

CHAPTER 4. FURTHER STUDY TO BE CARRIED OUT

In this chapter breakdown study for the next stage to implement the rehabilitation work is mentioned.

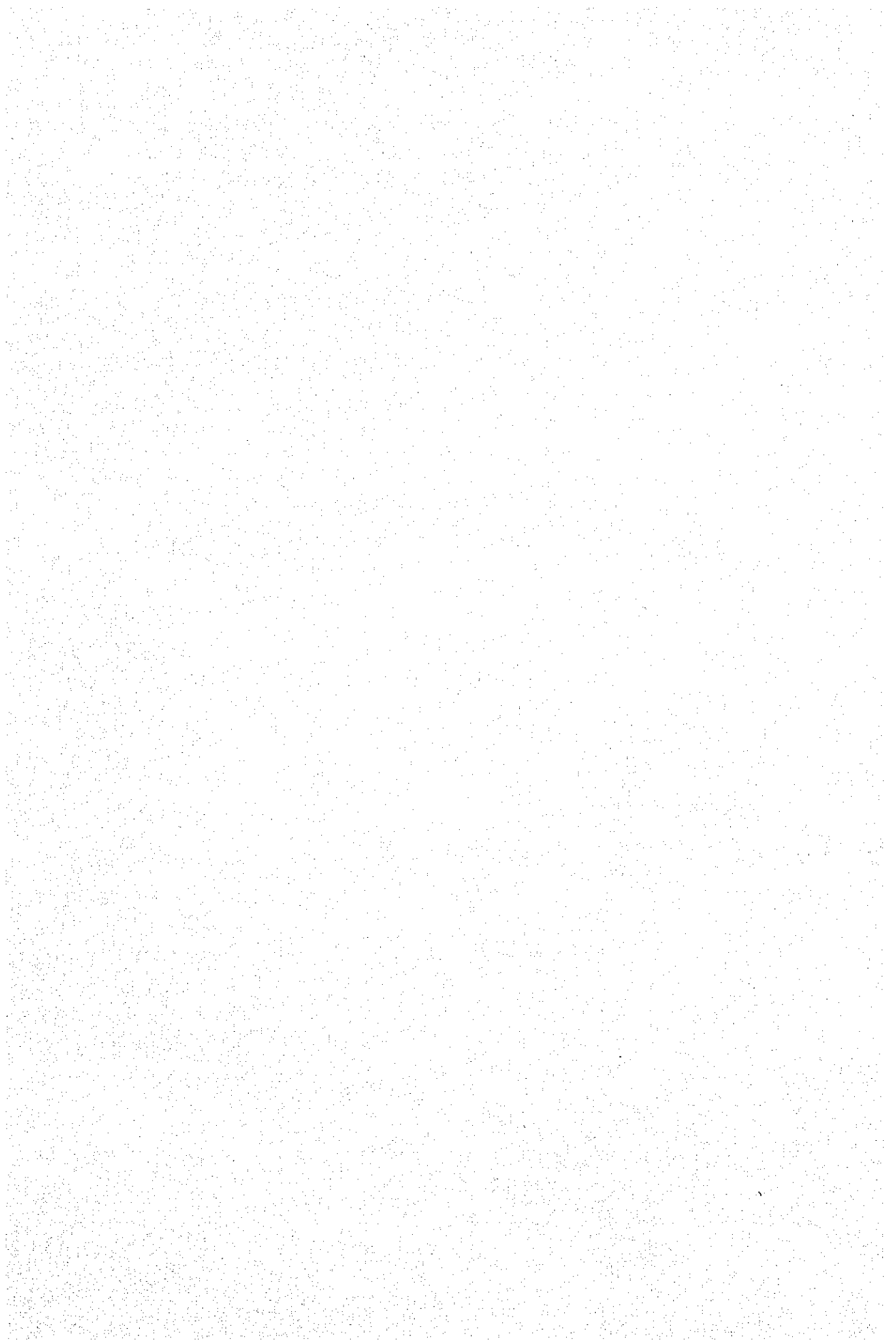
And the following will cover the area between this survey and coming actual execution of rehabilitation work.

1. For improvement of plant operations and maintenance

- | <u>JICA</u> | <u>NAPOCOR</u> |
|--|---|
| 1. Assistance for developing implementing improvements in operating procedures/practices | a. Data preparation of operation procedures and maintenance practices |
| a) Dispatching of supervisors for maintenance and operation | |
| b) Advices on the NAPOCOR's operation procedures and maintenance practices | |
| 2. Preparation of general/standard training " <u>text book</u> " for operation and maintenance | b. --- |
| 3. Training of NAPOCOR "personnel" in supervisory positions in Japan | c. Training in Philippines in each thermal plant by the "Personnel" using the text book |

2. For "improvement of plant system"

- | <u>JICA</u> | <u>NAPOCOR</u> |
|---|--|
| <u>Within power plant</u> | |
| 1. Assist in the engineering to fix how to execute the actual | a. Actual contact with the equipment manufacturers |



replacement, expansion, addition and/or repair work, especially the other items not mentioned in NAPOCOR's rehabilitation program.

on the basis of the recommendation of the "Report".

2. Detail survey and check on the base of the "Report" and this time the surveyor will check the plant by own observation. Sometimes additional items to be improved in the same time of the rehabilitation will be found out.

- b. NAPOCOR executes
 - * Assistance for access in plant
 - * Necessary data issue

3. For planning and management of scheduled plant outage

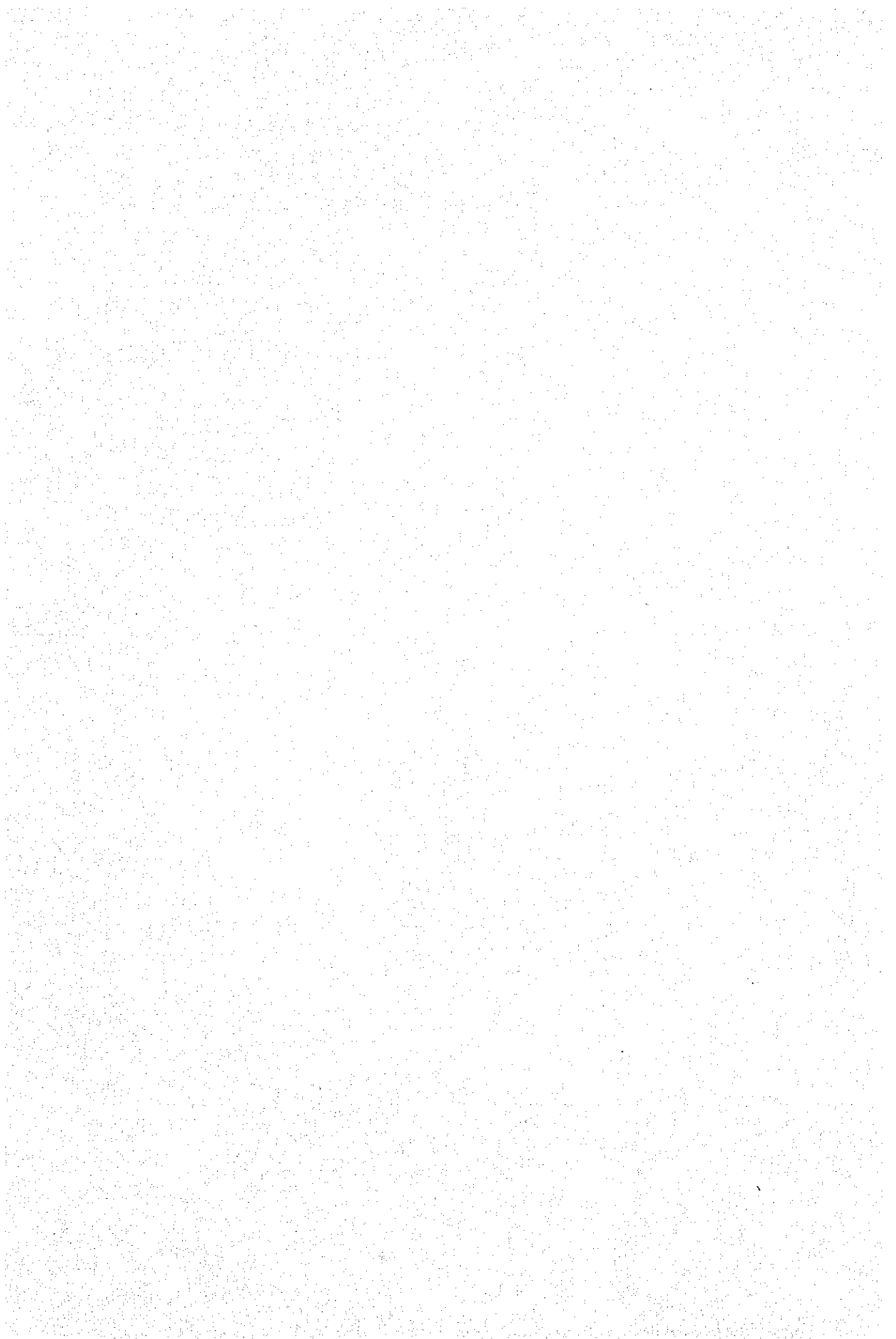
JICA

NAPOCOR

1. Review the adequate rehabilitation work (physical one) schedule and duration
 - * Establish recommend rehabilitation work (physical one) and duration schedule

- a. Provide the rehabilitation schedule
- b. Review and fix the actual rehabilitation schedule to be actually implemented.

2. Dispatching of maintenance supervisor

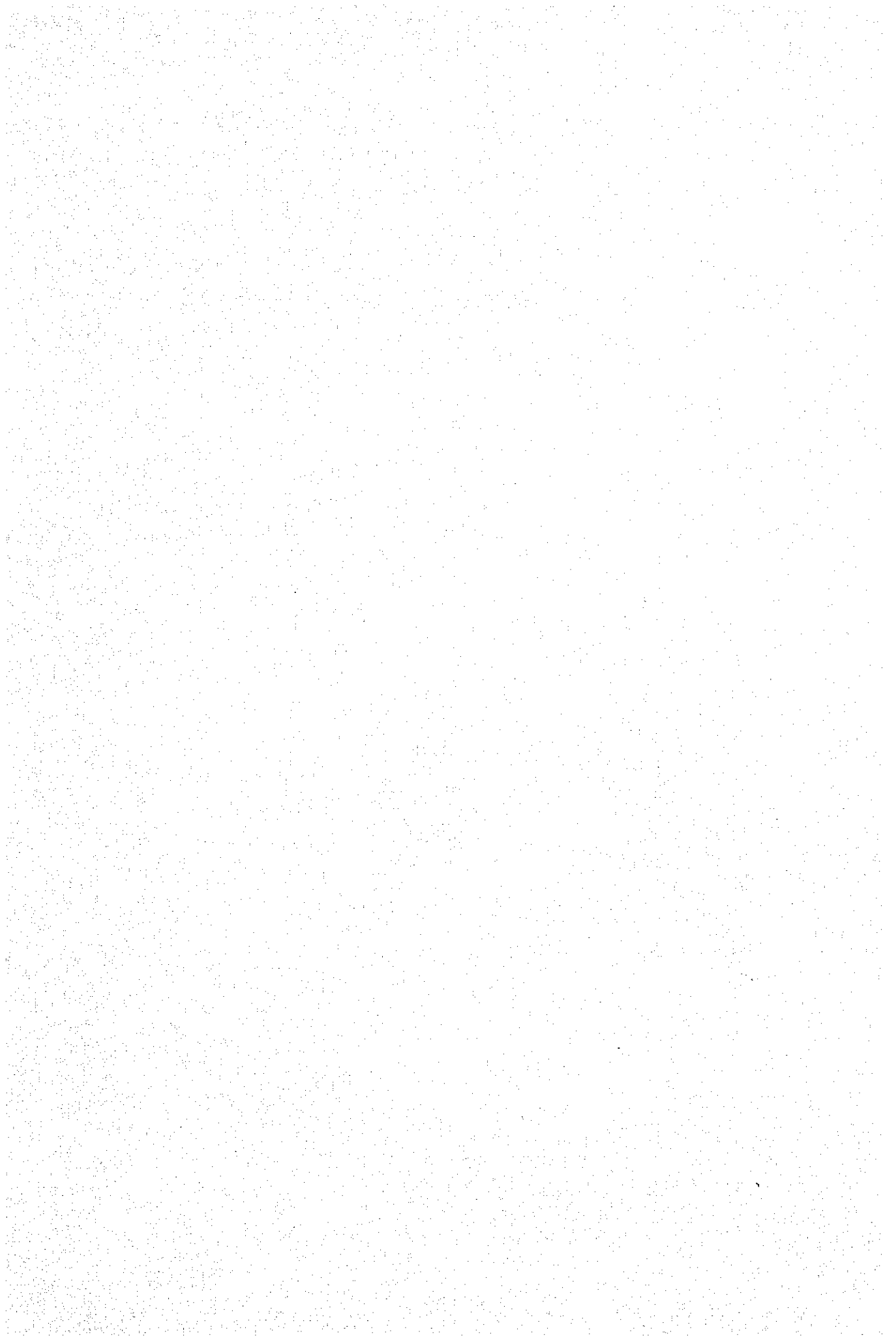


APPENDIX I

PAST TROUBLE RECORD IN EACH POWER PLANT

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

The most common troubles are classified and listed up in Section 2-3.1 and individual fundamental matters are mentioned in Section 2-3.3.

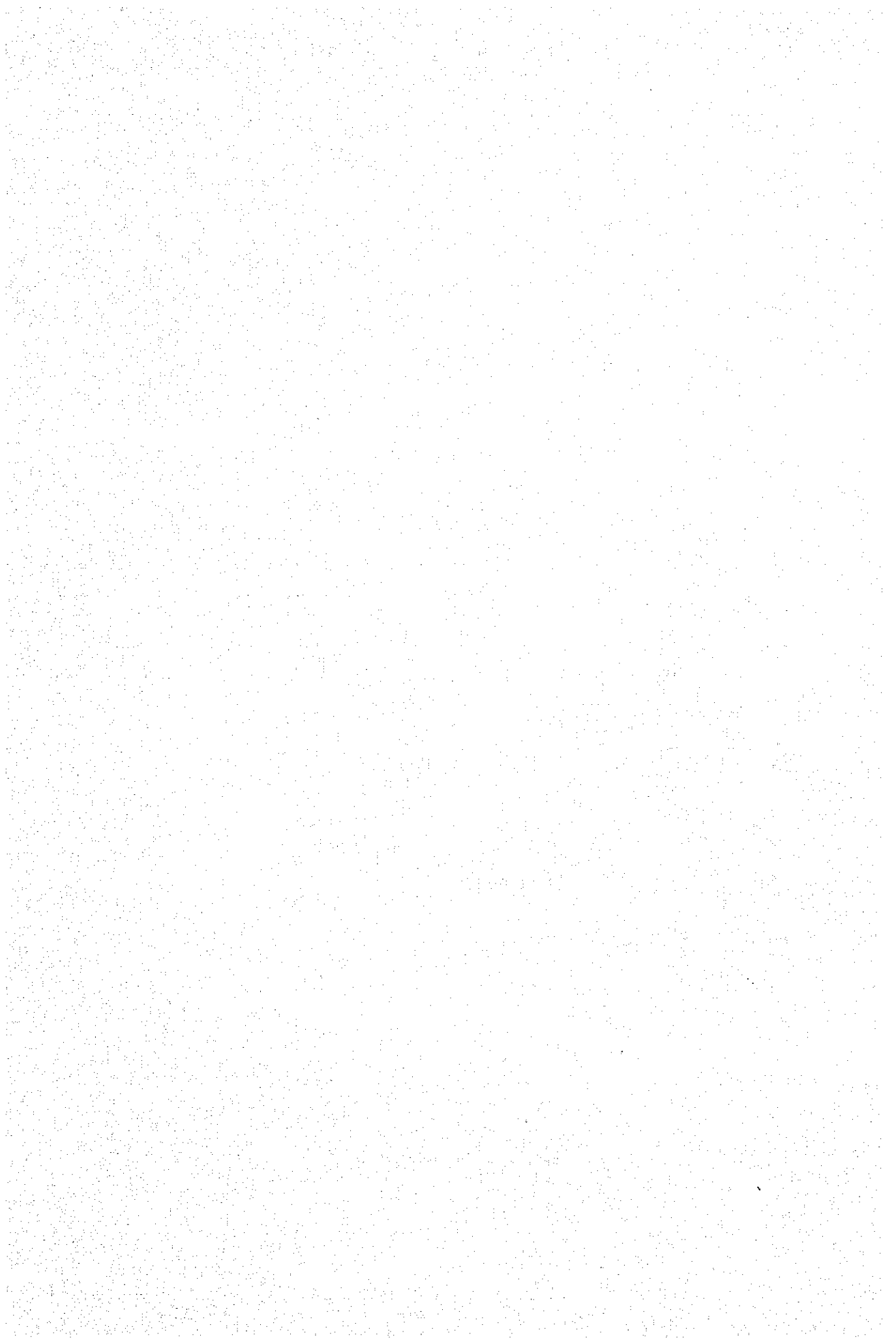


RECORD OF FORCED OUTAGES

Gardner Unit No. 1

July 2/68 to Dec. 31/81

<u>EQUIPMENT/SYSTEM</u>	<u>NATURE OF TROUBLE</u>	<u>NO. OF TIMES</u>
1) Boiler	a) Valve leaks	6
	b) Tube leak	13
	c) Fire at burner vestibule & windbox	2
	d) Leak at burner flex hose	1
2) Condensing System	a) Main condenser tube leak	11
	b) Hotwell recirculation valve malfunction	2
	c) Air ejector leakage	1
3) Air Heater	a) Burned elements	3
	b) Clogging	29
	c) Drive mechanism trouble	1
4) Main Turbine	a) Control valve trouble	2
	b) Burned turbine asbestos insulation	1
	c) Crossover pipe leak	1
	d) Control mechanism trouble	8
5) Forced Draft Fan	a) Excessive vibration	7
	b) Defective discharge damper	2
6) Steam Coil Air Heater	a) Clogging	8
	b) Replacement of heating elements	3
7) High Pres. Heaters	a) Tube leak	1
8) Circulating Water Pump	a) Defective rubber expansion joint	2
	b) Leakage at discharge pipe	3
9) Feedwater Regulator	a) Mechanical trouble	5
10) Gas Recirculation. Fan	a) Overload and heating up of motor	2
11) Boiler Stop Valve	a) Leakage at seal ring	1
12) Main Fuel Oil System	a) CDFOP leakage	1
	b) MFOP discharge line leakage	2
13) Control Air System	a) Contamination with oil	1
14) Main Transformer	a) Defective jumper	3
	b) Oil leak	1
	c) Bank tapping	2
	d) Power cable trouble	2
	e) Over-excitation relay trouble	3
	f) Disconnect switch failure	2
15) Generator	a) Loss of excitation	4
	b) Voltage regulator trouble	4

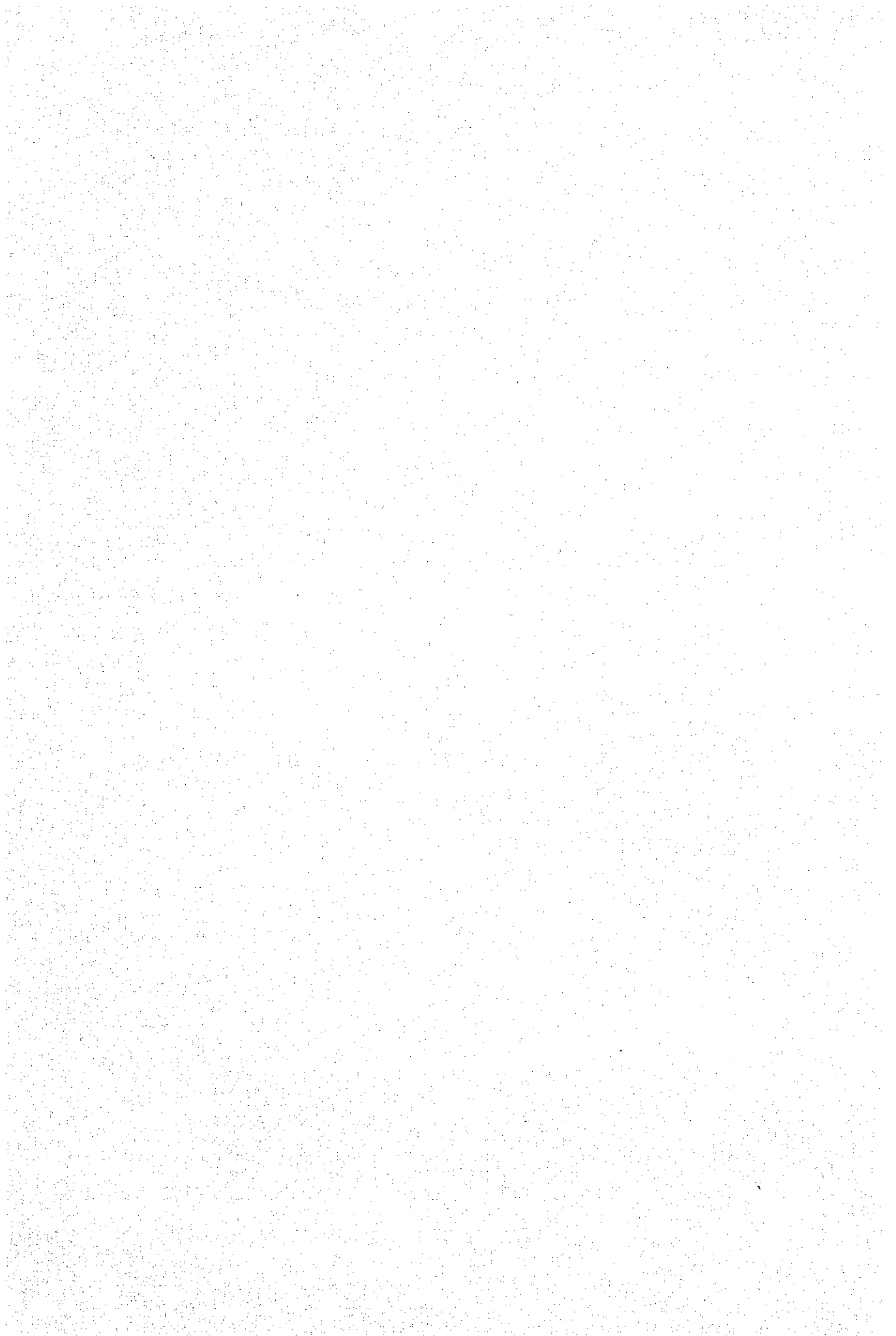


RECORD OF FORCED OUTAGES

Gardner Unit No. 1

July 2/68 to Dec. 31/81

<u>EQUIPMENT/SYSTEM</u>	<u>NATURE OF TROUBLE</u>	<u>NO. OF TIMES</u>
16) Boiler Feed Pump	a) Suction strainer clogging	1

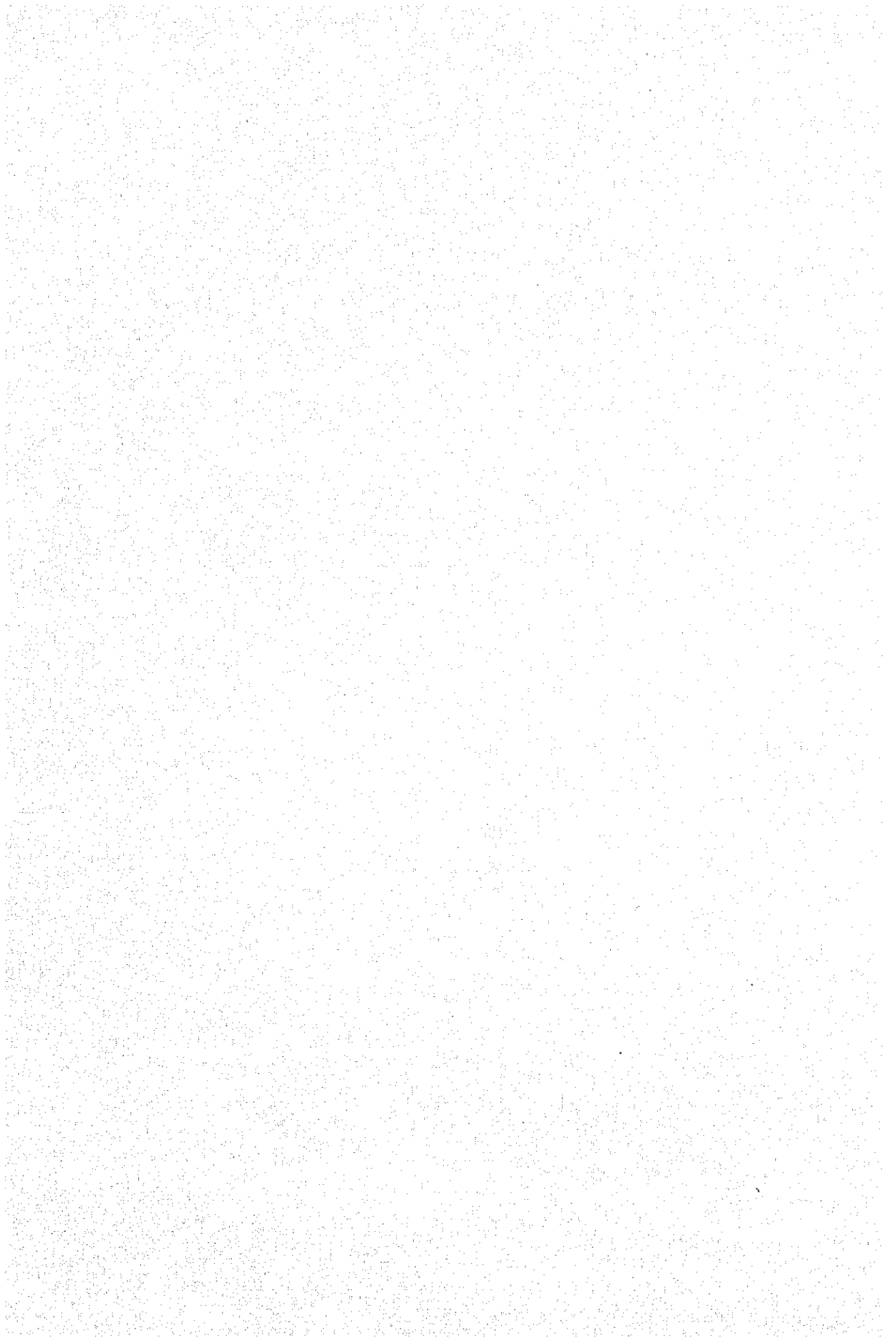


RECORD OF FORCED OUTAGES

Gardner Unit No. 2

Oct. 11/69 to Mar. 25/82

<u>EQUIPMENT/SYSTEM</u>	<u>NATURE OF TROUBLE</u>	<u>NO. OF TIMES</u>
1) Boiler	a) Uncontrollable steam & boiler metal temp.	10
	b) Tube leak	36
	c) Valve leaks	14
	d) Burner trouble	2
	e) Reheater flushing	1
2) High Pres. Heaters	a) Tube leak	2
	b) Drip line leak	3
	c) Isolating valve leak	3
3) Turbine-Driven Boiler Feed Pump	a) Balancing leak-off line trouble	5
	b) Defective vacuum trip device	6
	c) Min. flow line trouble	5
	d) Clogging of suction strainer	1
	e) Damaged internal parts	5
	f) Leakage of steam at turbine inlet pipe	1
4) Motor-Driven Boiler Feed Pump	a) Pump leakage	4
	b) Temperature equalizing pump line leakage	7
	c) Min. flow valve failure	9
	d) Leakage at suction valve	3
	e) Trip-out breaker failure	1
5) Air Preheater	a) Clogging	27
	b) Burned elements	5
	c) Damaged parts	1
6) Forced Draft Fans	a) Excessive vibration	3
7) Turbine	a) Auxiliary oil failure	9
	b) Control mechanism failure	16
	c) Bearing damage	3
	d) Control valves failure	7
	e) Excessive vibration	1
	f) Turbine blade failure	1
8) Main Transformer	a) Jumper wires heating up	1
	b) Tripping of differential lock-out relay	5
9) Main Condenser	a) Tube leak	4
	b) Damaged condenser diaphragm	1
10) Generator	a) Hydrogen leak	2
	b) Voltage regulator failure	1
	c) Back-up lockout switch	1
	d) Main exciter failure	2
	e) Oil circuit breaker failure	2

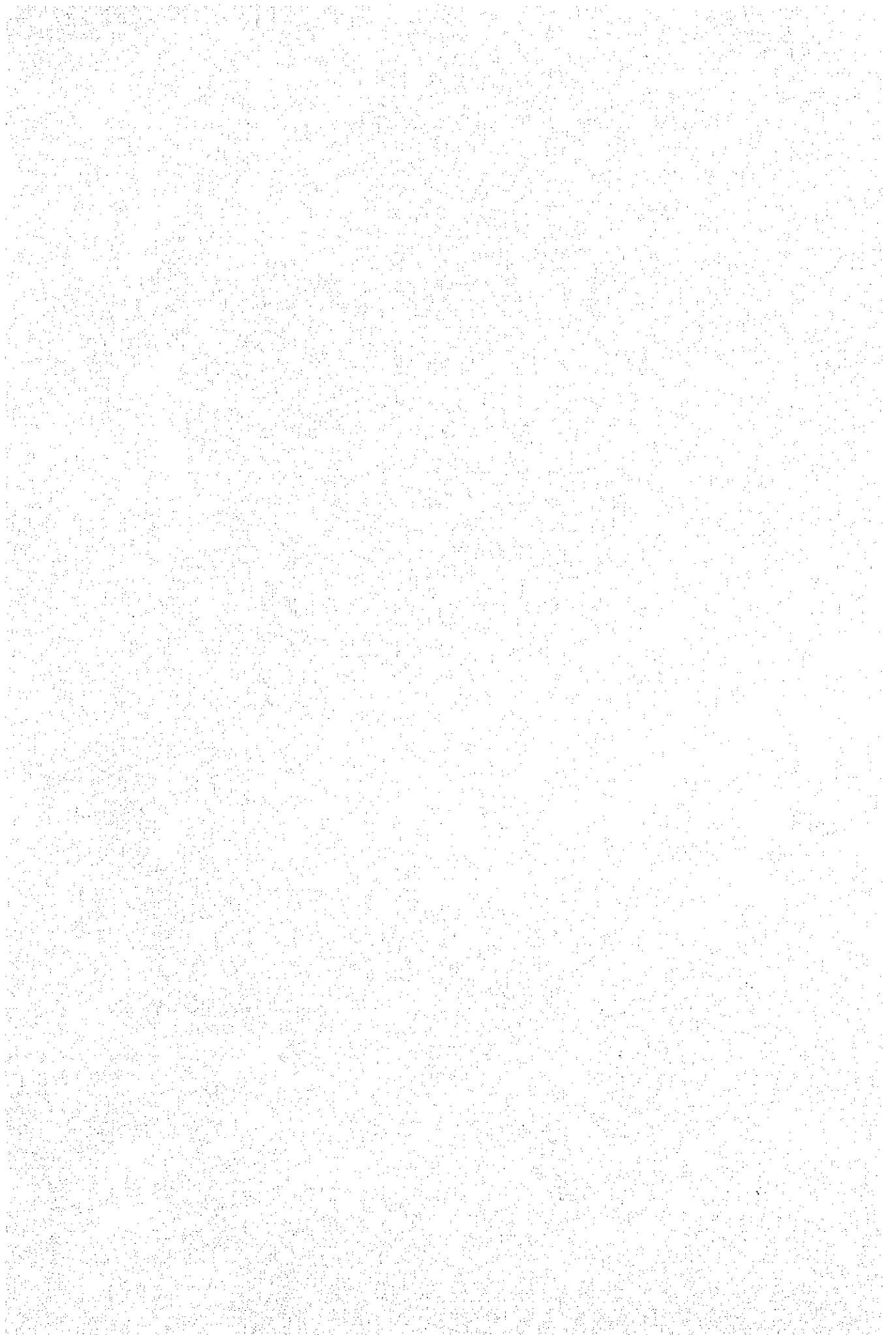


RECORD OF FORCED OUTAGES

Gardner Unit No. 2

Oct. 11/69 to Mar. 25/82

<u>EQUIPMENT/SYSTEM</u>	<u>NATURE OF TROUBLE</u>	<u>NO. OF TIMES</u>
11) Condensate Make-Up System	a) Contamination of CST b) Low demineralized water reserve	1 1
12) Main Fuel Oil System	a) MFOP seal leakage b) MFO shut-off valve malfunction	3 1
13) Boiler-Turbine Interlock	a) Malfunction of controls	6
14) Circulating Water Pump	a) Planetary gear failure	2

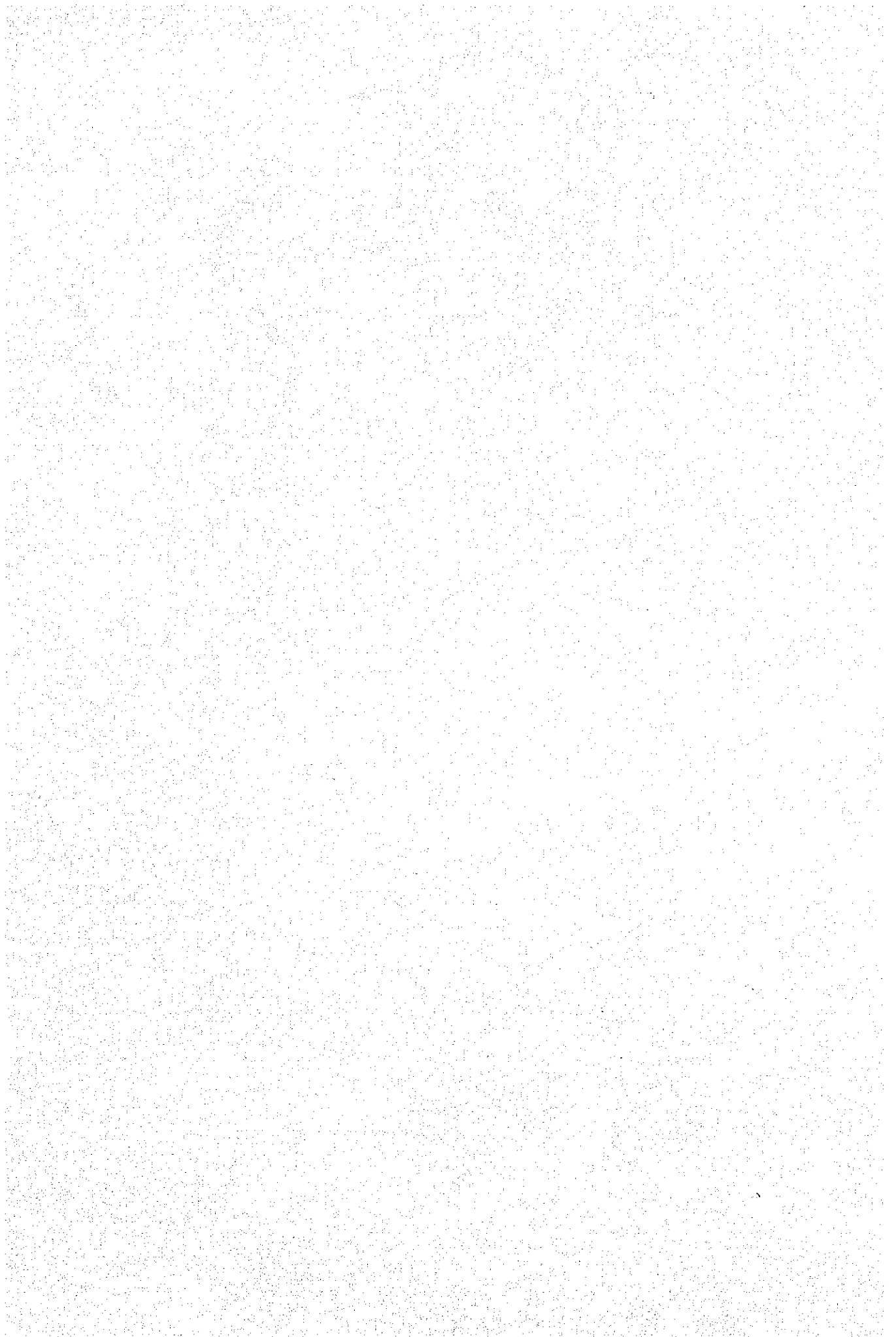


RECORD OF FORCED OUTAGES

Snyder Unit No. 1

Apr. 30/71 to Mar. 25/82

<u>EQUIPMENT/SYSTEM</u>	<u>NATURE OF TROUBLE</u>	<u>NO. OF TIMES</u>
1) Boiler	a) Burner failure	2
	b) Valve leaks	9
	c) Tube leaks	14
	d) Burner windbox burned	2
	e) Uncontrollable steam temperature	6
2) Turbine	a) Blade failures	7
	b) Excessive vibration	11
	c) Control valves trouble	5
	d) Cross-over pipe & expansion bellows leakage	4
	e) Hydraulic control system trouble	10
	f) Inspection of internals and parts	3
	g) Tripping device trouble	11
	h) Blade washing	2
	i) Fire accident	1
3) Air Heater & Steam Coil Air Heater	a) Clogging	25
	b) Drive mechanism trouble	2
	c) Damaged main parts	2
4) High Pres. Heaters	a) Tube leaks	5
	b) Drip lines trouble	10
5) Turbine-Driven Boiler Feed Pump	a) Balancing leak-off system trouble	3
	b) Clogging of suction strainer	
	c) Temp. equalizing pump recirc. trouble	2
	d) Damaged on pump parts	7
	e) Min. flow system trouble	
6) Low Pres. Heaters	a) Tube leaks	6
7) Motor-Driven Boiler Feed Pump	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
8) Condensing, Condensate & Make-up System	a) Tube leak at main condenser	9
	b) Leakage at raw water box	1
	c) Low demineralized water reserve	3
	d) Leakage at condensate pump suction expansion joint	1
9) Main Fuel Oil System	a) Leakage at F.O. heater & MOP pipes	2
	b) MFOP mechanical trouble	3
	c) F.O. header pres. regulator trouble	2

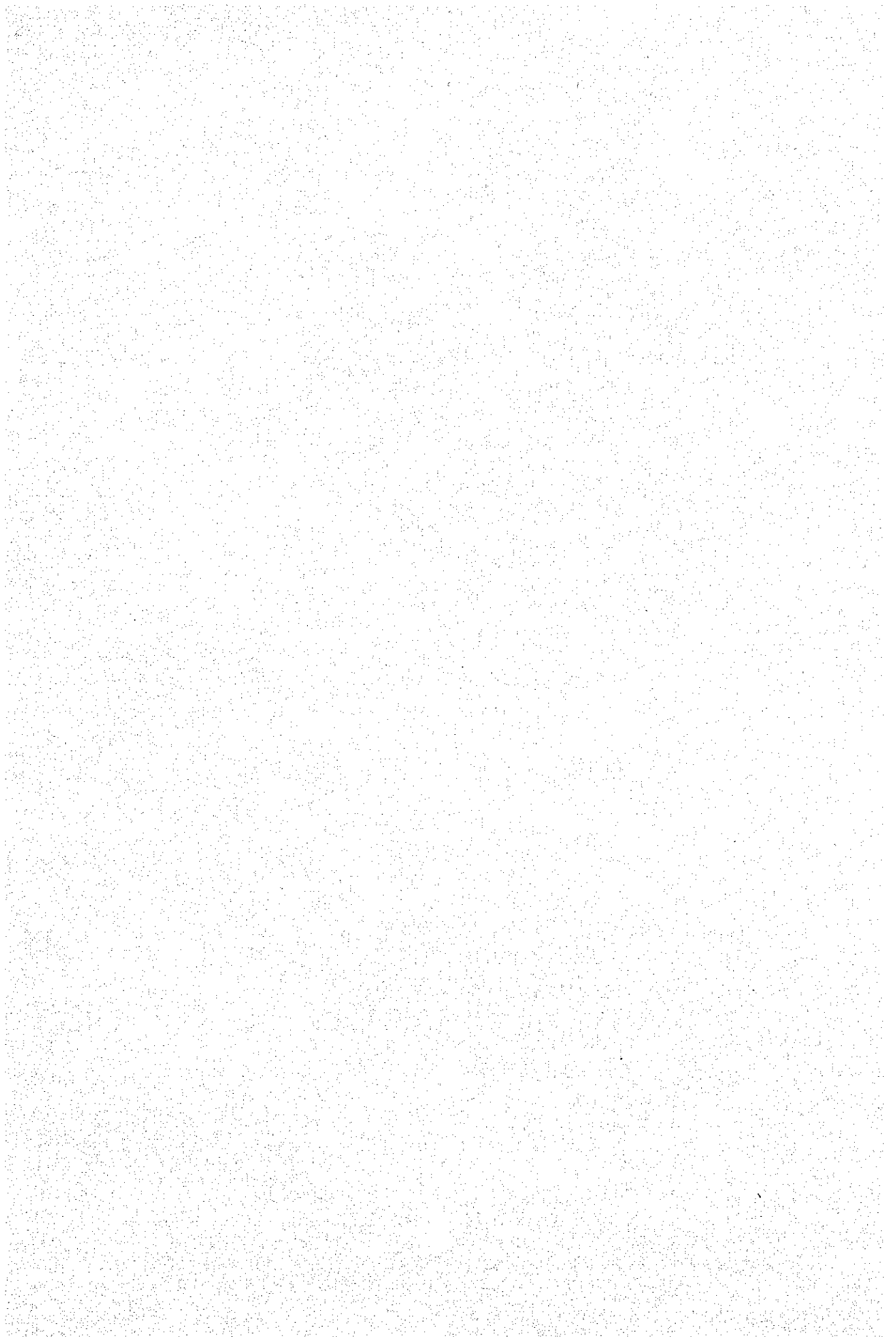


RECORD OF FORCED OUTAGES

Snyder Unit No. 1

Apr. 30/71 to Mar. 25/82

<u>EQUIPMENT/SYSTEM</u>	<u>NATURE OF TROUBLE</u>	<u>NO. OF TIMES</u>
10) Gas Recirc. Fan	a) Motor overload	1
11) Generator	a) Breaker G3GG8 trouble	2
	b) Wet generator control cubicle	1
	c) Oil circuit breaker malfunction	1
	d) Grounded Bus "D"	1
	e) Reverse power relay trouble	3
	f) Shorted emergency trip relay and back-up relay	3
	g) Voltage regulator trouble	1
12) Main Transformer	a) Jumper line faults	4
	b) Bursting of lightning arrester phase C	1
	c) Differential lockout trouble	1
13) Electrical System	a) Tripping of 115 kV lines due to heavy downpour	1
	b) Loss of 4160 V power supply	1
14) Boiler-Turbine Interlock	a) Feedwater regulator malfunction	5
	b) Poor combustion, drop in air flow	1
	c) 4160 V Bus "D" grounded	2
15) Circulating Water Pump	a) Planetary gear failure	3

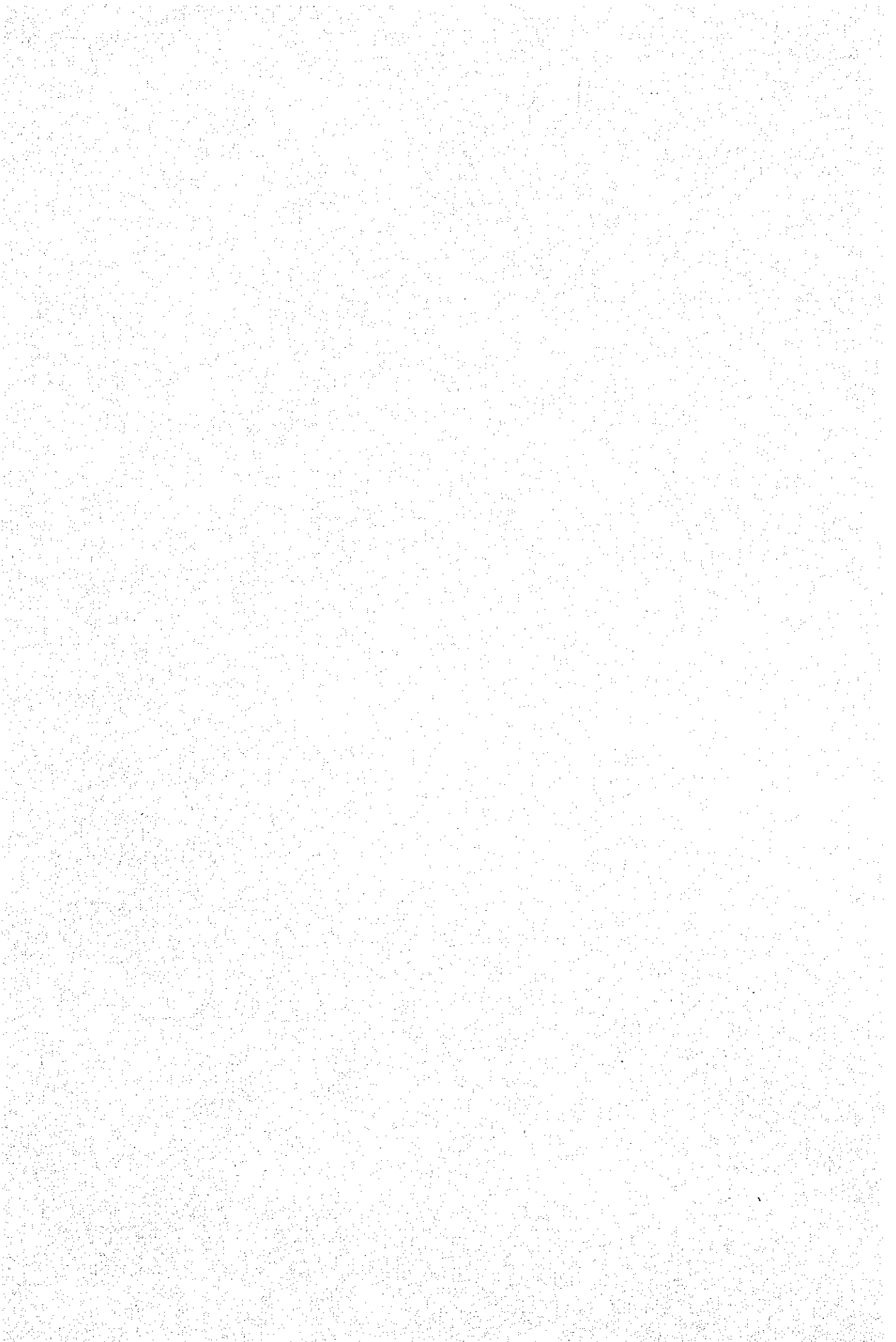


RECORD OF FORCED OUTAGES

Snyder Unit No. 2

June 2/72 to Dec. 31/81

<u>EQUIPMENT/SYSTEM</u>	<u>NATURE OF TROUBLE</u>	<u>NO. OF TIMES</u>
1) Boiler	a) Tube leak	19
	b) Gas leak at casing	7
	c) Uncontrollable temp/pres.flow conditions	10
	d) Burner damage	1
	e) Valve leaks	9
2) Main Turbine	a) Excessive vibration	13
	b) Electro-hydraulic governor failure	8
	c) Control valves failure	11
	d) Exhaust flange leakage	1
	e) Damaged bearing & turbine rotating parts	5
	f) Broken blades	3
3) Air Preheater	a) Clogging	37
	b) Damaged bearing and parts	2
	c) Replaced burned elements	3
	d) Sootblower failure	1
4) High Pres. Heaters	a) Tube leak	15
	b) Drip line leakage	8
	c) Leakage at isolating valve	4
5) Low Pres. Heaters	a) Tube leak	2
6) Turbine-Driven Boiler Feed Pump	a) Min. flow system trouble	3
	b) Control mechanism failure	1
	c) Low vacuum at auxiliary condenser	3
	d) Leakage at turbine gland steam	1
7) Motor-Driven Boiler Feed Pump	a) Clogging of suction strainer	1
	b) Temp. equalizing pump line leakage	2
8) Main Condenser	a) Tube leak	15
	b) Leakage at drain line to condenser	2
	c) Hotwell level regulator failure	1
9) Condensate System	a) Ammonex exhaustion	2
	b) Low demineralized water reserve	1
10) Main Fuel Oil System	a) Leakage at CDFOP pipe flange	1
	b) Header pres. regulator line leakage	5
	c) Fire accident at MFOP area	1
11) Forced Draft Fan	a) Excessive vibration	3
12) Major Piping & Valves	a) Leakage at auxiliary steam header	1
	b) Leakage at CRH end flange	2
	c) Extraction A-4 flange leak	2

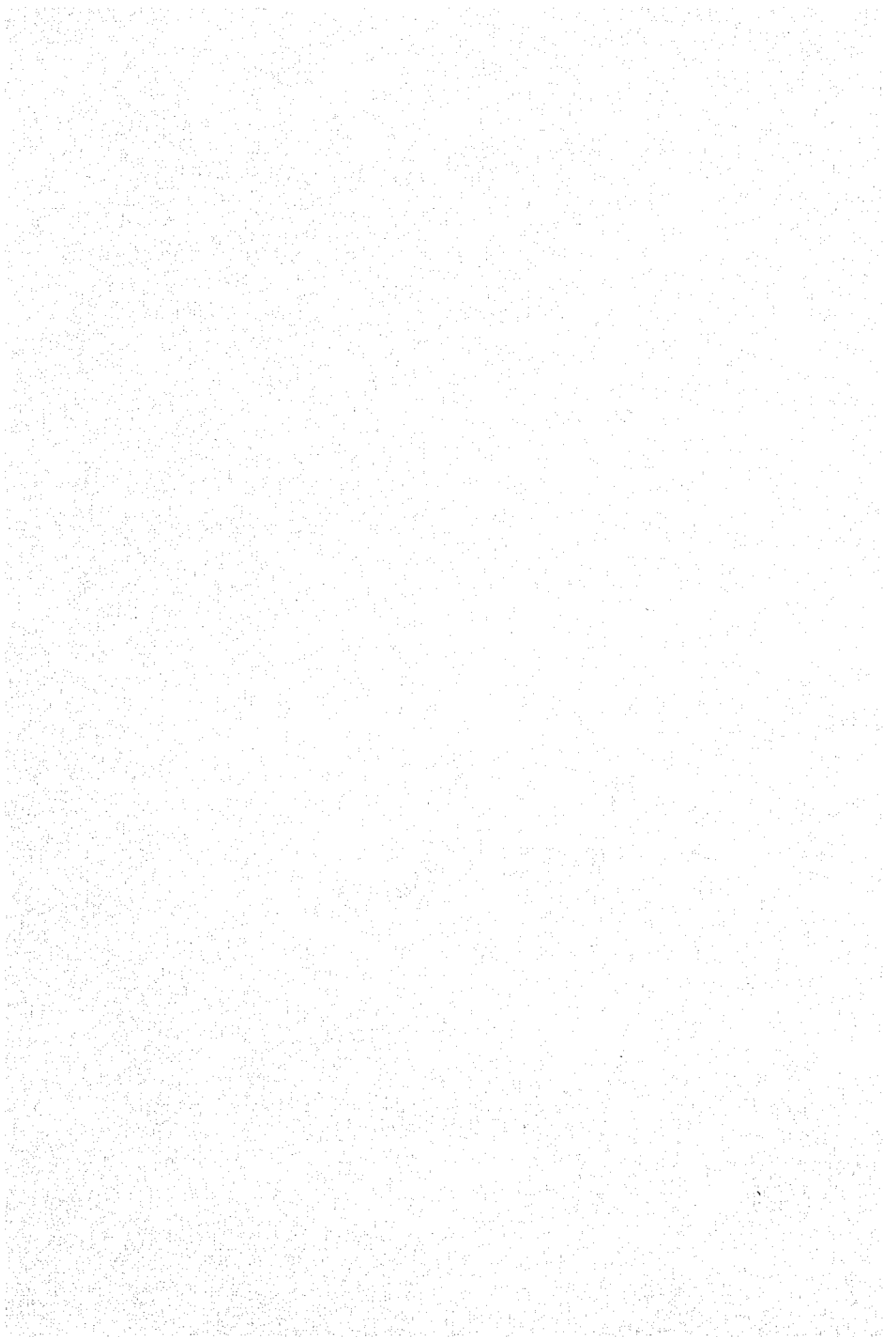


RECORD OF FORCED OUTAGES

Snyder Unit No. 2

June 2/72 to Dec. 31/81

<u>EQUIPMENT/SYSTEM</u>	<u>NATURE OF TROUBLE</u>	<u>NO. OF TIMES</u>
13) Generator	a) Reverse power relay failure	2
	b) Voltage regulator trouble	1
	c) DC hi-pot test of stator	1
	d) Grounded breaker control cable	1
	e) Excitation loss	1

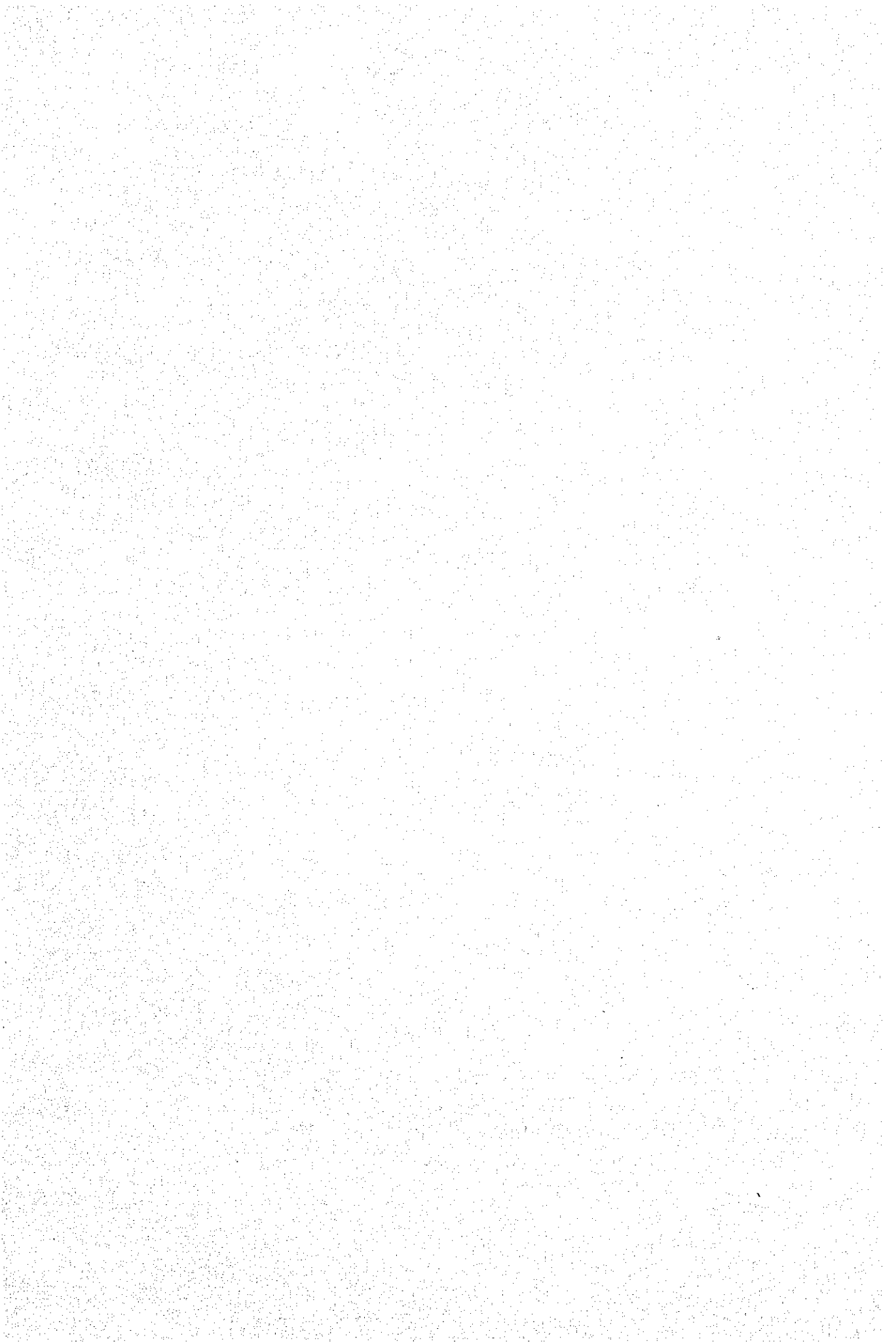


RECORD OF FORCED OUTAGES

Malaya Unit No. 1

Dec. 21/74 to Mar. 25/82

<u>EQUIPMENT/SYSTEM</u>	<u>NATURE OF TROUBLE</u>	<u>NO. OF TIMES</u>
1) Boiler	a) Uncontrollable steam temperature	15
	b) Boiler tube leak	6
	c) Fire at F-3 air register assembly and oil leak	2
	d) Low feedwater flow w/c result to BTI actuation	6
2) Generator	a) Loss of excitation	1
	b) Damaged bearings #2 and #8	1
	c) Over-excitation	2
	d) Tripped with alarm indications for generator reverse power, 480 Bus A & B	1
	e) Detachment of voltage regulator	1
3) Turbine Boiler Feed Pump (TBFP)	a) Malfunction of TBFP speed adjuster	1
	b) Trouble at planetary gear of T-BFP booster pump	1
	c) Repair of TBFP min. flow valve	2
	d) Excessive steam leak at flexitallic gasket	2
4) High Pressure Heaters	a) Leaking HPH tubes	11
	b) Leak at HPH drain valve	1
	c) Steam leak at orifice flange connection of HPH 6B	1
	d) Leak at HPH 6A outlet valve	1
	e) High water level of HPHs	1
5) Main Fuel Oil Pump	a) Overload of MFOP 1A	1
	b) Tripping of MFOP 1A motor	1
	c) Tripping of MFOP 1A due to relief valve excessive leak	1
	d) Leak at MFOP discharge line	1
	e) Tripped due to busted TBFP condenser safety device diaphragm	1
6) Main Transformer	a) Differential lockout	2
	b) Explosion of lightning arrester bushing phase B of 115 kV line	1
7) Low Pressure Heaters	a) Tube leak	1
	b) Tripped due to extremely high level at LPH #3	1

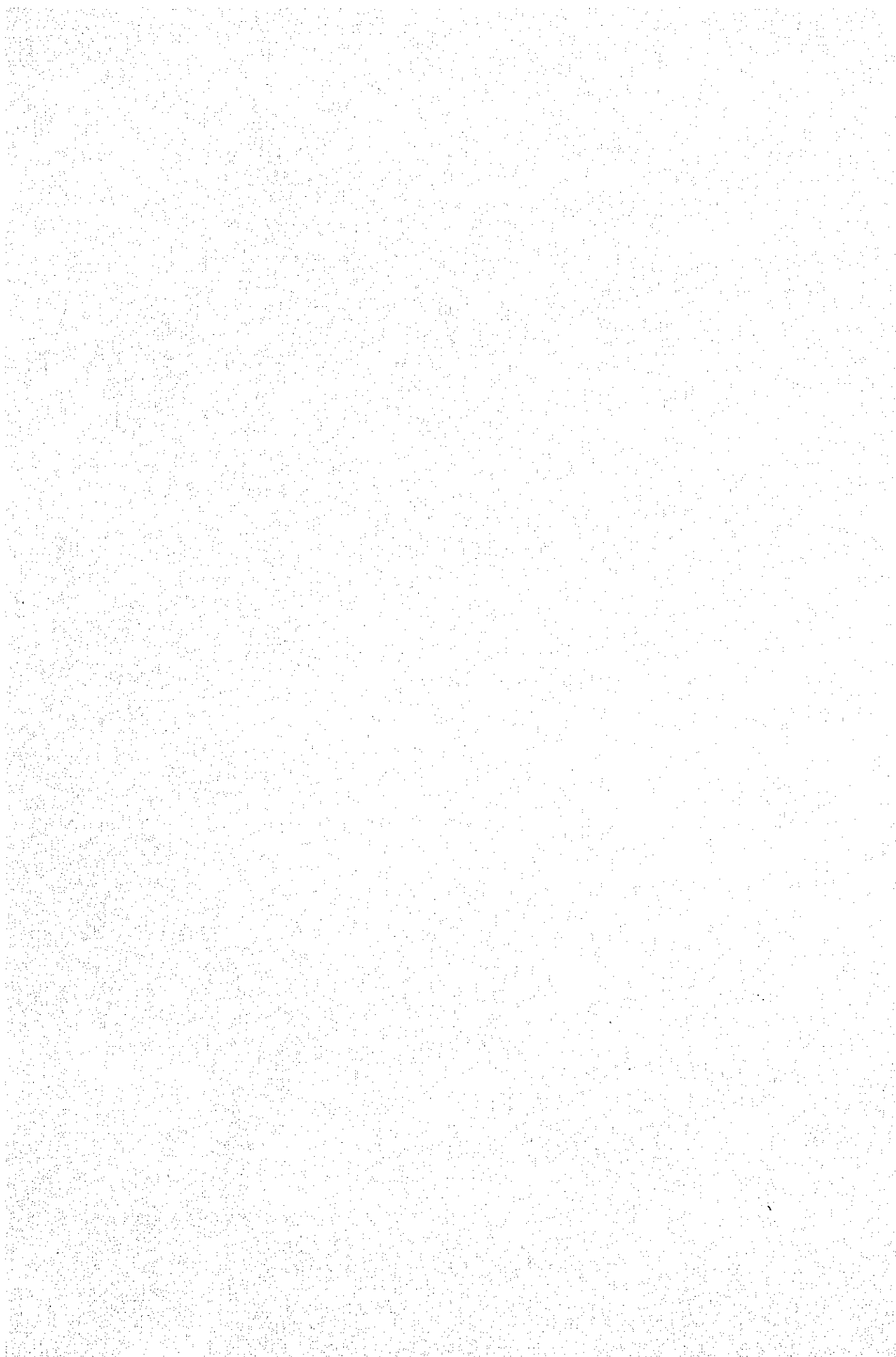


RECORD OF FORCED OUTAGES

Malaya Unit No. 1

Dec. 21/74 to Mar. 25/82

<u>EQUIPMENT/SYSTEM</u>	<u>NATURE OF TROUBLE</u>	<u>NO. OF TIMES</u>
8) Turbine	a) Drain station leak	1
	b) Crack turbine blades	1
	c) Excessive vibration	12
	d) Jacking oil pump leak	1
	e) Seal oil unit line leak	1
	f) Leak at HP admission sensing line	1
	g) Leak at HP exhaust sensing line	1
	h) Busted rupture diaphragm	1
	i) Leak at cold reheat flange	2
	j) IPCV #1 drain line excessive leak	3
	k) IPCV #2 drain line leak	1
l) IPCV #3 drain line leak	1	
9) Controls - (Pneumatic/Electrical)	a) Oil contamination of pneumatic controls	1
	b) EHG control fault	2
	c) Tripped due to actuation of LPH extreme high level protection	1
	d) Malfunction of remote tripping solenoid valve	1
	e) Failure of thrust bearing safety device to reset	1
10) By-Pass System Control Valve	a) CV-101 expansion joint steam leak	2
	b) CV-104 uncontrollable operation	1
11) Motor Boiler Feed Pump (MBFP)	a) Tripped when low deaerator level float control was actuated	1
12) Circulating Water Pump (CWP)	a) Tripping of both CWPs as a result of DC failure	1
13) Condenser	a) Low vacuum	2
	b) Chloride contamination	3
	c) High conductivity	1
14) Outside Trouble	a) Tagig-Dolores line	1
	b) Blaisdell-Sta. Mesa Line	1
	c) Failure of 230 kV line	1
	d) System disturbance	2
	e) San Jose-Tiwi line	1
	f) Line fault at Dolores 1 & 2	3
	g) Dolores-Malaya 115 kV line	4
	h) Gardner-Tagig line	1

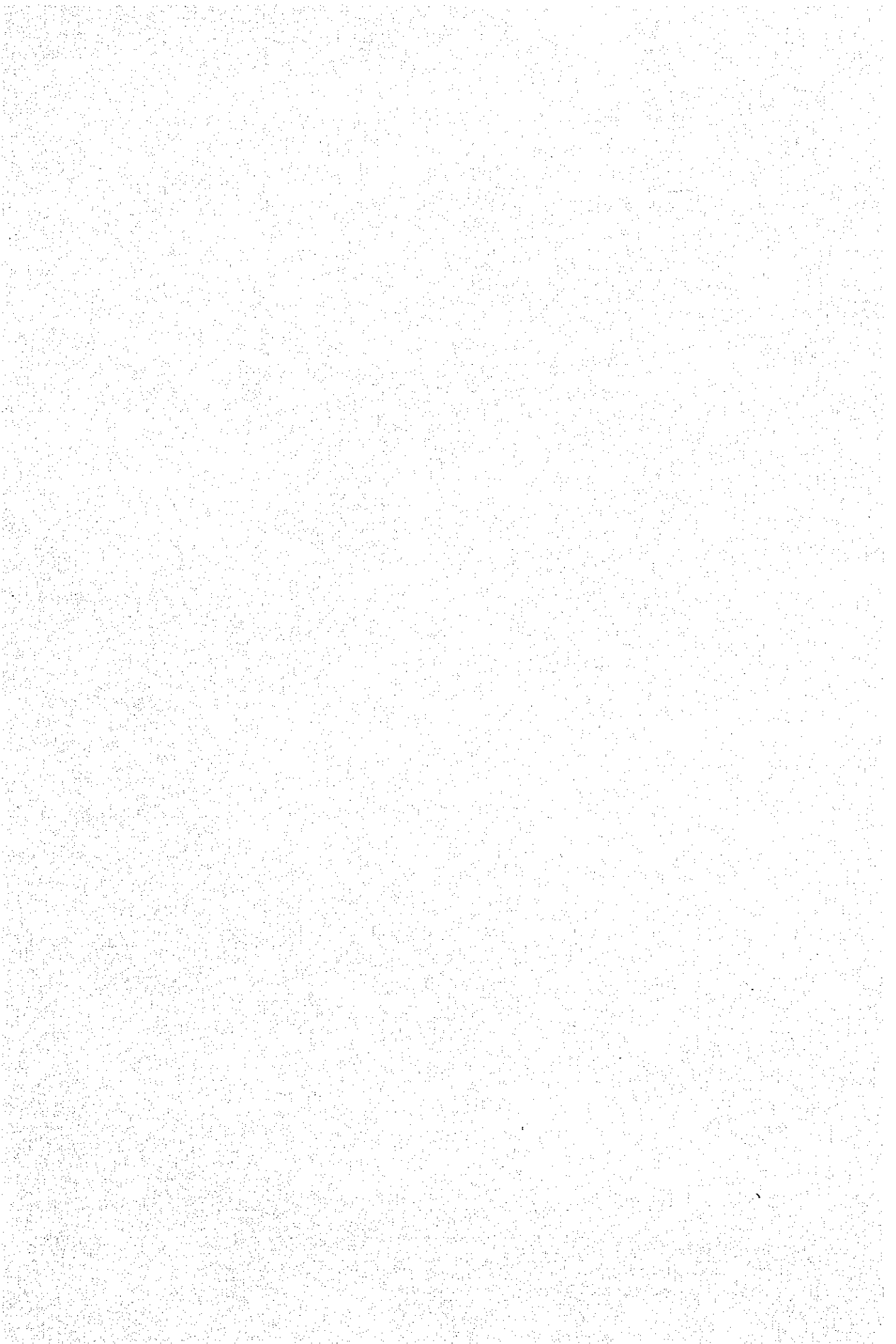


RECORD OF FORCED OUTAGES

Malaya Unit No. 2

Mar. 11/79 to Mar. 25/82

<u>EQUIPMENT/SYSTEM</u>	<u>NATURE OF TROUBLE</u>	<u>NO. OF TIMES</u>
1) Boiler	a) Tube failure	2
	b) Furnace pressure high	2
	c) Loss of BACC power	3
2) Main Fuel Oil Pump	a) Leak one pre-heating discharge line	1
	b) Tripping of MFOP 2A	1
	c) Failure of MFOP 2B	1
	d) Low discharge pressure	1
	e) Low suction pressure	1
3) Drum Level Transmitter	a) Malfunction of level transmitter	1
	b) Low boiler drum level	4
	c) Leak at sensing line	1
4) DC Power Supply	a) Failure of DC power supply	1
5) Condenser	a) Low vacuum	2
	b) Chloride contamination of Dem. water	1
6) Turbine	a) Excessive turbine vibration	3
	b) Turbine balancing due to excessive vibration	1
	c) Bearing damage due to DC oil pump failure	1
	d) Uncontrollable temperature	1
	e) Oil leak at No. 2 bearing	1
7) Generator	a) Malfunction of stator cooling regulator	2
	b) Burnt-out carbon brushes	1
	c) Reverse power caused by malfunction of relay on AVR	1
	d) Excitation system failure	2
8) Control Air supply	a) Sudden tripping of MFO shut-off valve due to low control air supply	1
9) Circulating Water Pump	a) Tripping of both CWPs due to low vacuum	3
10) Station Service	a) Loss of station service, emergency feed fails to cut in	1
11) Deaerator	a) Leaky deaerating heater manhole cover	1
12) Main Transformer	a) Tripped due to differential lockout	2
	b) Busting of relief diaphragm	1
	c) Oil pressure drop from relief diaphragm	1
	d) Explosion of lightning arrester	1

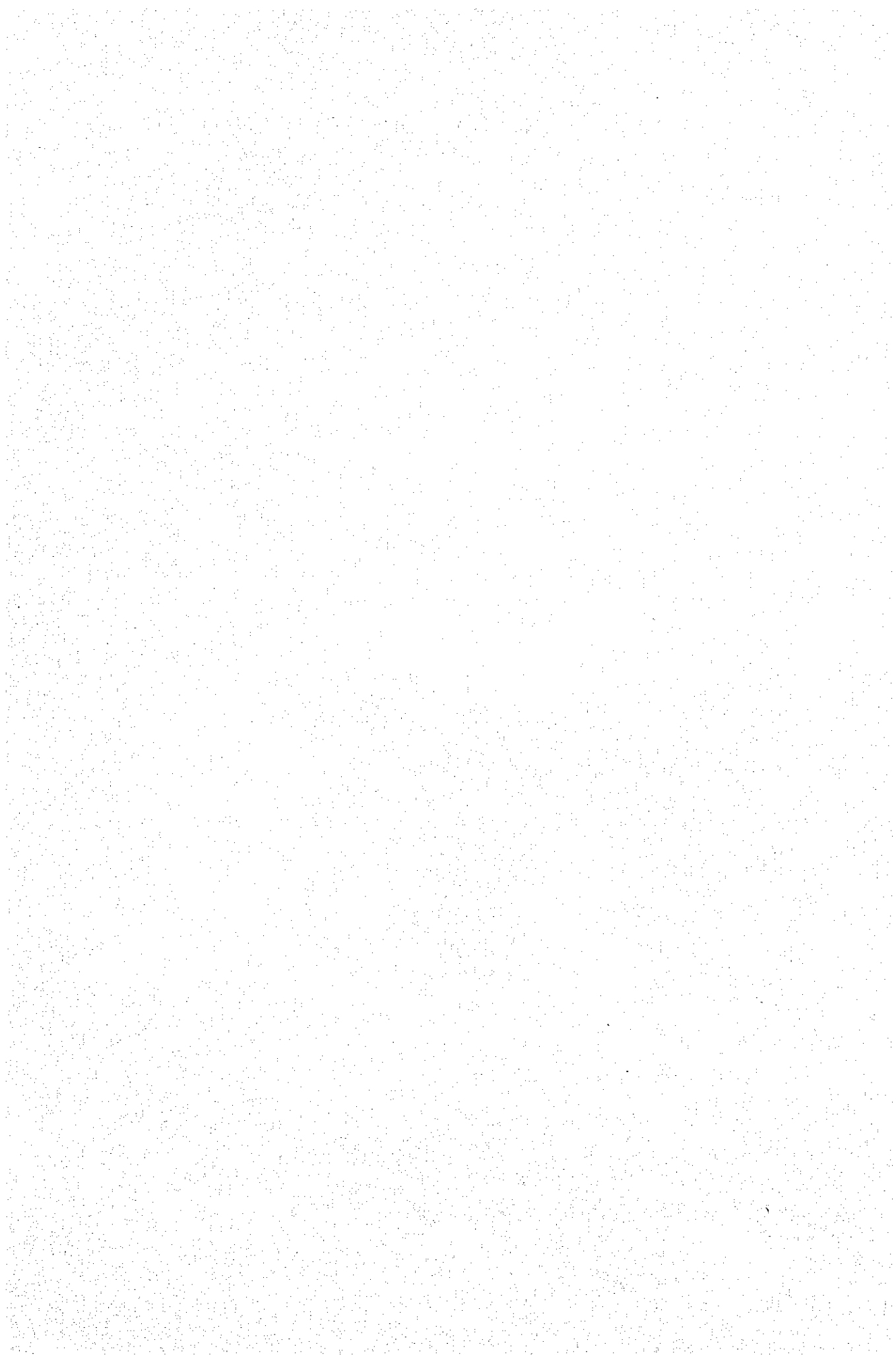


RECORD OF FORCED OUTAGES

Malaya Unit No. 2

Mar. 11/79 to Mar. 25/82

<u>EQUIPMENT/SYSTEM</u>	<u>NATURE OF TROUBLE</u>	<u>NO. OF TIMES</u>
13) Motor Boiler Feed Pump	a) Tripped during change-over	1
14) Outside Trouble	a) Tripping of Dolores Line	1
	b) System Disturbance	1



POWER STATION: _____ UNIT NO. _____

APPENDIX II

CHECK SHEET FOR PERIODICAL INSPECTION

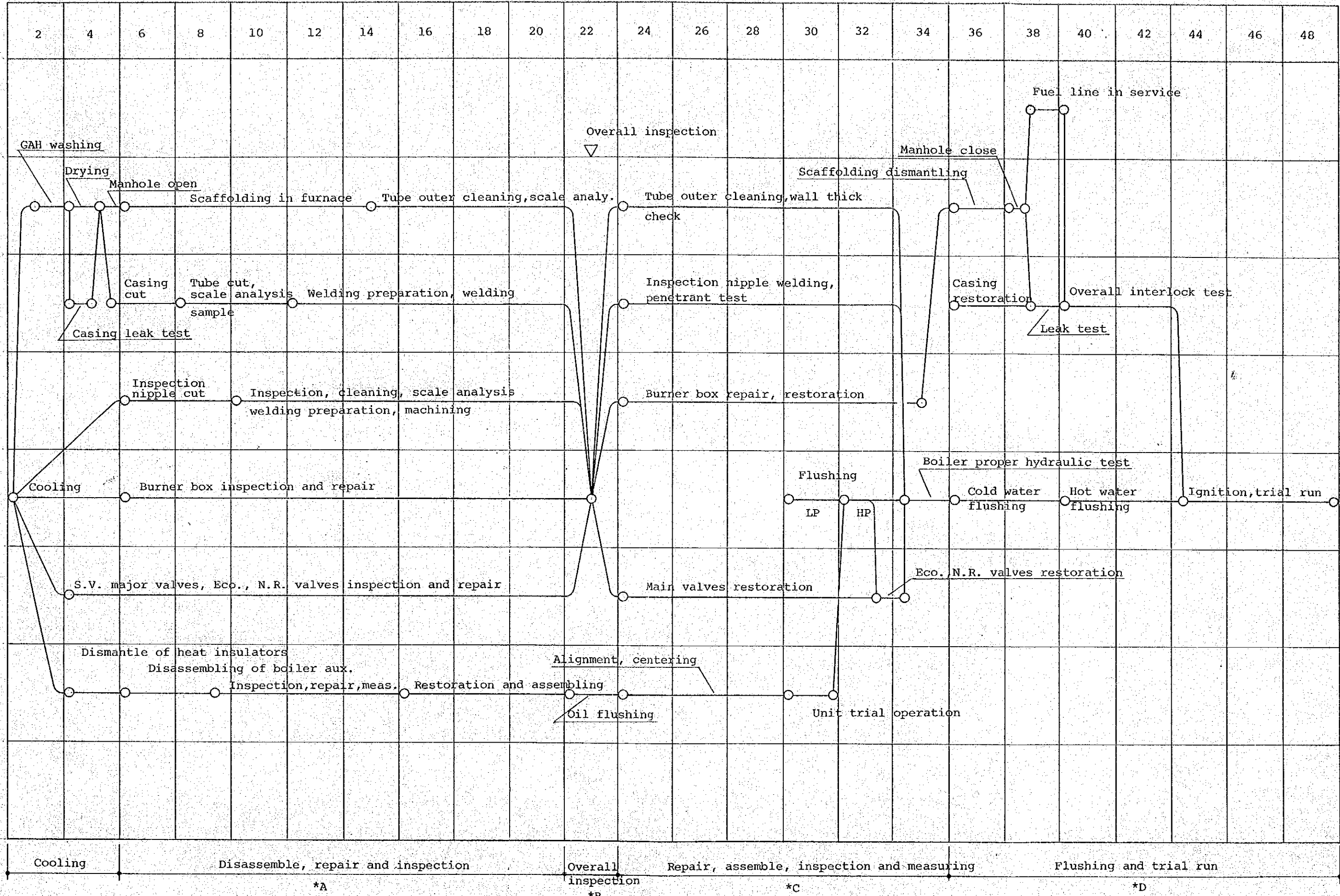
Periodical Inspection & Maintenance

- 。 Purpose: To find and analyze the actual situations, and to give appropriate guidance to suit the actual conditions.
- 。 Attached: An example and check sheets are attached in following sheets, and the numbers filled in shows actual standard practice (interval year) in the power station (unit), however, shows "occasional inspection/maintenance" e.g. in case of failure, shows "not executed or not planned till this stage".

Followings are additional remarks based on discussion between NAPOCOR and JICA mission.

- On maintenance manual and judgement standard of inspection
- On actual situation and actual periodical inspection
- JICA mission comments

BOILER



Cooling

Disassemble, repair and inspection

Overall inspection

Repair, assemble, inspection and measuring

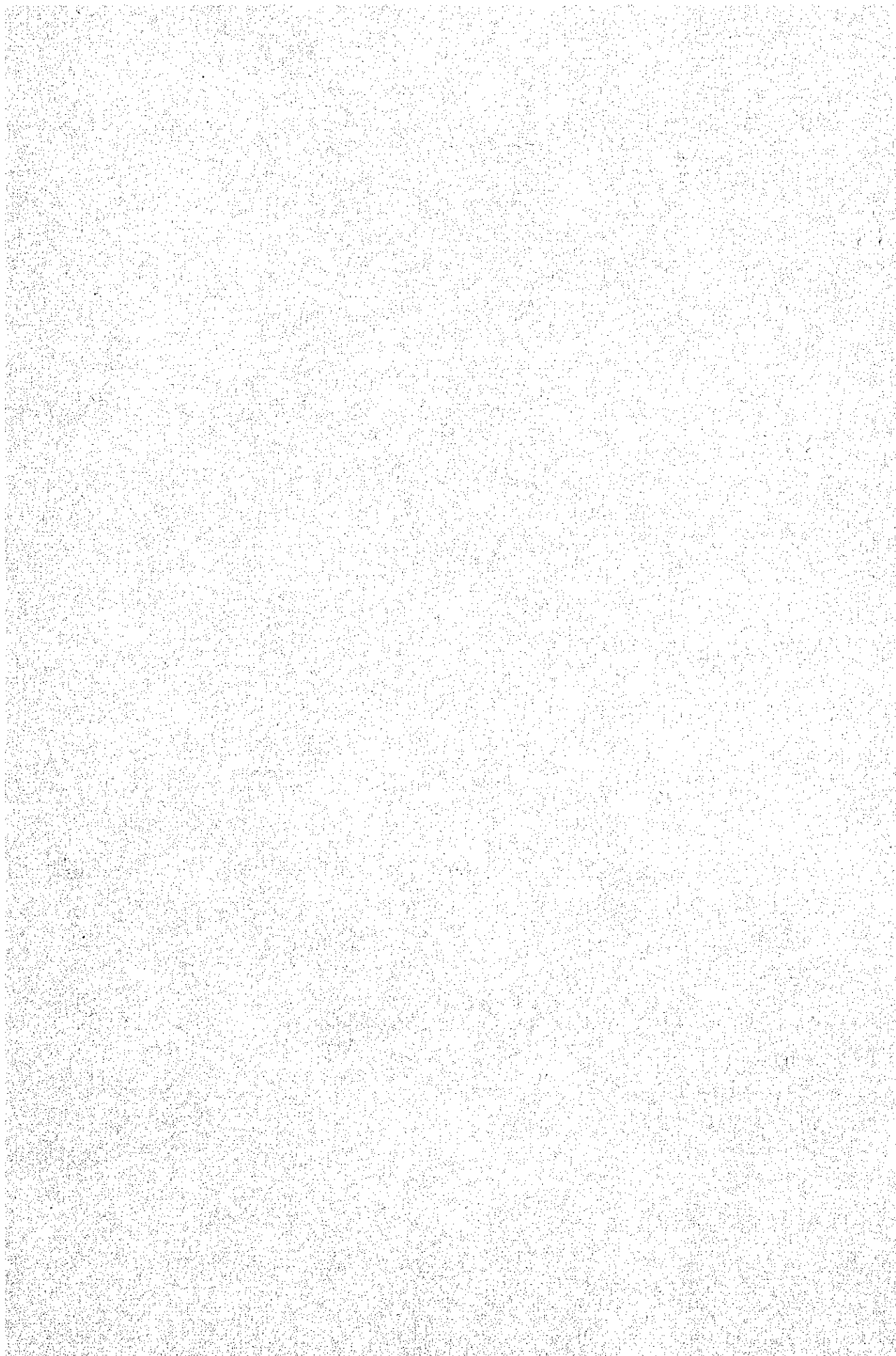
Flushing and trial run

*A

*B

*C

*D



POWER STATION: _____ UNIT NO. _____

*A Disassemble, repair and inspection

Disassemble

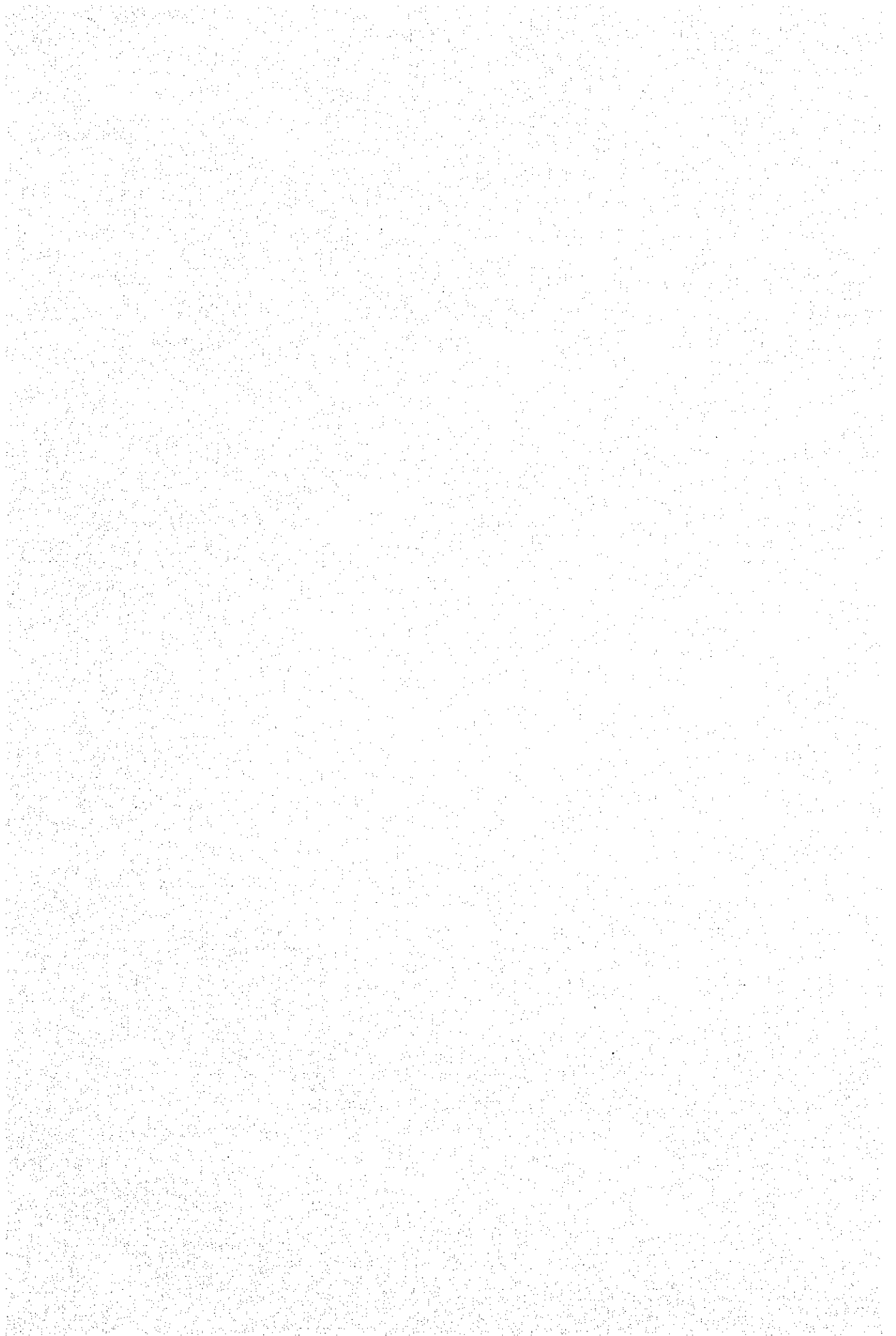
- Safety valve
- Sample tube cut
- Inspection nipple cut
- Boiler feed water pump
- Fuel oil pump
- Forced draft fan
- Auxiliaries

Repair

- Cleaning of outer tube
- GAH water washing
- Air blowing
- Spotting

Inspection

- Visual inspection
- Measurement of thickness
- Non-destructive test



POWER STATION: _____ UNIT NO. _____

*B Overall inspection

Water wall and burner section

Visual inspection

Color check of major portion

Tubes

Surface visual inspection

Measurement of outer diameter

Measurement of wall thickness

Inspection nipples

Visual check of outer surface

Inside check of header, etc.

Safety valve

Visual check of disassembled parts

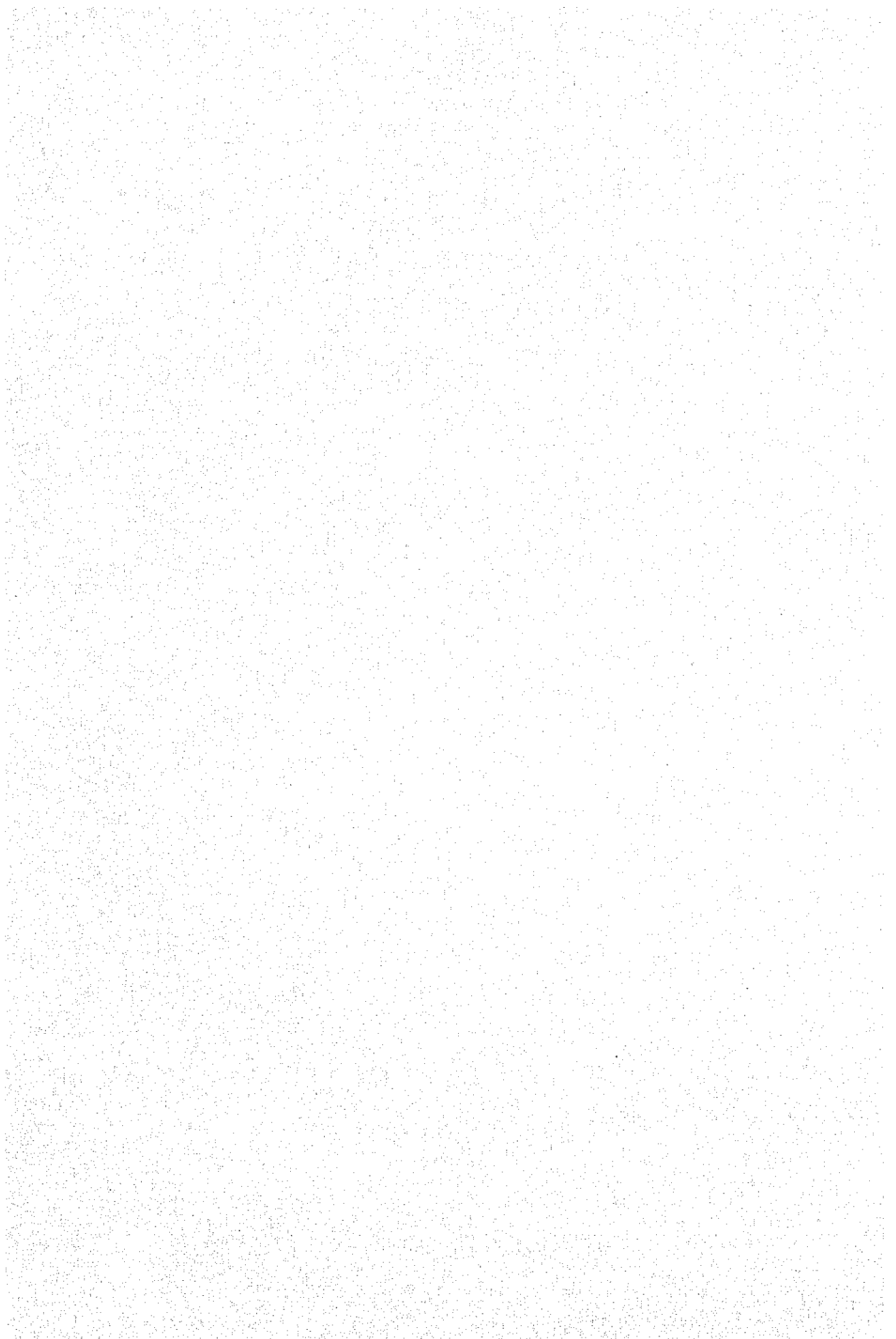
Color check of main parts

Measurement of valve stem bending

Boiler main valves

Visual check of disassembled parts

Color check of main parts



POWER STATION: _____ UNIT NO. _____

*C Repair, assemble, inspection and measurement

Repair

Tube outer cleaning

Spotting

Assemble

Main valves

Evapulator tubes

SH, RH tubes

Inspection nipples

Auxiliaries

Measurement

Clearance

Alignment

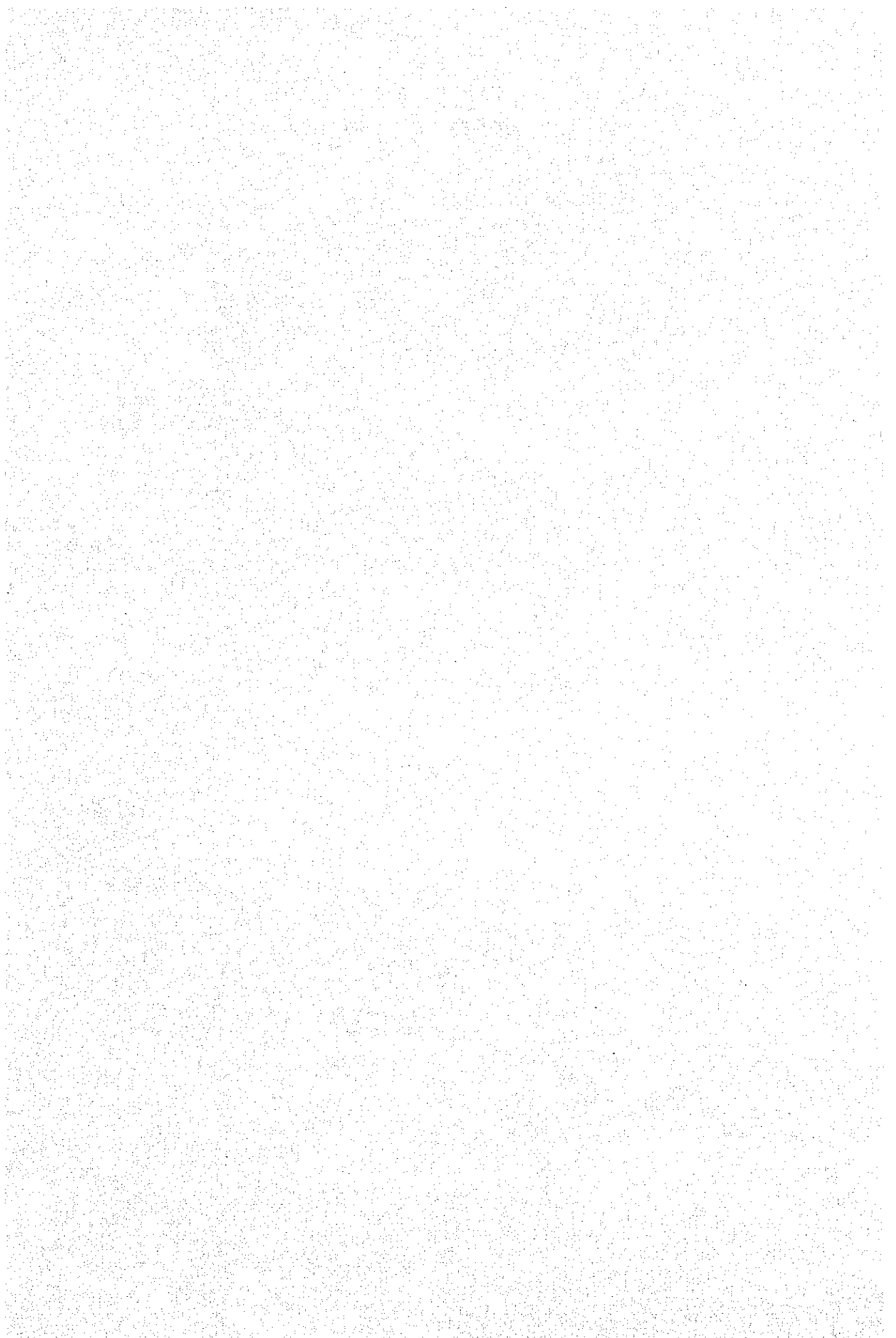
Outside diameter

Wall thickness

Inspection

Visual inspection

Non-destructive test



POWER STATION: _____ UNIT NO. _____

*D Flushing and trial run

Adjustment and trial run

Load test of each auxiliary

Interlock test of each auxiliary

Each line flushing

Each water analysis

Adjustment of each control valve lift

Safety valve operation test

Overall interlock test

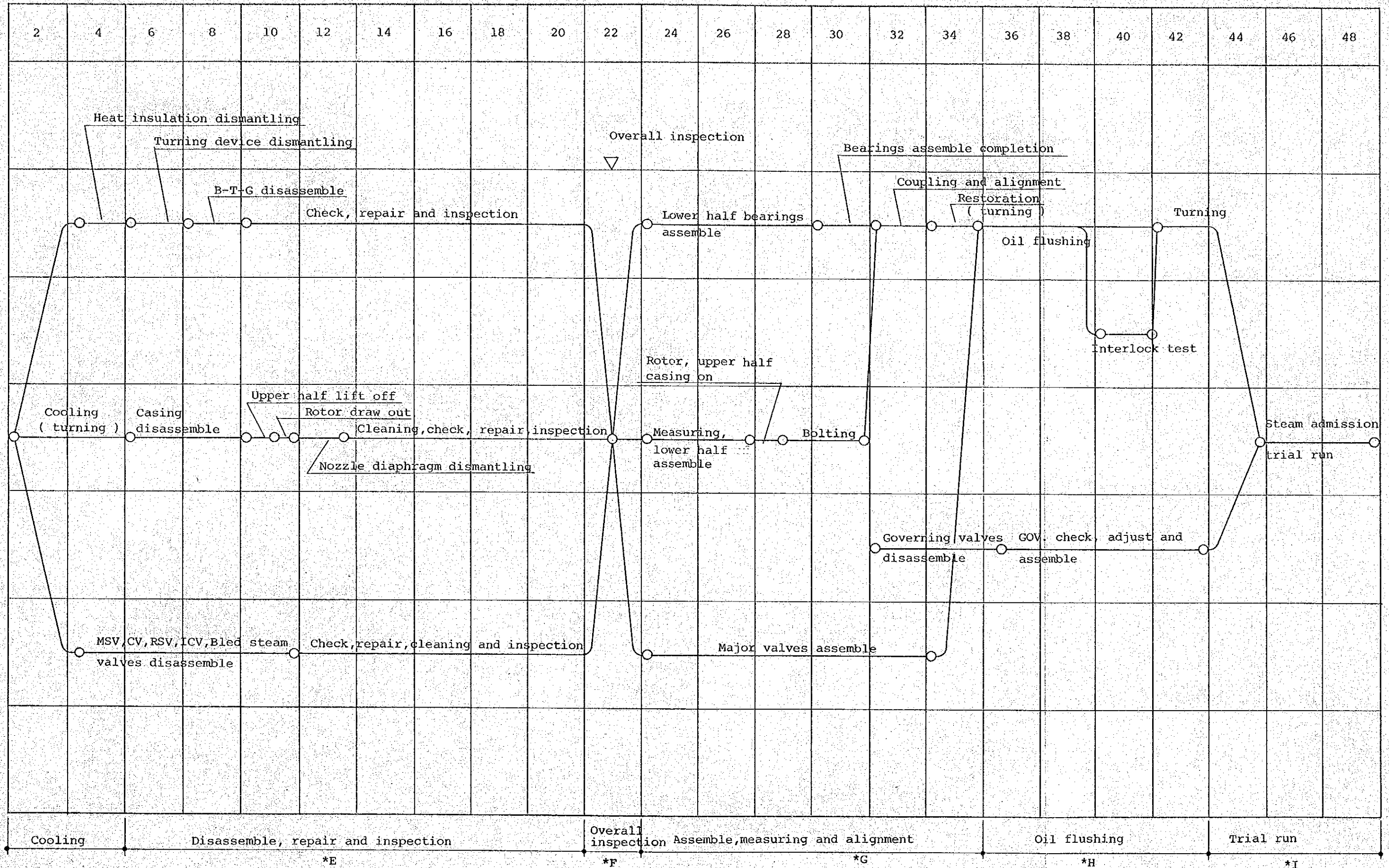
Load test (heat run)

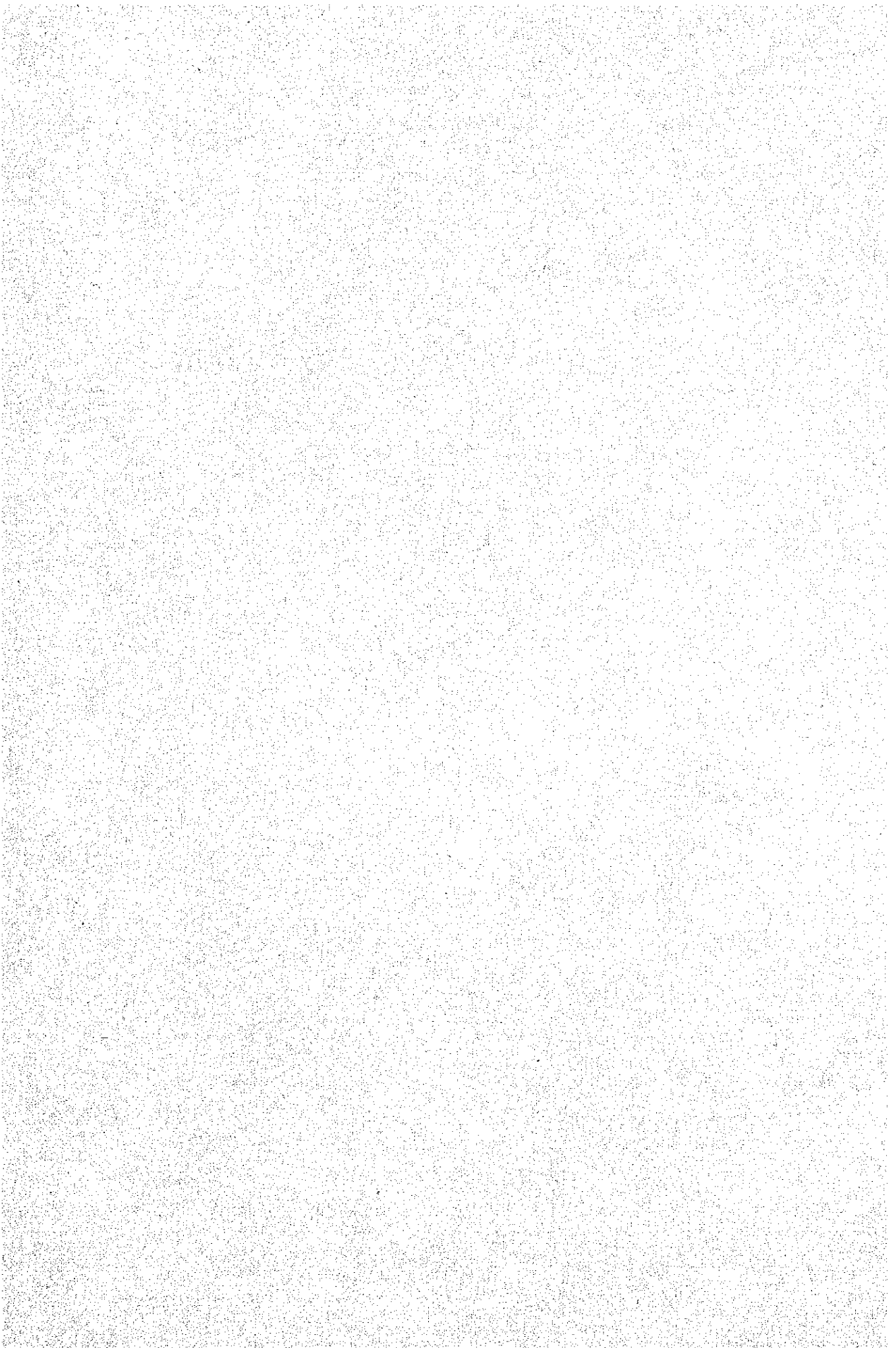
Adjustment of throttle valve

Control/interlock setting point

Performance test

TURBINE





*E Disassemble, repair and inspection

Disassemble

Bearing

Casing

Rotor

Nozzle diaphragm

Labyrinth packing

MSV

CV

RSV

ICV

Main oil tank

Bled steam valves

Majour valves

Repair

Air blowing

Wipe out

Spotting

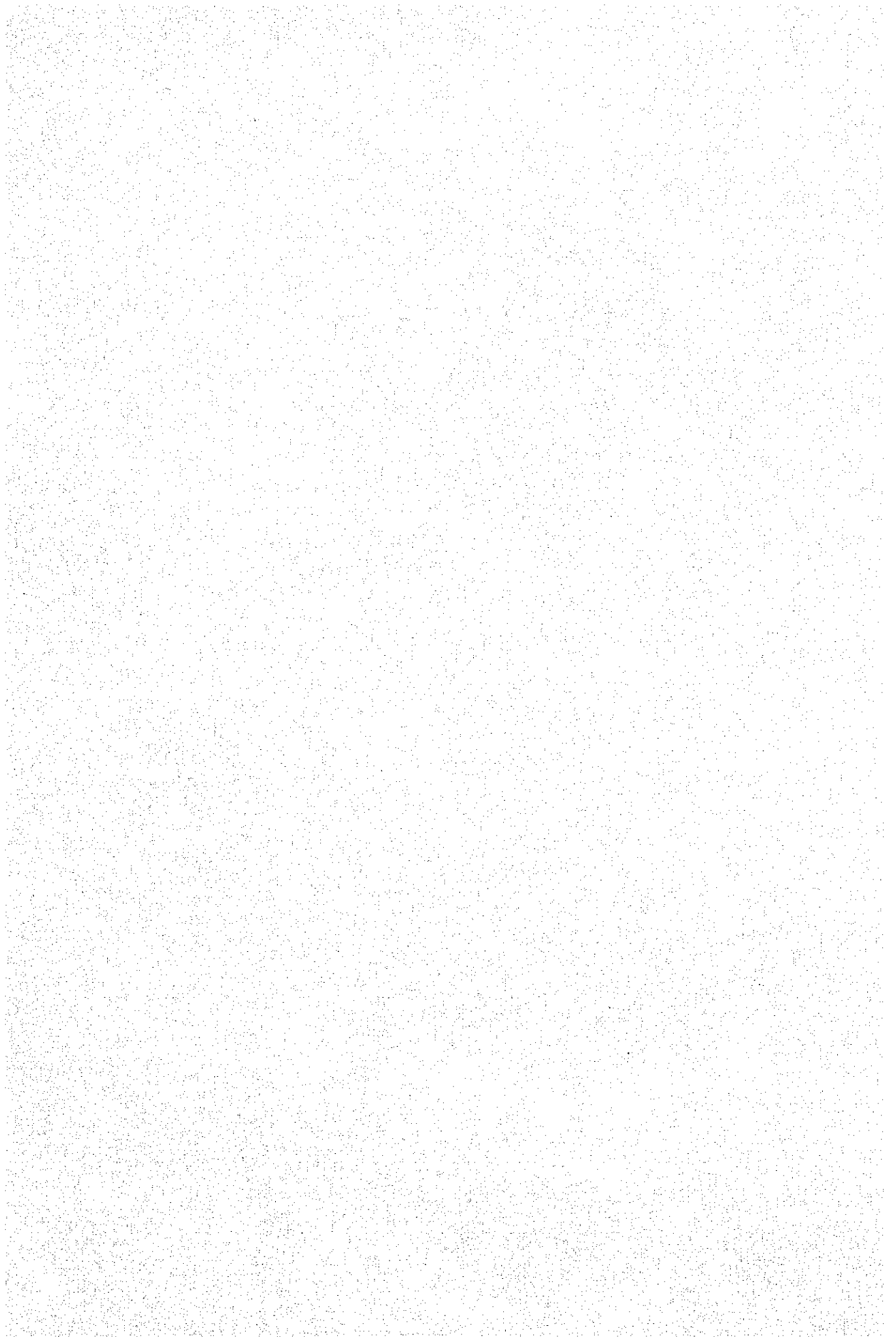
Inspection

Dimensions measure

Visual inspection

Nondestructive test

Handness measure



*F Overall inspection

Casing

Inner casing visual inspection

Outer casing visual inspection

Inner surface colour check

Bearing (Turbine & Generator)

Upper/Lower half visual check

Metal portion colour check

Rotor

Visual inspection

Bucket colour check

Rotor disk colour check

Nozzle diaphragm

Visual inspection

Colour check

Valve

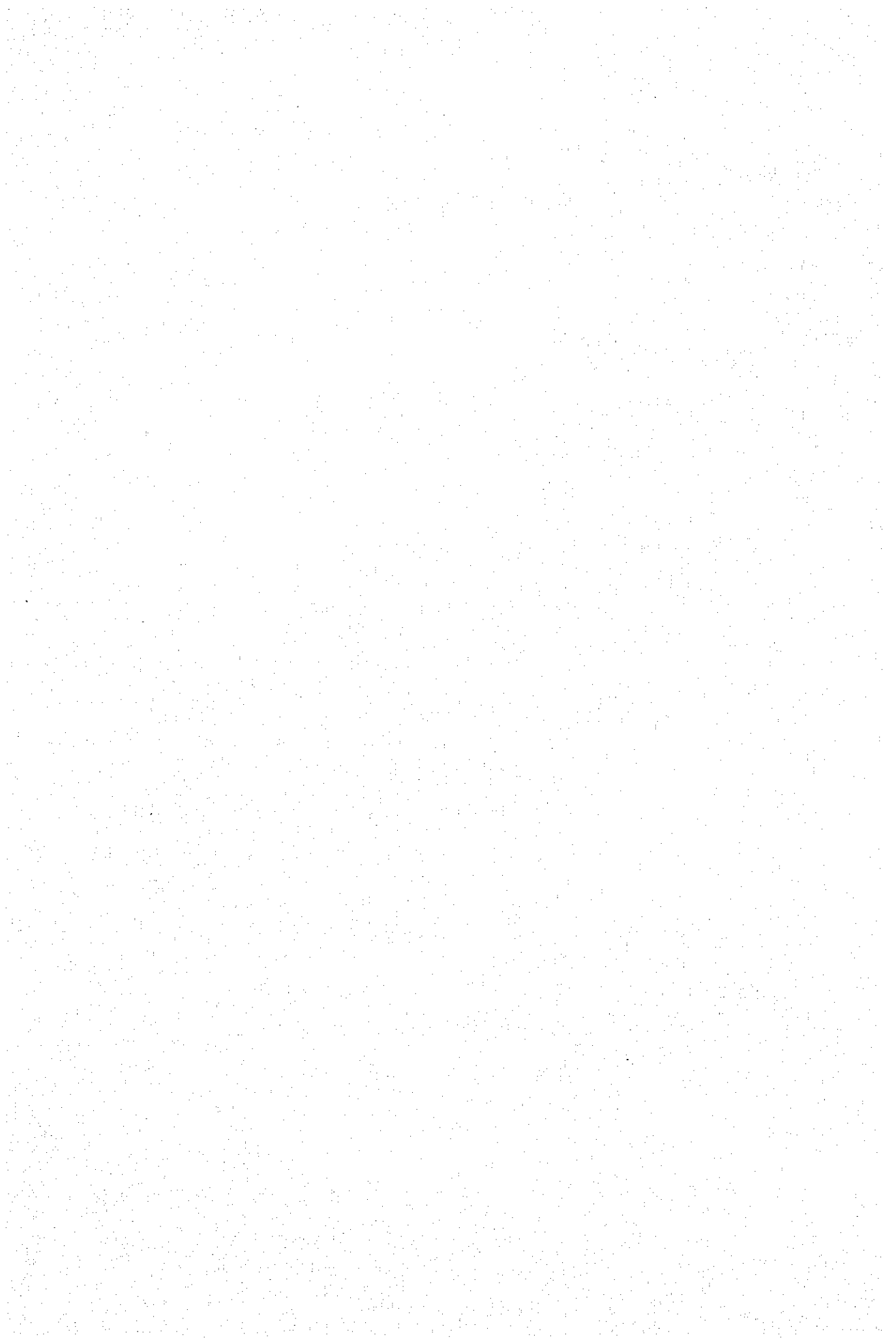
Stem colour check

Valve sheet colour check

Body colour check

Visual inspection

Actuator operation



POWER STATION: _____ UNIT NO. _____

*G Assemble, measuring and alignment

Assemble

Bearing

Casing

Nozzle diaphragm

Rotor

Labyrinth packing

Major valves

Measurement

Clearance

Centering

Alignment

POWER STATION: _____ UNIT NO. _____

*H Oil flushing

Adjust/Test/Trial run

Majour valves operation

Majour valves lift measure

Control/Interlock setting point

Interlock test

Protection system

No load test

Load test

Performance test

POWER STATION: _____ UNIT NO. _____

GENERATOR

* Disassemble

Coolers draw out

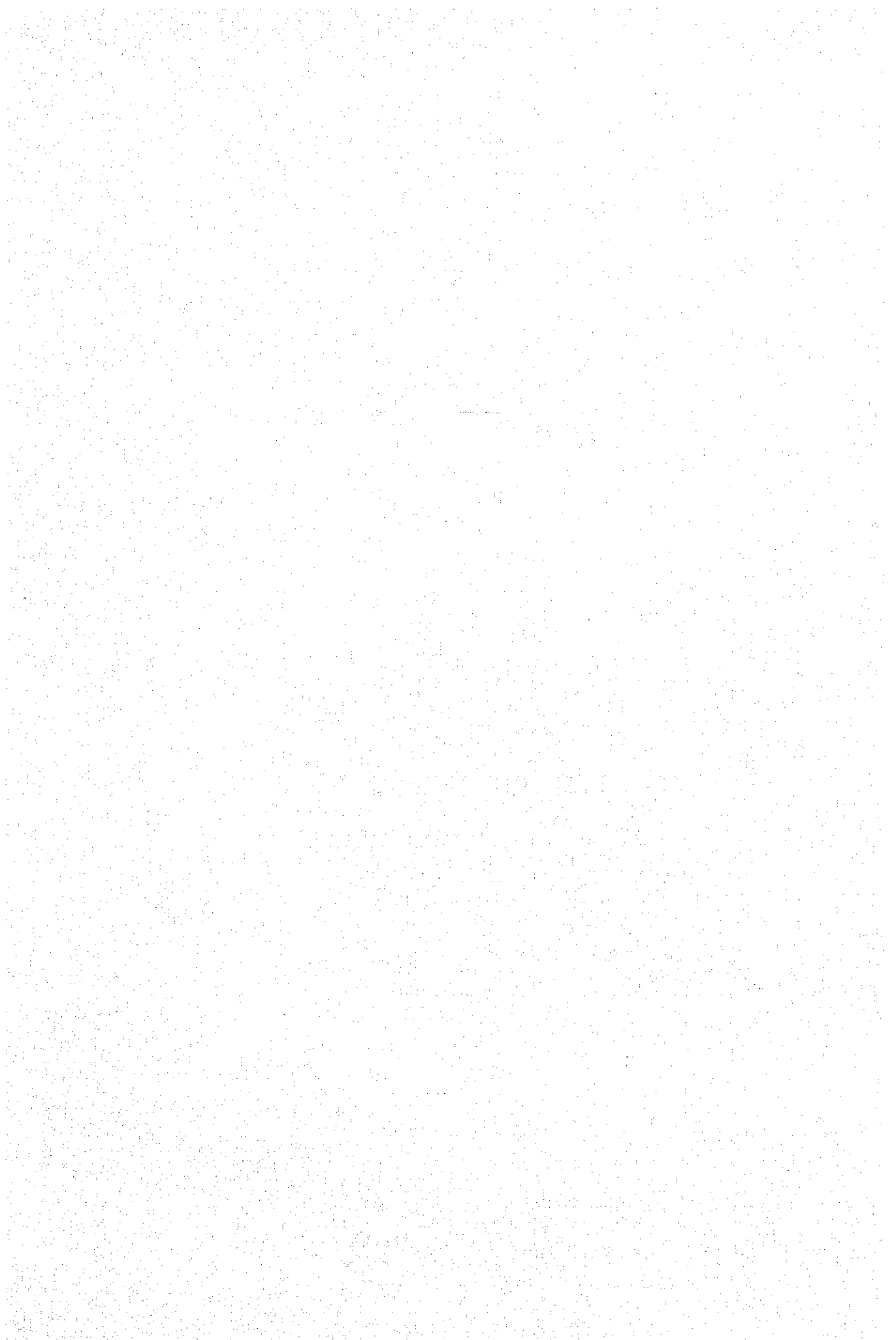
Rotor draw out

* Inspection Items

- o Rotor
 - Rotor fan blade/bolt colour check
 - Wedge UST and visual inspection
 - Wedge alignment, slip visual inspection
 - Balance weight location and lock visual inspection
 - Insulation visual inspection & insulation check
 - The others visual inspection

- o Stator frame
 - Oil leak visual inspection
 - RTD fixing & lead wire visual inspection
 - Rust visual inspection
 - Header pipe fixing visual inspection
 - Cooler room condition visual inspection
 - Packing gland fixing leak test
 - The others visual inspection

- o Stator core
 - Stud fixing hammering noise check
 - Core end epoxy finishing visual inspection
 - Compression ring hammering noise check
 - Inner cage support visual inspection
 - Rust and the others visual inspection



POWER STATION: _____ UNIT NO. _____

GENERATOR

- Stator coil
 - Coil end condition visual inspection (support, stain)
 - Coil end insulator condition visual inspection
 - Slot & spacer visual inspection
 - Wedge hammering noise check
 - The others visual inspection

- Terminal box
 - Oil leak visual inspection
 - Support insulator crack visual inspection
 - Bushing fixing packing leak test
 - Coil outgoing end connection portion visual inspection
 - Outgoing bushing visual inspection

- Collector ring
 - Stain, wear visual inspection
 - Insulation resistance measurement
 - Fixing condition inspection

- Brush, brush holder
 - Fixing visual inspection & hammering noise check
 - Crack, defrict visual inspection
 - Sliding part visual inspection

POWER STATION: _____ UNIT NO. _____

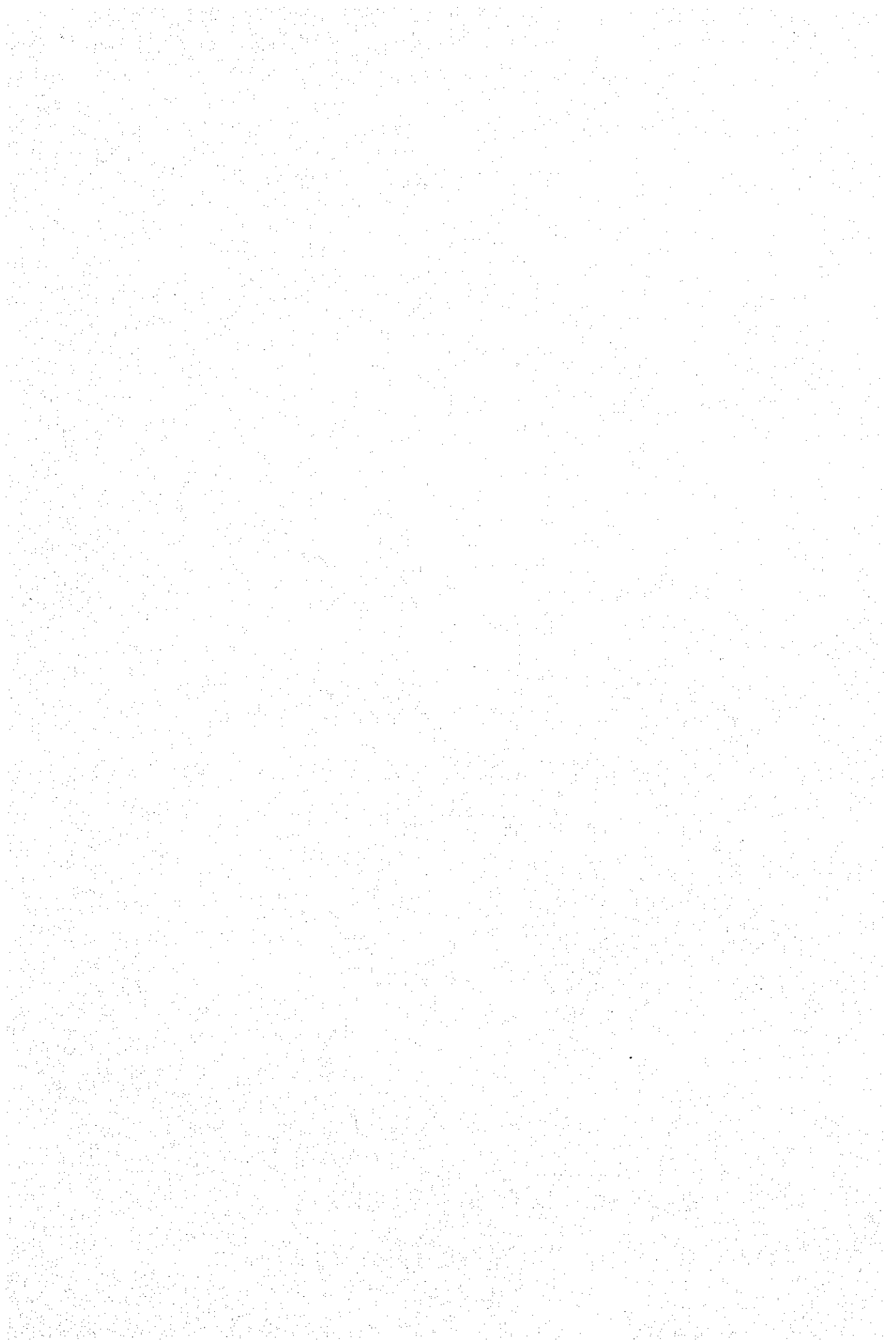
GENERATOR

- Seal casing
 - Journal-seal ring clearance measurement
 - Seal ring inner diameter measurement
 - Seal ring sliding part wear/discoloration visual inspection
 - Rust, crack, wear of spring - colour check

- BCT
 - Filling material (crack, leakage, expand) visual inspection
 - Lead wire, conduit pipe, packing visual inspection

- Hydrogen gas cooler
 - Tube sheet visual inspection
 - Fin stain visual inspection
 - Cooling tube crack visual inspection & pressure test
 - Air vent pipe visual inspection

- The others
 - Electro-chemical corrosion visual inspection
 - IPB construction visual inspection
 - IPB duct inside visual inspection
 - IPB duct insulation resistance check



POWER STATION: _____ UNIT NO. _____

CONDENSER

* Inspection Items

- o Waterbox, tube plate, tube
 - Cooling tube inner/outer surface erosion, corrosion - visual inspection/eddy current test
 - Tube plate erosion, corrosion - visual inspection/dimensional inspection
 - Shell inner parts erosion - visual inspection/dimensional inspection
 - Cooling tube expanding part leak - visual inspection/pressure test
 - Waterbox inner coating, lining - visual inspection/pin-hole test
 - Waterbox corrosion - visual inspection/dimensional inspection

- o Expansion
 - Rubber expansion deterioration - visual inspection/hardness measure
 - Expansion holder crack - visual inspection/colour check

POWER STATION: _____ UNIT NO. _____

LP & HP FEEDWATER HEATER

* Inspection Items

o LP Heater

Heating tube outer surface NH_3 attack - eddy current test
Shell abnormal erosion - thickness measure/visual inspection
Heating tube expanding portion slackness - visual inspection
Heating tube leakage - pressure test
Heater cover (for neck heater) condition - visual inspection
Waterbox dashboard crack - visual inspection/colour check

o HP Heater

Heating tube inner surface rust, scale - visual inspection
Heating tube outer surface rust, scale - visual inspection
Tube end inlet attack - dimensional inspection
Tube & tube welding portion leakage - pressure test
Water box dashboard crack - colour check
Defect, embrittlement of bolts for waterbox cover/diaphragm
- ultra sonic/hardness/visual inspection
Waterbox corner stress crack - magnetic/colour/visual inspection
Diaphragm - Ditto
Shell abnormal erosion - thickness measure
Heating steam, drain inlet joint - thickness measure
Heating steam, drain inlet joint - thickness measure
Relief valve leakage - visual inspection/pressure test
Shell inner construction welding part - ultra sonic test

