

RECORD OF FORCED OUTAGES

V. Snyder Unit No. 2
June 2, 1972 - June 30, 1982

<u>Equipment/System</u>	<u>Nature of Trouble</u>	<u>No. of Times</u>
<u>1. Boiler and Auxiliary</u>		<u>106</u>
1) Boiler	a) Tube leak	21
	b) Gas leak at casing	7
	c) Burner damage	1
	d) Uncontrollable temperature/pressure/ flow condition	10
2) Fuel oil system	a) Leakage of CDFOP pipe flange	1
	b) Header pressure regulator line leakage	5
	c) Fire accident at MFOP area	1
3) Air Heater	a) Clogging	37
	b) Replaced burned elements	3
	c) Damaged bearing and parts	2
	d) Sootblower failure	1
4) Forced draft fan	a) Excessive vibration	3
5) Gas recirculation fan		0
6) Valve and piping	a) Boiler valve leak	9
	b) Leakage at auxiliary steam header	1
	c) Leakage at CRH end flange	2
	d) Leakage at extraction A-4 flange	2
7) Control system		0
<u>2. Turbine and Auxiliary</u>		<u>59</u>
1) Main turbine	a) Excessive vibration	13
	b) Broken blades	3
	c) Damaged bearing & turbine rotating parts	5
	d) Exhaust flange leakage	1
2) Condenser	a) Tube leak	15
	b) Leakage at drain line to condenser	2

<u>Equipment/System</u>	<u>Nature of Trouble</u>	<u>No. of Times</u>
3) Circulating water pump		0
4) Control System	a) Electro-Hydraulic governor failure	9
	b) Turbine control valve failure	11
	c) Hotwell level regulator failure	1
<u>3. Condensate and Feedwater System</u>		<u>45</u>
1) Condensate and make-up system	a) Ammonex exhaustion	2
	b) Low demineralized water reserve	1
2) Motor driven BFP	a) Clogging of suction strainer	1
	b) Temperature equalizing pump line leakage	2
3) Turbine driven BFP	a) Minimum Flow system trouble	3
	b) Low vacuum at auxiliary condenser	3
	c) Leakage at turbine gland steam	1
4) Low pressure heater	a) Tube leak	2
5) High pressure heater	a) Tube leak	16
	b) Drip line leakage	8
	c) Leakage at isolating valve	4
6) Control system	a) Hotwell level regulator failure	1
	b) T-BFP control mechanism failure	1
<u>4. Electrical Equipment</u>		<u>4</u>
1) Generator and Exciter	a) Generator breaker control cable grounded	1
	b) DC Hi-pot test of stator	1
	c) Excitation loss	1
2) Transformer & Substation		0
3) Station service system		0
4) Control system	a) Voltage regulator trouble	1
<u>5. Others</u>		<u>6</u>
1) B-T interlock		0
2) Generator Back-up	a) 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 line	1
	b) Frequency disturbance	2
	c) Typhoon	1

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VI. Malaya Unit No. 1
December 21, 1974 - June 30, 1982

<u>Equipment/System</u>	<u>Nature of Trouble</u>	<u>No. of Times</u>
1. <u>Boiler and Auxiliary</u>		<u>32</u>
1) Boiler	a) Tube leak	6
	b) Fire at air register assembly	2
	c) Uncontrollable steam temperature	15
2) Fuel oil system	a) Overload of MFOP-1A	1
	b) Tripping of MFOP-1A	2
	c) Leak at MFOP discharge line	1
3) Air heater		0
4) Forced draft fan		0
5) Gas recirculation fan		0
6) Valve and piping	a) CV - 101, expansion joint steam leak	2
	b) CV - 104, uncontrollable operation	1
	c) Leak on thermowell economizer inlet	1
7) Control system	a) Oil contamination of pneumatic control	1
2. <u>Turbine and Auxiliary</u>		<u>39</u>
1) Turbine	a) Crack turbine blades	1
	b) Excessive vibration	12
	c) Leak at HP admission sensing line	1
	d) Leak at HP, exhaust sensing line	1
	e) Leak at cold reheater flange	2
	f) IPCV, drain line leak	5
	g) Drain station leak	1
	h) Burst rupture diaphragm	1
	i) Jacking oil/seal oil leak	3
2) Condenser	a) Low vacuum	2
	b) Chloride contamination	3
	c) High conductivity	1

<u>Equipment/System</u>	<u>Nature of Trouble</u>	<u>No. of Times</u>
	d) Tube leak	1
3) Circulating water pump	a) Tripped of both CWPs as a result of DC failure	1
4) Control	a) EHG control fault	2
	b) Malfunction of remote tripping solenoid valve	1
	c) Failure of thrust bearing safety device to reset	1
<u>3. Condensate and Feedwater System</u>		<u>25</u>
1) Condensate and make-up system		0
2) Motor driven BFP	a) Tripped when low deaerator level float control was actuated	1
3) Turbine driven BFP	a) Excessive steam leak	2
	b) Repair of minimum flow valve	2
	c) Trouble at planetary gear of booster pump	1
	d) Malfunction of speed adjuster	1
	e) Busted T-BFP condenser safety device diaphragm	1
4) Low pressure heater	a) Tube leak	1
5) High pressure heater	a) Tube leak	11
	b) Steam/water line leak	2
	c) Leak at drain valve	1
	d) High water level	1
6) Control system	a) Tripped due to extremely high level of LPH	1
<u>4. Electrical Equipment</u>		<u>9</u>
1) Generator and Exciter	a) Damaged bearings #2 and #8	1
	b) Loss of excitation	1
2) Transformer & Substation	a) Main transformer differential lockout	2
	b) Explosion of lightning arrester bushing	2

<u>Equipment/System</u>	<u>Nature of Trouble</u>	<u>No. of Times</u>
3) Station service system		0
4) Control system	a) over excitation	2
	b) Detachment of voltage regulator	1
5. <u>Others</u>		<u>23</u>
1) B-T interlock	a) LPH extreme high level	1
	b) Low feedwater flow	6
2) Generator back-up	a) Generator reverse power relay	1
3) Outside trouble	a) Failure of 230 KV line	3
	b) Malaya - Dolores 115 KV line	4
	c) Line fault at Dolores	4
	d) System disturbance	4

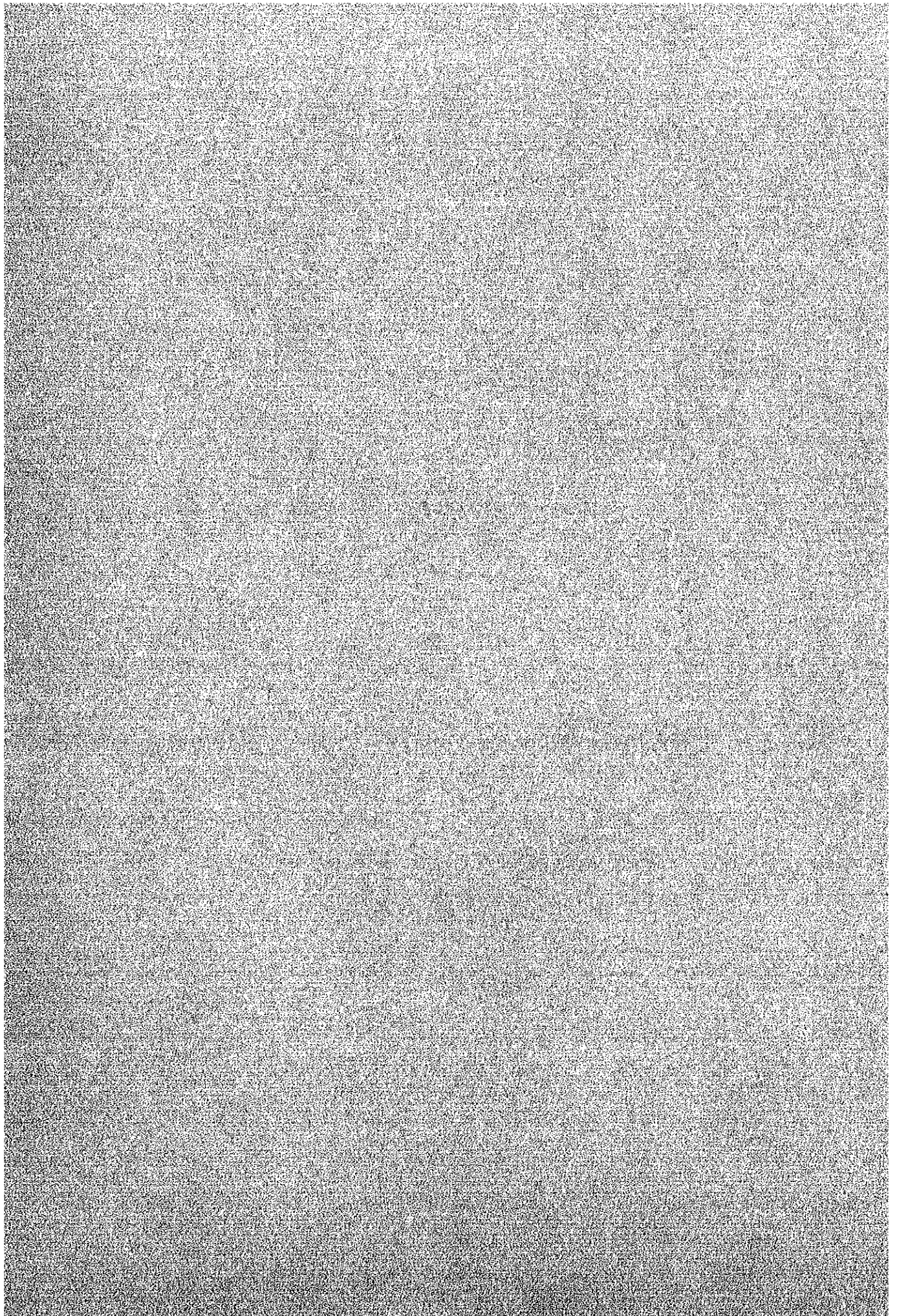
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VII. Malaya Unit No. 2
March 11, 1979 - June 30, 1982

<u>Equipment/System</u>	<u>Nature of Trouble</u>	<u>No. of Times</u>
<u>1. Boiler and Auxiliary</u>		<u>16</u>
1) Boiler	a) Tube failure	4
2) Fuel oil system	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) Air heater		0
4) Forced draft fan		0
5) Gas recirculation fan		0
6) Valve and piping		0
7) Control system	a) Tripped of MFO shut-off valve due to low control air supply	1
	b) Malfunction of drum level transmitter	1
	c) Low boiler drum level	4
	d) Leak at drum level sensing line	1
<u>2. Turbine and Auxiliary</u>		<u>12</u>
1) Main turbine	a) Excessive vibration	3
	b) Balancing due to vibration	1
	c) Bearing damage due to DC oil pump failure	1
	d) Oil leak at No. 2 bearing	1
	e) Uncontrollable temperature	1
2) Condensing system	a) Condenser low vacuum	2
3) Circulating water pump	a) Tripping of both CWPs due to low vacuum	3
4) Control system		0

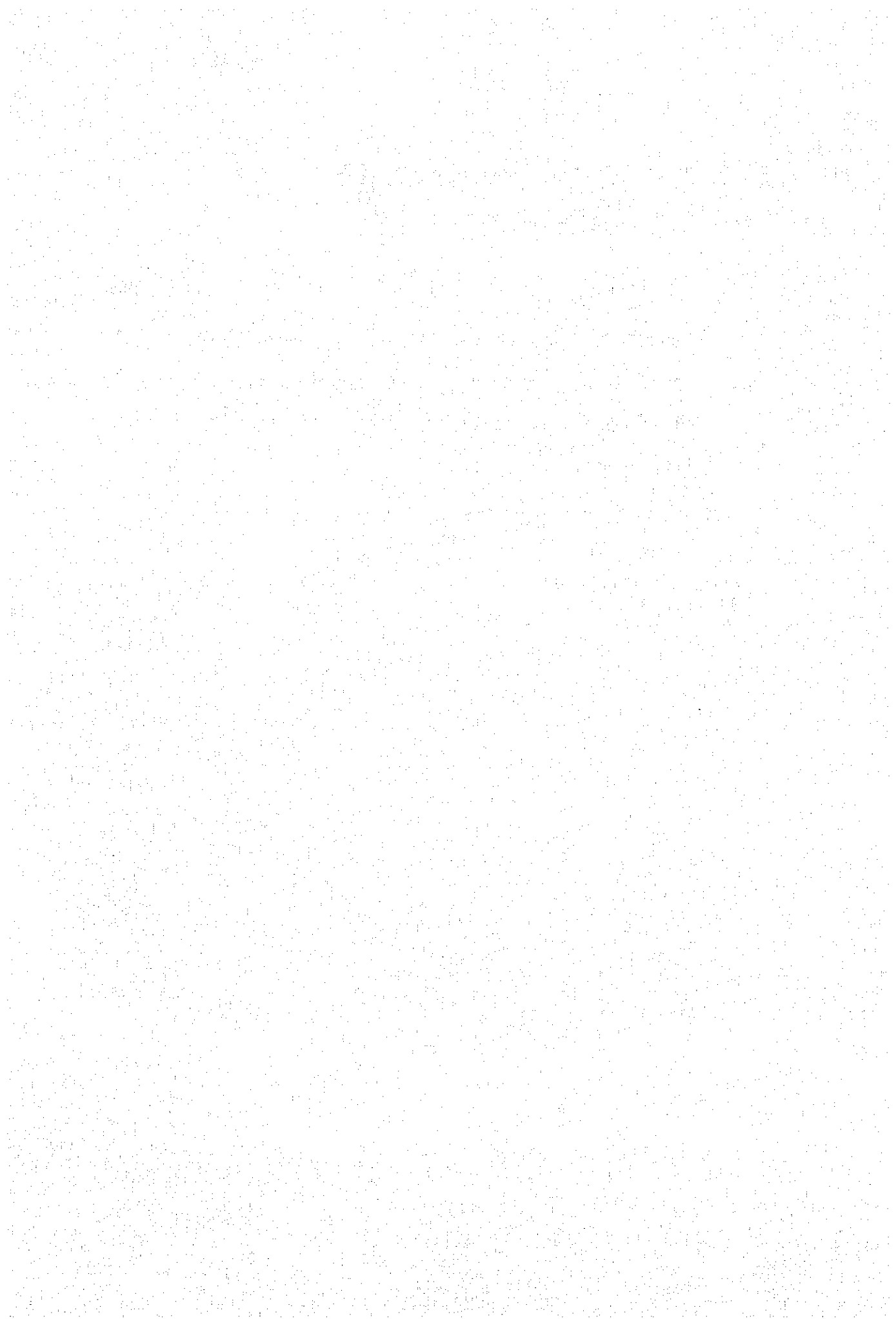
<u>Equipment/System</u>	<u>Nature of Trouble</u>	<u>No. of Times</u>
<u>3. Condensate and Feedwater System</u>		<u>3</u>
1) Condensate and make-up system	a) Chloride contamination of Demineralized water	1
2) Motor driven BFP	a) Tripped during change-over	1
3) Turbine driven BFP		0
4) Low pressure heater	a) Leak at deaerator manhole cover	1
5) High pressure heater		0
6) Control system		0
<u>4. Electrical Equipment</u>		<u>15</u>
1) Generator & Exciter	a) Burnt-out carbon brushes	1
	b) Excitation system failure	2
	c) Malfunction of stator cooling regulator	2
2) Transformer & Substation	a) Tripped due to differential lock out	2
	b) Busting of relief diaphragm	1
	c) Oil pressure drop from relief diaphragm	1
	d) Explosion of lightning arrester	1
3) Station service system	a) Loss of station service, emergency feed fails to cut in.	1
	b) Loss of BACC power	3
	c) Failure of DC power supply	1
4) Control system		
<u>5. Others</u>		<u>8</u>
1) B-T interlock	a) Furnace pressure high	2
2) Generator back-up	a) Reverse power caused by malfunction of relay on AVR	1
3) Outside trouble	a) Tripping of Dolores line	3
	b) System disturbance	2

APPENDIX-9 PRESENT CONDITIONS OF DOUBLE CIRCLED ITEMS
IN THE PRELIMINARY REPORT



PRESENT SITUATION OF DOUBLE CIRCLED ITEMSIN THE PRELIMINARY REPORT

	<u>T I T L E</u>	<u>P A G E</u>
I .	GARDNER UNITS -----	1
II .	SNYDER UNITS -----	5
III .	MALAYA UNITS -----	8



I. GARDNER UNITS

ITEMS	GARDNER UNIT-1	GARDNER UNIT-2
1. Re-check and test of all equipments in accordance with recommended periodical inspection check sheet in "Preliminary Interim Report"	Under implementation planning during next overhauling	Under implementation based on the check list prepared by WEST JEC mechanical expert during on-going overhauling
2. Addition of HP heater by-pass	Originally installed	Installed
3. Calibration, loop check for local control system	Already finished during last overhauling	Under implementation during on-going overhauling
4. Re-check and test all equipments in accordance with check sheet for periodical inspection in "Preliminary Interim Report"	Under implementation planning during next overhauling	Under implementation based on the check list prepared by WEST JEC mechanical expert during on-going overhauling
5. Boiler trip interlock system (instruments and circuits) re-check	Already checked last overhauling, further detailed check will be done during next overhauling	Already checked during on-going overhauling
6. Turbine protection system (instruments and circuits) re-check	Same as boiler tripping interlock	Same as boiler tripping interlock
7. Addition of adequate instrument air dryer/dehumidifier	Under planning, but not yet ordered March '83	Under planning, but not yet ordered March '83

ITEMS	GARDNER UNIT-1	GARDNER UNIT-2
8. Re-consideration and improvement in operation method	Under preparation of SOP on preventive maintenance.	Same as G - 1 Unit
9. Practice of automatic operation	Already automatically operated except air flow control due to AH clogging	Loop check and calibration are being carried out during on-going overhauling
10. Re-check and improvement of pressure switches and temperature switches	Under planning Replacement March '83	Loop check and calibration are being carried out during on-going overhauling but not yet replaced. Replacement March '83
11. Re-check and improvement of EHG system including assistance by original manufacturer	_____	_____
12. Alarm and annunciation system reset	Several alarms are still lighted, some recommendations on alarm system will be presented,	Several alarms are still lighted, some recommendation on alarm system will be presented.
13. Re-wiring for defective wiring especially bare wiring around turbine supervisory system	Under implementation planning during next overhauling	Under implementation during on-going overhauling
14. Replace/repair of sampling system	Not yet replaced. Supplier's bids will be submitted on August 30, 1982	Under planning Same as G - 1 Unit
15. Replace/repair of continuous water	Not yet replaced. Supplier's bids will be submitted on August 30, 1982	Same as G - 1

ITEMS	GARDNER UNIT-1	GARDNER UNIT-2
16. Practice and follow-up of checking especially during unit start-up in accordance with the allowable valve limit	SOP was already prepared by MMRC Task Force, being implemented	Same as G - 1 Unit
17. Addition of re-generation facilities for each unit respectively	_____	Awaiting the decision of the steering committee.
18. Practice of immediate shut down or emergency appropriate action in case of condenser leakage	Being implemented. Leak test/plugging of leaky tubes or retubing if necessary	Being implemented Same as G - 1 Unit
19. Addition of continuous conductivity meter	Under planning. Supplier's bids will be submitted on August 30, 1982	Under planning Same as G - 1 Unit
20. Overall relay tests when generator/transmission line is shut down	Already finished during last overhauling (March 1982)	Already tested during on-going overhauling (June-July 1982)
21. Cleaning surface of lighting arrester when transformer is shut down	Planned during shutdown (March, 1982)	Already cleaned during on-going overhauling
22. Invitation of manufacturer's supervisor for the above checking/improvement/replacement work	Already invited HITACHI from Japan, GE from USA	Already invited HITACHI from Japan, SIEMENS from West Germany under on-going overhauling
23. Adoption of double wall central control room (Addition wall, window, air conditions)	Under planning	Same as G-1 Unit

ITEMS	GARDNER UNIT-1	GARDNER UNIT-2
24. Replace/addition of ventilation system	Under planning	Already rehabilitated
25. Addition of N. R. Valves on bled steam line for deaerator (G-1, G-2, S-1, S-2 and M-1)	Originally installed	Under planning Valve already delivered, will install on first opportunity
26. Re-balancing and re-alignment of T/G	Already finished during last overhauling	Planned during on-going overhauling
27. Addition of auxiliary steam back up system including pressure reducing-attemperator station	Already finished	Under study
28. Addition of adequate dissolved O ₂ meter and practice of continuous monitoring/checking	Under planning Supplier's bids will be submitted on August 30, 1982	Under planning Same as G - 1 Unit Included in order for sampling rack equipments
29. Lead wire checking when generator/transmission line is shut down.	Already finished	Already finished during on-going overhauling

II. SNYDER UNITS

ITEMS	SNYDER UNIT-1	SNYDER UNIT-2
1. Re-check and test of all equipments in accordance with recommended periodical inspection check sheet in "Preliminary Interim Report"	Under implementation planning during next overhauling	Same as S - 1 Unit
2. Addition of HP heater bypass	Materials already delivered, installation during scheduled overhauling October - December 1982	Already implemented during last overhauling
3. Calibration, loop check for local control system	Under planning during next overhauling	Under planning during next overhauling
4. Re-check and test all equipments in accordance with Check Sheet for periodical inspection in "Preliminary Interim Report"	Under planning during next overhauling	Same as S - 1 Unit
5. Boiler trip interlock system (instruments and circuits) recheck	Under planning during next, overhauling	Same as S - 1 Unit
6. Turbine protection system (instrument, and circuits) recheck	Same as boiler tripping interlock	Same as S - 1 Unit
7. Addition of adequate instrument air dryer/dehumidifier	Same as G-1 Unit Already ordered	Same as G - 1 Unit Already ordered
8. Reconsideration and improvement in operation method	Same as G - 1 Unit	Same as G - 1 Unit

TIPS	GARDNER UNIT-1	GARDNER UNIT-2
<p>9. Practice of automatic operation.</p>	<p>Loop check and calibration are being carried out during overhauling</p>	<p>New type ABC system being evaluated, and will be replaced during schedule overhauling.</p>
<p>10. Re-check and improvement of pressure switches and temperature switches.</p>	<p>Under planning but not yet ordered March '82</p>	<p>Same as G-2 Unit</p>
<p>11. Re-check and improvement of EHG system including assistance by original manufacturer.</p>	<p>Checking and repair will be done during schedule overhaul.</p>	<p>Same as S - 1</p>
<p>12. Alarm and annunciation system reset</p>	<p>Same as G - 1 Unit</p>	<p>Same as G - 1 Unit</p>
<p>13. Re-wiring for defective wiring especially bare wiring.</p>	<p>Same as G - 1 Unit</p>	<p>Same as G - 1 Unit</p>
<p>14. Replace/repair of sampling system</p>	<p>Same as G - 1 Unit</p>	<p>Same as G - 1 Unit</p>
<p>15. Replace/repair of continuous water.</p>	<p>Same as G - 1 Unit</p>	<p>Same as G - 1 Unit</p>
<p>16. Practice and follow-up of checking especially during unit start-up in accordance with the allowable value limit.</p>	<p>Same as G - 1 Unit</p>	<p>Same as G - 1 Unit</p>

ITEMS	SNYDER UNIT-1	SNYDER UNIT-2
17. Addition of re-generation facilities for each unit respectively.	Same as G - 1 Unit	Same as G - 1 Unit
18. Practice of immediate shut down or emergency appropriate action in case of condenser leakage.	Same as G - 1 Unit	Same as G - 1 Unit
19. Addition of continuous conductivity meter.	Same as G - 1 Unit	Same as G - 1 Unit
20. Overall relay tests when generator/transmission line is shut down.	Under planning during next overhauling	Already tested during last overhauling (1981).
21. Cleaning surface of lightning arrester when transformer is shut down.	Under planning during next overhauling	Already cleaned during 1981 overhauling
22. Invitation of manufacturers supervisor for the above checking/improvement/replacement work.	Under planning during next overhauling	Already invited Spanish (AH), Japan (Boiler) and West Germany (Turbine) engineers.
23. Adoption of double wall central control room (Additional wall, window, air conditions)	Only double door system completed.	Double wall not yet completed.
24. Replace/addition of ventilation system.	Overall planning including air-conditioning system are ongoing.	

ITEMS	SNYDER UNIT-1	SNYDER UNIT-2
25. Addition of N.R. valves on bled steam line for deaerator (G - 1, G - 2, S - 1 S - 2 and M - 1).	OCT.---DEC. "82	Valve already delivered and be installed on first opportunity.
26. Re-balancing and re-alignment of T/G.	Planned during next overhauling	Same as S - 1 Unit.
27. Addition of auxiliary steam back-up system including pressure reducing-attenuator-station.	Same as G - 2 Unit	Same as G - 2 Unit
28. Addition of adequate dissolved O2 meter and practice of continuous monitoring/checking	Under planning Same as G - 2 Unit	Under planning Same as G - 2 Unit
29. Lead wire checking when generator/transmission line is shut down.	Under planning during next overhauling	Under planning during next overhauling

III. MALAYA UNITS

ITEMS	MALAYA UNIT - 1 & 2	TARGET DATE
1. Re-check and test of all equipments in accordance with recommended periodical inspection check sheet in "Preliminary Interim Report"	HITACHI procedure being implemented for M-2 T/B and M-1 B during annual overhaul. For KWU turbine, check list being prepared.	For implementation, during annual overhaul.
2. Addition of HP heater bypass	Work order under process.	For implementation, during annual overhaul.
3. Calibration and loop check for local control system	Being implemented under standard practice.	During every opportunity.
4. Re-check and test of all equipments in accordance with check sheet for periodical inspection in "Preliminary Interim Report"	HITACHI procedure being implemented for M-2 T/B and M-1 B. For KWU turbine, check list being prepared.	For implementation, during annual overhaul.
5. Boiler trip interlock system (instruments and circuits) re-check	Simulation of all protective device and trip interlock	Done during every scheduled shut-down.
6. Turbine protection system (instruments and circuits)	Being implemented.	During long shutdown

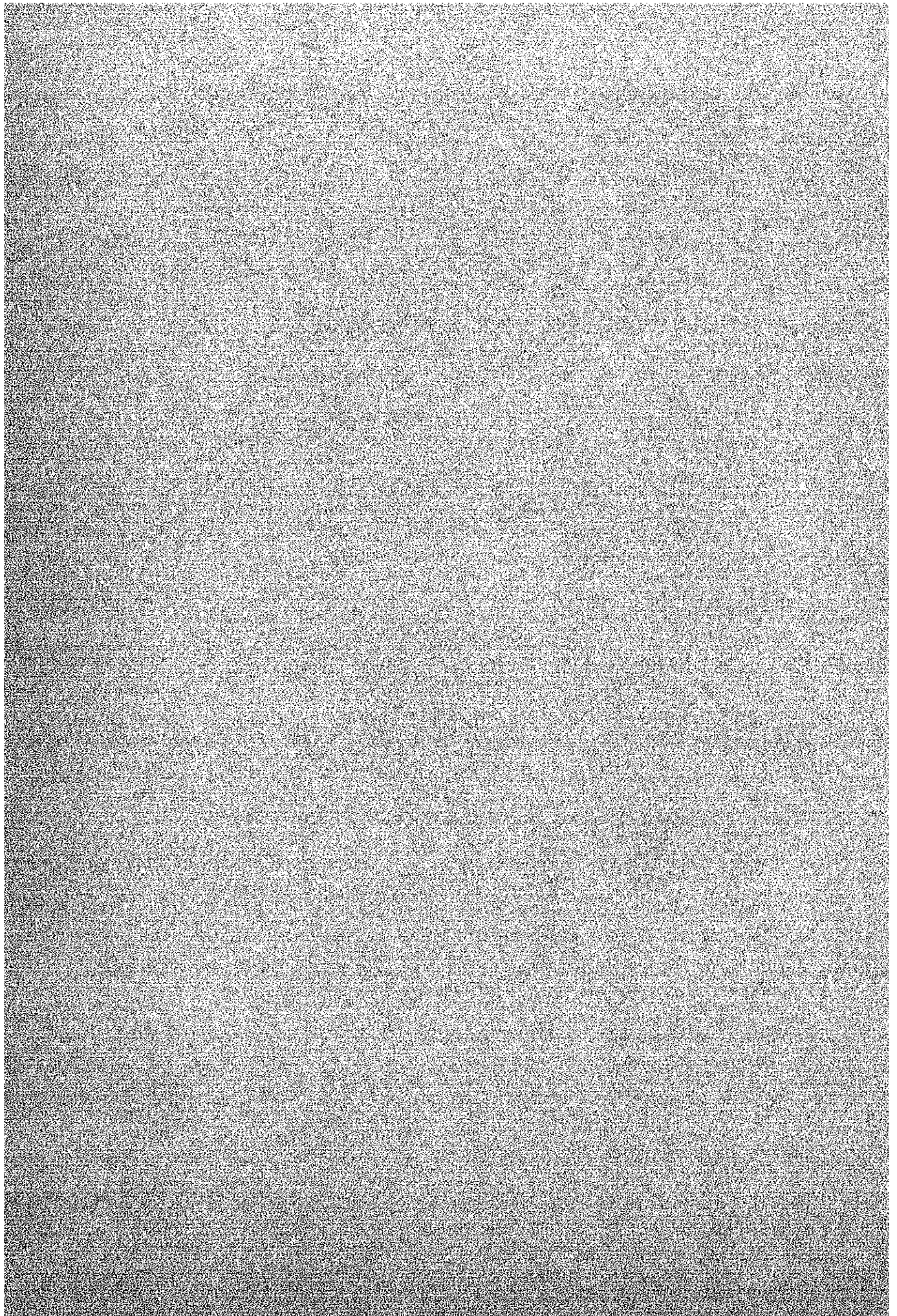
ITEMS	MALAYA UNIT - 1 & 2	TARGET DATE
<p>7. Addition of adequate instrument air dryer/dehumidifier</p>	<p>Prepared PR #3010 dated 6-13-82 for two additional heaterless dryers.</p>	<p>For installation in parallel with existing. Upon receipt of order.</p>
<p>8. Recommendation and improvement in operation method</p>	<p>1) Routine inspection of instruments on a weekly and monthly basis. 2) During shut-down - - simulation of controls before start-up 3) Overhauling of unit, calibration simulation, fine tuning of controls of supervisory instruments during annual overhauling.</p>	<p>on a weekly and monthly basis. before start-up fine tuning of controls of annual overhauling.</p>
<p>9. Practice of automatic operation</p>	<p>Conducted investigation of existing conditions of the automatic controls for operation</p>	<p>Prepared PR's for improvement of automatic operation. Fine-tuning on boiler master done. Now on auto in M2</p>
<p>10. Re-check and improvement of pressure switches and temperature switches.</p>	<p>Standard practice during overhauling and scheduled shutdown.</p>	
<p>11. Re-check and improvement of EHG system including assistance by original manufacturer.</p>	<p>Needs assistance of a KWU engineer.</p>	
<p>12. Alarm and annunciation system reset</p>	<p>Recalibration of all sensors for false alarms.</p>	<p>Being implemented during every opportunity.</p>
<p>13. Re-wiring for defective wiring especially bare wiring around turbine supervisory system.</p>	<p>Main turbine metal and steam seal temperature sensor. Top and bottom HP casing temperature sensor.</p>	<p>Scheduled for re-wiring during the annual unit overhauling.</p>

ITEMS	MALAYA UNIT - 1 & 2	TARGET DATE
14. Replace/repair of sampling system	Complete rehabilitation of monitoring instruments and recorders.	Ordered spare parts for the complete rehabilitation during overhauling.
15. Replace/ repair of continuous water	Ordered spare parts for conductivity of M.S. ECO, DEA, and CRH for M1 M2 conductivity recorder M2 Hydrazine analyzer	For installation upon arrival. For proper maintenance under repair and calibration for servicing.
16. Practice and follow-up of checking especially during unit start-up in accordance with the allowable value limit	It is a standard practice to follow-up and check allowable value limitation during unit start-up.	For strict implementation.
17. Addition of re-generation facilities for each unit respectively.	Recommended by JICA for GSTP only.	
18. Practice of immediate shutdown or emergency appropriate action in case of condenser leakage	Continuous monitoring on trend of condenser leakage then inform operation when excessive for unit shutdown.	For strict compliance.
19. Addition of continuous conductivity meter	For complete rehabilitation.	Awaiting specification from TSD re-monitoring instruments
20. Overall relay tests when generator/transmission line is shut down.	Calibration, time setting, re-setting are being conducted annually or during occasional period.	For strict compliance
21. Cleaning surface of lightning arrester when transformer is shut down	Occasional cleaning by substation crew or electrical group when found dirty	For strict compliance

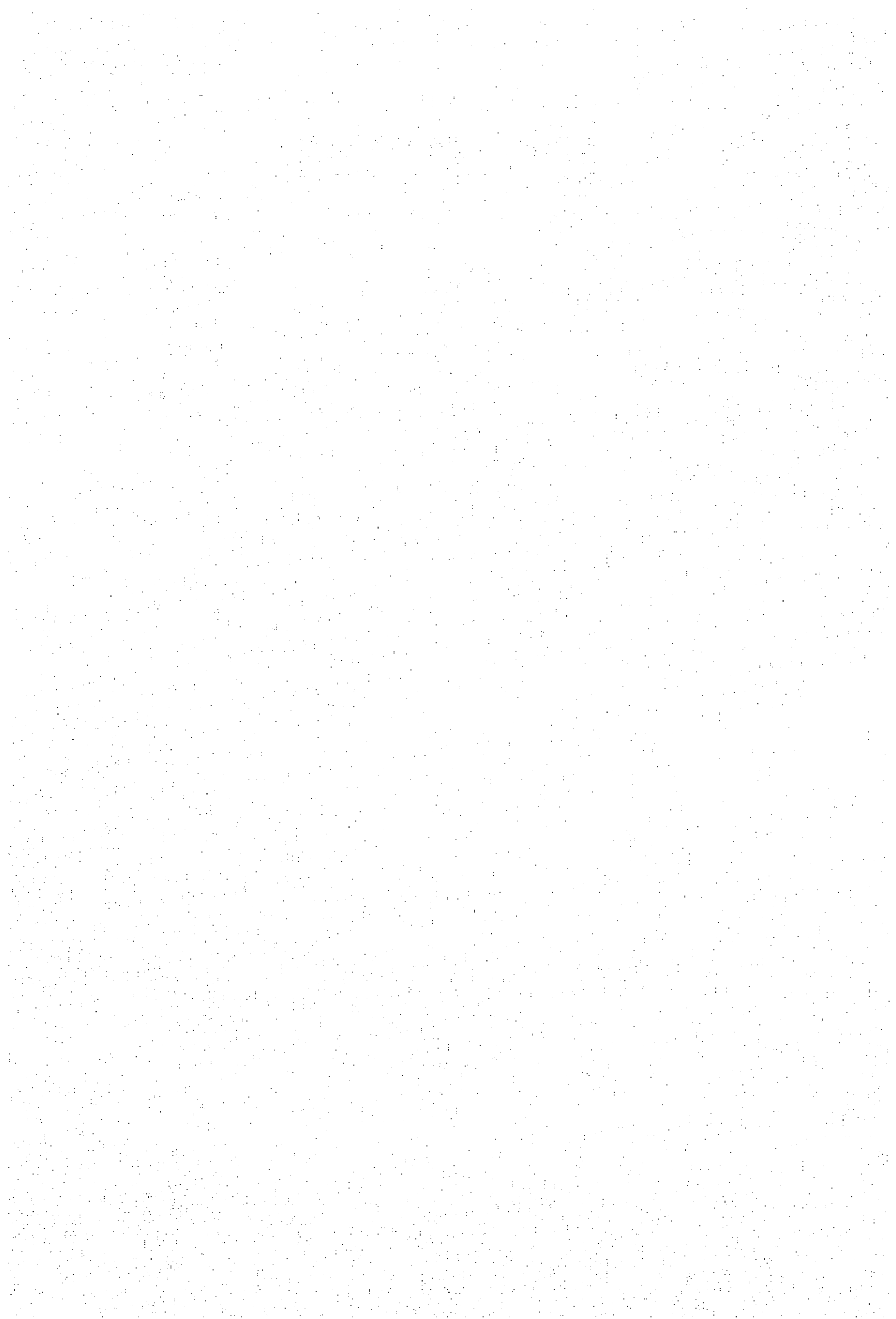
ITEMS	MALAYA UNIT - 1 & 2	TARGET DATE
22. Invitation of manufacturer's supervisor for the above checking/improvement/replacement work	For implementation	Under Work Order No. 1486 expansion and rehabilitation of control room
23. Adoption of double wall central control room (addition wall, window, air conditions)	Under study to close the north side wall and provide additional windows on the east side.	Project will be referred to JICA and West JEC Team for approval. Fan belts were ordered for the roof exhaust fan. All fans will be rehabilitated.
24. Replace/addition of ventilation system	TSD will prepare the correct specification	Balancing of M1 turbo-generator set will be done after re-blading.
25. Addition of N. R. valves on bled steam line for deaerator (G-1, G-2, S-1, S-2 and M-1)	Ordered re-blading of M1-LPI-TE & GE. For the coming overhauling. OK for MTP but needs rehabilitation of auxiliary boiler	For order and implementation
26. Re-balancing and re-alignment of T/G	Scheme on M2 will be adopted in M1	
27. Addition of auxiliary steam back up system including pressure reducing attenuator station		
28. Addition of adequate dissolve O ₂ meter and practice of continuous monitoring/checking		

ITEMS	MALAYA UNIT - 1 & 2	TARGET DATE
29. Lead wire checking when generator/ transmission line is shut down		Recommend occasional Hi-Pot test by transmission or substation crew

APPENDIX-10 REANALYSIS OF THE PAST TROUBLE



RE-ANALYSIS OF THE PAST TROUBLE



TYPICAL TROUBLE	THE CAUSE	REMARKS
<p>1. High conductivity of feedwater</p>	<ul style="list-style-type: none"> a. Condenser tube leak b. Insufficient and defective sensors for water analysis c. Function of conductivity meter and maintenance of cation filter resin d. Overloading on CPP due to tube damage/piping leakage and hotwell regulator erratic operation e. Insufficient maintenance/operation of CPP service regeneration f. Insufficient capacity of water demineralizing and storage 	<p>It is commenced to install additional regeneration.</p> <p>Complete retubing for Malaya #2 will be done during coming overhaul.</p> <p>Sump pump should be repaired and operated.</p>

TYPICAL TROUBLE	THE CAUSE	REMARKS
<p>2. Feed water chloride contamination</p>	<p>equipments due to too many plant start/stops</p> <p>g. Imperfect drainage, sump arrangement around condenser, defective sump pump and insufficient maintenance</p> <p>Same as Item 1</p>	<p>Same as Item 1</p>
<p>3. Water induction on turbine and heater drain line</p>	<p>a. Inadequate turbine bled steam system design</p> <p>b. Tube leakages in heaters</p> <p>c. Defective interlock and annunciation system and no interlock with</p>	<p>Defective heater will be replaced in the rehabilitation.</p> <p>Additional feed water by-pass system are now under installation or in consideration. And related valve should be of motor-driven type.</p>

TYPICAL TROUBLE	THE CAUSE	REMARKS
	<p>turbine protection</p> <p>d. Defective level controller and level switch</p> <p>e. Heater drain system overloading due to large amount of heater tube leakage</p> <p>f. Lack in knowledge and action for emergency case</p> <p>g. Insufficient feedwater heater by-pass system</p> <p>h. Inadequate extraction non-return valve</p>	<p>Drain level switches used for boiler tripping interlock are not placed in service and these level switches should be replaced with micro switch type ones.</p>

TYPICAL TROUBLE	THE CAUSE	REMARKS
<p>4. Excessive turbine vibration</p>	<ul style="list-style-type: none"> a. Inadequate piping and support design connected to main turbine casing b. Insufficient rotor balancing c. Inadequate alignments d. Turbine bucket failure 	<p>Alignment of piping should be carried out again.</p> <p>Replacement of turbine blade should be planned.</p>
<p>5. BFP trip due to deaerator storage tank water level extremely low</p>	<ul style="list-style-type: none"> a. Too large load increase rate b. Cascade drainage from HP heater into LP heater and condenser due to HP heater tube leak c. Excessive feed water flow rate due to HP heater tube leaks 	

TYPICAL TROUBLE	THE CAUSE	REMARKS
<p>6. HP heater and LP heater tube leakage</p>	<p>d. Less NPSH are due to BFP - deaerator layout</p> <p>e. Overload on deaerator level control system capacity (LCV,CP) due to excessively high feed water flow rate due to the tube leak</p> <p>f. Tripping due to malfunction of level monitor by deaerator vibration and controller is not placed into AUTO.</p> <p>a. Defective design and manufacturing</p> <p>b. Worse water and steam quality</p> <p>c. Drain attack due to extremely</p>	<p>To put controller into AUTO after repairing/replacement of control system.</p> <p>To replace/relocate level switch.</p> <p>a. Heater tubes should be replaced</p>

TYPICAL TROUBLE	THE CAUSE	REMARKS
<p>7. Turbine exhaust hood rupture diaphragm burst due to CWP trip</p>	<p>high flow rate drain into LP heater due to cascade drainage from HP heater to deaerator, LP heater in case of HP heater tube leak.</p> <p>a. Chronic less margin in condenser vacuum due to inadequate condenser design condition.</p> <p>b. Insufficient circulating water system arrangement and design</p> <p>c. Unexpected much heater drain into condenser</p> <p>d. Deterioration of ejector capacity due to lower working steam pressure</p>	

TYPICAL TROUBLE	THE CAUSE	REMARKS
8. Boiler tube leakage	<p>and higher sealing water temperature, by which the vacuum pressure is restricted (saturated pressure of the temperature)</p> <ul style="list-style-type: none">a. Insufficient feed water and steam purityb. Inadequate combustion control/ feed water controlc. Inadequate spray control and defective spray stop valved. Unexpected feed water temperature fluctuation due to high pressure heater tube leake. Misoperation	<p>Secondary superheater tube under the most severe condition will be replaced with higher withstand temperature material.</p> <p>Water wall tubes and reheater tubes having pitting and thin tubes will be replaced.</p> <p>Data on valve opening vs. flow rate should be actually obtained and either replacement or repair of the</p>

TYPICAL TROUBLE	THE CAUSE	REMARKS
<p>9. Condenser low vacuum</p>	<p>a. Inadequate condenser design condition - inlet circulating water temperature, cleanness factor</p> <p>b. High CW inlet temperature due to circulating water recirculation (distance of in/out sheet pile)</p>	<p>control valve should be determined.</p> <p>Deteriorated gasket, diaphragm of condenser will be replaced in the rehabilitation.</p> <p>Deteriorated gland seal element will be replaced in the rehabilitation.</p>
<p>10. Fire on around turbine</p>	<p>a. Lube and control oil leakage from the oil piping</p> <p>b. Insufficient maintenance to</p>	<p>Reverse washing valves should be inspected and repaired.</p> <p>Through maintenance of pipings and repair of damaged heat insulation should be carried out.</p>

TYPICAL TROUBLE	THE CAUSE	REMARKS
<p>11. Turbine oil leakage</p>	<p><u>eliminate</u> the piping leakage</p> <p>c. Insufficient heat insulation on high temperature pipes including small drain and steam leak pipes</p> <p>d. Insufficient leak oil collection and drainage system</p>	
<p>12. T-BFP planetary gear trouble</p>	<p>a. Insufficient installation, sealing or design of lube oil piping</p> <p>b. Insufficient maintenance</p> <p>c. Misoperation of the oil centrifuge</p> <p>a. Overloading due to HP heater tube leakage-severe condition thru</p>	<p>Through maintenance of pipings should be carried out.</p>

TYPICAL TROUBLE	THE CAUSE	REMARKS
<p>13. Main fuel oil pump trouble</p>	<p>design condition</p> <p>b. Ordinal high vibration</p> <p>a. Overloading due to plant performance deterioration</p> <p>b. Unstable combustion/fuel consumption</p>	<ul style="list-style-type: none"> ◦ Prevention of unit trip due to malfunction of pressure switch ◦ Fuel oil transfer operation should be carefully carried out and operating procedure should be rechecked.
<p>14. Fire at A.H., frequent A.H. washing</p>	<p>a. Unstable combustion-carbon deposits accumulation</p> <p>b. Inadequate ash collecting and handling system including system design and materials</p>	<ul style="list-style-type: none"> ◦ At this stage thermal cleaning of AH is applied. ◦ Washing up water

TYPICAL TROUBLE	THE CAUSE	REMARKS
<p>15. Carry over</p>	<p>a. For B-T: Inadequate load down rate</p> <p>b. For CPP resin carry over: Defect of resin trap</p> <p>c. Fluctuation in flow, pressure in condensate due to hotwell level control rangeability</p>	
<p>16. Boiler casing</p>	<p>a. Low temperature corrosion attack (sulphur attack) due to high sulphur contents in fuel</p> <p>b. Unstable combustion which leads to corrosive deposits accumulation</p> <p>c. Water washing which accelerates the H_2SO_4 attack</p>	<p>Countermeasures to decrease the corrosive are recommended in the QA group overhaul record.</p> <p>Gas leak from boiler casing should be repaired.</p>

TYPICAL TROUBLE	THE CAUSE	REMARKS
<p>17. Shortage in make up demineralized water</p>	<p>d. Insufficient gas tight water wall</p> <p>e. Incomplete repair during over-hauling</p> <p>a. Too much plant shut-down and start-up due to above troubles - much larger make up water consumption than planned in plant design stage</p> <p>b. Raw water supply inadequate due to receding deepwell water table.</p>	<p>Demineralizing plant is under planning.</p>
<p>18. Dust handling system trouble</p>	<p>a. Clogging of dust conveying line due to inadequate capacities of piping and hydrovectors</p>	<p>Dust handling system should be replaced.</p>

TYPICAL TROUBLE	THE CAUSE	REMARKS
<p>19. Generator directional relay (67) actuation</p>	<p>b. Design deficiency of slurry pump</p> <p>c. Inadequate maintenance</p> <p>d. Irregular operation of dust handling system</p> <p>a. Due to loss of excitation</p> <p>b. Generator back-up relay (86GB) actuation after turbine trip</p>	<p>In the existing plant tripping interlock, turbine tripping signal does not trip the generator circuit breaker instantaneously.</p> <div style="text-align: center;"> <pre> graph LR TT[Turbine Trip] --- RPR[Reverse Power relay] RPR --- GCO[Generator circuit breaker open] </pre> <p>86GB</p> </div> <p>Generator breaker should be tripped instantaneously after turbine trip.</p>