relevant to "A" Inspection item.	———	a. More than two units will be disassembled and inspected. b. As for pumps not to be disassembled, tests being capable of confirming existence of abnormality of pumps will be implemented by means of pressure, electric current, etc.	Excluding the following, the case is to be same as periodical inspection base on standard period. a. To "C" inspection of periodical inspection based on standard period, the following is to be added. · Tests being capable of confirming existence of abnormality of pumps will be implemented by means of pressure, electric current, etc.	· Confirmation of Vibration, Noise	o It is recommendable to disassemble and to inspect every four years.
c. Coal Pulverizer	[In Case of Coal-Fired Boiler] a. Tests being capable of confirming existence of abnormality of coal pulverizer will be performed by means of electric current, etc.	[In Case of Coal-Fired Boiler] a. Same as described in the relevant to "A" Inspection item.	———	a. More than one unit will be disassembled and inspected. b. As for coal pulverizer not to be disassembled, tests being capable of confirming existence of abnormality will be implemented by means of electric current, etc.	Excluding the following, the case is to be same as periodical inspection based on standard period. a. To "C" inspection of periodical inspection based on standard period, the following is to be added. · Tests being capable of confirming existence of abnormality of coal pulverizer will be implemented by means of electric current, etc.	· Confirmation by visual inspection from outside.	o It is recommendable to disassemble and to inspect every four years.

Time and Contents of Periodical Inspection for Turbine Facilities (Inspection implemented by Installer)

Essential Equipment	1. Periodical Inspections based on Standard Periods			2. Initial Periodical Inspection	3. Periodical Inspection after Long-Term Operation	Measures taken in Daily Maintenance	Remarks
	A Inspection	B Inspection	C Inspection				
2. Steam Turbine (1) Casing	a. Removing Upper Casings and in the condition Diaphragm and Labyrinth packing are attached, inspection will be implemented. As the occasion demands, the following are to be performed. · PT test · Strain Measurement (on the surface of horizontal joint)	a. Removing Upper Casings of High and Intermediate Pressure, and in the condition Diaphragm and Labyrinth packing are attached, inspection will be implemented.	a. Visual Inspection will be implemented during operation.	a. To implement periodical inspection based on standard period, A Inspection. b. As the occasion demands, selecting high stress level portions (For instance, nozzle coupling portion) and the following is to be implemented. · MT test	Excluding the following, the case is same as periodical inspection based on standard period. a. To "A" inspection of periodical inspection based on standard period, the following is to be added. · As the occasion demands, selecting high stress level portions, the following is to be implemented. (For instance; nozzle coupling portion, etc.) b. To "B" inspection of periodical inspection based on standard period, the following is to be added. · Removing Upper Casing in the condition Diaphragm and Labyrinth packing are attached inspection will be implemented.	· Surveillance of Elongation · Surveillance of Elongation Difference · Surveillance of Temperature Difference between inside surface and outside surface. · Surveillance of Extraction Temperature · Confirmation of Allophone (Strange Noise) · Surveillance of Degree of Vacuum Surveillance of Exhaust Temperature · Measurement of Air Extraction Quantity	a. It is recommendable that the barrel-type steam turbine is fully opened and inspected once every four years to six years. b. For every 4 ~ 8 years, including Lower Casing, Diaphragm and Labyrinth Packing will be removed and it is recommendable to implement inspection. c. (*) Special precise inspection executed at the time of periodical inspection based on standard period is to be implemented according to the interval described below; · Initial: after 80,000 hours passed · After second time: It is determined to implement after every eight years or 60,000 ~ 80,000 hours.
(2) Turbine Shaft, Disc, Moving Blade	a. Rotating turbine shaft smoothly without its removal and the following inspections will be implemented. (a) turbine shaft (b) disc (c) vanes and the attached portions (d) shroud, lacing wire (e) setting condition of balance weight b. As the occasion demands, the following is to be implemented. · PT test	a. Rotating turbine shaft smoothly without its removal and inspection will be implemented.	a. Investigating the condition of shaft vibration change, and to confirm no existence of abnormality.	a. To implement periodical inspection based on standard period, A Inspection. b. Selecting typical spots of moving vanes and PT test will be implemented.	Excluding the following, the case is same as periodical inspection based on standard period. a. To "B" inspection of periodical inspection based on standard period, the following are to be added. o Without removing turbine shaft, turning it smoothly and the following inspection will be implemented. · turbine shaft, disc · vanes and the attached portions · shroud, lacing wire · setting condition of balance weight	· Fatigue Life Span Management · Surveillance of Shaft Vibration	a. It is recommendable to remove turbine shafts every 4 ~ 8 years and to inspect them. b. Special precise inspection executed at the time of periodical inspection based on standard period it to be implemented according to the interval described below; · Initial: after 80,000 hours passed · After second time: It is determined to implement after every eight years or 60,000 ~ 80,000 hours.

Essential Equipment	1. Periodical Inspections based on Standard Periods			2. Initial Periodical Inspection	3. Periodical Inspection after Long-Term Operation	Measures taken in Daily Maintenance	Remarks
	A Inspection	B Inspection	C Inspection				
(3) Diaphragm, Nozzle Stationary Blade	a. To inspect Nozzle at the first stage of high pressure, intermediate pressure, respectively. b. Diaphragm will be inspected in the condition being attached to casing. c. As the occasion demands, the following will be implemented. · PT test · Clearance Measurement · Measurement of Throat	a. To inspect upper side of nozzle at the first stage of high pressure, intermediate pressure, respectively. b. As the occasion demands, the following will be implemented. · PT test · Measurement of Throat	a. Under the confines of the following measures being not implemented at all, inspection is to be performed. · Surface Hardening Treatment · Simultaneous opening · closing method of multi-valves. (combined governing, 2, 3 admission) · Scale blow equipment · Adoption of improved material to secondary superheater tubes and reheater tubes of boiler (SUS347 or shot peening) · Consideration of operation control (Variable pressure operation, DSS) b. As the occasion demands, the following inspections will be executed. · PT test · Measurement of Throat	a. To implement periodical inspection based on standard period, A Inspection	Excluding the following, the case is same as periodical inspection based on standard period. a. To "B" inspection of periodical inspection based on standard period, the following is to be added. · The inspection will be implemented in the condition keeping diaphragm attached to casing.	· Surveillance of Shaft Vibration · Surveillance of Steam Pressure after First Stage · Management of Internal Efficiency of Turbine · Surveillance of Temperature Change after First Stage	a. It is recommendable to inspect after removing diaphragm every 4 ~ 8 years.
(4) Bearing	a. Visual inspection will be implemented on bearing portion	———	———	a. To implement periodical inspection based on standard period, A Inspection	Excluding the following, the case is same as periodical inspection based on standard period. a. To implement periodical inspection based on standard period, A Inspection. b. To "B" inspection of periodical inspection based on standard period, the following is to be added. · Visual inspection will be executed on bearing portions.	· Surveillance of Metal or Temperature of Supply · Discharge Oil · Surveillance of Shaft Vibration · Control of Shaft Voltage · Confirmation of Discharge Oil Quantity, Oil Color.	a. Whenever necessary, in accordance with the period of turbine shaft removal, the inspection will be implemented.

Essential Equipment	1. Periodical Inspections based on Standard Periods			2. Initial Periodical Inspection	3. Periodical Inspection after Long-Term Operation	Measures taken in Daily Maintenance	Remarks
	A Inspection	B Inspection	C Inspection				
(5) Main Valves [Main Stop Valve Steam Governing Valve Reheat Stop Valve Intercept Valve]	a. Disassembling each valve, strainer, valve body, valve seat, etc. will be inspected. b. As the occasion demands, the following will be implemented. · PT test · Clearance Measurement · Bending Measurement	a. Subsidiary Valve of Main Stop Valve will be inspected. b. As the occasion demands PT test will be implemented.	a. Under the confines of the following measures being not implemented for subsidiary valve of main stop valve at all, inspection is to be performed. · Anti-Corrosion Type Valve · Adoption of improved material to superheater · reheater tubes (SUS347, shot peening treatment tubes) · Scale blow equipment · Consideration of operation control (variable pressure operation, DSS) b. As the occasion demands, PT test will be executed.	a. To implement periodical inspection based on standard period, A Inspection	Excluding the following, the case is same as periodical inspection based on standard period. a. To implement periodical inspection based on standard period, A Inspection. b. To "B" inspection of periodical inspection based on standard period, the following are to be added. · Disassembling each valve, strainer, valve body, valve seat, etc. will be inspected. · As the occasion demands, the following will be implemented · PT test	· Confirmation of Vibration, Noise · Confirmation of Steam Leakage · Confirmation of Loosened Bolts, etc. · Working Test	a. Inspection performed by disassembling for each valve is recommendable to be implemented every 4 ~ 6 years.
(6) Speed Governing Device [Emergency Stop Device, etc.]	a. Visual inspection will be implemented on link mechanism of governor, emergency governor, trip mechanism, etc. b. Working test of auxiliary oil pump for emergency stop device, etc. will be implemented.	a. Same as described in the relevant to "A" Inspection item. b. Same as described in the relevant to "A" Inspection item.	a. Same as described in the relevant to "A" Inspection item. b. Same as described in the relevant to "A" Inspection item.	a. To implement periodical inspection based on standard period, "A" Inspection.	Contents are to be same as periodical inspection based on standard period.	· Greasing · Confirmation of Loosened Bolts and Whirl-Stop of Pins · Confirmation of Oil Leakage · Working Test	It is recommendable to implement the following inspections every 4 ~ 8 years a. Inspection of wear and rust condition of lever, link mechanism. b. Inspection of contamination of foreign material, wear condition of servo-valve, solenoid valve and their wear condition. c. Inspection of wear condition of hydraulic operation equipment.

Essential Equipment	1. Periodical Inspections based on Standard Periods			2. Initial Periodical Inspection	3. Periodical Inspection after Long-Term Operation	Measures taken in Daily Maintenance	Remarks
	A Inspection	B Inspection	C Inspection				
(7) Condenser	a. Opening water box, inspection will be implemented inside and small tubes. b. As the occasion demands, the following will be implemented. · Leakage Test of Small Tubes (Filling Water) · Vortex Flaw Detective Test of Small Tubes.	———	———	a. To implement periodical inspection based on standard period, "A" Inspection.	Excluding the following, the case is to be same as periodical inspection based on standard period. a. To "B" inspection of periodical inspection based on standard period, the following is to be added. · Opening water box, the inside and small tubes are to be inspected.	· Surveillance of Leakage · Surveillance of Electric Anticorrosion Device · Operation and Control of Prevention Device of Contamination of Foreign Material. · Operation and control of Cleaning Device. · Implementation of Back Washing.	
(8) Auxiliary Equipment of Steam Turbine (A) Feed Water Heater	a. Opening water chamber, the inside and small tubes will be inspected. b. As the occasion demands, leakage inspection of water supply side will be implemented.	——— ———	——— ———	a. To implement periodical inspection based on standard period, "A" Inspection.	Excluding the following, the case is to be same as periodical inspection based on standard period. a. To implement periodical inspection based on standard period, "A" Inspection. b. To "B" Inspection of periodical inspection based on standard period, the following is to be added. · Opening water chamber, the inside and small tubes will be inspected.	· Surveillance of Opening of Drain Valve · Surveillance of Water Level of Drain · Surveillance of Temperature Difference of Feed Water · Confirmation of Allophone (Strange Noise) · Surveillance of pressure Difference of Feed Water · Confirmation of Feed Water Leakage	

Notes; (*) The inspection means detailed inspection selected checking portion at the approaching time of rapture strength, which is 100,000 hours determined as design criteria of strength of thermal power plant facilities.

WEEKLY PREVENTIVE MAINTENANCE SCHEDULE
For the Period: 05/27/94 to 06/02/94

UNIT : MYT2 — MAP CENTER : CP — PAGE : 2

REVIEWED BY: [signature] PEDROCILLO/TM VILLONA,JR. -PLS — APPROVED BY: [signature] JT ABELA - Opn. Manager

DATE : 05.26.94 — DATE :

PMRC No. / PMRC Seq. No.	PLANT EQUIPMENT	MON	TUE	WED	THU	FRI	SAT	SUN	PM ACTIVITY DESCRIPTION	SL	CL
MYT2-94-3374	FO234PMP02	01WK							LUBRICATE BEARINGS	015	000
OP-FO-1726-0009N	MAIN FUEL OIL PUMP 2 B										
MYT2-94-3474	BA205FAN01		01WK						LUBRICATE BEARINGS	015	000
OP-BA-013F-0009N	FLAME DETECTOR COOLI NG FAN A										
MYT2-94-3434	OR201PMP01		01WK						LUBRICATE BEARINGS	015	000
OP-OR-0031-0009N	BOILER SUMP PUMP 2A										
MYT2-94-3459	OR201PMP02		01WK						LUBRICATE BEARINGS	015	000
OP-OR-0041-0009N	BOILER SUMP PUMP 2B										
MYT2-94-3464	OR202PMP01		01WK						LUBRICATE BEARINGS	015	000
OP-OR-0071-0009N	TURBINE SUMP PUMP 2A										
MYT2-94-3469	OR202PMP02		01WK						LUBRICATE BEARINGS	015	000
OP-OR-0081-0009N	TURBINE SUMP PUMP 2B										
MYT2-94-3956	BA203FAN02			01WK					LUBRICATE BEARINGS	015	000
OP-BA-013F-0009N	FLAME DETECTOR COOLI NG FAN 2B										
MYT2-94-3961	CY213FAN01			01WK					LUBRICATE BEARINGS	015	000
OP-CY-0455-0009N	GLAND STEAM EXHAUSTE R FAN 2A										
MYT2-94-3966	CY213FAN02			01WK					LUBRICATE BEARINGS	015	000
OP-CY-0476-0009N	GLAND STEAM EXHAUSTE R FAN 2B										
MYT2-94-3941	GC203PMP01			01WK					LUBRICATE BEARINGS	015	000
OP-GC-0161-0009N	STATOR COOLING PUMP A										
MYT2-94-3951	GC202PMP02			01WK					LUBRICATE BEARINGS	015	000
OP-GC-0171-0009N	STATOR COOLING PUMP B										
MYT2-94-3876	VA201FAN01			01MO					LUBRICATE BEARINGS	015	000
OP-2VA0018-0009N	BOILER ROOF VENTILAT OR 2A										
MYT2-94-3877	VA201FAN02			01MO					LUBRICATE BEARINGS	015	000
OP-2VA0028-0009N	BOILER ROOF VENTILAT OR 2B										
MYT2-94-3878	VA201FAN03			01MO					LUBRICATE BEARINGS	015	000
OP-2VA0038-0009N	BOILER ROOF VENTILAT OR 2C										
MYT2-94-3879	VA201FAN04			01MO					LUBRICATE BEARINGS	015	000
OP-2VA0048-0009N	BOILER ROOF VENTILAT OR 2D										
MYT2-94-3880	VA201FAN05			01MO					LUBRICATE BEARINGS	015	000
OP-2VA0058-0009N	BOILER ROOF VENTILAT OR 2E										

WEEKLY PREVENTIVE MAINTENANCE SCHEDULE
For the Period: 06/27/94 to 07/03/94

PLANT : MYT1 | ADP CENTER : 10 | PAGE : 1

REVIEWED BY: JV PAZ IGI/TM VILLONA,JR. - P&S | APPROVED BY: AS PALPAL-LATOC - Maint. Manager
DATE : 6.24.94 | DATE :

PNNO No. / PMRC Seq. No.	PLANT EQUIPMENT	MON	TUE	WED	THU	FRI	SAT	SUN	PM ACTIVITY DESCRIPTION	SL	LL
MYT1-94-5515 / IC-MC-115A-0041N	1AR-8209 F. O. FLOW & MFOP DI SCH. PRESS. RECORDER	02WK							RECORDER INKING AND CLEANING	ESD	000
MYT1-94-5511 / IC-MC-107A-0041N	1FR-8211 FEED WATER FLOW RECO RDER	02WK							RECORDER INKING AND CLEANING	ESD	000
MYT1-94-5503 / IC-MC-091A-0039N	1TR-8100 GEN STATOR, HYDROGEN & EXCITER TEMP REC.	02WK							RECORDER INKING AND CLEANING	ESD	000
MYT1-94-5507 / IC-MC-099A-0039N	1TR-8119 EQUIPMENT BEARING TE MPERATURE RECORDER	02WK							RECORDER INKING AND CLEANING	ESD	000
MYT1-94-5601 / IC-MC-001B-0017N	1AR-8101 FAULT RECORDER (LS2)		02WK						RECORDER INKING AND CLEANING	EIS	000
MYT1-94-5573 / IC-MC-116A-0036N	1AR-8210 SH & RH FLOW, BFP DI SCH. PRESS. RECORDER		02WK						RECORDER INKING AND CLEANING	ESD	000
MYT1-94-5565 / IC-MC-092A-0037N	1TR-8109 GENERATOR CORE TEMPE RATURE RECORDER		02WK						RECORDER INKING AND CLEANING	ESD	000
MYT1-94-5569 / IC-MC-100A-0036N	1TR-8201 BOILER AIR & GAS TEM PERATURE RECORDER		02WK						RECORDER INKING AND CLEANING	ESD	000
MYT1-94-4494 / IC-MC-109A-0036N	1AR-8117 STRESS EVALUATOR REC ORDER			02WK					RECORDER INKING AND CLEANING	ESD	000
MYT1-94-4499 / IC-MC-117A-0036N	1AR-8212 BOILER FAULT RECORDE R			02WK					RECORDER INKING AND CLEANING	ESD	000
MYT1-94-4484 / IC-MC-093A-0036N	1TR-8109 STEAM TEMPERATURE RE CORDER			02WK					RECORDER INKING AND CLEANING	ESD	000
MYT1-94-4489 / IC-MC-101A-0036N	1TR-8202 BOILER STEAM & WATER TEMPERATURE RECORD.			02WK					RECORDER INKING AND CLEANING	ESD	000
MYT1-94-4692 / IC-MC-110A-0036N	1AR-8121 FAULT RECORDER (LS-1)				02WK				RECORDER INKING AND CLEANING	ESD	000
MYT1-94-4697 / IC-MC-111A-0034N	1AR-8205 FD & AIR FLOW, FD HD R & FLUE GAS PRESS.				02WK				RECORDER INKING AND CLEANING	ESD	000
MYT1-94-4702 / IC-MC-118A-0036N	1GR-8103 GENERATOR FREQUENCY RECORDER				02WK				RECORDER INKING AND CLEANING	ESD	000
MYT1-94-4682 / IC-MC-094A-0036N	1TR-8111 TURBINE BEARING TEMP ERATURE RECORDER				02WK				RECORDER INKING AND CLEANING	ESD	000

WEEKLY PREVENTIVE MAINTENANCE SCHEDULE

For the Period: 08/22/94 to 08/26/94

PLANT : MYT1 WORK CENTER : EE PAGE : 1

REVIEWED BY: JV RAZ III/TM VILLONA,JR. - P & S APPROVED BY: AS PALPAL-LATOC - Maint.Manager

DATE : 8.19.94 DATE :

PMWO No. / PMRC Seq. No.	PLANT / EQUIPMENT	MON	TUE	WED	THU	FRI	SAT	SUN	PM ACTIVITY DESCRIPTION	SL	LL
MYT1-94-6171 EE-DC-0018-0039M	DC103BAT 60-CELL STATION BATTERY (125V)	02WK							INSPECT, CLEAN AND TEST	EIS	000
MYT1-94-6193 EE-DC-0028-0039M	DC103BAT02 M1 48V STATION BATTERY		02WK						INSPECT, CLEAN AND TEST	EIS	000
MYT1-94-6215 EE-10C-068-0036M	DC103BAT03 48V TELEMETERING BATTERIES			02WK					INSPECT, CLEAN AND TEST	EIS	000
MYT1-94-6217 EE-10C-073-0036M	DC103BAT04 48V PABX COMMUNICATION BATTERIES			02WK					INSPECT, CLEAN AND TEST	EIS	000
MYT1-94-6240 EE-10C-098-0036M	DC103BAT06 FIRE PUMP DIESEL ENGINE BATTERY				02WK				INSPECT, CLEAN AND TEST	EIS	000
MYT1-94-6255 EE-1SY-978-0036M	SY1628AT 230KV SUBSTATION BATTERIES					02WK			INSPECT, CLEAN AND TEST	EIS	000
MYT1-94-6294 EE-10C-088-0036M	DC103BAT05 EMERGENCY DIESEL GENERATOR BATTERY.							02WK	INSPECT, CLEAN AND TEST	EIS	000

Received by:

Date: 8/22/94

PREVENTIVE MAINTENANCE SCHEDULE
For the Month of June , 1994

PLANT: KYT | APP CENTER: EC | Page :

REVIEWED BY: JV PAZ III/TM VILLONA,JR. - P&S | APPROVED BY: AS BALPAD-LATOC - Maint. Manager
DATE : 5.26.94 | DATE :

PMAC No. / PMRC Seq. No.	PLANT EQUIPMENT	MAINTENANCE ACTIVITY DESCRIPTION	SCHEDULE DATE	FREQ	DEPT SERV. LIMIT	UNIT LOAD REDUCTION
KYT2-94-3879	AS206FAN	VIBRATION AND TEMP.M	06/01/94	01MO	EIS	
EC-2A8-79C-0005N	GAS RECIRCULATION FAN	ONITORING				
KYT2-94-3872	FW205PMP01	MONITOR VIBRATION &	06/01/94	01MO	EIS	
EC-FW-059L-0005N	MOTOR-DRIVEN BOILER FEEDWATER PUMP#1	TEMPERATURE				
KYT2-94-3873	FW205PMP02	MONITOR VIBRATION &	06/01/94	01MO	EIS	
EC-FW-060L-0005N	MOTOR-DRIVEN BOILER FEEDWATER PUMP#2	TEMPERATURE				
KYT2-94-3874	TS209PMP	MONITOR VIBRATION &	06/01/94	01MO	EIS	
EC-2TS-259-0005N	TURBINE DRIVEN BOILER FEED PUMP	TEMPERATURE				
KYT2-94-3980	AB201FAN01	VIBRATION AND TEMP.M	06/02/94	01MO	EIS	
EC-AB-022L-0005N	FORCE DRAFT FAN 2A	ONITORING				
KYT2-94-3981	AB201FAN02	VIBRATION AND TEMP.M	06/02/94	01MO	EIS	
EC-AB-023L-0005N	FORCED DRAFT FAN 2B	ONITORING				
KYT2-94-4069	HS204PMP01	MONITOR VIBRATION &	06/03/94	01MO	EIS	
EC-HS-047J-0005N	HOUSE SERVICE CLOSE CYCLE PUMP-2A	TEMPERATURE				
KYT2-94-4070	HS204PMP02	MONITOR VIBRATION &	06/03/94	01MO	EIS	
EC-HS-048J-0005N	HOUSE SERVICE CLOSE CYCLE PUMP 2B	TEMPERATURE				
KYT2-94-4071	HS204PMP03	MONITOR VIBRATION &	06/03/94	01MO	EIS	
EC-HS-049J-0005N	HOUSE SERVICE CLOSE CYCLE PUMP 2C	TEMPERATURE				
KYT2-94-4132	CY203PMP01	MONITOR VIBRATION &	06/04/94	01MO	EIS	
EC-CY-029L-0005N	CONDENSATE PUMP 2A	TEMPERATURE				
KYT2-94-4133	CY203PMP02	MONITOR VIBRATION &.	06/04/94	01MO	EIS	
EC-CY-030L-0005N	CONDENSATE PUMP 2B	TEMPERATURE				
KYT2-94-4213	CW202PMP01	MONITOR VIBRATION &	06/05/94	01MO	EIS	
EC-CW-042K-0005N	CIRCULATING WATER PUMP NO. 2A	TEMPERATURE				
KYT2-94-4214	CW202PMP02	MONITOR VIBRATION &	06/05/94	01MO	EIS	
EC-CW-043K-0005N	CIRCULATING WATER PUMP NO. 2B	TEMPERATURE				
KYT2-94-4266	CW203PMP01	MONITOR VIBRATION &	06/06/94	01MO	EIS	
EC-CW-046F-0005N	SCREEN WASH PUMP NO.1	TEMPERATURE				
KYT2-94-4269	CW203PMP02	MONITOR VIBRATION &	06/06/94	01MO	EIS	
EC-CW-047F-0005N	SCREEN WASH PUMP NO.2	TEMPERATURE				
KYT2-94-4312	FO234PMP01	MONITOR VIBRATION &	06/07/94	01MO	EIS	
EC-FO-171L-0005N	MAIN FUEL OIL PUMP 2A	TEMPERATURE				
KYT2-94-4313	FO234PMP02	MONITOR VIBRATION &	06/07/94	01MO	EIS	
EC-FO-172L-0005N	MAIN FUEL OIL PUMP 2B	TEMPERATURE				
KYT2-94-4326	BA203FAN03	VIBRATION AND TEMP.M	06/09/94	01MO		
EC-2B4020A-0001M	FLAME DETECTOR COOLING FAN C	ONITORING				
KYT2-94-4327	BA203FAN04 +	VIBRATION AND TEMP.M	06/09/94	01MO		
EC-2B4020A-0002M	FLAME DETECTOR COOLING FAN D	ONITORING				
KYT2-94-4328	CY213FAN01	VIBRATION AND TEMP.M	06/10/94	01MO	EIS	
EC-CY-045E-0005N	BLAND STEAM EXHAUSTER FAN 2A	ONITORING				
KYT2-94-4330	CY213FAN02	VIBRATION AND TEMP.M	06/10/94	01MO	EIS	
EC-CY-047E-0005N	BLAND STEAM EXHAUSTER FAN 2B	ONITORING				
KYT2-94-4350	SC202PMP01	MONITOR VIBRATION &	06/11/94	01MO	EIS	
EC-SC-0154-0005N	STATOR COOLING PUMP A	TEMPERATURE				
KYT2-94-4351	SC202PMP02	MONITOR VIBRATION &	06/11/94	01MO	EIS	
EC-SC-0171-0005N	STATOR COOLING PUMP B	TEMPERATURE				

NATIONAL POWER CORPORATION

PREVENTIVE MAINTENANCE WORK ORDER

PMWO NO. MYT2-94-S-33

DATE ISSUED: 07/30/94

PLANT ID	SYSTEM	SPIN	LOCATION	LEAD WORK CENTER
MYT2	MC	STR-8176	K2 - -	IC

EQUIPMENT DESCRIPTION
AH 2B AIR INLET GAS OUTLET TEMP.RECORDER

INITIATING DOCUMENT
IC-MC-0276-0011H

PLANNED ACTIVITY SEQUENCE

RECORDER INKING AND CLEANING

1. Visually inspect recorders.
2. Clean internals and externals. Purge with dry low pressure instrument air if necessary.
3. Refill recorder ink.
4. calibrate recorder if required.
5. Random checking of input signal.
6. Report adverse findings to supervisor for proper disposition.

NOTE: Observe 'Plant Housekeeping and Cleanliness Control'

CRAFT	M-HRS
IIC2	0.50
TOTAL	0.50

PART/MAT/TOOLS/EQPT	NSN OR P/N	U/M	QTY
RAGS INK			

REQUIREMENTS

PRIORITY 3	FREQUENCY 02WK
DUEDATE 07/23/94	EQPT. REQMT. CODE EIS

CLEARANCE? [ ] YES [ ] NO
NO.

FOR EXECUTION:

SHIFT SUPT. DATE

OPERATIONS TEST REQUIRED? [ ]YES [ ]NO [ ]N/A

WITNESS DATE

TAG REMOVED? [ ]YES [ ]NO [ ]N/A

PRINT NAME & SIGN DATE

STATUS CODE: [CS] [CA] [DF] [RS]

ACTUAL COMPLETION DATE:

RESCHEDULED DATE:

WORK SUMMARY/REMARKS:

DG - CLOGGED RECORDER INK LINE

SKILL CODE	MPWR	M-HRS	PART/MATERIAL	NSN or PN	QTY	COST

LABOR COST: EQUIPMENT COST: PART/MATERIAL COST:

COMPLETED BY:

FOREMAN/LEADER DATE: 8/1/94

REVIEWED/APPROVED BY:

Work Center SUPT. DATE: 8-1-94

ACCEPTED BY:

SHIFT SUPT. DATE: 8/2

CLOSED OUT BY:

P&S SECTION CHIEF DATE:

Appendix 5-7

NATIONAL POWER CORPORATION

PREVENTIVE MAINTENANCE WORK ORDER

PLANT	SYSTEM	SPIN	LOCATION	LEAD WORK CENTER
MTI2	AS	AC201FAN01		

EQUIPMENT DESCRIPTION (FDF-2A B3-1) FORCE DRAFT FAN 2A FAN

INITIATING DOCUMENT: Word order no. EC-AG-022L-0005N

PLANNED ACTIVITY SEQUENCE	CRAFT	M-HRS
VIBRATION AND TEMP. MONITORING VIBRATION MONITORING: 1. Take radial and axial filter out reading at all bearing points. 2. For failed bearing take radial and axial filter in readings. 3. Record test results on applicable data sheets. TEMPERATURE MONITORING: 1. Measure ambient temperature of the area. 2. Measure bearing temperature. 3. Record readings on applicable data sheets. 4. Allow stabilization time of 2 to 3 minutes for newly operated equipment. NOTE: Observe Plant Housekeeping and Cleanliness Control.	1ECA 1ECS 1ECX	0.50 0.50 0.50
	TOTAL	1.5

PART/MAT/TOOLS/EQPT	NSN OR P/N	U/M	QTY
IRD 308 OR EQVL		SET	1.00
THERMOMETER		PC.	1.00
DATA SHEETS			
EAR MUFFS		PCS	2.00
CLIP BOARD		PC.	1.00
BALLPEN		PC.	1.00

REQUIREMENTS

PRIORITY	FREQUENCY
3	01F
DUEDATE ✓ 06/02/94	EQPT. REQMT. CODE: EIS

CLEARANCE? [ ] YES [ ] NO

FOR EXECUTION:

SHIFT SUPT. DATE

OPERATIONS TEST REQUIRED? [ ] YES [ ] NO [ ] N/A

WITNESS DATE

TAG REMOVED? [ ] YES [ ] NO [ ] N/A

PRINT NAME & SIGN DATE

STATUS CODE: [CS] [CA] [DE] [RS]

ACTUAL COMPLETION DATE:

RESCHEDULED DATE:

WORK SUMMARY/REMARKS:

VIBRATION
Highest @ Point # 4 (Hor)
Fan outboard bearing
Sharp mode 76 microns
5.2 mm/sec
Severity - SLIGHTLY ROUGH

TEMPERATURE
Highest @ Pt. # 3
Fan inboard - 58°C
Ambient - 36°C

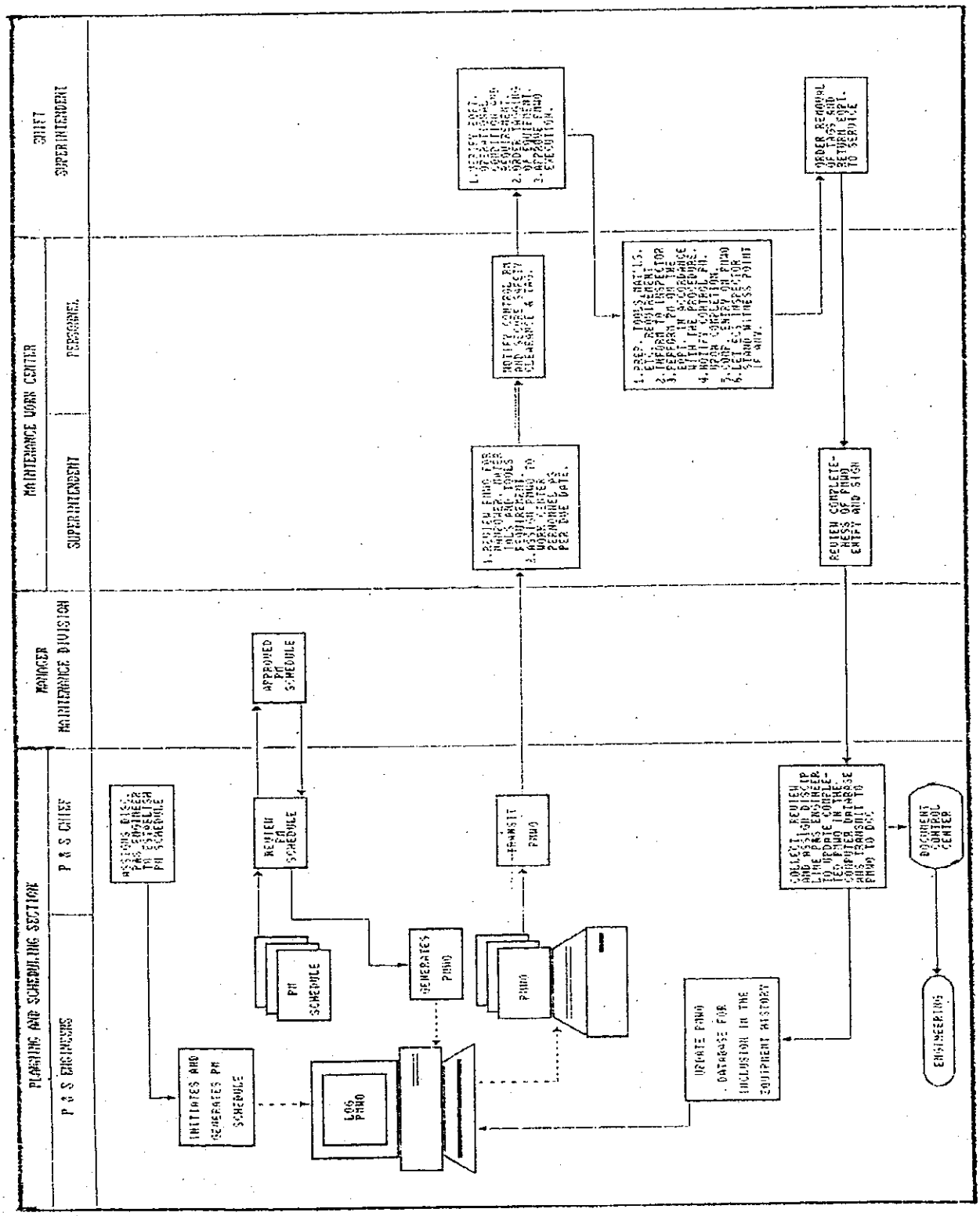
Load - 320 MW
Speed: - 1480 RPM
Amperage - 340 Amps
Blade opening - 76%

SKILL CODE	MPWR	M-HRS	PART/MATERIAL	NSN or PN	QTY	COST
ECA	1	0.1	IRD 650			
ECS	2	0.2				

LABOR COST: EQUIPMENT COST: PART/MATERIAL COST:

COMPLETED BY:	REVIEWED/APPROVED BY:	ACCEPTED BY:	CLOSED-OUT BY:
R. GARCIA FOREMAN/SUPVR. DATE: 6/30/94	W.M. [illegible] Work Center SUPT. DATE: 7/5/94	SUPT. SUPT. DATE:	P&S SECTION CHIEF DATE: 7.6.94

PREVENTIVE MAINTENANCE WORK ORDER FLOW CHART



NATIONAL POWER CORPORATION
MALAYA THERMAL PLANT
CORRECTIVE MAINTENANCE WORK ORDER

CMWO NO. 9 4 - 0 6 1 7
RESPONSIBLE MAINT. GROUP: ME | EE | IC | RE | TS | CM
LOCATION CODE:

ORIGINATOR

PLANT ID: MPP - 2
SYSTEM:
EQPT. SPIN:
INITIATING DOCUMENT:

EQUIPMENT DESCRIPTION: T-RFP.
DESCRIPTION OF WORK/TROUBLE NOTED: HAV UNUSUAL SOUND, PLS. TAKE VIBRATION TEST.

ORIGINATOR: LINDO
DATE REPORTED: 9-4-94
CONTACT MAN: MAINTENANCE

OPERATIONS

PLANT EQUIPMENT
☐ 1 - Emergency ☑ 2 - Urgent ☐ 3 - Expedite ☐ 4 - Routine ☐ 5 - Start-up
NON-PLANT EQUIPMENT
☐ 3 - Immediate ☐ 4 - General Services

SPECIAL INSTRUCTION

EQUIPMENT ISOLATION STATUS: ☑ EIS - In-Service ☐ ESD - Out-of-Service
CLEARANCE REQUIRED? ☐ YES ☐ NO
CW / HP REQUIRED? ☐ YES ☐ NO
OPERATIONAL TEST REQUIRED ☐ YES ☐ NO

VERIFIED/APPROVED BY: A.V. CAMPOS
OPTN/CHEM. SUPERINTENDENT
DATE ISSUED: 9-4-94

P & S SECTION

NO.	ACTIVITY	CRAFT	NO.	M-HR	PARTS/MATLS.	NSN-P/N
	☐ CONT. SHEET					

EST. COMPL. DATE: TOTAL M-HR (Est. Std.)

PREPARED BY: P & S ENGINEER — DATE
APPROVED BY: P & S SECTION CHIEF — DATE

WCS

APPROVED FOR EXECUTION:
ECO. NO. _____ CW / HP NO. _____
OPTN/CHEM. SUPT. — DATE

WORK PERFORMANCE AND CLOSE-OUT REPORT

SUPPORT GROUP: ☐ ME ☐ EE ☐ PEC ☐ CHEM

WORK SUMMARY:
TURBINE SIDE (POINT #2 VERTICAL) IS SLIGHTLY ROUGH
V R 26.5 microns, 6.3 mm/sec FILTER IN
32 microns, 7 mm/sec FILTER OUT

INSTRUCTION:

REQUEST COMPLETED BY: _____ SIGNATURE/DATE

☐ CONT. SHEET

WORK STARTED MO.	DAY	YR.	HR.	WORK END MO.	DAY	YR.	HR.
9	5	94	10AM	9	5	94	10:30 AM

TAG REMOVED: YES ☐ NO ☐ N/A ☐ By: _____

DEFERRED BY: _____ NAME
Date Deferred — Date Lifted

DEFERRAL DUE TO:
☐ V - Awaiting Vendor/Contractor
☐ E - Engineering Disposition Req'd.
☐ M - Unavailability of Materials
☐ O - Awaiting Plant Outage
☐ U - System / Eqpt. not available

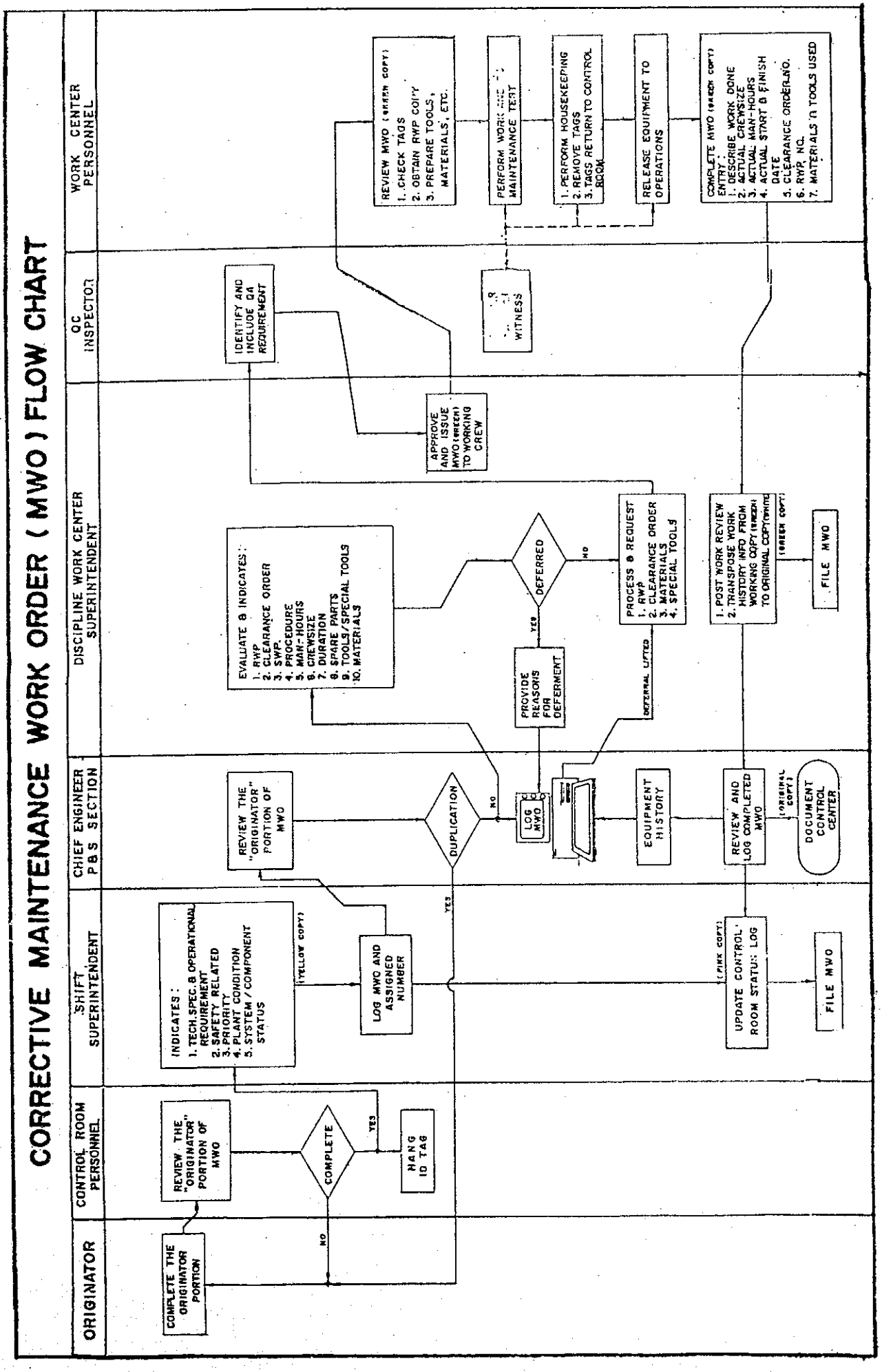
CRAFT	NO.	M-HR	PARTS/MATERIALS	QTY.	UNIT COST	MIV NO.	NSN-P/N	EQUIPT./SPECIAL TOOLS

COST SUMMARY: Labor _____ Parts & Matls. _____ Equipt. Use _____ Total _____

CONFORMED BY: [illegible] — W/C FOREMAN/SUPVR. — 9/5/94 DATE
APPROVED BY: [illegible] W/C SUPERINTENDENT — 9/6/94 DATE

COMPLETE: 9/7/94 DATE
WITNESSED BY
ACCEPTED BY: OPTN/CHEM/S SUPT. — 9/6/94 DATE
REVIEWED/CLOSED BY: P & S SECTION CHIEF — DATE

PRINT NAME AND SIGN. This form is quadruplicated, please WRITE HEAVILY.


CORRECTIVE MAINTENANCE WORK ORDER (MWO) FLOW CHART
ORIGINATOR
CONTROL ROOM PERSONNEL
SHIFT SUPERINTENDENT
CHIEF ENGINEER P&S SECTION
DISCIPLINE WORK CENTER SUPERINTENDENT
QC INSPECTOR
WORK CENTER PERSONNEL
COMPLETE THE ORIGINATOR PORTION
REVIEW THE "ORIGINATOR" PORTION OF MWO
COMPLETE
NO
YES
HANG ID TAG
INDICATES:
1. TECH. SPEC. & OPERATIONAL REQUIREMENT
2. SAFETY RELATED
3. PRIORITY
4. PLANT CONDITION
5. SYSTEM / COMPONENT STATUS
(YELLOW COPY)
LOG MWO AND ASSIGNED NUMBER
REVIEW THE "ORIGINATOR" PORTION OF MWO
DUPLICATION
NO
YES
EVALUATE & INDICATES:
1. RWP
2. CLEARANCE ORDER
3. SWP.
4. PROCEDURE
5. MAN-HOURS
6. CREWSIZE
7. DURATION
8. SPARE PARTS
9. TOOLS/SPECIAL TOOLS
10. MATERIALS
DEFERRED
NO
YES
PROVIDE REASONS FOR DEFERMENT
LOG MWO
EQUIPMENT HISTORY
PROCESS & REQUEST
1. RWP
2. CLEARANCE ORDER
3. MATERIALS
4. SPECIAL TOOLS
DEFERRAL LIFTED
REVIEW AND LOG COMPLETED MWO
(ORIGINAL COPY)
DOCUMENT CONTROL CENTER
1. POST WORK REVIEW
2. TRANSPOSE WORK HISTORY INFO FROM WORKING COPY (GREEN) TO ORIGINAL COPY (WHITE)
(GREEN COPY)
FILE MWO
(PINK COPY)
UPDATE CONTROL ROOM STATUS LOG
FILE MWO
IDENTIFY AND INCLUDE QA REQUIREMENT
APPROVE AND ISSUE MWO (GREEN) TO WORKING CREW
WITNESS
REVIEW MWO (GREEN COPY)
1. CHECK TAGS
2. OBTAIN RWP COPY
3. PREPARE TOOLS, MATERIALS, ETC.
PERFORM WORK AND MAINTENANCE TEST
1. PERFORM HOUSEKEEPING
2. REMOVE TAGS
3. TAGS RETURN TO CONTROL ROOM
RELEASE EQUIPMENT TO OPERATIONS
COMPLETE MWO (GREEN COPY)
ENTRY:
1. DESCRIBE WORK DONE
2. ACTUAL CREWSIZE
3. ACTUAL MAN-HOURS
4. ACTUAL START & FINISH DATE
5. CLEARANCE ORDER NO.
6. RWP. NO.
7. MATERIALS & TOOLS USED

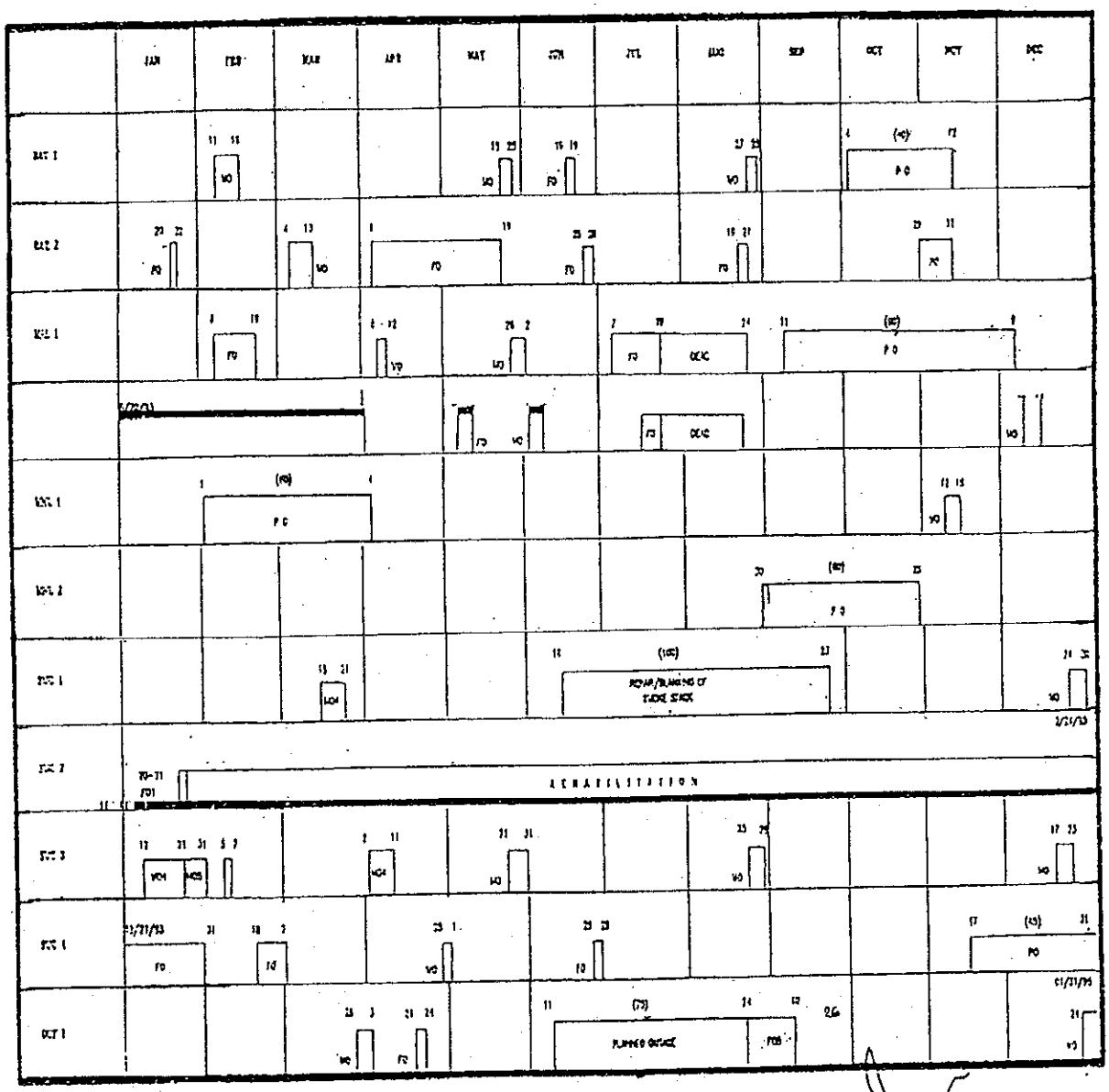
MAINTENANCE SCHEDULE

1994 – 08

RPD/OPPD/SO

DATE: AUGUST 23, 1994

THERMAL



Approved by :

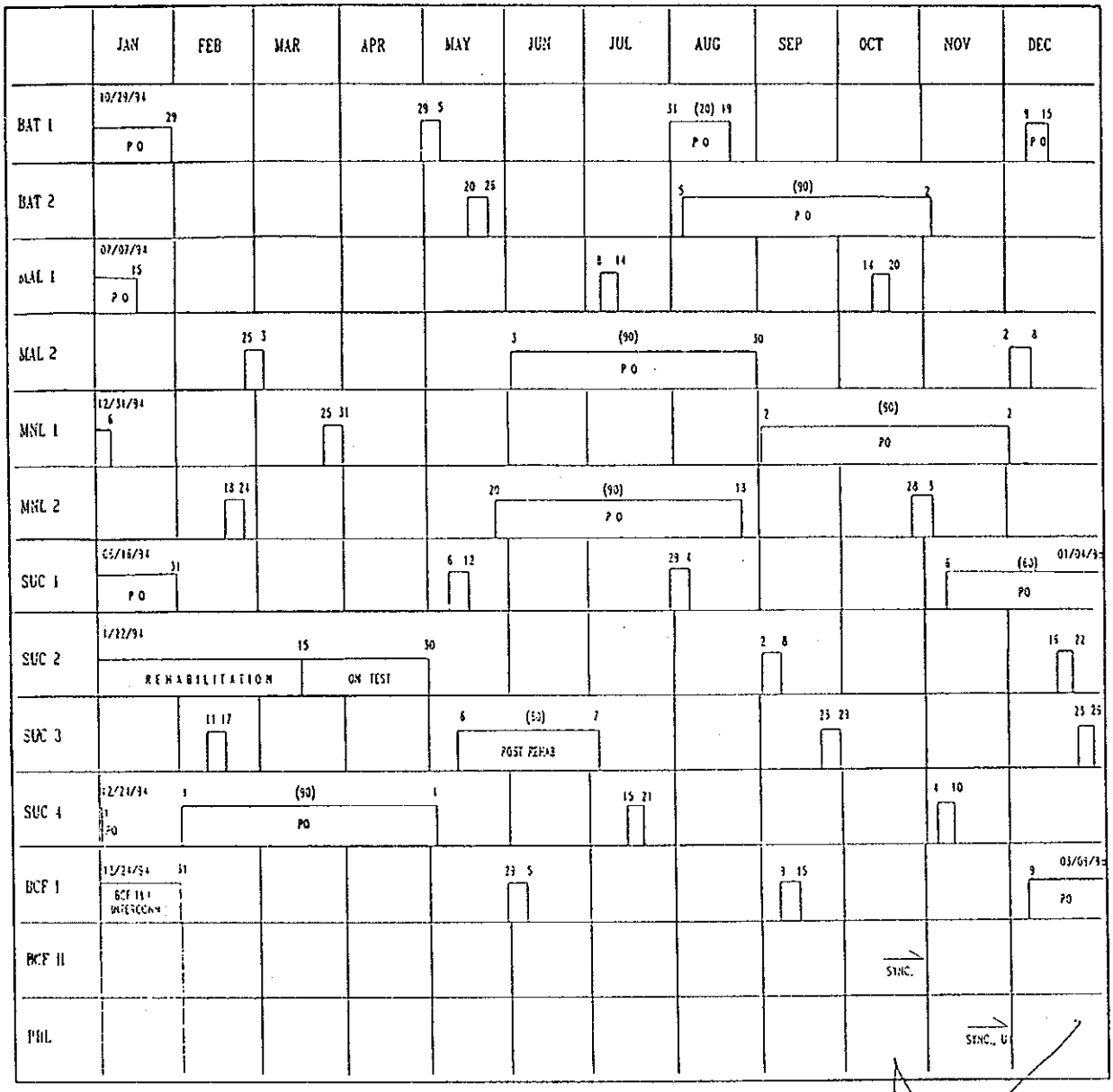
D. L. BULATAO
Vice President,
System Operations

MAINTENANCE SCHEDULE
1995 - CASE 01

PRPD/OPPD/SO

DATE : December 05, 1994

THERMAL



Approved by :

D. L. BULATAO
Vice President, System Operations

Long－Term Inspection Schedule for Unit NO. 1 (for Boiler)

Equipment		Year / Numbers of Periodic Inspection / Classification of Periodic Inspection	Frequency Every ×× Year	Contents of Inspection '92	'93	'94	'95	'96	'97	'98	'99	'00	'01	Remarks
				a	b	a	b	a	b	a	b	a	b	
Boiler Body	Drum	Inside Surface of Welding Portions of Steam Drum	1	P	P	P	P	P	P	P	P	P	P	PT or MT
		Outside Surface of Welding Portions of Steam Drum	8											ditto
		Nozzle Stub Welding Portions of steam Drum	8											ditto
		Steam Separator of Steam Drum	2	Q		Q		Q		Q		Q		at A Inspection, 1/4 detached
		Inside Surface of Welding Portions of Water Drum	1	P	P	P	P	P	P	P	P	P	P	PT or MT
		Outside Surface of Welding Portion of Water Drum	8											
		Nozzle Stub Welding Portion of Water Drum	8											
		Orifice Inner Diameter of Water Drum	2	R		R		R		R		R		at A Inspection, all is inspected
	Heat Exchanger Tube	Tube Thickness of Economizer	2	R		R		R		R		R		at A Inspection, 1/10 Sampling
		Generating Tube Thickness of Furnace	2	R		R		R		R		R		at A Inspection, all is inspected
		Sampling Tube Test of Generating Tube of Furnace	2	S		S		S		S		S		at A, B Inspections, four (4) are inspected
		Tube Thickness of Horizontal Superheater	2	R		R		R		R		R		at A Inspection, 1/10 Sampling
		Tube Thickness of Panel-Type Superheater	2	R		R		R		R		R		ditto
		Tube Thickness of Platen Superheater	2	R		R		R		R		R		
		Sampling Tube Test of Panel-Type Superheater	4	S				S				S		at A Inspection, 1/10 Sampling
		Tube Thickness of Pendant Superheater	2	R		R		R		R		R		
		Sampling Tube Test of Pendant Superheater	4			S				S				
		SUS Scale Test of Pendant Superheater	1	P	P	P	P	P	P	P	P	P	P	To be implemented if the case demands
		Tube Thickness of Horizontal Reheater	2	R		R		R		R		R		at A Inspection, 1/10 Sampling
		Tube Thickness of Pendant Reheater	2	R		R		R		R		R		ditto
	Header	Inlet of Economizer	Q											Open at Ministry Test(by Law)
		Outlet of Economizer		Q										ditto
		Upper Side of Furnace Front Wall			Q									ditto
		Upper Side of Furnace Back Wall				Q								ditto
		Upper Side of Furnace Side Wall(Right)					Q							ditto
		Upper Side of Furnace Side Wall(Left)						Q						ditto
		Upper Side of Back Wall of Rear Gas Duct							Q					ditto

Explanation of Symbols :

P : Non－Destructive Test (PT, MT, etc.)
Q : Visual Inspection
R : Measurement of Dimensions
S : Material Test

Notes :

Results shall be encircled by symbol of O (circle)

Long – Term Inspection Schedule for Unit NO. 1 (for Turbine)

Equipment		Year / Numbers of Periodic Inspection / Classification of Periodic Inspection	Frequency Every ×× Year	Contents of Inspection '92	'93	'94	'95	'96	'97	'98	'99	'00	'01	Remarks
				A	D	B	D	A	D	B	D	A	D	for Turbine
Steam Turbine Body	Casing	Outer Casings of High, Intermediate Pressure	4	T				T				T		Upper & Lower Halves
		ditto	4			T				T				Upper Half
		Inner Casings of High, Intermediate Pressure	4	F				F				F		Upper & Lower Halves
		ditto	4			T				T				Upper Half
		First Low Pressure	4	T				T				T		Upper & Lower Halves
		ditto	4			T				T				Upper Half
		Second Low Pressure	4	T				T				T		Upper & Lower Halves
		ditto	4			T				T				Upper Half
		Cross Over Pipe	2	T		T		T		T		T		
		Atmosphere Relief Valve	2	T		T		T		T		T		
	Rotor	Rotors of High, Intermediate Pressure	4	F				F				F		Taking out Rotor
		ditto				T				T				Without taking out Rotor
		First Low Pressure Rotor	4	F				F				F		Taking out Rotor
		ditto				T				T				Without taking out Rotor
		Second Low Pressure Rotor	4	F				F				F		Taking out Rotor
		ditto				T				T				Without taking out Rotor
	Diaphragm • Nozzle	Nozzles of Governing stage	4	T				T				T		Upper & Lower Halves
		ditto	4			T				T				Upper Half
		Diaphragm•Nozzles of High, Intermediate Pressure	4	T				T				T		Upper & Lower Halves
		ditto	4			T				T				Upper Half
		Nozzles of First Low Pressure	4	T				T				T		Upper & Lower Halves
		ditto	4			T				T				Upper Half
		Nozzles of Second Low Pressure	4	T				T				T		Upper & Lower Halves
		ditto	4			T				T				Upper Half
	Main Bolts	Bolts for Outer Casings of High, Intermediate Pressure	2	P		P		P		P		P		
		Bolts for Inner Casings of High, Intermediate Pressure	2	P		P		P		P		P		
		Coupling Bolts	2	P		P		P		P		P		
		Bolts for Main Valves	2	P		P		P		P		P		

Explanation of Symbols :

P : Non – Destructive Test (PT, MT, etc.)
Q : Visual Inspection
T : Disassembly Inspection (Including P, Q)
F : Inspection after Taking out

Notes :

Results shall be encircled by symbol of O (circle)

Long – Term Inspection Schedule for Unit NO. 1 (for the Electrical)

Equipment		Year	Frequency Every ×× Year	Contents of Inspection '92	'93	'94	'95	'96	'97	'98	'99	'00	'01	Remarks
		Numbers of Periodic Inspection												
		Classification of Periodic Inspection		A	D	B	D	A	D	B	D	A	D	for Turbine
Generator and Auxiliary Equipment	Generator Body	Taking out Rotor and the Inspection	8					F						Detailed Inspection
		Opening Upper Half of End Bracket	2	A		A		A		A		A		
		Inspection after Opening Manhole	2		Q		Q		Q		Q		Q	
		Inspection of Seal Ring	2	T		T		T		T		T		
		Bearing	2	T		T		T		T		T		
		Collector Ring	1	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	
		Lead Wire Terminal	1	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	
		Shaft Current	1	D	D	D	D	D	D	D	D	D	D	
		Bushing Current Transformer	1	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	
	Hydrogen Cooling Unit	Hydrogen Gas Cooler	1	B	B	B	B	B	B	B	B	B	B	4 sets
		Gas Dryer	1	T	T	T	T	T	T	T	T	T	T	
		Pressure, Temperature Regulator	1	C	C	C	C	C	C	C	C	C	C	
		Hydrogen Cylinder	5	B					B					Test designated by Law five(5)years' Cycle
		Carbon Dioxide Gas Cylinder	5	B					B					
	Stator Coil Cooling Equipment	Tower of Ion exchange Resin	1	T	T	T	T	T	T	T	T	T	T	Exchange Resin
		Cooling Water Pump for stator A	2	T		T		T		T		T		
		ditto B	2		T		T		T		T		T	
		Pressure, Temperature Regulator	1	C	C	C	C	C	C	C	C	C	C	
		Filter for Cooking Water	1	T	T	T	T	T	T	T	T	T	T	
		Cooling Water Cooler for Stator	1	B	B	B	B	B	B	B	B	B	B	
	Seal Oil Unit	Vacuum Pump A	2	T		T		T		T		T		Pump, Reducer
		Vacuum Pump B	2		T		T		T		T		T	ditto
		Seal Oil Pump	2	T		T		T		T		T		
		Emergency Seal Oil Pump	2		T		T		T		T		T	
		Seal Oil Processor	1	C	C	C	C	C	C	C	C	C	C	Pressure Regulating Valve, Reservoir, Filter

Explanation of Symbols :

Q : Visual Inspection
D : Measurement
B : Water Pressure (Leakage Test)
C : Confirmation of Function
T : Disassembly Inspection
A : Inspection after Opening
F : Inspection after Taking Out

Notes : Results shall be encircled by symbol of O (circle)

Long－Term Inspection Schedule for Unit NO. 1 (for Control)

Equipment				Number of Sets of Equipment	'92	'93	'94	'95	'96	'97	'98	'99	'00	'01	Remarks
			Year												
			Classification of Periodic Inspection for Boiler												
			Classification of Periodic Inspection for Turbine												
Instruments and Control Equipment of Boiler	Control Equipment	Automatic Control System for Boiler	Transmitter, Convertor												
			Module, Relay, etc.												
			Power Unit, Loader, Controller												
			Moter Driven Control Drive												Including Control Valve
			Pneumatic Control Drive												ditto
			Variable Pressure Operation Equipment												
		Burner Control System	Logic Relay Panel												
			Control Panel												
			Flame Scanner												
			Ignition Torch												
			Valve for Burner												
			Valve for Purge												
			Insert/Extract Device of Oil Gun												
		Control System for Fuel Auxiliary Air, Damper	Transmitter												
			Controller, Limiter of Upper. Lower Limit												
			Proportional Computing Relay E/P Converter												
			Pressure Switch												
			Electromagnetic Valve												
		Local Control System for Boiler	Controller												Pressure, Temperature, Water Level
			Control Valve												
			Transmitter for Line Blend Control												Flow Meter
			Module for Line Blend												
			Controller Transmitter for Line Blend												

Contents of Inspection : ①Inspection · Repair of Equipment
②Replacement of Defective Parts
③Unit Test
④Loop Test

Required Time for Start-up/Shutdown of Unit NO.1

1. Required Time for Start-up

Item / Unit Start-UP Mode		Very Hot Start-up	Hot Start-up	Warm Start-up Ⅱ	Warm Start-up Ⅰ	Cold Start-up Ⅱ	Cold Start-up Ⅰ		
Metal Temp. of the First Stage		Over 450℃	350 ℃～450 ℃	240 ℃～350 ℃	150 ℃～240 ℃	100 ℃～150 ℃	under 100 ℃		
Start-UP Condition		Soon After Trip	DSS (8Hr)	WSS (30Hr)	WSS (60Hr)	Standby	Standby (Without changing Boiler Water)	Standby (With changing Boiter Water)	Long-Term shutdown
Preparation for Unit Start-up						4° -30´	4° -30´	9° -30´	47° -30´
Preparation for Boiler Light-off		15´	30´	30´	30´	30´	30´	30´	30´
Light-off ~ Parallel in	Boiler Light-off～Turbine start-up	5´	2° -00´	2° -30´	3° -00´	5° -00´	5° -00´	5° -00´	5° -00´
	Turbine Start-up～Parallel in	20´	25´	50´	(Notes 1) 60´	2° -00´	3° -00´	3° -00´	3° -00´
	(900rpm Heat Soak)					(1° -00´)	(2° -00´)	(2° -00´)	(2° -00´)
	(3,600rpm Heat Soak)			(25´)	(25´)	(25´)	(25´)	(25´)	(25´)
Parallel in～Full Load	Initial Load Heat Soak			30´	30´	30´	30´	30´	30´
	Initial Load～75MW	8´	19´	48´	48´	48´	48´	48´	48´
	Load Changing Rate	11.25MW/M	3.0MW/M	1.5MW/M	1.5MW/M	1.5MW/M	1.5MW/M	1.5MW/M	1.5MW/M
	Holding 75 MW (BFPT Automatic)	3´	10´	20´	20´	20´	20´	20´	20´
	75MW～170MW	8´	46´	52´	52´	52´	52´	52´	52´
	Load Changing Rate	11.25MW/M	2.0MW/M	2.0MW/M	2.0MW/M	2.0MW/M	2.0MW/M	2.0MW/M	2.0MW/M
	Holding 170 MW (BFPT Automatic)	2´	10´	20´	20´	20´	20´	20´	20´
	170MW～375MW	19´	35´	1° -10´	1° -10´	1° -10´	1° -10´	1° -10´	1° -10´
	Load Changing Rate	11.25MW/M	6.0MW/M	3.0MW/M	3.0MW/M	3.0MW/M	3.0MW/M	3.0MW/M	3.0MW/M
Preparation for Unit Start-up						4° -30´	4° -30´	9° -30´	47° -30´
Preparation for Boiler Light-off		15´	30´	30´	30´	30´	30´	30´	30´
Light-off ～Parallel in		25´	2° -25´	3° -20´	4° -00´	7° -00´	8° -00´	8° -00´	8° -00´
Parallel in ～Full Load		40´	2° -00´	4° -00´	4° -00´	4° -00´	4° -00´	4° -00´	4° -00´
SUS Purge			2° -00´	2° -00´	2° -00´	2° -00´	2° -00´	2° -00´	2° -00´
Silica Purge			2° -00´	3° -00´	3° -00´	6° -00´	6° -00´	10° -00´	10° -00´
Total Required Time		80´	8° -55´	12° -50´	13° -30´	24° -00´	25° -00´	34° -00´	72° -00´

2. Required Time for Shutdown

Item / Unit Shutdown Mode	Daily Shutdown	Weekend Shutdown		Long-Term Shutdown	
Boiler Shutdowon Condition	Banking	Banking	Forced Cooling	Banking	Forced Cooling
Shutdown Condition	DSS (8Hr)	WSS (30Hr,60Hr)	WSS (30Hr,60Hr)		
375MW～220MW/220MW～170MW	25´/15´	25´/15´	25´/15´	25´/15´	25´/15´
Load Changing Rate	6.0MW/M/3.0MW/M	6.0MV/M/3.0MV/M	6.0MW/M/3.0MW/M	6.0MW/M/3.0MW/M	6.0MW/M/3.0MW/M
BFPT Stop of the First set	10´	10´	10´	10´	10´
170MW ～75MW	50´	50´	50´	50´	50´
Load Changing Rate	2.0MW/M	2.0MW/M	2.0MW/M	2.0MW/M	2.0MW/M
BFPT Stop of the Second Set (T→M Change-over)	10´	10´	10´	10´	10´
75MW～Parallel off	50´	50´	50´	50´	50´
Load Changing Rate	1.5MW/M	1.5MW/M	1.5MW/M	1.5MW/M	1.5MW/M
Banking	20´	20´		20´	
Parallel off～Completion of Cooling			12° -00´		12° -00´
Total Required Time	3° -00´	3° -00´	14° -40´	3° -00´	14° -40´

※The inside of ( ) means included time

(Notes 1)

In case that the metal temperature of the first stage in under 200℃ as to Warm Start-up Ⅰ,the time comes to be ten minutes longer due to turbine speed up rate and heat soak time of low speed.

Date : . . . . Unit No.1 Start-up Curve (Schedule)

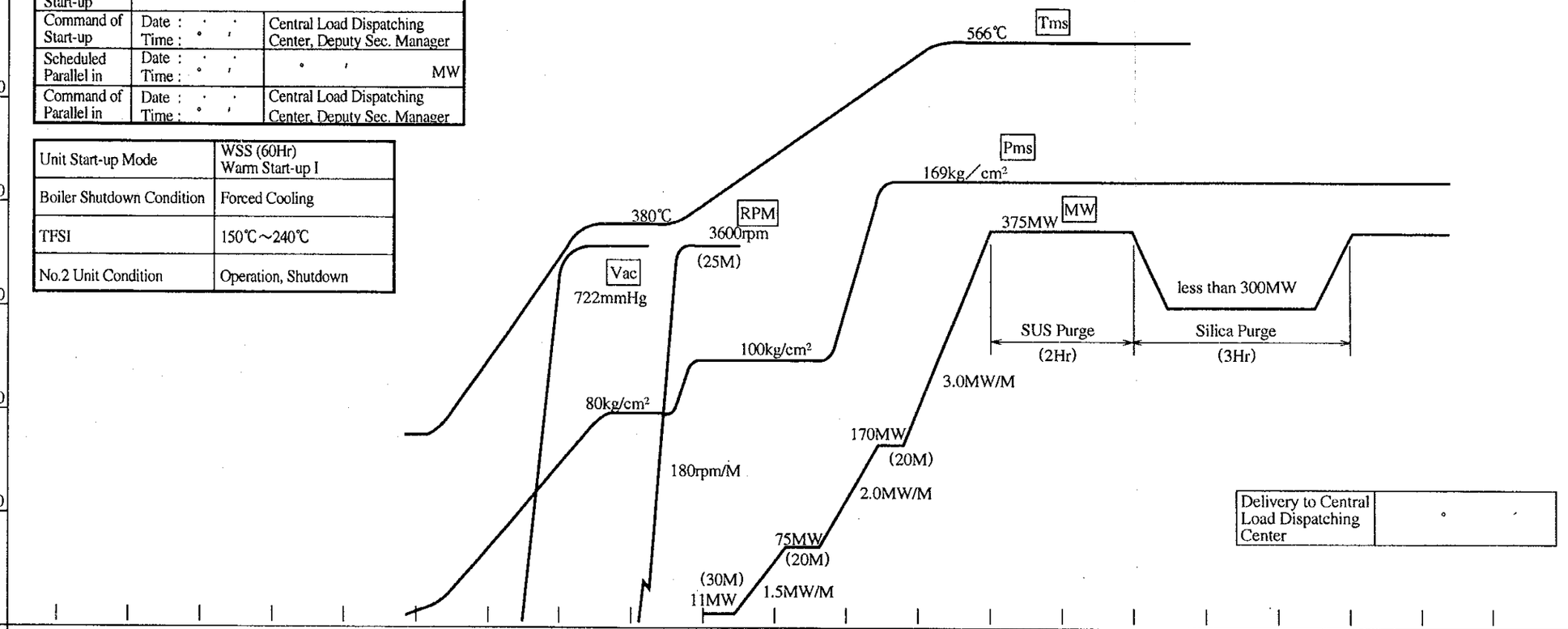
Sub Sec	Deputy Manager of Operation Sec	Manager of Operation Sec.	Deputy Plant Manager	Plant Manager

Prepared Date: . .

℃	mmHg	rpm	kg/cm²	MW
600	1,200	6,000		600
500	1,000	5,000	200	500
400	800	4,000		400
300	600	3,000		300
			100	
200	400	2,000		200
100	200	1,000		100

Reason for Start-up		
Command of Start-up	Date : . . Time : ° ′	Central Load Dispatching Center, Deputy Sec. Manager
Scheduled Parallel in	Date : . . Time : ° ′	° ′ MW
Command of Parallel in	Date : . . Time : ° ′	Central Load Dispatching Center, Deputy Sec. Manager

Unit Start-up Mode	WSS (60Hr) Warm Start-up I
Boiler Shutdown Condition	Forced Cooling
TFSI	150℃～240℃
No.2 Unit Condition	Operation, Shutdown



Delivery to Central Load Dispatching Center	° ′

		-9	-8	-7	-6	-5	-4	-3	-2	-1	0	1	2	3	4	5	6	7	8	9	10	11
Time																						
Major Schedule						Preparation for Boiler Light-off	Boiler Light-off		Vacuum up		Turbine Start-up	Parallel in	Switching to House Service	Reaching 75MW	Reaching 170MW	Reaching 375MW				Delivery to Central Load Dispatching Center		
Time	Schedule					(-)	(-)		(-)	(-)		(-)				(-)						
	Actual					(-)	(-)		(-)	(-)		(-)	(-)	(-)	(-)	(-)						
Commentaries						↑ Start-up Draft System ↑ Start-up Two Sets of BCP ↑ MFT Reset ↑ Light-off First Stage Light Oil Burner ↑ Start-up Third Set of BCP ↑ Supplying Auxiliary Steam ↑ Starting Ejector for start					↑ 20-110 ON ↑ GMF Start-up ↑ Changeover Light Oil/Fuel Oil ↑ TTV → GV Transfer ↑ GRF Start ↑ ACC Automatic ↑ First Set of BFPT Automatic (-) ↑ Second Set of BFPT Automatic (-)			↑ SUS Purge Start		↑ Silica Purge Start			

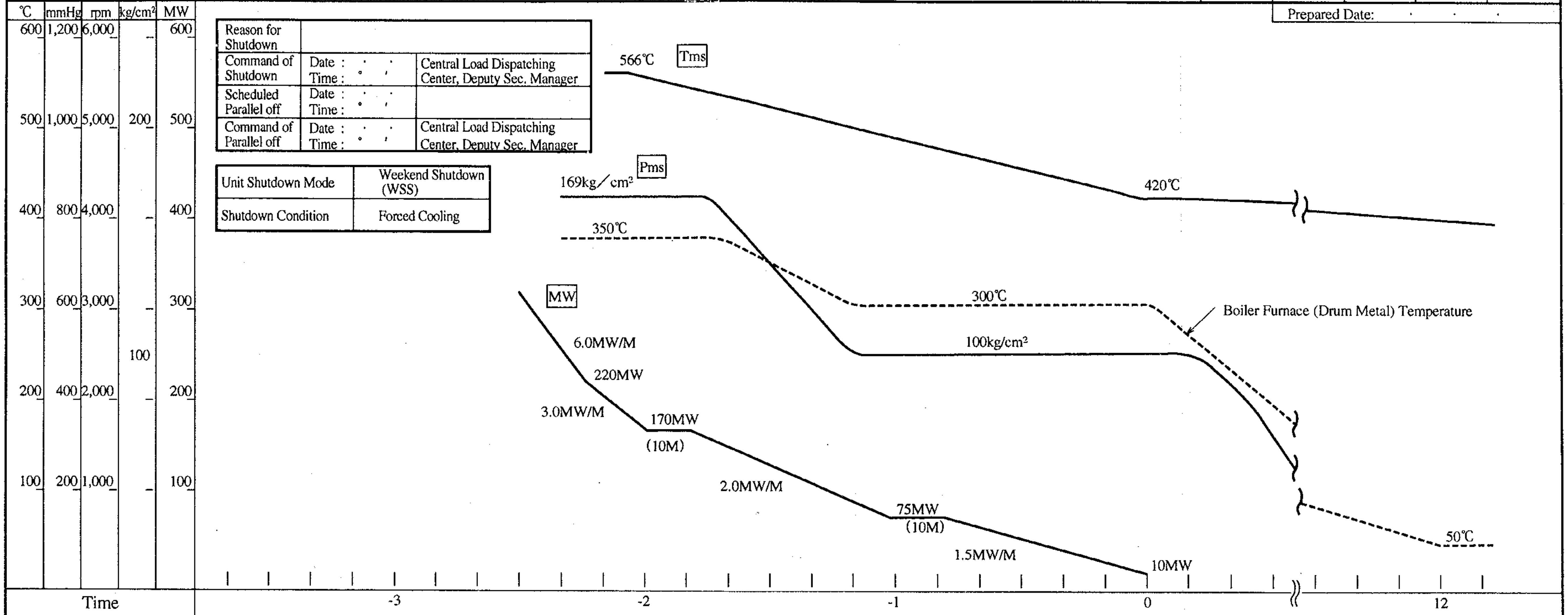
Date : . . . . Unit No.1 Shutdown Curve (Schedule)

Sub Sec	Deputy Manager of Operation Sec	Manager of Operation Sec.	Deputy Plant Manager	Plant Manager

Prepared Date: . . .

Reason for Shutdown		
Command of Shutdown	Date : . . Time : ° '	Central Load Dispatching Center, Deputy Sec. Manager
Scheduled Parallel off	Date : . . Time : ° '	
Command of Parallel off	Date : . . Time : ° '	Central Load Dispatching Center, Deputy Sec. Manager

Unit Shutdown Mode	Weekend Shutdown (WSS)
Shutdown Condition	Forced Cooling



Major Schedule		Reaching 170MW; Reaching 75MW; Switching to House Service; Parallel off; Boiler Extinguishing; Shutdown of Draft System	
Time	Schedule	(-) (-) (-)	
	Actual	(-) (-) (-) (-) (-) (-)	

Commentaries

*Forced Cooling (Without Boiler Water Draining)
- Required Time : about 12 Hours
- Air Flow Rate : 60～70%
- Boiler Furnace Temp (Temp standard for Drum Metal) Cooling Completion at 50℃

↑ First set of BFPT Stop
↑ Sliding Pressure Operation "ON"

↑ Completion of Sliding Pressure Operation
↑ BFPM Start-up
↑ ACC Change over
↑ SBP Stop
↑ HP Bleeding Stop
↑ Opening Recirculating Valve of Eco
↑ GRF Stop
↑ Second set of BFPT Stop
↑ LP Bleeding Stop

↑ Switching to House Service

↑ 20-110 OFF
↑ Turbine Trip
↑ Boiler Extinguishing
↑ GMF Stop
↑ Vacuum Break of Condenser
↑ Turning "ON" (-)

↑ Shutdown of Draft System
↑ BFPM Stop
↑ BCP Stop

Date:

Monthly Routine List for No.2 Unit (At the time of Operation)

Week	Day	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
1	Day							
	Shift Duties	Ⓒ ▲Ground Relay Test for Excitation Circuit · Ignition Test of Pilot Torch · Backwash of Cooler for Cooling Water · Auxiliary Equipment for start/stop of BFPT	Ⓒ Ⓒ · Oil Cooler of Main Turbine (→) (Jan.,Apr.,Jul.,Oct.) · BFPT Oil Cooler 2A (→) 2B (→) · TAG Check (to rewrite, if it is vague)	Ⓒ ▲Vacuum Pump of Condenser (→) · Measurement of Air Volume of Condenser Vacuum Pump 2A kg/H 2B kg/H	Ⓒ Ⓒ Ⓒ ■SC Feed Water Pump (→) · Condensate Booster Pump (→) · Condensate Pump (→)	· Request for Opening. Closing Test of Main Valves		Ⓢ ▲Cooling Fan for DC-TV Scanner · A,B-EMF Reactivation · Panel cleaning · ANN Test
	Day time Duty	Ⓞ Ⓦ ●Main Valves D M ●Extraction Check Valve of Turbine D M	· Filling in Data List	Ⓢ · Diesel Generator (at site) D E M	Ⓦ · Fire Extinguishing Appliance for Boiler, etc. (Boiler High·Low Pressure Pump Yard (May,Aug.,Nov.,Feb.)	· Overall Inspection, Oiling		
2	Day							
	Shift Duties	Ⓒ Ⓒ ▲Chemical Dosing Pump N_2H_4 (→) NH_3 (→) · Ash Disposal P (→)	Ⓒ Ⓢ · Reactivation of Hydrogen Gas Drier · Ignition Test of Pilot Torch · Vacuum Pump of Seal Oil (→) D · Emergency Pump of Seal Oil D	Ⓢ Ⓢ · BFPT Oil Pump D · ANN Test of oil Level of BFPT Oil Tank · Sea water Booster Pump Idling Time 2A Sec 2B Sec	Ⓢ Ⓢ Ⓒ ▲CWP Bearing Feed Water Pump ▲Light Oil Pump for Starting up ■Light Oil Pump for Ignition (→)	Ⓢ Ⓢ ■Auxiliary Oil Pump for FDF ■Control Oil Pump for FDF	Ⓒ · Supplement of Light Bulbs in the storage Box used for site (Apr.,Aug.,Dec.) ■Electrolysation Equipment of Sea Water Injection Pump (→) Sea Water Pump (→)	Ⓦ · Electromagnetic Valve of station service water of CWP · Panel Cleaning · ANN Test · Education for Hazardous Material Protection (once/year,on June)
	Day time Duty	Ⓞ Ⓦ ●BFPT Valve D M ●Thrust Protection Device for BFPT D M	· Data Input,making Lists (for one year)		Ⓦ Ⓦ Ⓢ ●Oil Trip Mg D M ●Thrust Protection Device Mg D M · Main Turbine Oil Pump D · ANN Test of Oil Level of Main Oil Tank	· Overall Inspection, Oiling		
3	Day							
	Shift Duties	Ⓒ · Control Air Compressor (→)	Ⓒ · Ignition Test of Pilot Torch · BCP (→)	Ⓒ · H-FOP (→)	Ⓒ ■Gland Exhauster (→)	Ⓢ · BFPM · Request for Opening. Closing Test of Main Valves	Ⓒ Ⓒ ▲Cooling Fan for Main Transformer (→) ▲Cooling Fan for No.2 Tie Transformer (→) #2 Spare	· Panel Cleaning · A,B-EMF Reactivation · ANN Test ▲Training for Wearing Protection Utensils for High Pressure Gas (To execute each Shift)
	Day time Duty	Ⓞ Ⓦ ●Main Valves D M ●Extraction Check Valve of Turbine D M	Ⓦ · Filling in Data List · Fire Extinguishing Appliance for Transformer (Main Trans.,Others) (May,Aug.,Nov.,Feb.)	Ⓢ · Diesel Generator (Central) D E M	· Equalizing Charge of Battery (Apr.,Oct.)	· Ammonia Nozzle Purge · Overall Inspection, Oiling		
4	Day							
	Shift Duties		Ⓒ · Ignition Test of Pilot Torch ▲Cooling Water Pump for Generator Stator (→)	Ⓒ Ⓒ ▲Bearing Cooling Water Pump (→) · Starting Procedure for Auxiliary Equipment of Condensate Demineralizer	Ⓞ · Water Spray Test of Nitrogection Equipment (Presence of Safety Guard Personnel) · Emergency Shut Off Valve of Ammonia	· A,B-AH Center Blow	Ⓒ Ⓒ ■IPB Cooling Fan (→) ■Main Rectifier Fan (→)	· Panel Cleaning · ANN Test · Training for Preservation and Protection of High Pressure Gas (twice/year,May,Nov.)
	Day time Duty	Ⓞ ●BFPT Valve D M	· Making Routine List for Next Month · Check of Routine execution condition · Data Input,Making Lists (for four years)			· Overall Inspection, Oiling · Checking Chart,Daily Log and Number of Sheets		

▲ : Even-Numbered Months
■ : Odd-Numbered Months
● : To be executed avoiding Heavy Loaded Period, Heavy Loaded Time
Ⓢ : Starting Test Ⓦ : Working Test
Ⓒ : Change-over Test Ⓞ : Opening·Closing Test

—— : Recording in Other Sheets
Mg : Presence of Manager
D : Presence of Deputy Manager
E : Presence of Electrical Personnel
M : Presence of Mechanical Personnel
Cp : Presence of Control Personnel

· Replacement of Chart : 1st Shift (1st day/Every month)
· Back wash of Condenser shall be executed in even-numbered days
· Request of Opening · Closing test of Main Valves shall be done in the morning
· To write down weekly safety book (Sunday every week)

Monthly Routine List for No.2 Unit (At the time of Economy Shutdown)

Date:

Week	Day	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
1	Day							
	Shift Duties	▲Ground Relay Test for Excitation Circuit	Ⓢ · Spray Pump of Antiforming Equipment · Tag Check (to rewrite,if it is vague)	Ⓢ Ⓢ Ⓢ · Turning of Main Turbine · Main Turbine TOP · Gland Exhauster · Gas Extractor of Main Oil Tank Ⓢ · Oil Purifier	Ⓞ · Fuel,Auxiliary Damper ■SAH Drain Pump ■Manual Turning of SC Feed Water Pump	Ⓢ Ⓞ Ⓞ Ⓞ Ⓢ · CWP (A) · FDF Moving Blade · Air·Gas Duct Damper · GMF Inlet Damper [Cp] · Sea Water Booster Pump Idling 2A Sec / Time 2B Sec		· ANN Test · Panel cleaning
	Day time Duties		· Filling in Data List	Ⓢ · Diesel Generator (at site) [D] [E] [M]	Ⓦ · Fire Extinguishing Appliance for Boiler,etc. (Boiler High·Low Pressure Pump Yard) (May,Aug.,Nov.,Feb.)	· Overall Inspection, Oiling		
2	Day							
	Shift Duties	Ⓦ Ⓦ Ⓒ · Burner Retracting · Burner Tilt · Ash Disposal (→)	Ⓢ · Reactivation of Hydrogen Gas Drier · Emergency Pump of Seal Oil. [D] Ⓒ · Vacuum Pump of Seal Oil (→) [D]	Ⓢ Ⓢ Ⓢ Ⓢ Ⓢ Ⓢ · Light Oil Pump for Starting up · Light Oil Pump for Ignition · Main Turbine Turning · BFPT Turning · AOP of BFPT · EOP of BFPT · Circulating Pump of BFPT	Ⓞ · Fuel,Auxiliary Damper [Cp]	Ⓞ Ⓞ Ⓞ · FDF Moving Blade · Air·Gas Duct Damper · GMF Inlet Damper [Cp]	Ⓢ · Wash Pump for Rotary Screen · Supplement of Light Bulbs in the storage Box used for Site (Apr.,Aug.,Dec.)	· ANN Test · Panel cleaning · Education for Hazardous Material Protection (once/year,on June)
	Day time Duties	Ⓒ · Control Air Compressor (→)	· Data Input,making Lists (for one year)			· Overall Inspection, Oiling		
3	Day							
	Shift Duties		Ⓢ · H-FOP,L-FOP	Ⓢ Ⓢ Ⓢ · Main Turbine Turning · AOP of Main Turbine · EOP of Main Turbine	Ⓞ · Fuel,Auxiliary Damper	Ⓢ Ⓢ Ⓞ Ⓢ Ⓢ Ⓞ · CWP (B) · Gas Draft System FDF,GMF,AH · FDF Moving Blade,GMF Inlet Damper [Cp] · EP Loading,Hammering Test · Pilot Torch,TV Scanner · GMF Turning · Air·Gas Duct Damper	Ⓢ Ⓢ ▲Cooling Fan for Main Transformer,Station Service Transformer ▲Cooling Fan for No.2 Tie Transformer (→) [# Spare]	▲Training for Wearing Protection Utensils for High Pressure Gas (To execute each Shift) · ANN Test · Panel Cleaning
	Day time Duties		Ⓦ · Fire Extinguishing Appliance for Transformer (Main Trans.,Others) (May,Aug.,Nov.,Feb.) · Filling in Data List	Ⓢ · Diesel Generator (Central) [D] [E] [M]	· Equalizing Charge of Battery (Apr.,Oct.)	· Overall Inspection, Oiling		
4	Day							
	Shift Duties		Ⓒ · Cooling Water Pump for Generator Stator (→)	Ⓢ Ⓢ Ⓢ Ⓒ · Main Turbine Turning · BFPT Turning · AOP of BFPT · Bearing Cooling Water Pump (→)	Ⓞ · Fuel,Auxiliary Damper · Water Spray Test of Nitrogection Equipment (Presence of Safety Guard Personnel)	Ⓞ Ⓞ Ⓞ · FDF Moving Blade · Air·Gas Duct Damper · GMF Inlet Damper [Cp]	Ⓢ · Wash Pump for Rotary Screen	· ANN Test · Panel Cleaning · Training for Preservation and Protection of High Pressure Gas (twice/year,May,Nov.)
	Day time Duties		· Making Routine List for Next Month · Check of Routine execution condition · Data Input ,Making Lists (for four years)			· Overall Inspection,Oiling · Checking Chart,Daily Log and Number of Sheets		

▲ : Even-Numbered Months　Ⓢ : Starting Test　Ⓦ : Working Test　—— : Recording in Other Sheets　[E] : Presence of Electrical Personnel　· Replacement of Chart : 1st Shift (1st day/Every month)

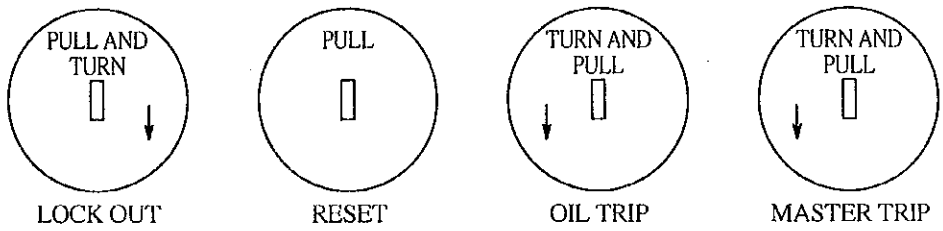
■ : Odd-Numbered Months　Ⓒ : Change-over Test　Ⓞ : Opening·Closing Test　[Mg] : Presence of Manager　[M] : Presence of Mechanical Personnel　· Routines such as starting,working test,etc.will be executed from one week after the unit shutdown

[D] : Presence of Deputy Manager　[Cp] : Presence of Control Personnel

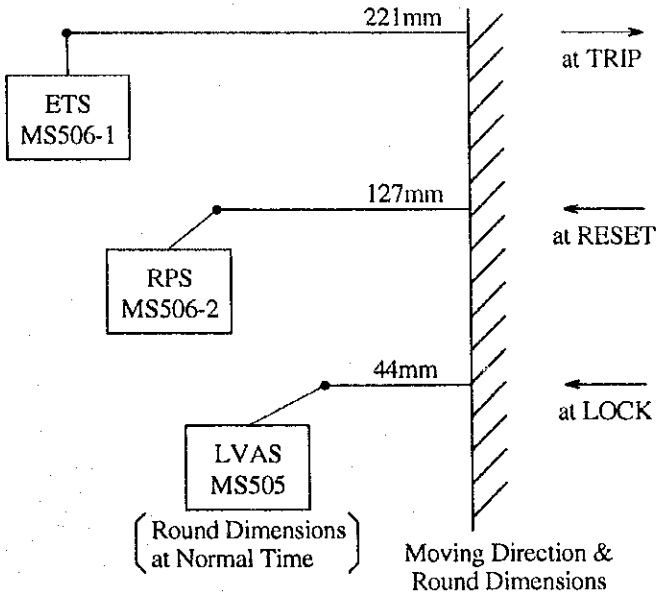
Routine Operation Check Sheet for Unit No.2

Routine No.2-Sat.	Main Turbine Oil Trip Test		
	Operation Procedure	Remarks	Check
1. Preparation			
《Check in Advance》			
1	Test start shall be reported to "Central Load Dispatching Center" and "Operation Manager" to obtain approval.		
2	Such things are prepared as metal fittings for lockout stop, gloves, routine test results recording paper.		
3	Test start is to be paged.	Superintendent is in charge of the implementation.	
《Measures in case of Emergency》			
1	In case that each process indicating lamp for oil trip test is not lighted. (1) To confirm the existence of burning lamp out (2) To confirm whether the stroke of each visible working part is normal or not.		
2	In emergency case of others, surveying & grasping the conditions, turbine is stoped, if needed.		

ARRANGEMENT OF TEST HANDLES



EMERGENCY DEVICE



- LOCK OUT
- RESET
- OIL TRIP

Stroke of each handle is about 32mm.

- LOCK OUT
- OIL TRIP

Ratating angle of each handle is about 30 degrees.

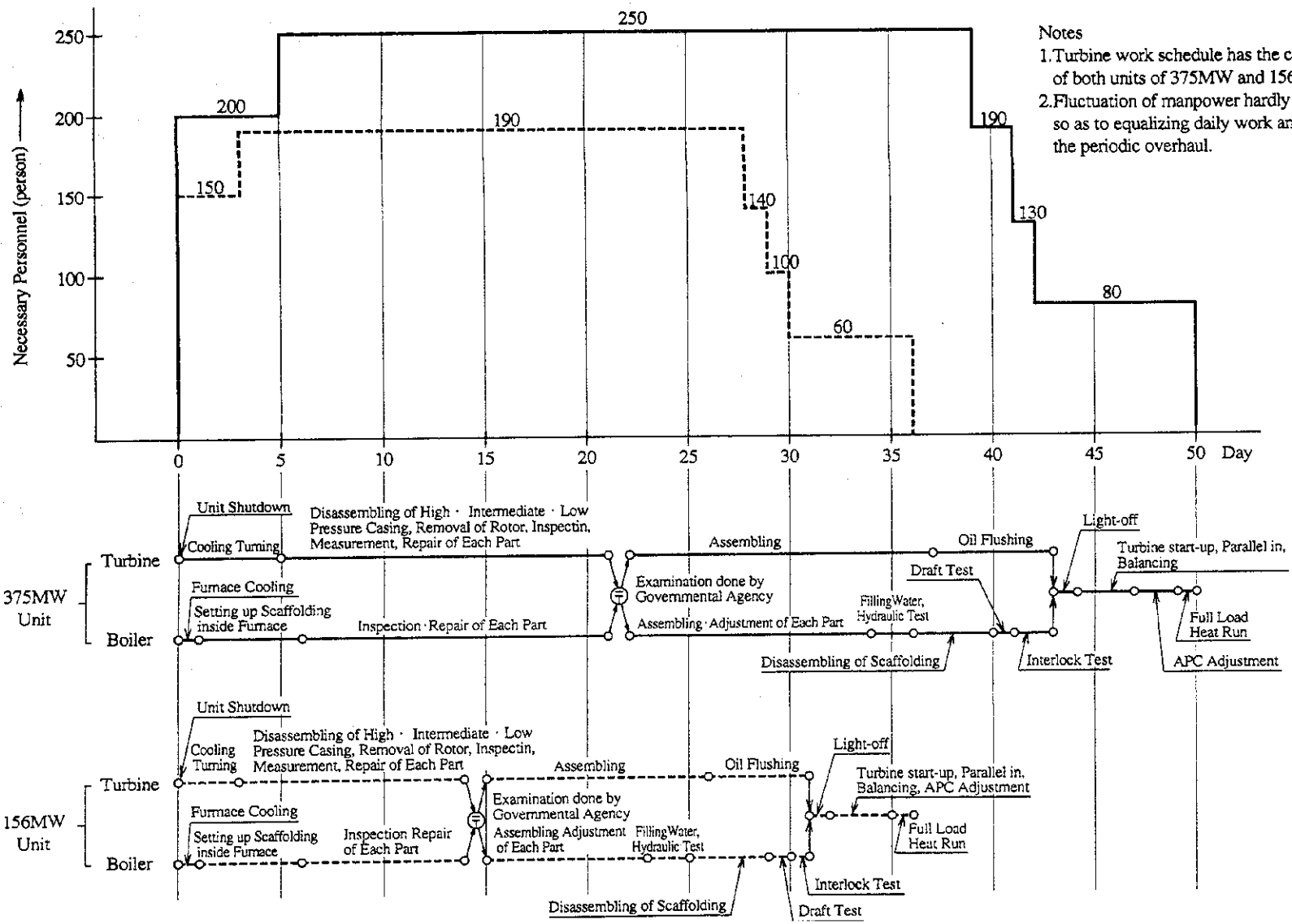
Lever Dimensions & the Arrangements for Indicating Each Process

Within Front standard of Turbine, on the Left.

	Operation Procedure	Remarks	Check
2. Operation			
《LOCK OUT》			
1	(1) Wearing gloves on both hands, keeping center of gravity lower in front of test handle and to set out operation position (2) Pulling lock handle by left hand, turning it to clockwise direction and to hold it until test completion. (3) To set stopper metal fittings to lock out handle. (4) To confirm lighting lock out indicating lamp .	To be lighted O lamp of the body To be lighted W lamp of BA panel	
《OIL TRIP》			
2	(1) Turning OIL TRIP handle to anti-clockwise direction until the end by right hand and pull it. (2) To confirm lighting trip indicating lamp, turning off reset indicating lamp.	To be lighted G lamp of TRIP body "Over Speed Trip" of BTG Panel To be turned off R lamp of Reset body To be turned off W lamp of BA panel	
《RESET》			
3	(1) To return OIL TRIP handle to its original position (2) To pull RESET handle until the end by right hand (3) To confirm lighting the indicating lamp during RESET, turning off tirp indicating lamp (4) To return RESET handle to its original position (5) To confirm lighting reset indicating lamp, turning off the indicating lamp during RESET	During RESET To be lighted O lamp of the body To be lighted W lamp of the BA panel To be turned off G lamp of TRIP body To reset ANN of BTG panel To be lighted R lamp of the RESET body To be lighted W lamp of BTG panel During RESET To be turned off O lamp of the body To be turned off W lamp of BA panel	
《RELEASE OF LOCK OUT》			
4	(1) To take off stopper metal fittings of LOCK OUT handle (2) To return LOCK OUT handle to its original position		
3. Completion			
1	(1) Test completion is to be paged. (2) Test results are to be recorded in the recording paper for routine test results.		

Routine No.2-Thur.	Emergency Seal Oil Pump Start-up Test		
	Operation Procedure	Remarks	Check
1. Preparation			
1	To confirm power source "ON" of emergency seal oil pump, the CS position of "Automatic"		
2. Operation			
1	To turn "ON" CS of the running vacuum pump.		
2	· H-35 Valve "CLOSE" · H-38 Valve "OPEN"	Valve Handling to Confirm Start-up Pressure of Emergency Seal Oil Pump	
3	Confirming delivery pressure (5.5kg/cm^2)of seal oil pump, to make root valve (H-33) of pressure SW "CLOSE", then to open testing valve (H-34) of pressure SW gradually.		
4	Under the delivery pressure 5.0kg/cm^2 of seal oil pump, automatic start-up of emergency seal oil pump.	To confirm ANN Local Panel · Seal Oil Delivery Pressure Low · Emergency Seal Oil Pump Start BTG Panel · Hydrogen Gas Seal Oil System Trouble	
5	To inspect the existence of abnormality of the pump.		
3. Recovery			
1	Without abnormality, closing testing valve (H-34) gradually, opening root valve (H-33) of pressure SW, then to confirm delivery pressure.		
2	· H-38 Valve "CLOSE" · H-35 Valve "OPEN"		
3	After delivery pressure restores normal value, emergency seal oil pump will be stopped and CS is set to automatic position.		
4	To return CS of running vacuum pump to the automatic position.		

Standard Work Schedule and Necessary Personnel for Major Overhaul at Oil -Fired Thermal Power Plants (375MW&156MW) in Japan



Notes

1. Turbine work schedule has the critilcal pass in major overhaul of both units of 375MW and 156MW.
2. Fluctuation of manpower hardly occur with planned schedule so as to equalizing daily work amount through the period of the periodic overhaul.