TYPICAL TROUBLE	THE CAUSE	REMARKS
		not through reverse power relay, and the reverse power relay should be applied to protect motoring of the generator.
20. System disturbance (high/ low frequency)	a. Unbalance between power demand and supply b. Inadequate power regulation and load cutting out at emergency case, and defective coordination of power plants and load dispatching center. c. Poor transmission line system and capacity	A definite evidence was observed at Gardner/Snyder and Malaya Thermal Power Stations on 8 September, 1982. Reinforcement of transmission and distribution lines and prompt construction of load dispatching center are expeted.

TYPICAL TROUBLE	THE CAUSE	REMARKS
21. Uncontrollable steam temperature	a. Defective maintenance of temperature sensors, and defective spray control valve b. Manual operation due to defective sensors and control valves c. Inadequate operation at unit start-up	The steam temperature can not be maintained properly only by manual operation at sudden load changes and unit start-up. Defective sensors and control valves should be repaired.
22. Boiler trip interlock action	a. Defective maintenance of BTI sensors b. Inadequate installation of BTI sensors c. Poor pre-alarm system and maintenance	The existing mercury type BTI sensors will be easily initiated by slight vibration. The mercury type BTI sensors should be replaced with micro switch type and BTI sensors should be installed in local cubicle. To furnish pre-alarm annunciators to give notice

TYPICAL TROUBLE	THE CAUSE	REMARKS
		to operators before unit trip
23. BTI by low economizer inlet feed water pressure	a. Tube/piping leakage	In almost all plants, the BTI, Economizer inlet feed water pressure low is not placed into service due to reduced pressure operation.
24. Main and all auxiliaries switch gear, motor c/c failure.	a. Bad circumstances for station electrical facilities	Station service auto bus transfer test should be carried out every shut-down.
	b. Insufficient layout engineering and poor maintenance of building and ventilation system	To repair roof leakage
	c. Insufficient maintenance of switch gears and control centers	To replace the existing auxiliary relays with seal-in type ones.
	d. Poor electrical contact due to	

TYPICAL TROUBLE	THE CAUSE	REMARKS
	open-type auxiliary relay.	
25. Master trip solonoid malfunction	a. Inadequate arrangement in cabling wiring and instruments and sensors b. Insufficient maintenance	Turbine tripping interlock test should be strictly carried out every unit shut-down.
26. Thrust bearing safety device test	a. Malfunction of testing device	Carry out the thrust bearing safety device test after through repair and calibration.
27. Major trouble due to back-up system failure	a. Insufficient routine back-up test and poor maintenance	Back-up tests for emergency equipments should be strictly carried out as routine work.
28. Loss or over excitation of generator	a. Exciter failure	Insulation of exciter should be checked during unit shut-down.

TYPICAL TROUBLE	THE CAUSE	REMARKS
29. Low feed water flow/BFP minimum flow	a. Malfunction of BFP minimum flow flow control system. b. Erosion of minimum flow control valve	The existing minimum flow control valves are replaced with new hydraulic type valves for units: G-2, S-2 (T-BFP), and M-1 (T-BFP) other defective minimum flow control valves should be replaced.
30. Instrument air contamination by fuel oil	a. Inadequate or insufficient instrument air supply due to plenty of air leak. b. Leakage from non-return valve on back-up line. c. Misoperation of valve during burner purge.	To repair air leak urgently. To blow out the instrument air and station service airlines. To install an additional instrument air compressor.

TYPICAL TROUBLE	THE CAUSE	REMARKS
31. Turbine electrohydraulic control fault	———	To inspect the EHG with manufactu-rers engineer's during every annual shut-down.

11

APPENDIX-11 INSTRUMENT PIPING STANDARDS

DESIGN STANDARDS FOR INSTRUMENT PIPING

I. INSTRUMENT PIPING

I - 1. Specifications

(1) Selection standards on piping materials

applicable design pressure for selection of an instrument piping should be same pressure as main piping.

Applicable design temperature for selection of an instrument piping should be same as main piping up to instrument valve (up to reservoir when reservoir is needed)., and applicable design temperature for downstream of the root valve should be saturated temperature equivalent to main piping pressure.

(a) Classification by temperature

Temperature °F (°C)	-662 -(350)	663-752 (351-400)	753-932 (401-500)	933-1112 (501-600)
Piping Materials	STPG38	STPT38	STPA12 or STPA22	STPA22 or STPA24

Note: Copper should be applied to sea water instrument pipings.

(b) Nominal diameter

2B(50A): Balancing Pipe, instrument for level transmitter mounted on a tank or vessel.

1B(25A): Instrument piping up to instrument root valve for pressure or flow transmitter on high pressure line, and boiler drum level transmitter.

3/4B(20A) : Instrument piping for water level gauge or transmitter.

1/2B(15A) : Instrument piping for pressure or flow meter.

(C) Pipe Thickness

In principle, pipe thickness should be in accordance with SGP schedule No. 40, 60, 80.

(2) Selection standards for valves, connectors materials

Applicable design pressure for valves, connectors are same as I-1 (1).

(a) Classification by temperature

Temperature °F (°C)	(-400)	(401-500)	(501-600)
Valves, connectors materials	S25C, S28Cor SF45	A182-F11 orA182-F12	A182-F12 or A182-F22

Note: Bronze castings should be applied to sea water, air and cooling water pipings.

(b) Nominal diameter

Same as I-1 (1)-(a)

(c) Pipe thickness

Same as I-1 (1)-(b)

(d) Valve Type

Ball valve with handle should be in principle applied to.

(3) Size of tapping line for pressure and flow detecting devices should be, in principle, classified into two types by the pressure applied to.

1B (25A) : More than 50 Kg/cm^2

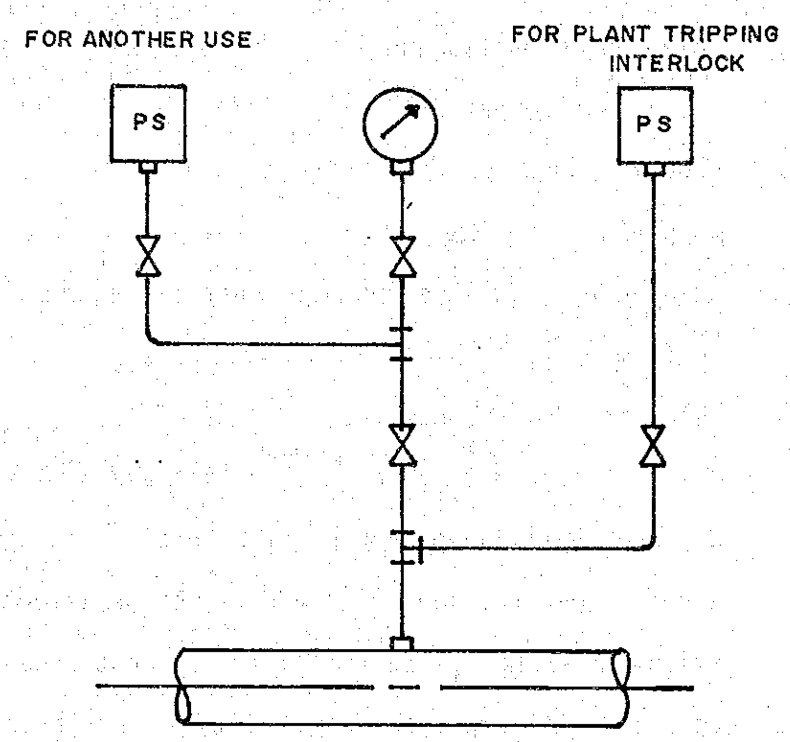
1/2B (15A): Less than 50 Kg/cm^2

Note: Size of tapping line for cold reheat and not reheated line should be 25A.

(4) Double instrument root valve should be applied to piping more than 50Kg/cm^2.

(5) Reservoirs should be installed after the instrument root valves for steam pressure difference detecting device, however, in case of liquid pressure difference detecting devices, or in case of force balance type high pressure difference detecting devices that the performance will not be affected by volume changes, the reservoirs are not needed.

(6) In case that more than one instruments are branched from one pipe, most important instrument used for plant tripping interlock and auxiliary tripping interlock should branched before the instrument root valve, but that for another use should be branched after the instrument root valve.


FOR ANOTHER USE
FOR PLANT TRIPPING
INTERLOCK
PS
PS

(7) Test plug (PT-1/4B) should be in principle installed in the instrument pipings for pressure transmitter, controller and switch for the purposes of tests and replacement of scaling liquid, etc.

(8) Drain blow valve should not be installed in oil piping for the purpose of diminishing the leaky portions as possible.

For the vacuim detecting line, the instrument should be installed in a higher location than detecting point for non-clogging of drain, and drain blow valve should not be installed in the line to avoid leakage.

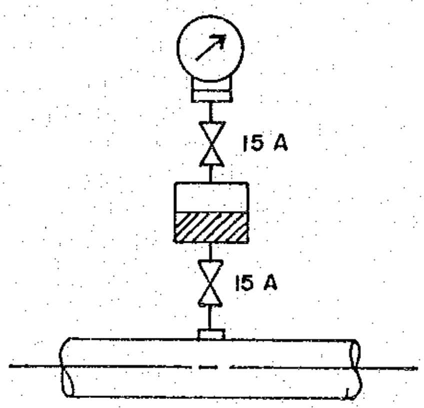
(9) Instrument piping should be installed taking the thermal expansion and the movement due to heat into consideration.

(10) Instrument piping should be supported by adequate supporter.

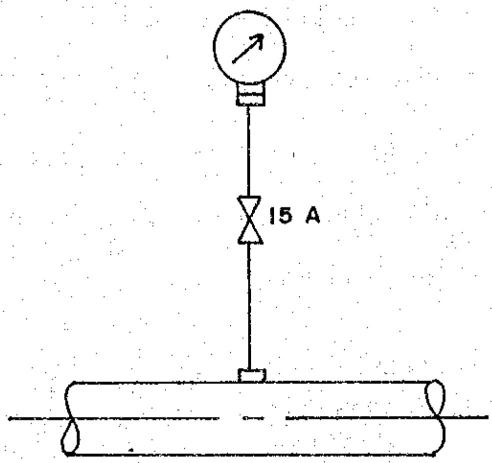
I - 2 INSTALLATION

(1) Local pressure gauge and test tap

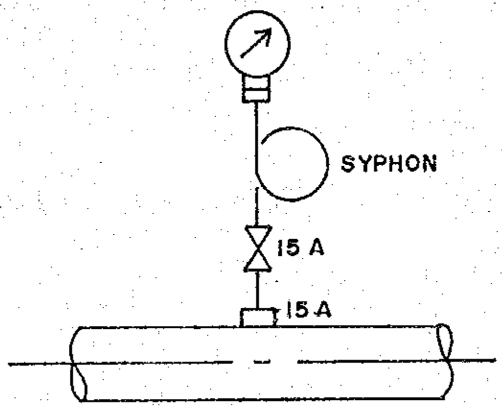
(a) Fuel Oil Line



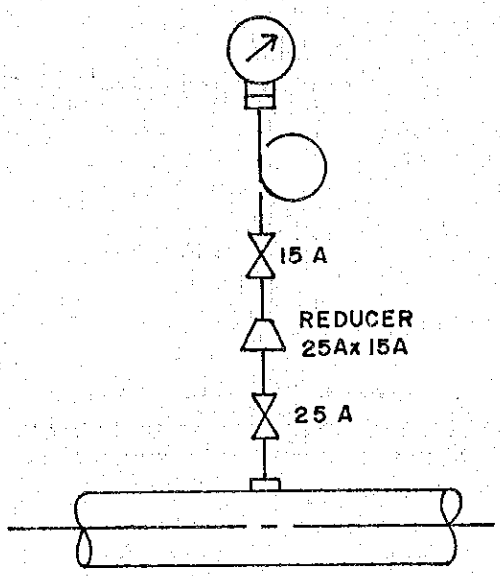
(b) Air line less than 50 kg/cm^2 or water line less than 100^{o}C.



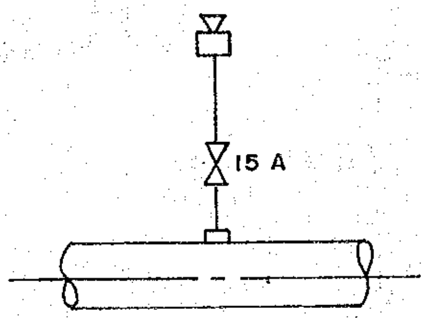
(c) Steam, water line less than 50 kg/cm^2 and more than 100^{o}C.



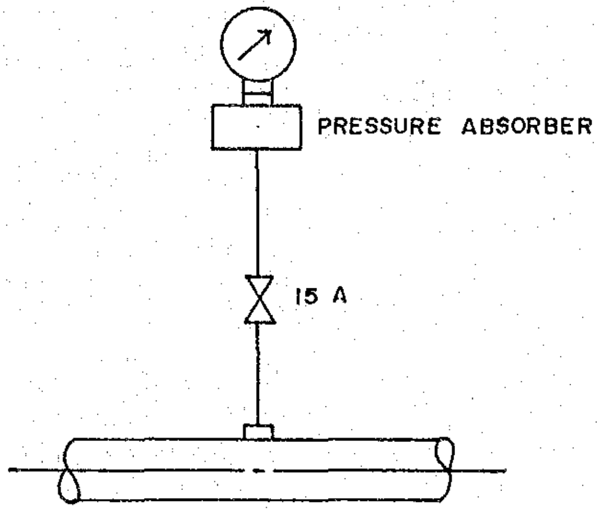
(d) Steam water line more than 50 kg/cm^2 and more than 100^oC.



(e) Test Tap.

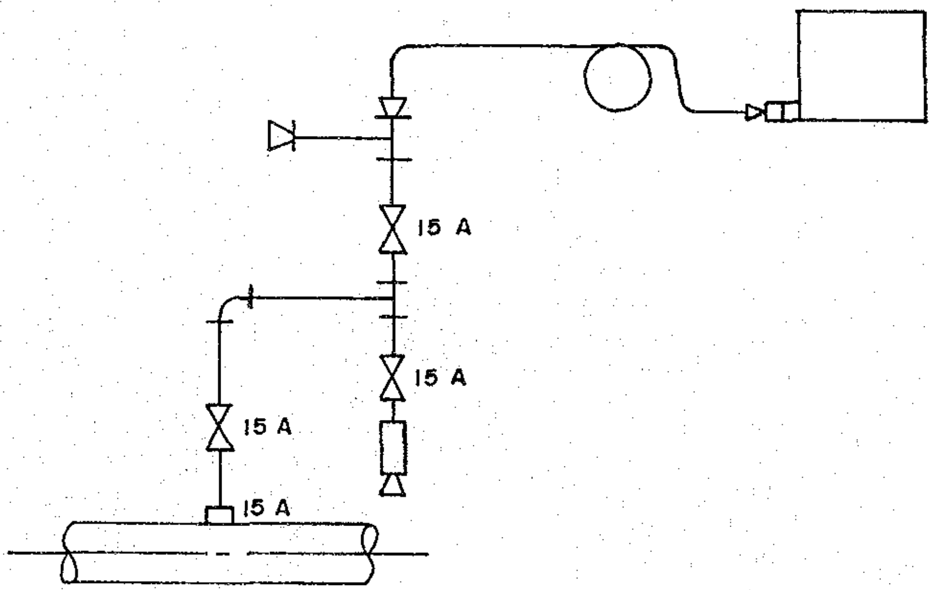


(f) Installation of pressure absorber.

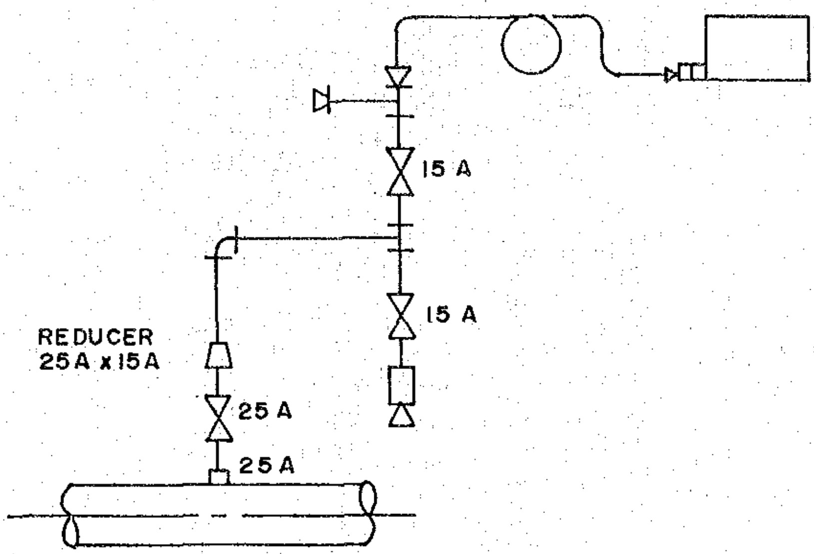


(g) Pressure transmitter, controller and switch

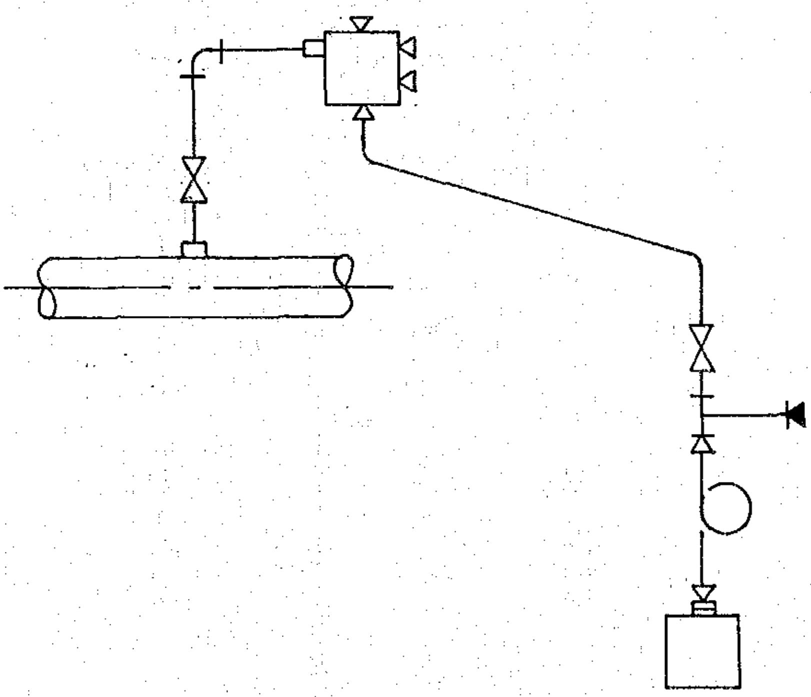
(a) Less than the pressure of 50 Kg/cm^2



(b) More than the pressure of 50 Kg/cm^2.

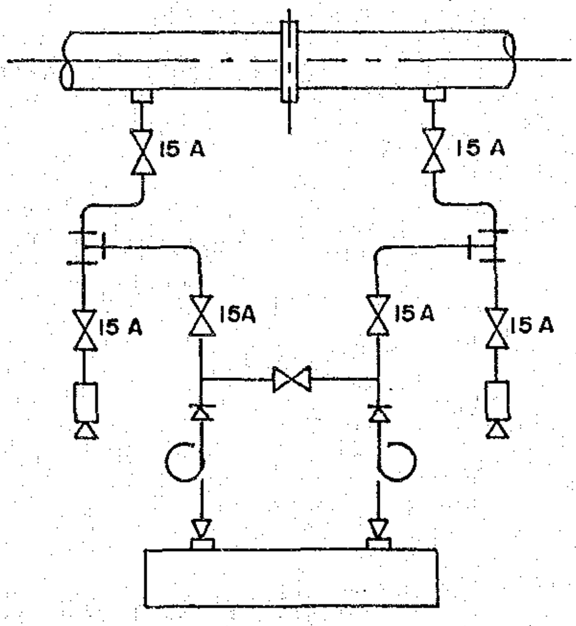


(c) In case of installation of oil separating chamber.

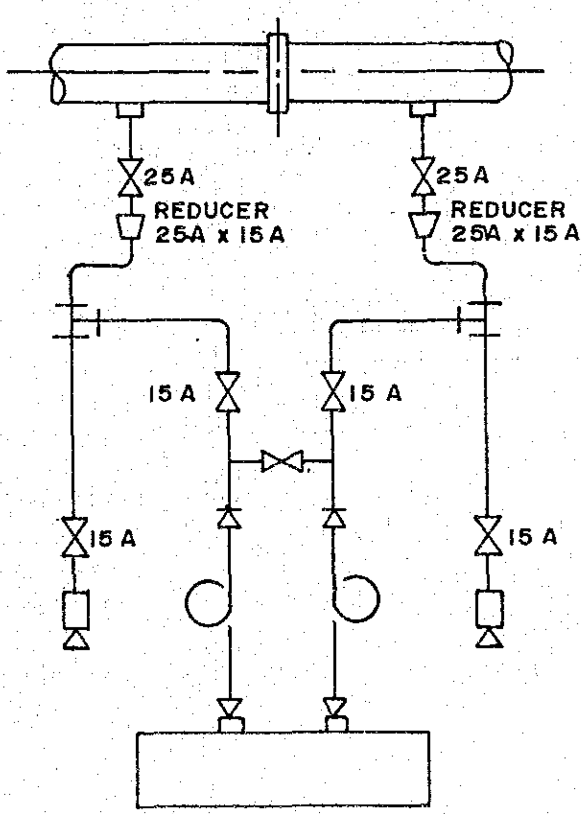


(3) Differential pressure transmitter

(a) Less than the pressure of 50 Kg/cm^2

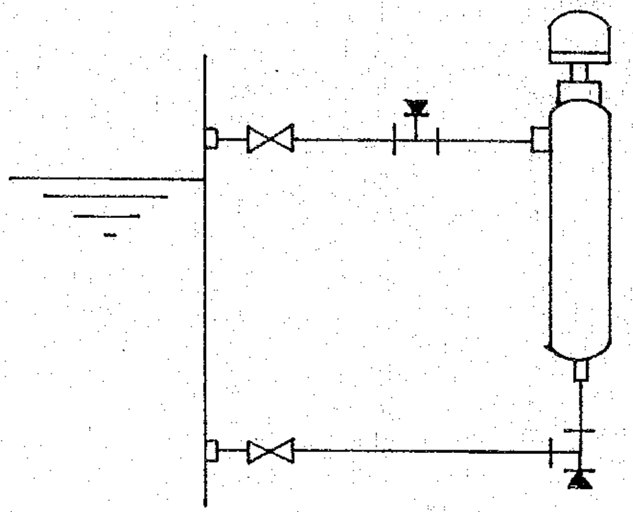


(b) More than the pressure of 50 Kg/cm^2

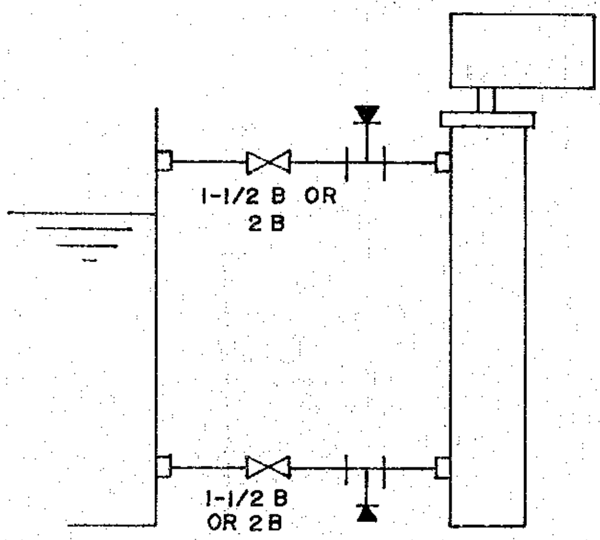


(5) Displacement type level transmitter, controller and switch.

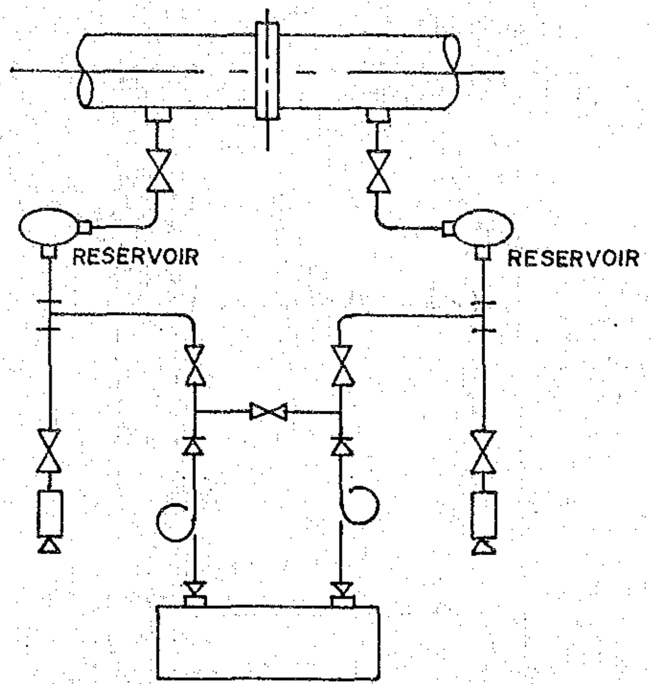
(a) Float type



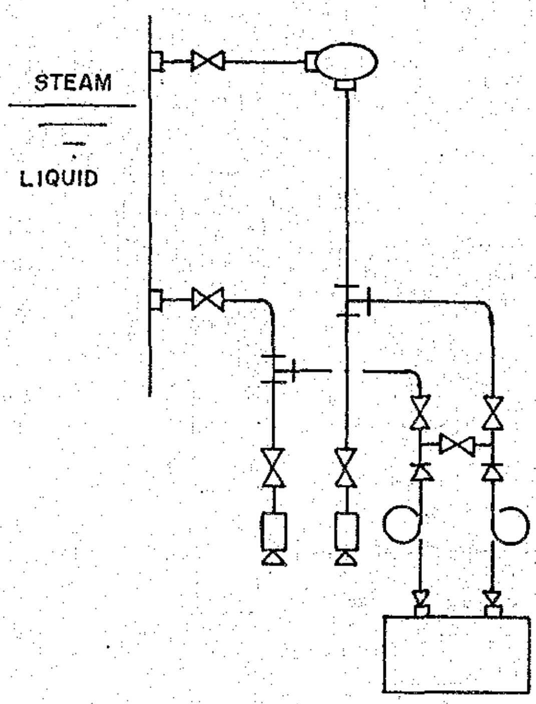
(b) Displacement type



(c) In case of installation of reservoir (for steam)



(4) Differential pressure type level transmitter



II. SUPPLY AND SIGNAL AIR PIPING

II - 1 Specifications

(1) Selection of piping materials

Piping	Materials	Size	Remarks
Supply Air			
a) Up to interface point	SGP-W	1/2B, 1B, 1-1/2B, 2B	JIS G-3452
b) From interface point to control cabinet	Copper pipe PJC-DCut	6/4 Ø 8/6 Ø 10/8 Ø	JIS H-3603
c) Inside Cabinet	Copper Pipe	6/4 Ø 10/8	JIS H-3603
SIGNAL AIR			
Output Signal	Copper pipe	6/4 Ø 8/6 Ø 10/8 Ø	JIS H-3603 JIS C-3401

(2) Selection of attachment materials

	Name	Type	Materials	Remarks
SGP-W	Connector		SGP, FCBM or BSBF	Taper Screw
	VALVE		BC	Taper Screw
Copper Pine	Connector	Flare	BSBM	
Copper Pipe				
Cable	Valve	Flare	BSBM	Miniature valve
Cabinet or :unctional box inside	Terminal block,supply header	Flare	BSBM	
	valve	flare	BSBM	Miniature valve

(3) Instrument air to controller, transmitter and controller air should be supplied from supply air header installed in the junction box

(4) Copper pipe cable should be in principle arranged in the cable tray or cable duct same method as electrical cabling.

II - 2. INSTALLATION

(1) Branch pipe on the supply air header pipe should be installed upward.

(2) All air supply pipe materials should be SGP-W and all connections should be of screw-connection type.

and telflon seal tape and seal bondage should be used at every connecting portion.

(3) Controller and instrument should be connected to instrument air pipe through the bare copper pipe for the purpose of flexibility.

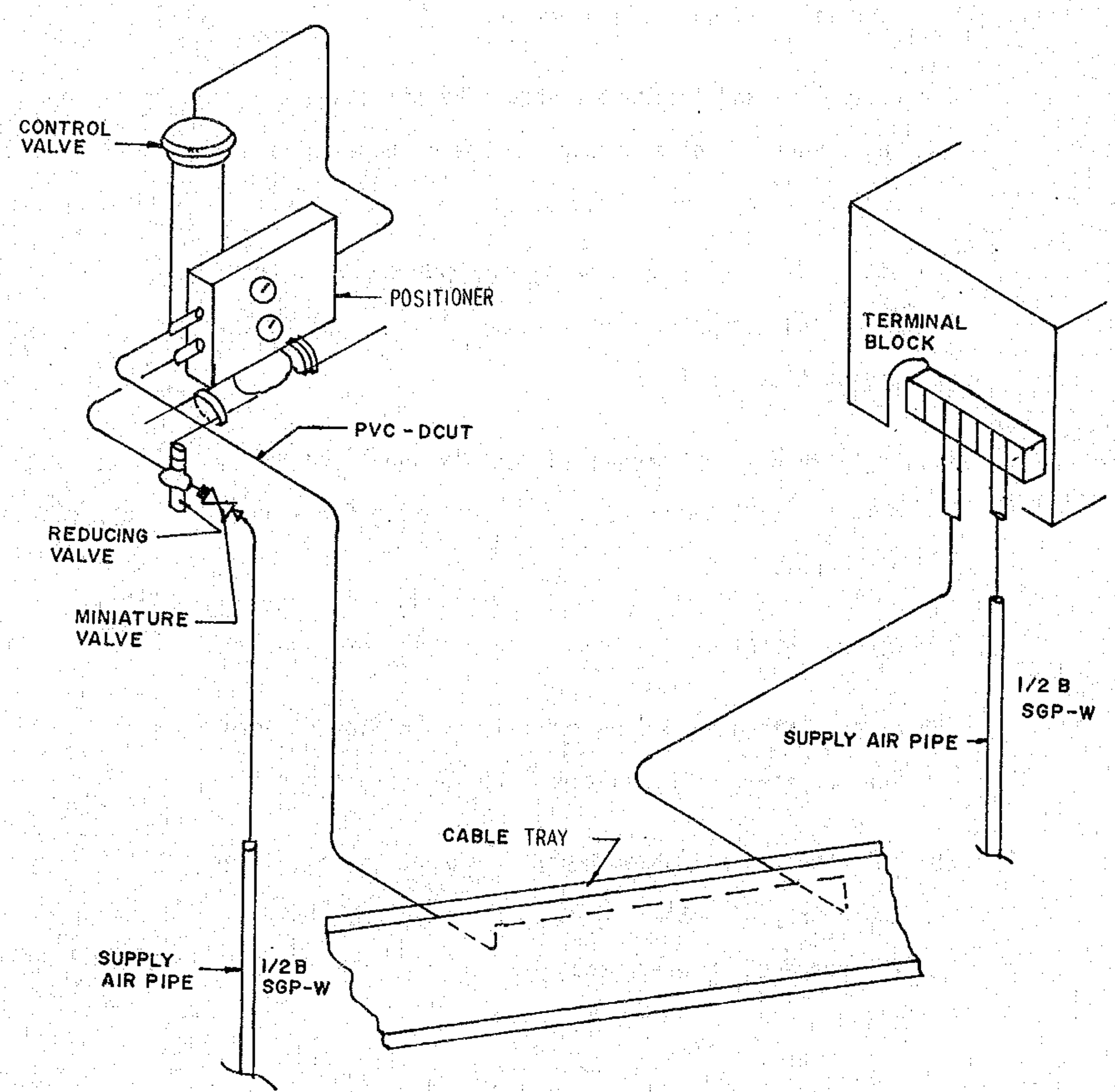
(4) Signal air pipe should be of PJC-DCut copper pipe cable and connector should be of flare sleeve type having flare angle of 37°.

(5) Bending radius of copper pipe cable should be more than ten (10) times of outside diameters for smooth air supply.

(6) Cable tag number should be put on the cable end.

(7) Copper cable should be supported on boiler structure or on pipe rack by universal channel and clamp.

(8) The copper pipe cable should be connected to outdoor cable tray or outdoor duct through bell-mouth for the purpose of water-proof.


CONTROL
VALVE
POSITIONER
TERMINAL
BLOCK
PVC - DCUT
REDUCING
VALVE
MINIATURE
VALVE
1/2 B
SGP-W
SUPPLY AIR PIPE
CABLE TRAY
SUPPLY
AIR PIPE
1/2 B
SGP-W

12

APPENDIX-12 DESIGN CONCEPT FOR HEATER

DESIGN CONCEPT FOR FEED WATER HEATER

TITLE	PAGE

DESIGN CONCEPT FOR FEED WATER HEATER

This concept is presented only as an example. With regards to detailed specifications, please discussed with manufacturer.

I. Fluid Velocity in Tube

Design Point

Usually approximately 2 m/s ± 0.2 m/s
In case of one-sided operation, the fluid velocity will be allowed up to approximately 3 m/s at approximately 75% load of MCR.

II. Heating Steam Velocity

The limitation will be around 180% flow rate of design point to prevent tube vibration and erosion.

III. Flow Velocity Inside the Bled Steam Piping

Maximum allowable velocity will be up to approximately 80 to 90 m/s, however, it depends on pressure loss in the piping.

IV. Flow Velocity Inside the Heater Drain Piping

Maximum allowable velocity will be up to approximately 1.5 to 2.0 m/s.

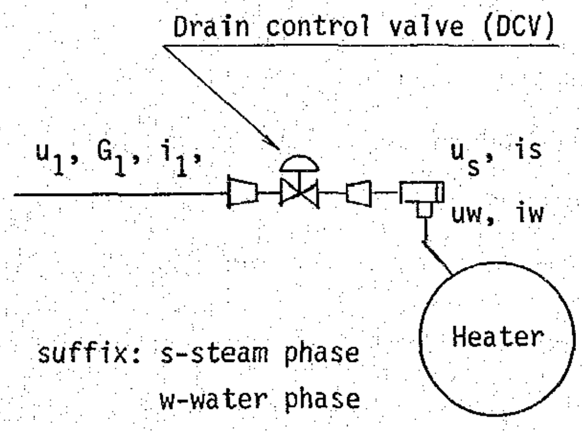
V. Inlet/Outlet Feed Water Velocity

Maximum allowable velocity will be up to approximately 3.0 m/s.

VI. Heater drain inlet velocity

1. Two-phase flow (water/steam): $G^2 mass/r \leqq 6000$
2. Flush steam : $G^2 mass/r \leqq 1500$
3. Water (P = 1) : Max. velocity $\fallingdotseq$ 1.2 m/s

G mass: Flow rate/area second ($kg/m^2/s$)
r : Specific weight (kg/m^3)
G : Total heater drain flow rate (kg/h)
i : Specific enthalphy (kcal/kg)
u : Specific volume (m^3/kg)



From the heater balance around DCV, the following formula can be attained.

$$G1 \cdot i1 = Gw \cdot iw + Gs \cdot is$$

$$G1 = Gs + Gw$$

$$G1.i1 = (G1-Gs).iw + Gs.is \qquad G1.i1 = Gw.iw + (G1-Gw).is$$

$$Gs = \frac{G1(i1-iw)}{is - iw} \qquad Gw = \frac{G1(is-i1)}{is - iw}$$

$$Gw = G1 - Gs \qquad Gs = G1 - Gw$$

$$r = \frac{Gs + Gw}{Gs.us + Gw.\ uw}$$

$$\text{Velocity} = \frac{Gw.Uw + Gs.Us}{\text{Area}}$$

$$\text{G mass} = \frac{G1}{3600 \times \text{Area}} \qquad kg/m2/s$$

For heater drain piping after DC$\bar{V}$;

- in case of Gmass/r $\leq$ 6000, carbon steel pipe will be applicable
- in case of G mass/ r $>$ 6000, alloy steel pipe schedule 80 will be necessary.

VII. Heating Steam (Bled steam), Heater Inlet Flange Velocity

Maximum allowable velocity will be up to approximately 45 m/s

VIII. Heater drain, Heater Outlet Flange Velocity

- in case that heater drain level is maintained normally: Max. 1.2 m/s
- in case that heater drain level is not maintained normally : Max. 0.6 m/s

IX. Nitrogen (N_2) Sealing

In case of application of N_2 seal, the necessary volume of N_2 gas will be approximately 1.4 times of heater volume

X. Relief Valve Capacity

1. Shell Side: 10% of feed water flow rate under rated output (10% tube leakage is considered.)

2. Water Box Side:

    - Feedwater flow rate more than 150 t/h: size 20A
    - Feedwater flow rate less than 150 t/h: size 15A

XI. Vent Capacity

1. Approx. 1/200 (t/h) of heating steam flow rate under rating output.
2. For deaerator, 1/100 (t/h) of heating steam flow rate under rating output. (In case of tray type deaerator --- since the tray type deaerator has condensing function by direct contact of steam-cool water in the tray system up to vent pipe.)

APPENDIX-13 GENERAL ASSESSMENT OF ON-GOING G-2 ANNUAL OVERHAUL

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GENERAL ASSESSMENT ON G - 2 OVERHAUL

QAG-82-0160
August 17, 1982

Mr. V. G. Villanueva
Manager
Sukat Thermal Plant

SUBJECT: General Assessment on
G-2 Overhaul

Transmitted herewith is a copy of the JICA Mission report on the above subject for your information and reference.

It is therefore requested that items in the report which could possibly be implemented be given preferential attention prior to the forthcoming Unit-start-up.

L. E. OSILLA
Manager
Quality Assurance Group
Office of the President

Atta. : a/s

cc.: Mr. T. H. Calasanz
Mr. M. Mano
Mr. A. Estandian
Mr. T. Oga
Mr. N. Pedron
Mr. S. Aberin
QA File

August 13, 1982

MEMORANDUM -

FOR : Mr. L. F. Osilla
Manager
Quality Assurance Group

FROM : JICA Group Members
Gardner/Snyder Thermal Plants

SUBJECT : General Assessment of Ongoing G-2 Annual Overhaul

In compliance with your request and as confirmed by Mr. T. Oga, JICA Group members assigned at Gardner/ Snyder Thermal Plant, together with NPC counterparts conducted a thorough ocular inspection of Gardner Unit No. 2 for two days, (August 12-13, 1982 inclusive) in order to have a general assessment on the ongoing annual overhauling of the Unit.

Attached herewith are our general findings for your information and endorsement to appropriate level of plant management for possible implementation. Further, we would like to emphasize that with the Unit overhaul already nearing completion based on schedule, there are still several valves in almost all plant systems which were not inspected, repaired and/or repacked, and if not attended to may possibly affect operation of the Unit

Should you need some further clarification on the attached report please feel free to contact us.

K. Ariyoshi

K. ARIYOSHI
Mechanical Engineer
WEST JEC

JICA - NPC COUNTERPART INSPECTION REPORT
ON G-2 OVERHAUL CONDUCTED AUGUST 12 - 13, 1982

1.0 COMMON ITEMS TO ALL FACILITIES

1.1 Replacement of valve gland packings.

Gland packings of the following valves should all be replaced without fail prior to unit start-up.

1.1.1 Root valves for instrument

1.1.2 Root valves for sampling (Refer to Sheet-A)

1.1.3 Control valves (Refer to item 4.2)

1.1.4 Air vent valves and drain valves on high pressure, temperature piping

1.1.5 Valves on vacuum line

1.1.6 Root valves for level indicator (HP, LP heater; Deaerator, etc.)

1.1.7 Other defective valves

1.1.8 Retightening of gland packings after start-up

1.1.9 Provide identification on piping, and/or name plate of valves including instruments to avoid misoperation.

1.1.10 Complete heat insulation of pipings and equipments requiring insulation.

1.1.11 Repair or installation of additional sump pumps to avoid flooding of areas and for protection of equipments.

1.2 Inspection and repair of all control valves and/or replace if necessary, to ensure smooth operation of plant systems.

2.0 BOILER AND RELATED FACILITIES

2.1 Inspection and repair of fuel oil strainers. Provide also spare strainers.

2.2 Installation of economizer inlet check valve in order not to subject Feed Water Heaters to possible backflow of high temperature fluid from the boiler during trip-out.

2.3 Inspection and repair of relief valves on all high pressure pipings.

2.4 Inspection of condition of high pressure pipings and boiler hangers including vibration eliminators.

3.0 TURBINE AND RELATED FACILITIES

3.1 Eddy current test on condenser tubes

3.2 Thickness measurement and possible patch weld repair of circulating water pipe portion found to be below required allowable thickness.

3.3 Inspection and repair of reversing valve if tide level condition permits.

3.4 Installation of feed water heater by-pass line.

3.5 Inspection and repair of condenser baffle plates.

3.6 Inspection and repair of condensate pump inlet strainer. Provide also spare strainers.

3.7 Inspection and repair of feed water pump strainer Provide also spare strainer.

3.8 Provide high pressure pipings and heater drains and vent valves with series valves.

4.0 ELECTRICAL, INSTRUMENT AND CONTROL

4.1 Replacement of mercury-type pressure switches with micro swithch-type.

4.2 Recheck and adjustment of the following valve control systems should be made after completion of mechanical works.

4.2.1 <u>Motor-driven valves</u>

MV-1, MV-2, MV-3, MV-4, MV-5

4.2.2 <u>Control valves</u>

CV-1A/1B, CV-101 A/B, CV-102, CV-103, CV-104, CV-105, CV-107, CV-108, CV-109

4.2.3 Local control valves

* Auxiliary steam pressure control valves·
* All deaerator control valve
* HP heater drain level control valves
* LP heater drain level control valves
* Steam air preheater control valves
* Instrument air control
* Station air control
* Fuel oil temperature control valves
* Soot blowing steam pressure control valves
* Turbine extraction steam line drain control valves
* Fuel oil pressure control valve
* Ignitor oil pressure control valve
* SAH control valve
* Boiler expansion tank temperature control

4.3 Deaerator pegging steam pressure control valve (Not operational)

By-pass valve - - - - - - - - - - - opened

Normal valves (before and after regulator - - - - - - - - - - - - - isolated

4.4 Provide adequate support for instrument air piping specially around boiler yard.

4.5 Calibration of fuel flow meters, air flow meters, feed water flow meters and steam flow meters required for satisfactory operation of once-through boiler.

4.6 Operation tests before unit start-up

* Motor-driven valves
* Pneumatic-actuated control valves
* Solenoid valves
* Hydraulic-actuated valves

4.7 Blowing-out/Purging of instrument air line at controller terminals

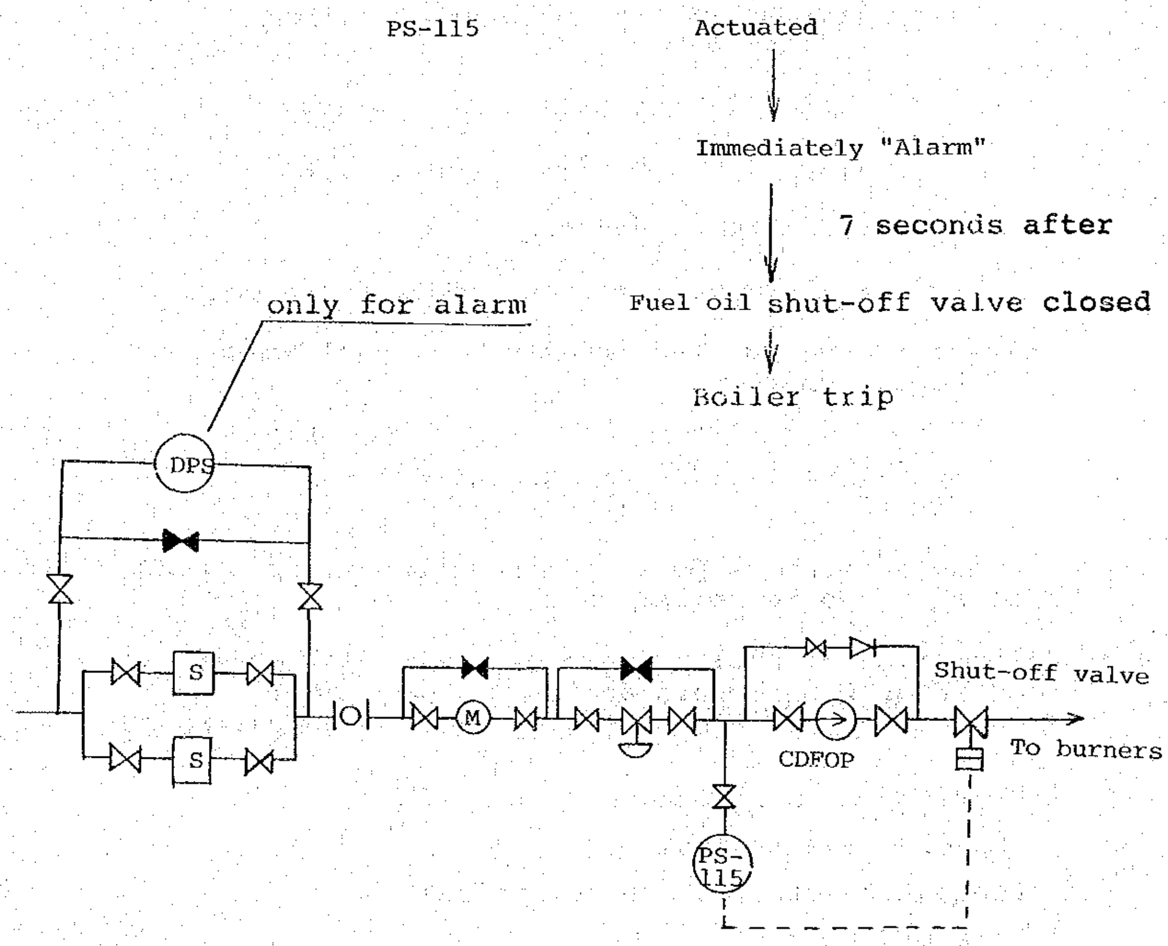
4.8 Boiler, turbine and generator tripping interlock relay tests and re-confirmation of the set points.

4.9 Insulation test (meggering) of power cables and motor windings before test run.

4.10 Alarm sensor test (sensor to annunciator lamp)

4.11 "Strainer differential pressure high" alarm .

Differential pressure indicator with alarm contacts should be separately provided. (only for pre-alarm)



4.12 Supervisory instrument calibration and signal check mounted on central control panel including transmitter, transducer and modules.

5.0 ADDITIONAL ITEMS TO BE CARRIED OUT
(Refer to Attachment Sheet B)

5.1 Improve ventilation of boiler room

5.2 Provide sufficient auxiliary power for lighting and additional outlets for welding job during overhauling

Caution:

Do not use auxiliary power from load centers of another units under normal operation.

5.3 Preventive measures against scattering the insulation materials removed from pipings.

5.4 Improvement of staircase

5.5 Additional lighting both for overhauling and normal daily inspection.

5.6 Blowing out of instrument air pipings at controller terminals.

5.7 Adoption and religious implementation of tagging system.

R E P O R T E D B Y :

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M. Kotani
M. KOTANI
Electrical Engineer
WEST JEC

ATTACHMENT SHEET - A

ROOT VALVE FOR SAMPLING

a) HP Heater Drip Flow

b) Hot RH Steam

c) Main Steam

d) Condensate Before Deaerator

e) Deaerator Storage Tank

f) Condensate Pump Discharge

g) Water Wall Header

h) House Service Closed Cycle

i) All other sampling valves

j) All sampling tubes should be replaced with SUS materials, including chemical injection lines (water, chemical).

k) SH and RH Spray Control Valves and Stop Valves should be checked, inspected and adjusted.

- ooo Oooo -

ATTACHMENT SHEET B

1. ADEQUATE AND CONTINUOUS VENTILLATING SYSTEM

Inherent in the operation of a power plant are heat emission from various plant systems specially from major equipments. Unwanted gas leaks and soots from boiler casing and ductworks are sometimes encountered. All these factors contributes to the establishment of undesirable working condition which does not only affect the health of plant personnel but also their efficiency and effectiveness in performing operation, preventive maintenance, inspection and overhauling activities. It is therefore suggested that all ventillating fans should be properly maintained and kept continuously runningboth during overhauling and normal operation. Further, a portion of the boiler house sidewall should be removed during overhauling to provide additional ventillation for the boiler room.

2. HOUSEKEEPING AND SAFEGUARDS TO CONTROLS AND EQUIPMENTS.

It was noted during the inspection that removed insulation materials from pipings heaters, boiler casing and ductworks and scraps are left scattered in various work areas specially in the boiler room. This condition affects to a large extent the safety and mobility of plant personnel. Secondly, locally mounted instruments and equipments already repaired are exposed or affected by falling dust. In this connection, it is suggested that removed insulations and scraps be immediately collected/ placed in empty containers and moved to a designated area. Or the gratings where the activity is being performed should be covered with canvass. Fire proof type canvass should be used also to cover gratings just under areas where welding jobs are being done for reasons of safety.

3. POWER SUPPLY AND LIGHTING FOR OVERHAULING WORKS.

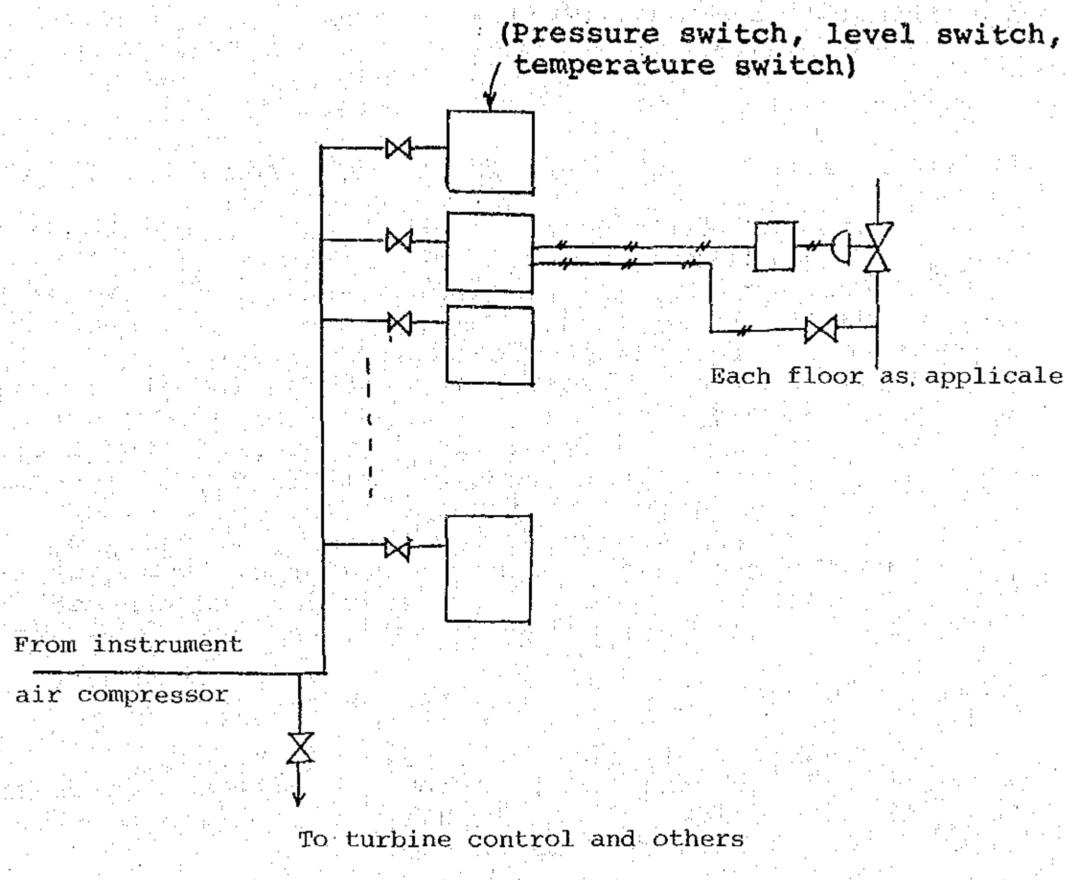
Adequate outlets should be provided at various portions and/or different locations of boiler. In case of overhauling, low voltage lighting power (about 20 to 40 V AC) is required for safety.

It is recommended that auxiliary power supply for overhauling works such as welding jobs, lighting, etc. should be taken only from auxiliary power load centers of unit undergoing overhaul, not from other units under normal operation. Short circuited or grounding of power cables or electric welding equipment may lead to serious troubles of other running units, thus causing unit tripout. Control center of units under normal operation adjacent to unit being overhauled should be covered for prevention against dust and damage from possible falling objects.

4. CONTROL INSTRUMENT AIR PIPING

Blowing out/purging of instrument air pipings for control units including locally mounted control units is required for satisfactory operation of automatic controls.

For long term rehabilitation, instrument air piping should be modified as follows:



5. ADOPTION OF APPROPRIATE TAGGING SYSTEM

Each detailed overhauling work such as replacement of valve packing, calibration of instruments, adjustment of valve opening and test run should be confirmed by tagging system.

FOR EXAMPLE:

______________ Tag

		Date	Signature
Valve No.	(CV-101)	Aug. 1. 1982	
Valve Seat	(Replaced)		
Packing	(O K)		
Positioner	(Adjusted)		
Actuator	(O K)		
Controller	(Calibrated)		

Checked by: ______________________

Approved by: ______________________

6. PROVIDE NAME PLATE FOR EACH VALVES (VALVE NO. OR VALVE NAME

K. Ariyoshi
K. ARIYOSHI
Mechanical Engineer
WEST JEC

H. Maeda
H. MAEDA
Mechanical Engineer
NEW JEC

J. Fujimoto
JE. FUJIMOTO
Electrical Engineer
WEST JEC

M. Kotani
M. KOTANI
Electrical Engineer
WEST JEC