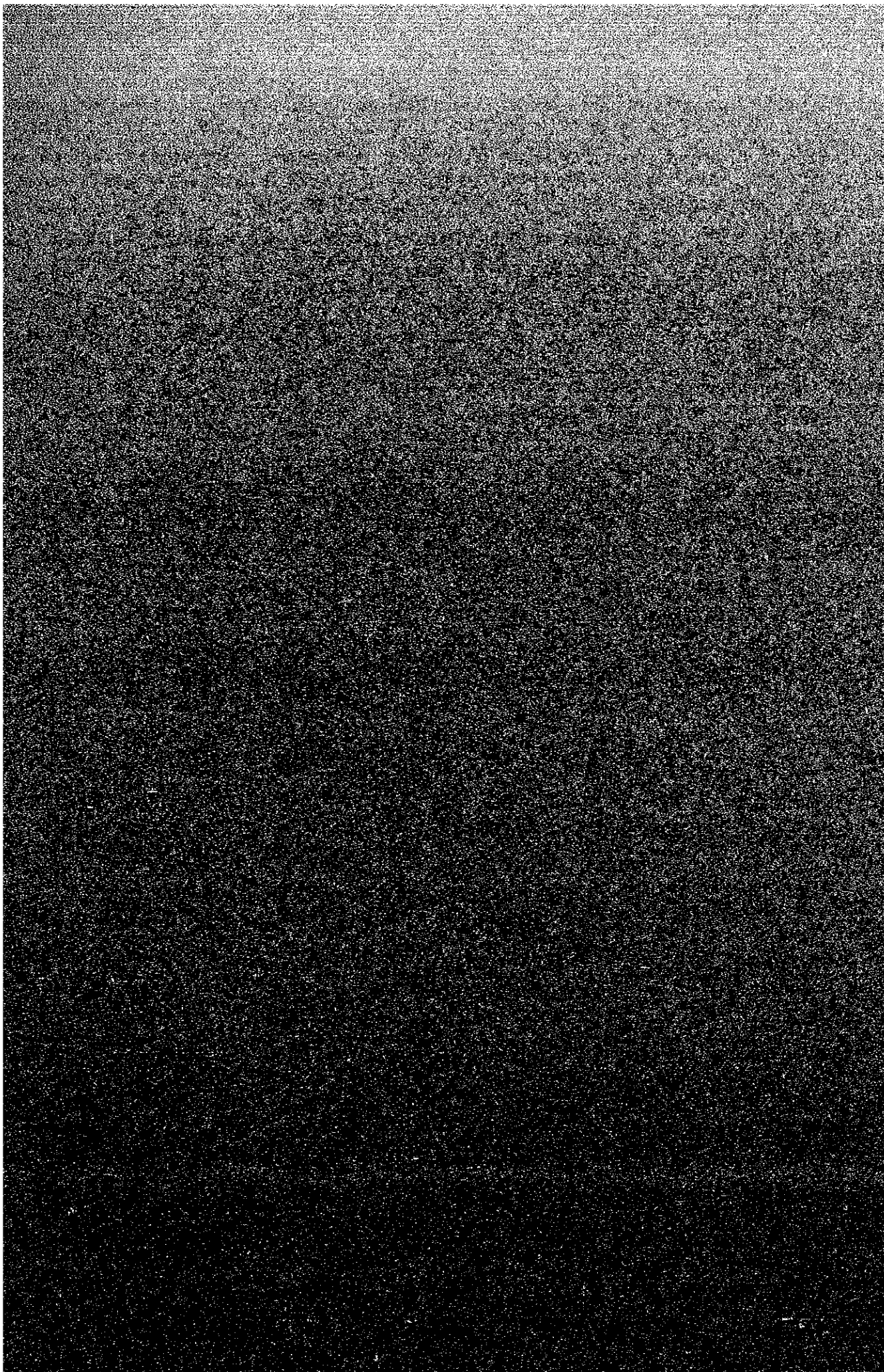


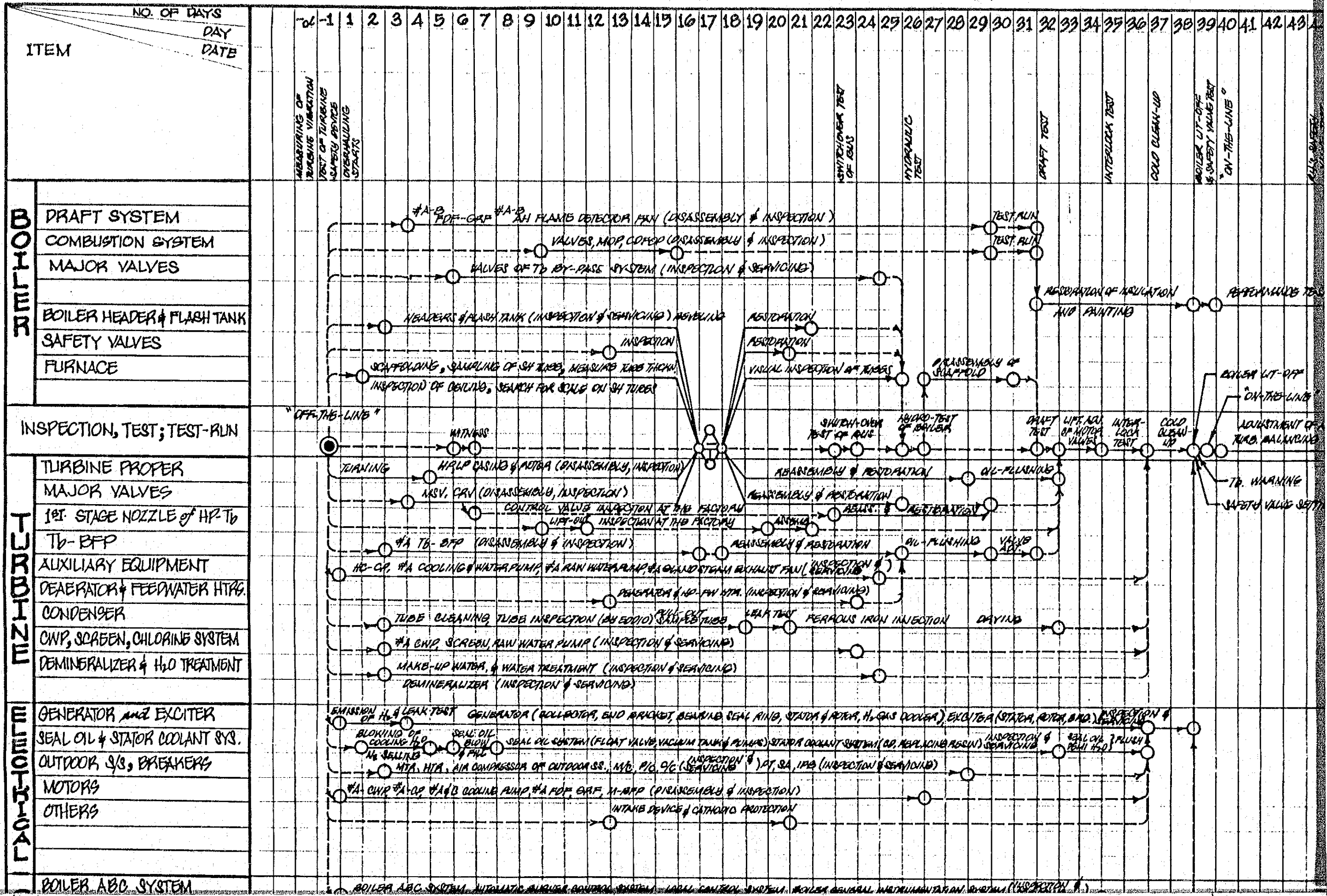
APPENDIX-6 STANDARD OVERHAULING SCHEDULE



STANDARD OVERHAULING SCHEDULE

# SCHEDULE OF OVERHAULING FOR

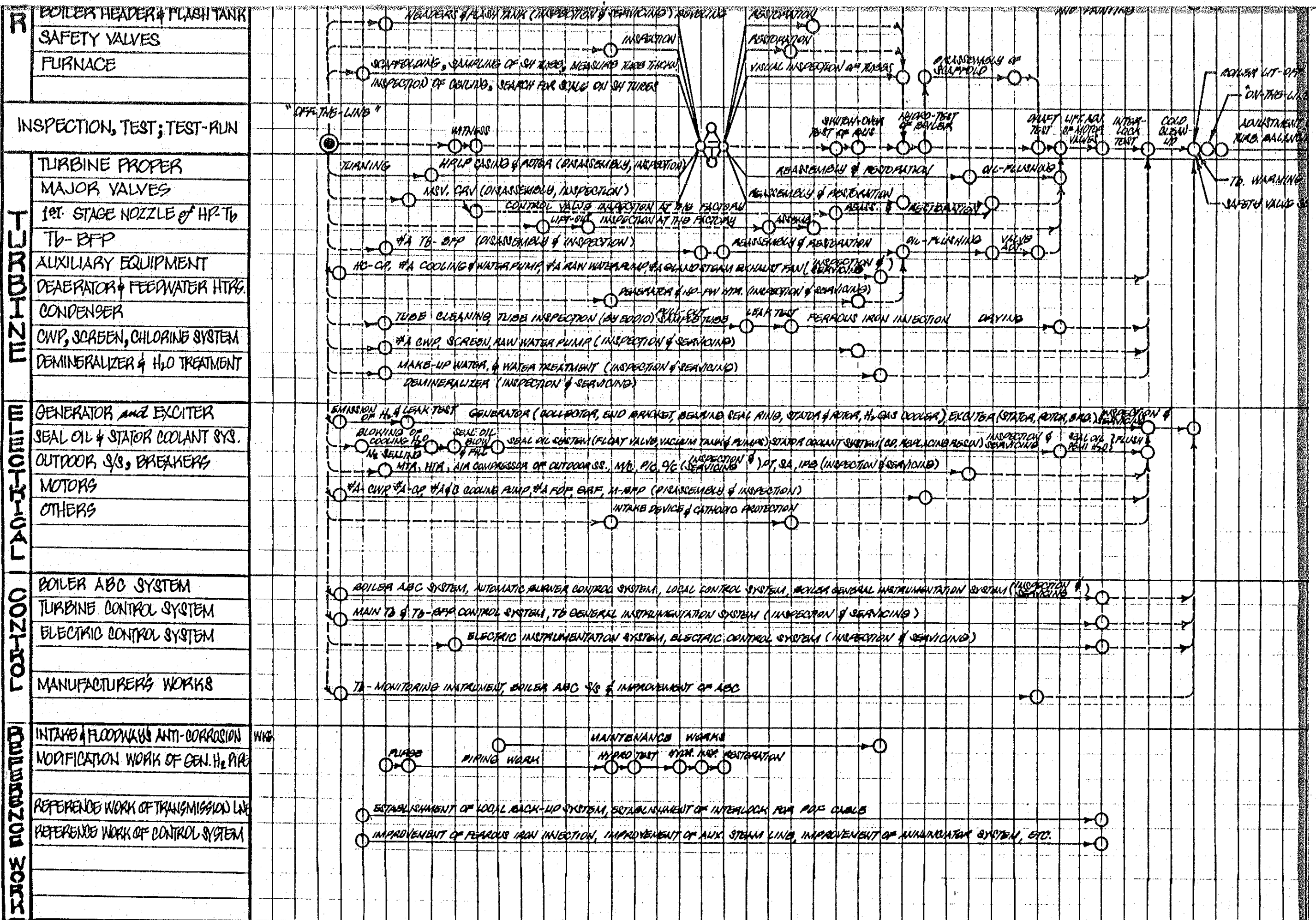
PERIOD OF OVERHAULING



# SCHEDULE OF OVERHAULING FOR

## PERIOD OF OVERHAULING

5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	REMARKS						
																							SWITCHOVER TEST OF BUS																								
																							HYDRAULIC TEST																								
																							DRAFT TEST																								
																							INTERLOCK TEST																								
																							COLD CLEAN-UP																								
																							BOILER LIT-OFF & SAFETY VALVE TEST																								
																							ON-THE-LINE																								
																							AH'S SAFETY VALVE TEST																								
																							OVERHAULING ENDS																								
																							TEST MAIN																								
																							TEST MAIN																								
																							VALVES, MOP, COVER (DISASSEMBLY & INSPECTION)																								
																							VALVES OF TD BY-PASS SYSTEM (INSPECTION & SERVICING)																								
																							REPAIRS & FLASH TANK (INSPECTION & SERVICING) REWELDING																								
																							INSPECTION																								
																							SAMPLING OF SH TUBES, MEASURE TUBE THICKNESS OF BENDING, SEARCH FOR SCALE ON SH TUBES																								
																							REASSEMBLY & REOIL																								
																							VISUAL INSPECTION OF TUBES																								
																							DISASSEMBLY OF PUMP/OLD																								
																							SWITCH-OVER TEST OF BUS																								
																							HYDRO-TEST OF BOILER																								
																							DRAFT TEST																								
																							LIFT MAIN OF MOTOR VALVE																								
																							INTER-LOCK TEST																								
																							COLD CLEAN-UP																								
																							BOILER LIT-OFF "ON-THE-LINE"																								
																							ADJUSTMENT OF MOP T.M.O. BALANCING																								
																							END OF OVERHAULING WORK																								
																							TD. WARMING																								
																							SAFETY VALVE SETTING																								
																							WITNESS																								
																							H.P. CASING & MOTOR (DISASSEMBLY, INSPECTION)																								
																							REASSEMBLY & REOIL																								
																							OIL-FLUSHING																								
																							S.V. CRV (DISASSEMBLY, INSPECTION)																								
																							REASSEMBLY & REOIL																								
																							OIL-FLUSHING																								
																							CONTROL VALVE INSPECTION AT THE FACTORY																								
																							INSPECTION AT THE FACTORY																								
																							LIFT-OIL																								
																							REASSEMBLY & REOIL																								
																							OIL-FLUSHING																								
																							VALVE ADJ.																								
																							SFP (DISASSEMBLY & INSPECTION)																								
																							REASSEMBLY & REOIL																								
																							OIL-FLUSHING																								
																							COLLING WATER PUMP, #A RAW WATER PUMP, #A GRIND STEAM EXHAUST FAN (SERVICING)																								
																							INSPECTION & SERVICING																								
																							REASSEMBLY & REOIL																								
																							OIL-FLUSHING																								
																							CLEANING TUBE INSPECTION (BY EDDY)																								
																							PICK-UP SAMPLE TUBES																								
																							LEAK TEST																								
																							FERROUS IRON INJECTION																								
																							DRYING																								
																							D.P. SCREEN, RAW WATER PUMP (INSPECTION & SERVICING)																								
																							INSPECTION & SERVICING																								
																							RAW WATER & WATER TREATMENT (INSPECTION & SERVICING)																								
																							INSPECTION & SERVICING																								
																							NEURALIZER (INSPECTION & SERVICING)																								
																							INSPECTION & SERVICING																								
																							TEST GENERATOR (COLLECTOR, END BRACKET, BEARING SEAL RING, STATOR & ROTOR, H <sub>2</sub> GAS COVER), EXCITER (STATOR, ROTOR, END BRACKET)																								
																							INSPECTION & SERVICING																								
																							SEAL OIL SYSTEM (FLOAT VALVE, VACUUM TANK & PUMPS) STATOR COOLANT SYSTEM (OP. REPLACING RESIN)																								
																							INSPECTION & SERVICING																								
																							SEAL OIL FLUSH																								
																							AIR COMPRESSOR OF OUTDOORS, M.O. P.G. O.C. (INSPECTION & SERVICING)																								
																							INSPECTION & SERVICING																								
																							#A/B COOLING PUMP, #A FDF, GAF, H-APP (DISASSEMBLY & INSPECTION)																								
																							INSPECTION & SERVICING																								
																							INTAKE DEVICE & CATHODIC PROTECTION																								



**R**  
 BOILER HEADER & FLASH TANK  
 SAFETY VALVES  
 FURNACE

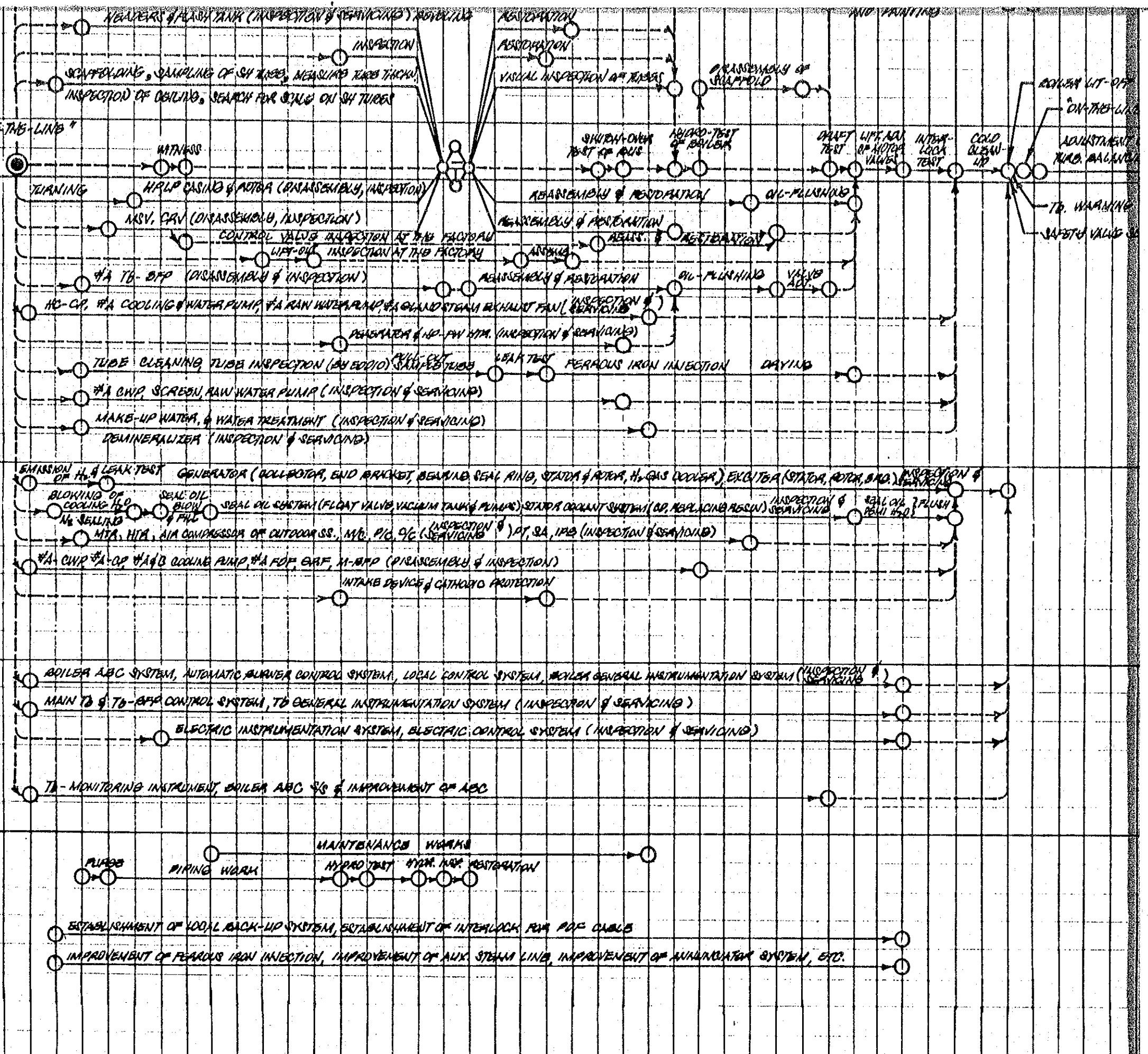
INSPECTION, TEST; TEST-RUN

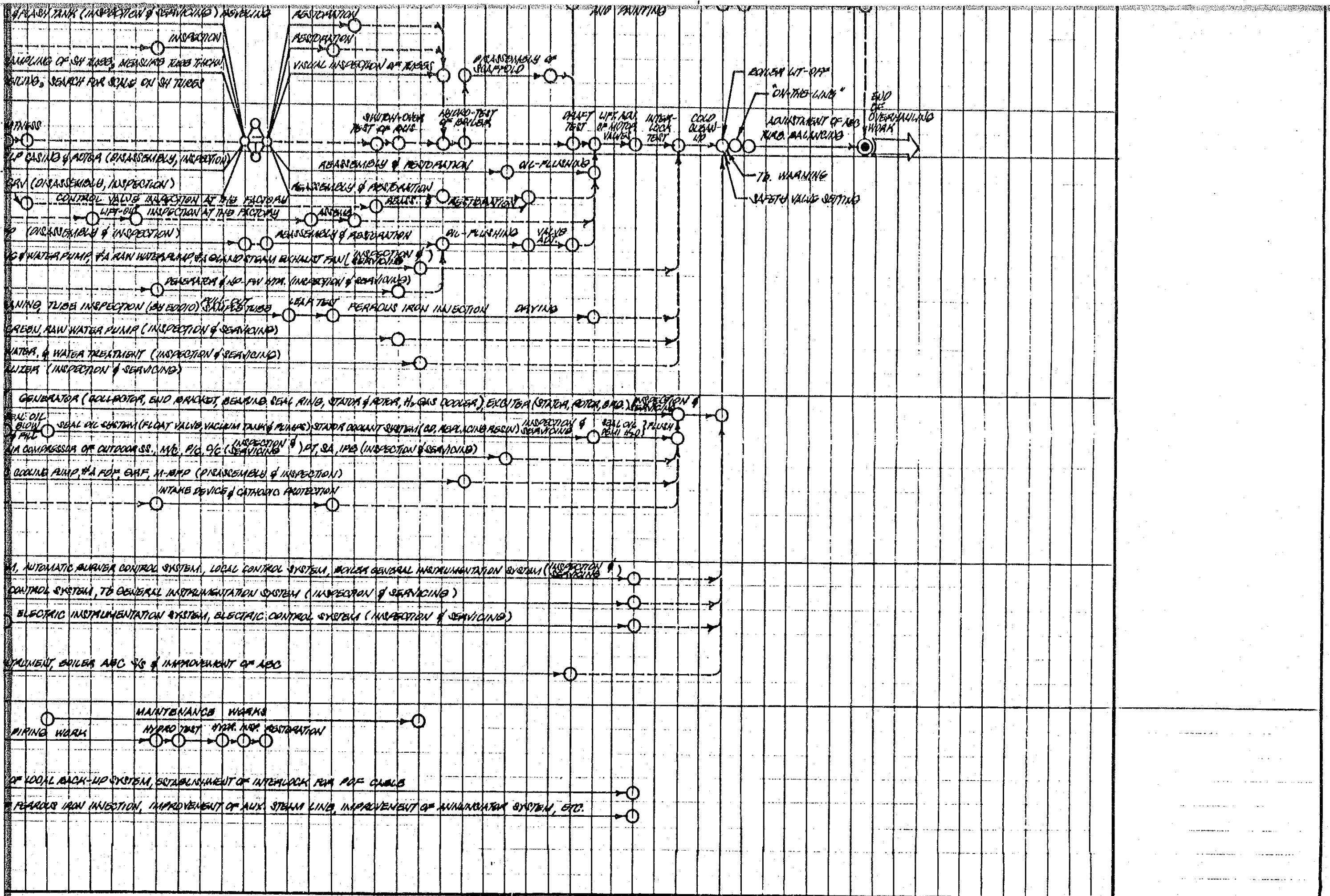
**TRENCHING**  
 TURBINE PROPER  
 MAJOR VALVES  
 1ST STAGE NOZZLE of HP-Tb  
 Tb-BFP  
 AUXILIARY EQUIPMENT  
 DEAERATOR & FEEDWATER HTRS.  
 CONDENSER  
 CWP, SCREEN, CHLORINE SYSTEM  
 DEMINERALIZER & H<sub>2</sub>O TREATMENT

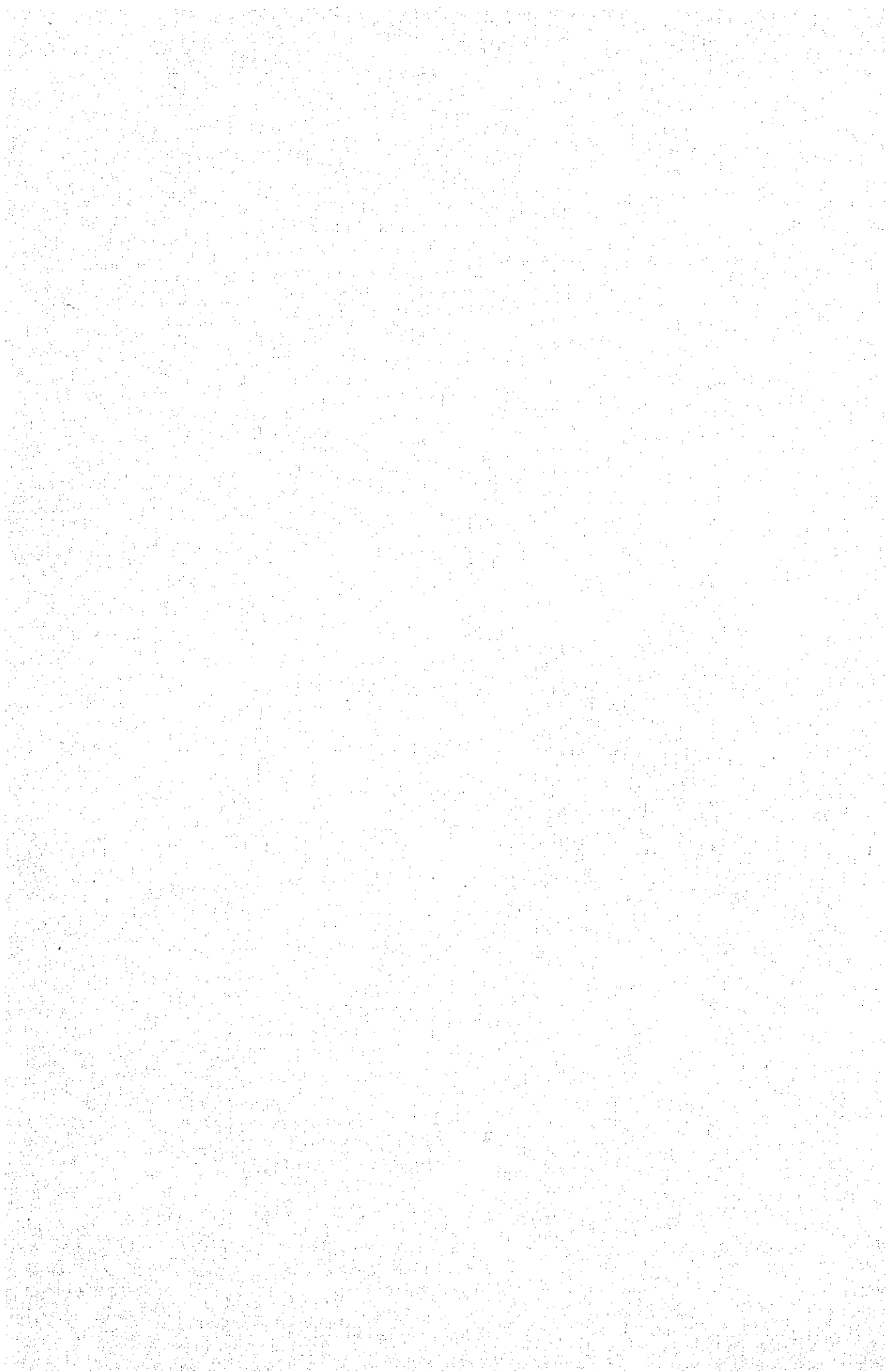
**WINDING**  
 GENERATOR and EXCITER  
 SEAL OIL & STATOR COOLANT SYS.  
 OUTDOOR S/S, BREAKERS  
 MOTORS  
 OTHERS

**CONTROL**  
 BOILER ABC SYSTEM  
 TURBINE CONTROL SYSTEM  
 ELECTRIC CONTROL SYSTEM  
 MANUFACTURERS WORKS

**CONSTRUCTION WORK**  
 INTAKE & FLOODWAYS ANTI-CORROSION  
 MODIFICATION WORK OF GEN. H<sub>2</sub> PIPE  
 REFERENCE WORK OF TRANSMISSION LINE  
 REFERENCE WORK OF CONTROL SYSTEM

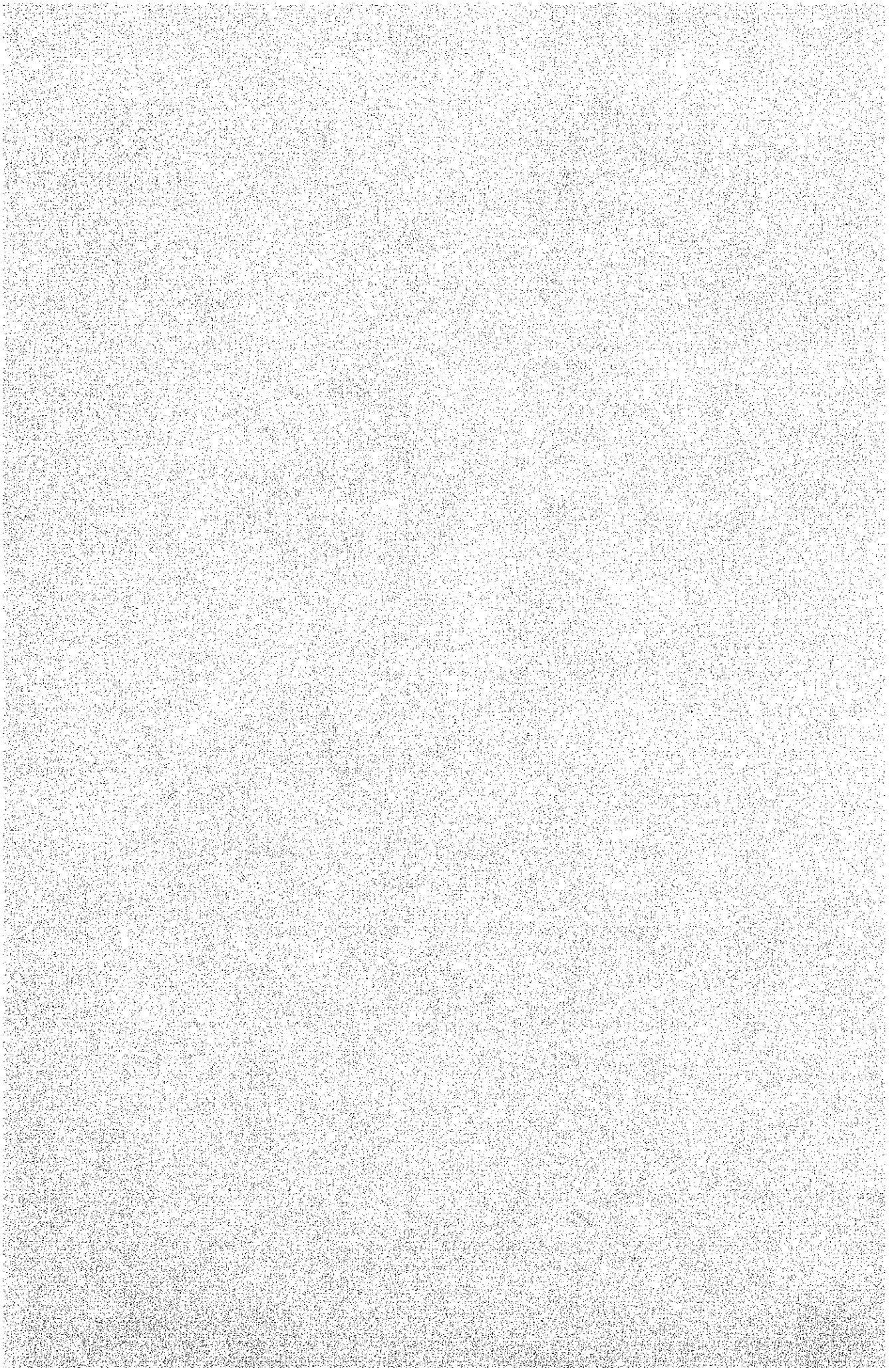








APPENDIX-7 TESTING ITEMS AND PROCEDURES



TESTING ITEMS AND PROCEDURES

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## I. Testing Items

Generally, testing items to be carried out during overhauling should include at least boiler safety valve, steam turbine emergency shut-down device, auxiliary oil pump and emergency oil pump for steam turbine, condenser, feed water pumps, forced draft fans, gas recirculation fan, air preheaters and feed water heaters.

Overhauling records should be reported in detail, and covers dismantling, reassembling records and its method, scope of repair works, calibration and adjusting records including data and information and test records.

Testing items to be carried out during overhauling are as follows:

- 1) Hydraulic test
- 2) Safety valve test
- 3) Boiler tripping interlock test
- 4) Feed water pump test
- 5) Fuel oil pump test
- 6) Air preheater test
- 7) Soot blower test
- 8) Light off and pressurization test
- 9) Turbine major valve test
- 10) Turbine tripping interlock test
- 11) Vacuum up test
- 12) Turbine stretch out test
- 13) Turbine acceleration test

- 14) Lubricating oil system test
- 15) Feed water heater leak test
- 16) Condensate pump test
- 17) Circulating water pump test
- 18) Generator
- 19) Transformer

## II. Testing Procedures

### II - 1. Hydraulic test

- a) Apply pressure to boiler with the aid of boiler feed water pump.
- b) Use pure water of temperature at about 40°C.
- c) Pressure increase and decrease rates should be 3~5 kg/cm<sup>2</sup>/minute, and pressurize at the slower rate in proximity to maximum working pressure.
- d) Safety valve should be mechanically locked with the aid of gag at pressure of about 80% of maximum working pressure.
- e) 1.15 times of maximum working pressure should be kept for about 30 minutes to 1 hour.

#### Check items

- \_\_\_\_\_ Leak from any portion of boiler
- \_\_\_\_\_ Distortion and deformation of tubes, headers, etc.

### II - 2. Safety valve test

- a) Pressurize boiler up to spouting pressure setting with small capacity burner.

- b) In case of drum type boiler, keep the drum level low since the level increases after spouting of safety valve.
- c) Another safety valve except testing safety valve should be mechanically locked with gag so as not to be spouted.
- d) After safety valve spouting, decrease firing rate and open the drain valves so that the boiler pressure decreases.
- e) Close the drain valves at adequate pressure for next safety valve tests.
- f) Use precise pressure gauge temporarily installed for safety valve test.
- g) Safety valve test can be carried out with use of hydraulic jack.

Check items

- \_\_\_\_\_ Popping pressure
- \_\_\_\_\_ Reset pressure
- \_\_\_\_\_ Blowing down pressure
- \_\_\_\_\_ Safety valve lift
- \_\_\_\_\_ Working condition

II - 3. Boiler tripping interlock test

All of actual unit trip may not be carried out in accordance with the test items described below, some of them can be tested only by relay.

- a) Both FDFs trip test:
  - 1) Trip the FDF by manual operation. FDF should be tripped one by one.

- 2) When one FDF tripped, confirm the damper conditions (opened or closed).
- 3) Trip another FDF by manual operation. Confirm the damper conditions.

Check items

\_\_\_\_\_ Alarm annunciation

\_\_\_\_\_ Damper interlock

b) Reheater protection interlock test:

- 1) Decrease fuel flow gradually up to interlock setting.
- 2) Confirm setting point and alarm annunciation.

Check items

\_\_\_\_\_ Alarm annunciation

\_\_\_\_\_ Fuel flow setting and timer setting

\_\_\_\_\_ Air flow

c) Furnace draft high interlock test:

- 1) Increase furnace draft gradually by closing gas side damper.
- 2) Confirm pressure setting and alarm annunciation.

Check items

\_\_\_\_\_ Alarm annunciation

\_\_\_\_\_ Pressure setting point

d) Fuel oil low pressure interlock test:

- 1) Decrease fuel oil header pressure by gradual closing fuel oil flow control valve.
- 2) Confirm pressure setting point.



Check items

- \_\_\_\_\_ Alarm annunciation
- \_\_\_\_\_ Confirm the pressure setting point and timer setting point
- \_\_\_\_\_ Fuel oil pumps stoppage
- \_\_\_\_\_ Fuel oil shut-off valve closed
- \_\_\_\_\_

e) Purge interlock test:

- 1) Operate FDFs.
- 2) Confirm the damper conditions.
- 3) Purge the furnace for about 5 minutes at about 30% air flow up to MFT reset.

Check items

- \_\_\_\_\_ Air flow
  - \_\_\_\_\_ Purge timer setting
  - \_\_\_\_\_ Alarm annunciation reset
  - \_\_\_\_\_ Fuel oil system interlock after MFT reset
- Fuel oil shut-off valve
  - Light oil shut-off valve
  - Fuel oil pump
  - Light oil pump
  - Fuel oil burner valve
  - Light oil burner valve

II - 4. Feed water pump test (motor-driven)

- a) Auxiliary oil pump auto start test.
- b) Start BFP-M keeping discharge valve fully closed.
- c) Open the discharge valve gradually.
- d) Adjust the feed water flow until the minimum flow control valve closes.

Check items

- \_\_\_\_\_ Abnormal sound and vibration
- \_\_\_\_\_ Bearing lubricating oil temperature and pressure
- \_\_\_\_\_ Auxiliary oil pump auto-start pressure set point
- \_\_\_\_\_ Cooling water flow
- \_\_\_\_\_ Motor current
- \_\_\_\_\_ Inlet and outlet feed water pressure
- \_\_\_\_\_ Minimum flow control flow set point
- \_\_\_\_\_ Leakage from pump gland

II - 5. Fuel oil pump test

- a) Start fuel oil pump after formation of fuel oil line from pump discharge to fuel oil storage tank.

Check items

- \_\_\_\_\_ Abnormal sound, vibration
- \_\_\_\_\_ Bearing temperature
- \_\_\_\_\_ Motor current
- \_\_\_\_\_ Fuel oil temperature
- \_\_\_\_\_ Differential pressure between inlet and outlet of oil strainer
- \_\_\_\_\_ Operating condition of pump discharge relief valve
- \_\_\_\_\_ Oil leakage from the pump and pipings

II - 6. Air preheater test

- a) Operate the AH with motor or air motor.

Check items

- \_\_\_\_\_ Abnormal sound, vibration
- \_\_\_\_\_ Bearing temperature

- \_\_\_\_\_ Lubricating oil temperature
- \_\_\_\_\_ Lubricating oil flow
- \_\_\_\_\_ Cooling water flow
- \_\_\_\_\_ AH balancing
- \_\_\_\_\_ Motor current
- \_\_\_\_\_ Gas side differential pressure
- \_\_\_\_\_ Air side differential pressure
- \_\_\_\_\_ Inlet and outlet temperature of AH

II - 7. Soot blower test

- a) Confirm normal operation of auxiliary steam pressure control valve.
- b) Confirm the drainage before blowing test.
- c) Blowing test from remote control panel in the central control room.

Check items

- \_\_\_\_\_ Abnormal sound, vibration
- \_\_\_\_\_ Blowing steam pressure
- \_\_\_\_\_ Travelling speed, blowing time
- \_\_\_\_\_ Emergency extraction
- \_\_\_\_\_ Steam leakage from head valve and pipings

II - 8. Light off and pressurization test

- a) After the confirmation of boiler protection device functions, operate the equipments necessary for unit start-up.

Check items

- \_\_\_\_\_ Burner operating condition
- \_\_\_\_\_ Burning condition

- \_\_\_\_\_ Water, steam and gas temperature
- \_\_\_\_\_ Temperature increase rate
- \_\_\_\_\_ Steam quality
- \_\_\_\_\_ Furnace expansion
- \_\_\_\_\_ Expansion of pipe hanger
- \_\_\_\_\_ Gas, water, drain and steam leakage

II - 9. Turbine major valve test

a) Main stop valve:

This valve should be tested at turbine start-up, unit loading and unit shut-down.

Check items

- \_\_\_\_\_ Stroke of valve lift
- \_\_\_\_\_ Full stroke operating time
- \_\_\_\_\_ Operating condition
- \_\_\_\_\_ Interlock
- \_\_\_\_\_ Indicating lamps and positioner
- \_\_\_\_\_ Limit switches

b) Governing valve:

This valve should be tested at turbine start-up, unit loading and unit shut-down.

Check items

- \_\_\_\_\_ Oil cylinder stroke and opening
- \_\_\_\_\_ Operating condition
- \_\_\_\_\_ Indicating lamps and positioner
- \_\_\_\_\_ Balancing valve
- \_\_\_\_\_ Lead pipe, drain valve

\_\_\_\_\_ Valve lift

\_\_\_\_\_ Limit switches

c) Reheat stop valve:

This valve should be tested at turbine start-up, unit loading and unit shut-down.

Check items

\_\_\_\_\_ Valve stroke

\_\_\_\_\_ Operating condition

\_\_\_\_\_ Interlock

\_\_\_\_\_ Indicator and positioner

\_\_\_\_\_ Limit switches

d) Intercept valve:

This valve should be tested at turbine start-up, unit loading and unit shut-down.

Check items

\_\_\_\_\_ Valve stroke

\_\_\_\_\_ Full stroke operating time

\_\_\_\_\_ Operating condition

\_\_\_\_\_ Interlock

\_\_\_\_\_ Balancing valve

\_\_\_\_\_ Limit switches

\_\_\_\_\_ Indicator and positioner

II - 10. Turbine tripping interlock test

All of actual unit trip may not be carried out in accordance with the test items described below, some of them can be tested only by relay.

a) Manual trip lever test:

This test should be carried out before turbine start-up.

Check items

- Operating condition
- Alarm annunciation
- Indicating lamps
- Interlock with turbine major valves

b) Vacuum trip test:

- 1) Operate air ejector, and vacuum up to about 700mmHg.
- 2) Open gradually vacuum break valve.

Check items

- Confirmation of low vacuum set point
- Alarm annunciation
- Interlock with turbine major valves

II - 11. Vacuum up test

Operate gland steam regulator and air ejectors, and vacuum up. If the vacuum up rate will be slow, check the leakage.

Check items

- Vacuum up rate
- Leakage and extraction air
- Gland steam regulator

II - 12. Turbine stretch out test

After steam admission to turbine, turbine casing should be heated uniformly changing condenser vacuum.

Check items

- \_\_\_\_\_ Casing expansion
- \_\_\_\_\_ Uniform expansion
- \_\_\_\_\_ Eccentricity
- \_\_\_\_\_ Bearing oil temperature and pressure
- \_\_\_\_\_ LP turbine exhaust steam temperature
- \_\_\_\_\_ Vacuum
- \_\_\_\_\_ Abnormal sound
- \_\_\_\_\_ Chest metal temperature

II - 13. Turbine acceleration test

When the turning gear is disengaged, stop the steam admission to turbine and carry out rub check. Confirm that there is no abnormality, then accelerate turbine revolution. Pay attention to bearing oil temperature and adjust the oil cooler.

Check items

- \_\_\_\_\_ Turbine speed
- \_\_\_\_\_ Eccentricity
- \_\_\_\_\_ Expansion
- \_\_\_\_\_ Differential thermal expansion
- \_\_\_\_\_ Vibration
- \_\_\_\_\_ Abnormal sound
- \_\_\_\_\_ Bearing oil temperature and pressure
- \_\_\_\_\_ Governing oil pressure and control oil pressure
- \_\_\_\_\_ Metal temperature inside and outside of chest
- \_\_\_\_\_ Oil pressure set point of auxiliary oil pump stop
- \_\_\_\_\_ Operating conditions of governor

II - 14. Lubricating oil system test

(Turning oil pump, auxiliary oil pump and emergency oil pump)

- a) Automatic start-up of the oil pumps should be tested after reassembling of the oil units.
- b) Confirm that the oil pumps start at the normal set point pressure.

Check items

- \_\_\_\_\_ Abnormal sound
- \_\_\_\_\_ Vibration
- \_\_\_\_\_ Oil pressure
- \_\_\_\_\_ Set point of automatic start-up
- \_\_\_\_\_ Leakage from oil pipings and flanges

II - 15. Feed water heater leak test

Apply pressure to water chamber of feed water heater, and confirm that there is no leakage from heating tube.

Check items

- \_\_\_\_\_ Leakages
- \_\_\_\_\_ Test pressure

II - 16. Condensate pump test

Check items

- \_\_\_\_\_ Abnormal sound
- \_\_\_\_\_ Vibration
- \_\_\_\_\_ Bearing temperature
- \_\_\_\_\_ Motor current
- \_\_\_\_\_ Suction and discharge pressures
- \_\_\_\_\_ Leakage from pump gland



II - 17. Circulating water pump test

Check items

- \_\_\_\_\_ Abnormal sound
- \_\_\_\_\_ Vibration
- \_\_\_\_\_ Bearing temperature
- \_\_\_\_\_ Motor current
- \_\_\_\_\_ Suction and discharge pressure
- \_\_\_\_\_ Bearing cooling water flow
- \_\_\_\_\_ Lubricating water flow
- \_\_\_\_\_ Cooling water solenoid valve
- \_\_\_\_\_ Interlock

II - 18. Generator

a) Leak test of generator:

Leak test should be carried out after reassembly of generator and seal oil unit.

- 1) Operate seal oil unit including stand-by of back-up system.
- 2) Supply the generator with freon gas by 0.5 or 1.0% of generator capacity and with air up to specified pressure.
- 3) Check leakage at valve flange and other places completely by soap method and freon gas detector.
- 4) After leak check, pressurize up to specified pressure then close the air supply valve.
- 5) Read the generator pressure by mercury manometer and temperature.

- 6) Keep the above condition for 6 hours at least.
- 7) Compute leakage quantity by the following formula:

$$L = 0.0316 \frac{V}{H} \left[ (M1 - M2) - \frac{T1 - T2}{273 + T1} (M1 + B1) + (B1 - B2) \right]$$

L: Leakage quantity at 760mmHg and T1 [m<sup>3</sup>/day]

H: Time [hour]

V: Capacity of generator and pipeline [m<sup>3</sup>]

B1, B2: Atmospheric pressure before/after test [mmHg]

M1, M2: Generator pressure before/after testing [mmHg]

T1, T2: Generator air temp. before/after testing [°C]

Air quantity dissolved into oil:

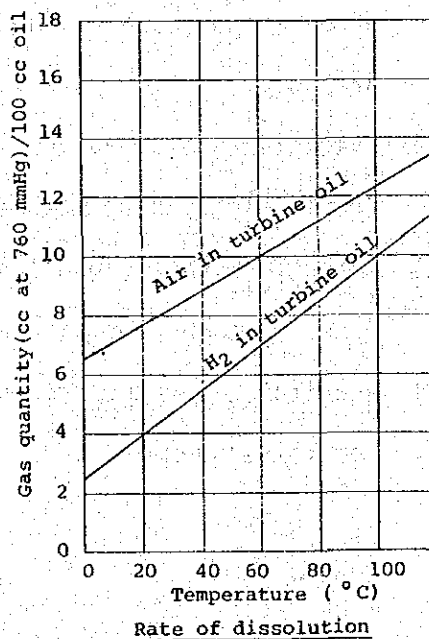
$$a = 1.44 QAP$$

a: dissolved air into air [m<sup>3</sup>/day]

Q: return flow of oil [l/min]

A: rate of dissolution ( See Figure shown below )

P: Absolute gas pressure [atm]



Actual gas leak:

$$L_{air} = L - a$$

$$L_h = 3.75 \times \sqrt{\frac{P_h}{P_{air}}} \cdot L_{air}$$

$L_{air}$ : Leakage quantity at  $P_{air}$  of air (760 mmHg at T1)  $m^3/day$

$L_h$ : Leakage quantity at  $P_h$  of hydrogen (760 mmHg at T1)  $m^3/day$

$P_{air}$ : Air press. ( $kg/m^2_{abs}$ )

$P_h$ :  $H_2$  press. ( $kg/m^2_{abs}$ )

8) Compare data with past record and guaranteed figure by manufacturer.

b) Test of seal oil unit:

- 1) Alarm test
- 2) Back-up test
- 3) Adjustment of seal oil pressure

c) Stator coil cooling water system:

- 1) Megger test before filling water
- 2) Performance check of ion exchanger
- 3) Leak test of stator cooling water system
- 4) Characteristic test of cooling water pump
- 5) Performance test of temperature control valve and pressure reducing valve
- 6) Check of thermocouple and conductivity meter
- 7) Measurement of flow rate and pressure of each part
- 8) Annunciator and interlock test

II - 19. Transformer

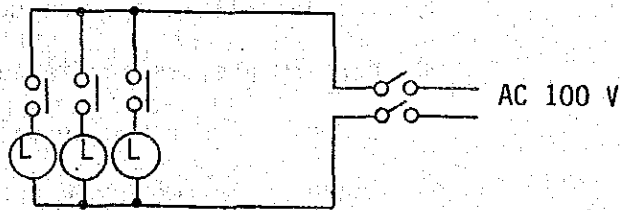
- a) Megger test
- b) Operation test of cooling fan and cooling oil pump
- c) Automatic start-stop test of cooling fan
- d) Annunciator test
- e) Insulation oil breakdown test

Circuit breaker (230 KV and 115 KV):

- a) Operation test
- b) Megger test
- c) Alarm test
- d) Insulation oil test (115 KV)  
(breakdown test and measurement of neutralization number)
- e) Open-close test

- Measurement of contact timing

All contacts to be closed simultaneously should be confirmed by lamp test method while moving contact slowly by hand.



- Measurement of switching time

Time for open and close can be measured by oscillograph.

APPENDIX-8 RECORD OF FORCED OUTAGE

the fact that the  $\mathbb{Z}_2$ -action on  $\mathbb{R}^n$  is not free, the quotient space  $\mathbb{R}^n/\mathbb{Z}_2$  is not a manifold.

Let us now consider the quotient space  $\mathbb{R}^n/\mathbb{Z}_2$  for  $n \geq 2$ . We will show that this space is a manifold.

Let  $x \in \mathbb{R}^n/\mathbb{Z}_2$ . We will show that there is a neighborhood of  $x$  that is homeomorphic to an open subset of  $\mathbb{R}^n$ .

Let  $\tilde{x} \in \mathbb{R}^n$  be a representative of  $x$ . We will show that there is a neighborhood of  $\tilde{x}$  that is homeomorphic to an open subset of  $\mathbb{R}^n$ .

Let  $U$  be a neighborhood of  $\tilde{x}$  that does not contain any other points of the form  $\tilde{x} + v$  for  $v \in \mathbb{Z}_2$ .

Let  $V$  be a neighborhood of  $\tilde{x}$  that is homeomorphic to an open subset of  $\mathbb{R}^n$ .

Let  $W$  be the intersection of  $U$  and  $V$ . Then  $W$  is a neighborhood of  $\tilde{x}$  that is homeomorphic to an open subset of  $\mathbb{R}^n$ .

Let  $z \in \mathbb{R}^n/\mathbb{Z}_2$  be another point. We will show that there is a neighborhood of  $z$  that is homeomorphic to an open subset of  $\mathbb{R}^n$ .

Let  $\tilde{z} \in \mathbb{R}^n$  be a representative of  $z$ . We will show that there is a neighborhood of  $\tilde{z}$  that is homeomorphic to an open subset of  $\mathbb{R}^n$ .

Let  $U'$  be a neighborhood of  $\tilde{z}$  that does not contain any other points of the form  $\tilde{z} + v$  for  $v \in \mathbb{Z}_2$ .

Let  $V'$  be a neighborhood of  $\tilde{z}$  that is homeomorphic to an open subset of  $\mathbb{R}^n$ .

Let  $W'$  be the intersection of  $U'$  and  $V'$ . Then  $W'$  is a neighborhood of  $\tilde{z}$  that is homeomorphic to an open subset of  $\mathbb{R}^n$ .

Let  $z' \in \mathbb{R}^n/\mathbb{Z}_2$  be another point. We will show that there is a neighborhood of  $z'$  that is homeomorphic to an open subset of  $\mathbb{R}^n$ .

Let  $\tilde{z}' \in \mathbb{R}^n$  be a representative of  $z'$ . We will show that there is a neighborhood of  $\tilde{z}'$  that is homeomorphic to an open subset of  $\mathbb{R}^n$ .

Let  $U''$  be a neighborhood of  $\tilde{z}'$  that does not contain any other points of the form  $\tilde{z}' + v$  for  $v \in \mathbb{Z}_2$ .

Let  $V''$  be a neighborhood of  $\tilde{z}'$  that is homeomorphic to an open subset of  $\mathbb{R}^n$ .

Let  $W''$  be the intersection of  $U''$  and  $V''$ . Then  $W''$  is a neighborhood of  $\tilde{z}'$  that is homeomorphic to an open subset of  $\mathbb{R}^n$ .

Let  $z'' \in \mathbb{R}^n/\mathbb{Z}_2$  be another point. We will show that there is a neighborhood of  $z''$  that is homeomorphic to an open subset of  $\mathbb{R}^n$ .

Let  $\tilde{z}'' \in \mathbb{R}^n$  be a representative of  $z''$ . We will show that there is a neighborhood of  $\tilde{z}''$  that is homeomorphic to an open subset of  $\mathbb{R}^n$ .

Let  $U'''$  be a neighborhood of  $\tilde{z}''$  that does not contain any other points of the form  $\tilde{z}'' + v$  for  $v \in \mathbb{Z}_2$ .

Let  $V'''$  be a neighborhood of  $\tilde{z}''$  that is homeomorphic to an open subset of  $\mathbb{R}^n$ .

Let  $W'''$  be the intersection of  $U'''$  and  $V'''$ . Then  $W'''$  is a neighborhood of  $\tilde{z}''$  that is homeomorphic to an open subset of  $\mathbb{R}^n$ .

Let  $z''' \in \mathbb{R}^n/\mathbb{Z}_2$  be another point. We will show that there is a neighborhood of  $z'''$  that is homeomorphic to an open subset of  $\mathbb{R}^n$ .

Let  $\tilde{z}''' \in \mathbb{R}^n$  be a representative of  $z'''$ . We will show that there is a neighborhood of  $\tilde{z}'''$  that is homeomorphic to an open subset of  $\mathbb{R}^n$ .

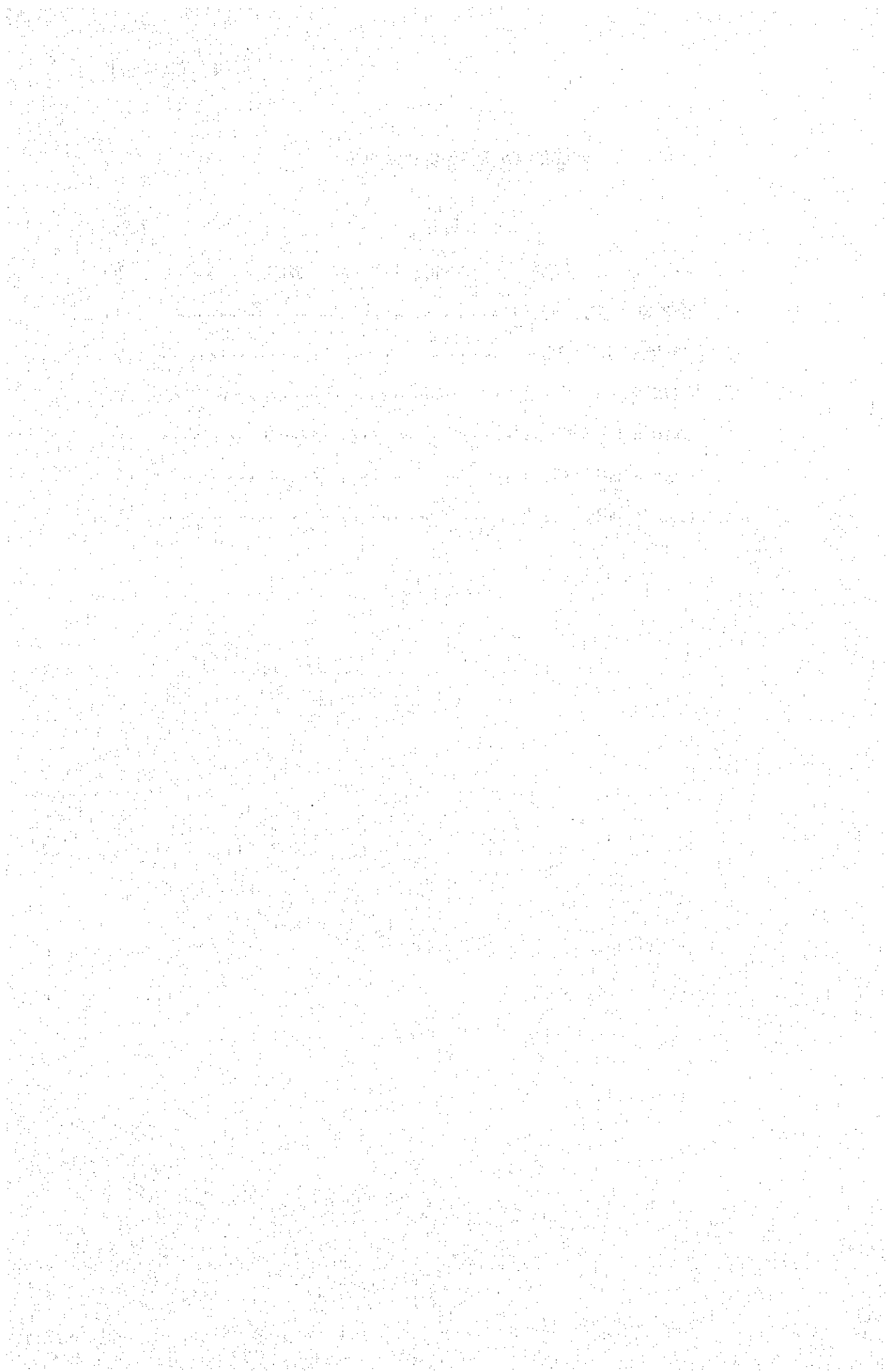
Let  $U''''$  be a neighborhood of  $\tilde{z}'''$  that does not contain any other points of the form  $\tilde{z}''' + v$  for  $v \in \mathbb{Z}_2$ .

Let  $V''''$  be a neighborhood of  $\tilde{z}'''$  that is homeomorphic to an open subset of  $\mathbb{R}^n$ .

Let  $W''''$  be the intersection of  $U''''$  and  $V''''$ . Then  $W''''$  is a neighborhood of  $\tilde{z}'''$  that is homeomorphic to an open subset of  $\mathbb{R}^n$ .

RECORD ON FORCED OUTAGES

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RECORD OF FORCED OUTAGES

Attached sheets indicate the actual trouble records for each unit and these will be understood as reference data to grasp actual situation, tendency and cause of trouble.

I. Historical Record of Trouble for Each Unit

	Gardner Unit 1	Gardner Unit 2	Snyder Unit 1	Snyder Unit 2	Malaya Unit 1	Malaya Unit 2
Commercial Operation	8/01/68	1/15/70	07/01/71	07/31/72	09/04/75	06/26/79
1968	10	-	-	-	-	-
1969	10	-	-	-	-	-
1970	8	11	-	-	-	-
1971	10	9	8	-	-	-
1972	23	15	23	9	-	-
1973	9	16	17	24	-	-
1974	7	18	25	22	-	-
1975	7	24	13	20	11	-
1976	4	22	23	18	18	-
1977	9	21	21	15	19	-
1978	16	34	20	28	36	-
1979	14	29	23	33	14	10
1980	16	23	25	26	21	16
1981	12	19	28	23	24	21
1982	3	13	6	4	9	7
Total	158	254	232	222	152	54
Record of Forced Outage	147	243	229	222	128	54

SUMMARY RECORD OF FORCED OUTAGES

	Gardner Unit 1	Gardner Unit 2	Snyder Unit 1	Snyder Unit 2	Malaya Unit 1	Malaya Unit 2	Total
1. Boiler and Auxiliary	84	102	72	106	32	16	412
1) Boiler	17	49	25	39	23	4	157
2) Fuel oil System	3	3	5	7	4	5	27
3) Air heater	45	33	30	43	0	0	151
4) Forced draft fan	9	3	0	3	0	0	15
5) Gas recirculation fan	2	0	1	0	0	0	3
6) Valve and piping	7	14	9	14	4	0	47
7) Control system	1	0	2	0	1	7	11
2. Turbine and Auxiliary	31	45	66	60	39	12	253
1) Main turbine	2	14	39	22	27	7	111
2) Condenser	14	6	9	17	7	2	55
3) Circulating H <sub>2</sub> O pump	5	2	3	0	1	3	14
4) Control system	10	23	15	21	4	0	73
3. Condensate and feed water system	2	59	54	45	25	3	188
1) Condensate and make-up system	0	2	6	3	0	1	12
2) Motor driven BFP	1	23	12	3	1	1	41
3) Turbine driven BFP	-	24	15	7	7	0	53
4) Low press. heater	0	0	6	2	1	1	10
5) High press. heater	1	8	15	28	15	0	67
6) Control system	0	2	0	2	1	0	5
4. Electrical Equipment	21	15	15	4	9	15	79
1) Generator & Exciter	4	7	3	3	2	5	24
2) Transformer and Substation	10	6	6	0	4	5	31
3) Station service system	0	1	4	0	0	5	10
4) Control system	7	1	2	1	3	0	14
5. Others	9	22	22	7	23	8	91
1) B-T interlock	0	7	6	0	7	2	22
2) Generator Back-up	0	4	6	3	1	1	15
3) Outside trouble	9	11	10	4	15	5	91
TOTAL	147	243	229	222	128	54	1023

RECORD OF FORCED OUTAGES

II. Gardner Unit No. 1  
July 2, 1968 - June 30, 1982

<u>Equipment/System</u>	<u>Nature of Trouble</u>	<u>No. of Time</u>
<u>1. Boiler and Auxiliary</u>		<u>84</u>
1) Boiler	a) Tube leak	14
	b) Fire at burner	2
	c) Leak at burner flex hose	1
2) Fuel oil system	a) CDFOP leakage	1
	b) MFOP discharge line leakage	2
3) Air heater	a) AH burned elements	3
	b) AH drive mechanism trouble	2
	c) AH clogging	29
	d) SAH clogging	8
	e) Replacement of G1 AH elements	3
4) Forced draft fan	a) Excessive vibration	7
	b) Defective discharge damper	2
5) Gas recirculation fan	a) Overload and heating up of motor	2
6) Valve and piping	a) Valve leak	6
	b) Main stop valve leakage at sealing	1
7) Control system	a) Control air contamination with oil	1
<u>2. Turbine and Auxiliary</u>		<u>31</u>
1) Main turbine	a) Burned turbine asbestos insulation	1
	b) Crossover pipe leak	1
2) Condenser	a) Condenser tube leak	11
	b) Hotwell recirculation valve malfunction	2
	c) Air ejector leakage	1
3) Circulating water pump	a) Defective of rubber expansion joint	2
	b) Leakage at discharge pipe	3
4) Control system	a) Main turbine control valve trouble	2
	b) Main turbine control mechanism trouble	8

<u>Equipment/System</u>	<u>Nature of Trouble</u>	<u>No. of Times</u>
3. <u>Condensate and Feedwater System</u>		<u>2</u>
1) Condensate and make-up system		0
2) Motor driven BFP	a) Suction strainer clogging	1
3) Turbine driven BFP		0
4) Low Press. Heaters		0
5) High Press. heaters	a) Tube leak	1
6) Control system		0
4. <u>Electrical Equipment</u>		<u>21</u>
1) Generator and Exciter	a) Loss of excitation	4
2) Transformer & Substation	a) Main transformer, defective jumper	3
	b) Main transformer, oil leak	1
	c) Bank tapping	2
	d) Power cable trouble	2
	e) Disconnect switch failure	2
3) Station service system		0
4) Control system	a) Voltage regulator trouble	4
	b) Over excitation relay trouble	3
5. <u>Others</u>		<u>9</u>
1) B-T, interlock		0
2) Generator back-up		0
3) Outside trouble	a) Tripping of 115 KV line	2
	b) Frequency disturbance	6
	c) Typhoon	1

RECORD OF FORCED OUTAGES

III. Gardner Unit No. 2  
October 11, 1969 - June 30, 1982

<u>Equipment/System</u>	<u>Nature of Trouble</u>	<u>No. of Times</u>
<u>1. Boiler and Auxiliary</u>		<u>102</u>
1) Boiler	a) Tube leak	36
	b) Reheater flushing	1
	c) Burner trouble	2
	d) Uncontrollable steam & metal temp.	10
2) Fuel oil system	a) MFOP seal leakage	3
3) Air Heater	a) Clogging	27
	b) Burned element	5
	c) Damaged parts	1
4) Forced draft fan	a) Excessive vibration	3
5) Gas recirculation fan		0
6) Valve and piping	a) Valve leak	14
7) Control system		0
<u>2. Turbine and Auxiliary</u>		<u>45</u>
1) Main turbine	a) Auxiliary oil failure	9
	b) Bearing damage	3
	c) Excessive vibration	1
	d) Turbine blade failure	1
2) Condenser	a) Tube leak	5
	b) Damaged condenser diaphragm	1
3) Circulating water pump	a) Planetary gear failure	2
4) Control system	a) Main turbine control mechanism failure	16
	b) Main turbine control valves failure	7
<u>3. Condensate and Feedwater System</u>		<u>56</u>
1) Condensate and make-up system	a) Contamination of CST	1
	b) Low Dem. water reserve	1

<u>Equipment/System</u>	<u>Nature of Trouble</u>	<u>No. of Times</u>
2) Motor driven BFP	a) Pump leakage	4
	b) Temperature, equalizing line leakage	7
	c) Main flow line trouble	9
	c) Leakage at suction valve	3
3) Turbine driven BFP	a) Balancing leak-off line trouble	5
	b) Defective vacuum trip device	6
	c) Main flow line trouble	5
	d) Clogging of suction strainer	1
	e) Damaged internal parts	5
	f) Leakage of steam/water pipe	2
4) Low Pressure Heaters		0
5) High Pressure Heaters	a) Tube leak	2
	b) Drip line leak	3
	c) Isolating valve leak	3
6) Control system	a) Malfunction of T-BFP control valve	1
	b) Trouble at feed water flow	1
<u>4. Electrical Equipment</u>		<u>15</u>
1) Generator and Exciter	a) Hydrogen leak	2
	b) Main exciter failure	3
	c) Oil circuit breaker failure	2
2) Transformer and Substation	a) Main transformer jumper wire heating up	1
	b) Tripping of differential lockout relay	5
3) Station service system	a) M-BFP trip-out breaker failure	1
4) Control system	a) Voltage regulator failure	1
<u>5. Others</u>		<u>22</u>
1) B-T interlock	a) MFO shut-off valve malfunction	1
	b) Malfunction of controls	6
2) Generator back-up	a) Back-up lockout switch	2
	b) Reverse power relay	2

<u>Equipment/System</u>	<u>Nature of Trouble</u>	<u>No. of Times</u>
3) Outside trouble	a) Tripping of 115 KV switch	2
	b) Frequency disturbance	8
	c) Typhoon	1

RECORD OF FORCED OUTAGES

IV. Snyder Unit No. 1  
April 30, 1971 to June 30, 1982

<u>Equipment/System</u>	<u>Nature of Trouble</u>	<u>No. of Times</u>
<u>1. Boiler and Auxiliary</u>		<u>72</u>
1) Boiler	a) Tube Leak	14
	b) Burner failure	2
	c) Burner windbox burned	2
	d) Uncontrollable steam temperature	6
	e) Gas leak	1
2) Fuel oil system	a) Leakage of F.O. Heater & pipe	2
	b) MFOP mechanical trouble	3
3) Air heater	a) Clogging	25
	b) Drive mechanism trouble	9
	c) Damaged main parts	2
4) Forced draft fan		0
5) Gas recirculation fan	a) Motor overload	1
6) Valve and piping	a) Boiler valve leak	9
7) Control system	a) F.O. Heater press, regulator trouble	2
<u>2. Turbine and Auxiliary</u>		<u>66</u>
1) Main turbine	a) Blade failure	7
	b) Excessive vibration	11
	c) Inspection internals and parts	3
	d) Tripping device trouble	11
	e) Blade washing	2
	f) Cross-over pipe & expansion bellows leakage	4
	g) Fire accident	1
2) Condenser	a) Tube leak	9
3) Circulating water pump	a) Planetary gear failure	3



<u>Equipment/System</u>	<u>Nature of Trouble</u>	<u>No. of Times</u>
4) Control system	a) Main turbine control valve trouble	5
	b) Hydraulic control system trouble	10
<b>3. <u>Condensate and Feedwater System</u></b>		<b><u>54</u></b>
1) Condensate & make-up system	a) Leakage at condensate pump suction expansion joint	1
	b) Leakage at raw water	3
	c) Low demineralizing water reserve	1
	d) Busted condensate line	1
2) Motor driven BFP	a) Temp. Equalizing line trouble	2
	b) Tripping device trouble	2
	c) Leakage at discharge & suction of pump	4
	d) Motor overload	1
	e) Clogging of suction strainer	3
3) Turbine driven BFP	a) Balancing leak-off system trouble	3
	b) Clogging of suction strainer	1
	c) Temp. equalizing recirculation trouble	2
	d) Damage on pump parts	7
	e) Main flow system trouble	2
4) Low Pressure heaters	a) Tube leak	6
5) High Pressure Heaters	a) Tube leak	5
	b) Drip lines trouble	10
6) Control system		0
<b>4. <u>Electrical Equipment</u></b>		<b><u>15</u></b>
1) Generator & Exciter	a) Oil circuit breaker (G3GG8) trouble	2
	b) Oil circuit breaker malfunction	1
2) Transformer & Substation	a) Main transformer jumper line faults	4
	b) Bursting of lightning arrester	1
	c) Differential lockout trouble	1
3) Station service system	a) Loss of 4160 V power supply	1
	b) 4160 V bus grounded	3

<u>Equipment/System</u>	<u>Nature of Trouble</u>	<u>No. of Times</u>
4) Control system	a) Wet generator control cubicle	1
	b) Voltage regulator trouble	1
5. <u>Others</u>		<u>20</u>
1) B-T interlock	a) Feedwater regulator malfunction	5
	b) Poor combustion, drop in air flow	1
2) Generator Back-up	a) Shorted emergency trip relay and back-up relay	3
	b) Reverse power relay	3
3) Outside trouble	a) Tripping of 115 KV lines due to heavy down power	2
	b) Frequency disturbance	7
	c) Typhoon	1