Ref. Dwg.: B1-081-P50-001
B1-083-P50-001
B1-016-P50-002
B1-028-P50-004
B1-044-P50-006
B1-046-P50-006
B1-071-P50-006
B4-534-P50-006
B4-535-P50-006
B7-059-P50-001

STEAM, CONDENSATE AND FEEDWATER SYSTEM DESCRIPTION

A. BOILER STEAM OUTLETS - NOS. 1, 2, 3, 4, and 5

Superheated steam at 1250 PSIG and 950°F leaves the boilers through the superheater outlet header via the boiler steam lead line which is connected directly to a common main steam header. Each lead line is equipped with a floating disc non-return valve which prevents reverse flow of steam from the main steam header back into the boiler. The boiler lead lines are of varying sizes consistent with their design load capacities. The size of the main steam header varies from 16" at Boilers 1 and 2 to 18" starting at Boiler 3. The original header at Boilers 1 and 2 is connected to the header for Boiler 3 via two 10" lines and one 4" expansion loop equipped with isolating valves. The headers between Boilers 3, 4, and 5 are similarly connected via isolating valves. Expansion loops are provided between Boilers 3, 4, and 5 to prevent distortion of the header due to the high operating temperature of the steam.

The superheated steam passes through flow nozzles in each boiler lead line where the flow is measured for Control Room recorder indication and for feedwater-drum level control. This is described in detail in the "Three Element Feedwater Control" section. Pressure and temperature of the steam in each lead line is also measured for recorder indication and for steam temperature control on Boilers 3, 4, and 5.

Direct-current motor-operated valves are provided on each lead line at the connection to the main steam header. The control switches for the MOV's are located on the Mechanical Console Boards and in addition the valves are equipped with local push-button stations and handwheels. The push-button station at each valve is interlocked with the control switch on the Console Board. This interlock circuit has been designed to prevent the switch on the board from operating against the push-button station while the valve is being operated locally. The control circuit of the valve can be disconnected by either pulling out the control switch on the Board or by opening the line switch at the valve starter, thus avoiding accidental operation of the valve during maintenance.

Between Boilers 1 and 2, two 8" lines from the 16" main steam header provide steam to a 475# Pressure Reducing and Desuperheating Station and a 235# Pressure Reducing and Desuperheating Station. These lines are equipped with manual isolation valves.

Between Boilers 3 and 4, a 10" line takes off from the 18" main steam header for No. 2 235# Pressure Reducing and Desuperheating Station. This line is equipped with a manual isolation valve adjacent to the main steam header and a direct-current motor-operated valve immediately upstream of the Pressure Reducing Valve. The Control Switch for this MOV is located on the Boiler 4 Console Board.

A 2" auxiliary steam header takes off from the 16" main steam header between Boilers 1 and 2 supplies high pressure-high temperature steam to the air ejector, hogging jet and to the steam driven auxiliary oil pump for Turbine 1. Also, a backup for Turbine 1 sealing steam is provided from the take-off to the hogging jet.

A second 2" auxiliary steam header take-off from the 18" main steam header at Boiler 3 supplies steam to the steam seal regulator and steam driven auxiliary oil pump for Turbine 2.

An electromatic relief valve (ERV-1) is installed on the 16" main steam header between Boilers 1 and 2 for automatic or remote controlled relief of the main steam header pressure. The remote-manual control switch for the valve is located on the Mechanical Console Board. Identical valves (except for relieving capacity) are installed on the boiler side of the non-return valves on Boilers 3, 4, and 5. Their control switches are also located on the Mechanical Console. The popping pressure of these valves are the lowest of all relief valves on the boilers and will vary from approximately 1320 PSIG to 1350 PSIG.

B. STEAM TO NO. I TURBINE

Two 10" lines connected to the 16" main steam header at Boilers 1 and 2 supply steam through a 10" X 16" "Y" fitting to the Turbine 1 stop valve at 1250 PSIG and 950°F. A 10" D.C. motor-operated valve is installed in each line adjacent to the main steam header. The operation of these valves is identical to that described for the boiler lead lines.

The steam flow of each 10" line to the turbine is measured by a flow nozzle and is transmitted to a recorder on the Mechanical Vertical Board. The flow from both 10" lines to the turbine is totalized through integrators installed in the Mechanical Vertical Board. The pressure and Temperature of the turbine steam are also recorded on the M.V. Board.

After expanding through the first six stages of the turbine, steam is automatically extracted at 475 PSIG for process use. After expanding through Stages 7, 8 and 9, steam is automatically extracted at 235 PSIG for process use. After expanding through Stages 10 and 11, there is a non-automatic uncontrolled extraction opening where steam is supplied to the Power Plant 30 PSIG header for deaerating and heating of the boiler feedwater. Two low-pressure, uncontrolled extraction openings in the low pressure turbine are used for condensate heating within the Low Pressure Heater. The remainder of the steam passing through the low pressure turbine is exhausted to the surface condenser where it is cooled and condensed by coming in contact with the tube bundles which have circulating water (untreated river water) flowing through them.

C. CONDENSER NO. 1

The condensed exhaust flow from the turbine, the drains from the gland seal condenser and the air ejector are accumulated in the hotwell of the condenser. The Allis-Chalmers 30,000 sq. ft. surface condenser is a horizontal, two-pass unit with a divided hotwell. It is designed to condense a maximum turbine exhaust flow of 375,000 pounds per hour at 85° inlet circulating water temperature.

In the event of excessive condenser tube leakage, one side of the condenser can be isolated and still allow the turbine to continue operating, but at reduced load on the opposite half of the condenser. Contamination from the leakage is detected by two conductivity cells, one in each divided hotwell condensate outlet. The conductivity cells transmit a signal to a recorder on #1 Process Auxiliary Board. High conductivity in the condensate is annunciated on the Process Auxiliary Board.

The condenser is equipped with locally mounted level gauges in each half of the hotwell, locally mounted vacuum pressure gauge and temperature indicator. A pressure transmitter is used to transmit condenser back-pressure to a recorder on the Mechanical Console Board and to a draft gauge on the Process Auxiliary Board.

A constant water level of 7" in the hotwell is maintained by means of a level controller. The level controller delivers an air loading signal to throttle a 3" control valve located at the main condensate header. This control valve is equipped with a manual operator and has the lock-in position feature during control air failure. A 6" by-pass line with a 6" globe valve is provided. High or low water level (3 1/2" above or 4 1/2" below normal water level) in each half of the hotwell will be annunciated on the Mechanical Vertical Board.

A 6" manually operated globe valve, located at the side of the condenser with a 6" stack is used for breaking the condenser vacuum. A 1/2" seal water line is connected to the stack to detect any leakage of the normally closed 6" globe valve.

D. CONDENSATE PUMPS 1A AND 1B

Two 900 GPM full-capacity vertical pumps, one of which is a stand-by, with a differential head of 225 feed are used to take suction from the condenser hotwell and discharge condensate through a 6" condensate header to the air ejector, then to the turbine gland seal condenser, low pressure heater and to the common condensate header connected to the Deaerators.

The suction line is 14" for each condensate pump with a valved 14" line interconnecting both condensate pump suctions. The interconnecting line provides the flexibility of one pump normally taking suction from both halves of the hotwell and to enable an emergency pump-out of the contaminated half condenser hotwell by the other pump. The pump-out discharge connections are installed at the discharge outlet between the 6" check valve and the 6" gate valve. A closed and capped 3" globe valve is provided for the discharge of contaminated condensate to the condenser pit. In the event of a pump out, one condensate pump will be used for this purpose with the 6" gate valve at the discharge outlet and the 14" valve at the interconnecting suction line closed and the 3" globe valve open. The other condensate pump will be used to pump water in the normal manner from the uncontaminated condenser half.

The condensate pumps are directly connected to a vertical electric motor drive and can be started and stopped at a local push-button station. One pump is used during normal operation. A pressure switch is installed at the discharge header to start the standby pump upon low pressure. A low pressure alarm will be annunciated on both the Mechanical Vertical Board and the Process Auxiliary Board. A locally mounted pressure gauge is provided at each pump discharge outlet.

A 3/4" seal water line tapped off from the condensate discharge header supplies condensate for condensate pump shaft packing gland sealing. A pressure gauge is installed at the seal water inlet on each pump for pressure indication which will be positive while the pump is in operation.

E. AIR EJECTORS NO. 1

A two-stage, twin element air ejector with inter and after condensers is used for purging air from the condenser. A 2" steam line from the 16" main steam header supplies steam for operating both ejectors.

475# [illegible]

~~1~~250 PSIG ~~main steam~~ pressure is reduced to 400 PSIG ~~by means of a hand-operated valve~~ for operating the air ejector. Relief valves are provided with the air ejector to avoid over-pressure in the systems. The hogging ejector, used to evacuate the condenser during the start-up, discharges through a silencer to avoid excessively high noise level in the area surrounding the hogging ejector. Steam to the hogging jet is reduced to 500 PSIG by a manually-operated throttling valve.

The vapor and operating steam condensed in the inter and after condenser of the air ejector is returned to the main condenser through trap drains. The air ejector rejects the non-condensible gases to the atmosphere through an air meter.

The condensate pump discharge header supplies condensate to the air ejector for condensing the steam vapor. A 6" by-ass line with a 6" globe valve is provided for the condensate to bypass the main air ejector.

F. GLAND SEAL CONDENSER NO. 1

Main condensate is supplied to the gland seal condenser to condense all the leak-off vapor from the turbine glands. The condensate of the gland seal condenser is returned to the main condenser through a trap drain system. High water level of the gland seal condenser will be annunciated on #1 Process Auxiliary Board. The gland seal condenser is a shell-and-tube type heat exchanger and is furnished by the turbine manufacturer. A 6" bypass line with a 6" globe valve is installed for the main condensate to bypass the gland seal condenser.

A condensate recirculation control station is provided to maintain a minimum condensate flow of 200 gallons per minute through both the air ejector and the gland seal condenser while the turbine is generating minimum electric load and the condenser is operating at its minimum exhaust steam load.

The recirculation control station is installed in a 3" branch line tapped off from the main condensate header at downstream of the gland seal condenser. A 2" control valve is controlled from a flow orifice and a flow controller located at the condensate header after the low pressure heater. The control valve will be opened upon receiving a low flow signal from the flow controller and the condensate will be recirculated back to the main condenser through the control valve. A 3" globe valve is provided for the recirculation control valve by-pass.

G. LOW-PRESSURE HEATER NO. 1

A horizontal closed type heater with internal drain cooler welded in the main condenser transition piece receives extraction steam from the turbine low-pressure stages for main condensate heating. The extraction steam from the turbine low-pressure section is extracted through four 10" openings to two 16" headers connected to the heater shell. These extraction lines are located inside the condenser shell.

The extraction steam pressure, ranging from 4 psia to 18 psia, varies in proportion to the condenser steam loads. The extraction steam is condensed by the main condensate flowing through the heater tubes and the drain is connected to the suction of the low-pressure heater pump which discharges into the main condensate header. A level control valve in the discharge of the low-pressure heater pump is employed for controlling the normal drainage to the suction of the pump by receiving a signal from a level controller installed at the heater shell. In case of high level in the heater due to condensate tube leakage or outage of the pump, a 2" dump valve controlled by the same level controller will discharge the excess water through a separate 3" drain line to the condenser hotwell. High and low water levels in the heater will be annunciated both on the Electrical Board and the #1 Process Auxiliary Board. Temperature of the condensate is measured by locally mounted thermometers located before and after the low-pressure heater. A relief valve is installed on the water box of the heater to prevent overpressure in the heater. A 6" bypass line with a 6" globe valve is provided at the low-pressure heater for the main condensate to bypass the heater. Main condensate flow to the deaerators is recorded on the Process Auxiliary Board through flow transmitter.

H. STEAM TO TURBINE 2

Two 12" lines connected to the 18" main steam header near Boiler 3 supply steam through a 12" by 12" by 18" "Y" fitting to the Turbine 2 stop valve at 120 psig and 950°F. A 12" motor-operated gate valve is installed in each 12" line. The operation of these valves is the same as the MOV's to No. 1 Turbine.

The steam flow of each 12" line to the turbine is measured by a flow nozzle and is transmitted to a recorder on Turbine 2 Board. The flow from both 12" lines to the turbine is totalized through integrators. The temperature and pressure of the turbine steam is also recorded on the Turbine Board.

After expanding through Stages 1 through 6 in the high-pressure turbine, steam is automatically extracted from an opening controlled at 235 psig for process use. The turbine is designed to generate 60,000 KW with the automatic extraction supplying process steam of 1,000,000 #/hr. at 235 psig. Uncontrolled extraction openings (high pressure and low pressure)are provided between the seventh and eighth stages and the ninth and tenth stages to supply steam to the Power Plant 30 psig header for deaerating and feedwater heating. Normally the low-pressure opening is open with the high-pressure opening closed. Only one at a time can be used. Steam is also extracted (uncontrolled) from the low pressure turbine for condensate heating in the low pressure heater.

I. NO. 2 CONDENSER

The condensed exhaust flow from the turbine, the drains from the gland seal condenser, and the air ejector are accumulated in the hotwell of the condenser. This unit also has an L.P. Heater. Pump and its operation is identical to No. 1 Condenser. The Worthington 40,000 sq. ft. condenser is a horizontal, two-pass unit with a divided 2800 gallon hotwell. At maximum electric generation of 60,000 KW, the condenser is designed to condense turbine exhaust steam of 400,000#/Hr. at zero automatic extraction steam load and 280,000#/Hr. at full automatic extraction steam load.

In the event of excessive condenser tube leakage, one side of the condenser can be isolated and still allow the turbine to continue operating. but at reduced load, on the opposite half of the condenser. Contamination from the leakage is detected by two conductivity cells, one in each divided hotwell condensate outlet. The conductivity cells transmit a signal to a recorder in the Process Auxiliary Board. High conductivity in the condensate is annunciated in the Process Auxiliary Board.

The condenser is equipped with locally mounted level gauges in each half of the hotwell, locally mounted vacuum pressure gauge and temperature indicator. A pressure transmitter is used to record condenser backpressure in a recorder on the Mechanical Console Board and to a draft gauge on the Process Auxiliary Board.

A constant water level of 7" in the hotwell is maintained by means of a level controller. The level controller delivers an air loading signal to throttle a 2" control valve located at the main condensate header. This control valve is equipped with a manual operator and has the lock-in position feature during control air failure. A 6" bypass line with a 6" globe valve is provided. High or low water level (3 1/2" above or 4 1/2" below normal water level) in each half of the hotwell will be annunciated on the Mechanical Vertical Board.

A 6" manually operated globe valve, located at the side of the condenser with a 6" stack is used for breaking the condenser vacuum. A 1/2" seal water line is connected to the stack to detect any leakage of the normally closed 6" globe valve.

J. CONDENSATE PUMPS 2A AND 2B

Two 1030 GPM full-capacity vertical pumps, one of which is a standby with a differential head of 225 feet are used to take suction from the condenser hotwell and discharge condensate through a 6" condensate header to the air ejector then to the turbine gland seal condenser, low pressure heater and the common condensate header to the deaerator.

The suction line is 12" for each condensate pump with a line interconnecting both condensate pump sections. The interconnecting line provides the flexibility of one pump normally taking suction from both halves of the hotwell. A pump-out discharge connection is installed at the discharge space. A level controller sends an air loading signal to open an emergency dump valve when water level in the weir space exceeds 10". The overflow water is sent to the 500,000 gallon condensate storage tank through a 10" header. A perforated pipe extended inside the condensate storage tank is provided to disperse the flashing mixture of the overflow water. The dump valve will open intermittently to discharge the condensation which collects in the weir space.

The water level in the deaerator storage tank is indicated both on the Mechanical Vertical Board and Process Auxiliary Board. A level gauge is installed at the No. 1 water storage tank for local indication of the water level. Two thermometers are mounted at the deaerating section and at the storage tank for local temperature indication.

All the deaerator water storage tanks receive recirculation of feedwater from the boiler feed pumps.

The deaerators are connected on top of each storage tank by a 14" steam equalizing line. The function of this line is for equalizing the pressures between the deaerators. In order to attain an identical water level inside these parallel water storage tanks, a constant pressure must be maintained. A normally opened 14" gate valve is installed at the equalizing line for isolating the deaerators, if necessary. Two 2" steam lines supply steam from the 14" steam pressure equalizing line to various steam heating units for building steam heating.

O. BOILER FEED PUMPS 1, 2, 3, 4, 5, 6, 7, AND 8

Eight motor-driven, barrel-type, multi-stage, centrifugal pumps are used to supply boiler feedwater. Three Allis-Chalmers units, (Nos. 1, 2 and 3) are driven by 1250 h.p. Allis-Chalmers motors and are designed to pump 1160 gpm against 4000 foot head at 3580 rpm. Allis-Chalmers Pump 4 is driven by a 1750 h.p. Allis-Chalmers motor and is designed to pump 1590 gpm against 4000 foot head at 3570 rpm. Pacific Pumps 5 and 6, driven by 1500 h.p. General Electric motors, are designed to pump 1344 gpm atainst a 4020 foot head at 3570 rpm. Pacific Pump 7 and 8, driven by 2250 h.p. General Electric motors, are designed to pump 1934 gpm against a 4008 foot head at 3580 rpm. The lubricating oil for the bearings of each pump is supplied normally by a gear-type oil pump from the pump shaft. There is a standby electric motor-driven auxiliary lube oil pump for each boiler feed pump that can be started by a two-position control switch on Boiler Feed Pump Board. The auxiliary lube oil pump control switches can be selected to be "TEST" or "AUTOMATIC". The switch should be selected on "AUTOMATIC" during normal operation. In case of low lube oil pressure, the "AUTOMATIC" position pressure switch will start the pump and sound an alarm. The pressure switch stops the auxiliary lube oil pump when the shaft driven pump has restored the oil pressure. The auxiliary lube oil pump can be started manually by putting the switch to "TEST" prior to the start-up of the boiler feed pump.

Also, the functioning of the auxiliary lube oil pump of a standby boiler feed pump can be tested. One red light for each auxiliary lube oil pump is installed on Boiler Feed Pump Board to give indication as to which and when the auxiliary lube oil pump is in operation.

The pumps are equipped with recirculation lines to provide protection against overheating during low pumping rates. When a pump requirement is less than 60,000#/Hr., the recirculation control valve will open, allowing the pump to stay above minimum flow by recirculating feedwater back to the deaerators. When pump requirement rises above 140,000#/Hr., the recirculation valve will close.

The pumps are equipped with water cooled stuffing boxes. Process water is piped to water jacket around the stuffing boxes for the purpose of keeping the packing cool and is discharged through piping to the plant drainage system. The discharge line has a thermometer for observing outlet temperature.

During a normal operation, feedwater passing through the BFP's is above the boiling point and leakage past the packing is prevented from flashing by mixing this leakage with cool water piped from the discharge of the condensate pumps to the packing retaining flanges. These snuffing water lines have throttle valves at each flange. Backup snuffing water is provided by a tie-in to the make-up discharge line.

The discharge line from each pump is equpped with a non-return valve which prevents loss of pressure in the discharge header upon stopping a pump.

Necessary warm-up lines from the BFP discharge header bypasses the BFP non-returns and allows hot water from the header to back up through the BFP's keeping them at operating temperature when on standby.

Switches for starting or stopping the feed pumps 1, 2, 3, 4, 5, and 6 are located on the mechanical console and the boiler feed pump panels. Ammeters are also provided.

Boiler Feed Pumps 7 and 8 can only be started and stopped from the Process Auxiliary Board in No. 2 Auxiliary Control Room.

Condensate leaving the deaerator flows under pressure and force of gravity to the BFP suction header. Suction lines branch off of this header to supply condensate to the BFP's. A gauge is provided on each suction line just above the pumps for local pressure indication.

The BFP's discharge line supply 2000 PSI to the BFP discharge header. This header supplies high pressure feedwater to the boiler attemporator valves, the boiler's feedwater control valves, the desuperheating stations, and the chemical feed surge bottles.

Valves are provided in the discharge and suction lines to each pump for isolation purposes.

P. HIGH PRESSURE FEEDWATER HEATERS

Feedwater to Boilers #1, #2, and #3 is preheated before entering the economizers by the High Pressure Heaters, using 235 psi steam to raise the water temperature to approximately 390-400° F. Steam flow to the heaters may be adjusted remotely from the main Control Room, one controller for heaters #1 and #2, another for #3.

Condensate level in each heater is maintained by a regulator which controls drainage of condensate from each heater to the flash-tank. High level alarms are provided for each heater, annunciated in the main Control Room.

Condensate from the three heaters flows into the flash-tank where a portion of it flashes to steam and is piped into the 30# system. Condensate which accumulates in the bottom of the tank is pumped through a regulator, which controls the level in the tank, into the make-up system.

High level and high pressure alarms on the flash-tank are annunciated in the main Control Room.

Q. SPRAY WATER PUMP

This motor-driven pump has the function of supplying hotwell condensate, at sufficient pressure, to the attemporator spray water control valves on Boilers 3, 4, and 5 for superheat temperature control. It takes suction from the 8" condensate header near the southwest corner of Boiler 3 and discharges into the 6" spray water header. The header is reduced in size from 6" to 4" just downstream of the Boiler 4 take-off. The 4" take-offs to each Boiler are equipped with manual block valves and check valves, and are interconnected with lines from the boiler feed pump discharge header. Installed in each of these lines near the interconnection is a motor-operated valve and a check valve.

With proper valving arrangement, #5 boiler feed pump can also be used to pump condensate to the boiler sprays.

Q. AUTOMATIC EXTRACTION STEAM - NO. 1 TURBINE

The turbine is designed to supply process steam at two automatically controlled extraction openings. Each extraction opening is automatically controlled by a governor at a pressure of 475 PSIG and 235 PSIG, respectively, to deliver process steam varying from zero to 700,000 pounds per hour at 475# and 400,000 pounds per hour at 235#.

The flow, pressure and temperature of the extraction lines are recorded on the Mechanical Vertical Board.

Locally mounted pressure gauges are provided on the Turbine Start-up panel. In case of high temperature, an alarm will sound on both the Mechanical Vertical Board and process Auxiliary Board. Relief valves are installed upstream of the non-return valves for protection against over-pressure in the turbine.

These two groups of relief valves are installed to protect against over-pressure in the turbine under the following concurrent conditions.

1. Turbine operates at no process extraction with generator loaded between minimum to 50,000 KW.

2. The gate valves at each automatic extraction line being closed.

3. The extraction governor mechanisms fail.

4. The extraction valve gear fails closed forcing steam into the extraction lines under increasing pressure.

Two air-controlled, swing-check, non-return valves are installed in series in each of the automatic extraction lines to prevent re-entry of steam into the turbine from the process steam lines when the stop valve is tripped by relay action or by hand trip. Each is equipped with a side-mounted operating cylinder which encloses a spring-loaded piston connected by linkage to the non-return valve stem.

The inboard valves are controlled by an oil relay dump valve located on the turbine lube oil reservoir. The outboard valves are controlled by an air dump valve actuated by a cam installed on the lower inlet valve camshaft. In normal operation, air pressure is applied to the bottom of the piston, opposing the spring pressure, and the valve is free to operate as a swing check valve. When the stop valve trips, air pressure on the bottom of the spring loaded piston is dumped to atmosphere and the valve will close due to the stage pressure at the extraction opening dropping lower than line pressure and by the spring pressure in the operating cylinder.

The inboard non-return valves will close instantaneously upon tripping of the turbine stop valve, by reasons of:

1. 110% overspeed trip
2. Low vacuum trip
3. Hand trip
4. Generator differential trip

The outboard non-return valves will close when the lower inlet control valve camshaft rotates in a closed direction actuating the air dump valve to release air pressure on the bottom of the spring-loaded piston. The valves are closed completely by line pressure being higher than stage pressure and by spring pressure in the operating cylinder. The non-return valve in the uncontrolled extraction line operates in the same manner. Test valves are installed for each non-return valve for periodic operation to insure freedom of movement.

R. AUTOMATIC EXTRACTION STEAM - NO. 2 TURBINE

The turbine is designed to supply process steam at a single automatically controlled extraction opening. The extraction opening is controlled by a governor at a pressure of 235 PSIG to deliver process steam varying from zero to 1,000,000#/Hr.

This turbine has two extraction lines tied into a common extraction opening in the turbine. Each is equipped with a motor-operated shutoff valve and dual air-controlled non-return valve. Operation of these non-return valves is identical to No. 1 Turbine's.

Flow through the two lines is recorded on the turbine start-up panel. Pressure and temperature (common to both lines) is also recorded on the same instrument.

A locally mounted pressure gauge is provided also on the No. 2 Turbine Board. High temperature and high pressure annunciation is provided on the electrical board. Six (6) relief valves are installed upstream of the non-return valves for protection against over-pressure in the turbine which could occur for the same reasons as described for No. 1 machine.

NO. 3 TURBINE

No. 3 Turbine is the same as No. 2 except that it extracts through a single 24" line with a maximum design capacity of 1,100,000#/Hr. The extraction line ties into the 30" North-South header.

NO. 4 TURBINE

This unit is equipped for single automatic extraction at 475 psig with maximum design capacity of 1,250,000 #/hr. from a 24" opening in the turbine shell into a 20" line that ties into the 30" header to LHC II. From this 20" line, there is a 12" take-off increased to 16" that ties into the 18" east-west 235# process header. By use of a motor-operated throttling valve, we can bypass 475# extraction from this machine into the 235# process header.

In addition to the 475# extraction, this unit exhausts (at 30 psig) from a 42" opening in the turbine shell into the 30" deaerating feedwater heating header.

S. PRESSURE REDUCING AND DESUPERHEATING STATIONS

Steam from the 16" main steam header (between Boilers 1 and 2) is supplied through two 8" lines to two pressure-reducing and desuperheating stations, each of which provides 475 PSIG and 235 PSIG process steam respectively.

Each pressure-reducing and desuperheating station consists of a pressure control valve, a remote controller, a pressure controller, an atomizing steam regulating valve, a desuperheating water temperature control valve, a temperature controller, and desuperheating nozzles. These two desuperheating stations receive a common source of desuperheating water supplied through a pressure-reducing valve from the boiler feed pump discharge header.

High pressure, high temperature steam passes through the 8" pressure control valve controlled by a pressure controller which reduces its pressure from 1300 PSIG to the set pressure of 475 PSIG and 235 PSIG, respectively.

A remote controller is provided on the No. 1 Process Auxiliary Board for remote control of the pressure of each station. A 6" bypass line with a globe valve is installed for bypassing each control valve. A desuperheating station is located downstream of each pressure reducing station. Two desuperheating nozzles are installed at the 475 PSIG steam line and three desuperheating nozzles are installed at the 235 PSIG steam line. The desuperheating nozzles of each station receive a small quantity of high pressure steam through a 2" pressure reducing valve providing an atomizing effect to the incoming desuperheating water. The desuperheating water is supplied through a 2 1/2" pressure reducing valve controlled at 600 PSIG by a pressure controller from the feedwater discharge system. This water at 600 PSIG is common for both the 475 PSIG and 235 PSIG desuperheating station. A separate desuperheating water temperature control station receiving this 600 PSIG water is provided for regulating the desuperheating water quantity to each group of the desuperheating nozzles. This control station consists of a 1 1/2" temperature control valve and is regulated by a temperature controller. A Remote manual controller is installed on the Process Auxiliary Board for each of the temperature control valves and atomizing control valve. Remote indications of temperature and pressure of the process steam from the stations are provided on the Process Auxiliary Board facilitating the manual operation of the stations.

The feedwater reducing valve for the desuperheating water to the two temperature control valves is regulated by a pressure controller set at 600 PSIG. A remote manual controller for operating this valve is installed on the No. 1 Process Auxiliary Board. A pressure transmitter transmits the pressure of this supply header to a pressure indicator on the Process Auxiliary Board.

A restricting orifice installed at a 2" line tapped off from the desuperheating water supply header recirculates 5% of the water back to the deaerators, thus maintaining a minimum flow passing through the control valve to minimize the wire-drawing that causes the erosion of the valve while the water demand from the desuperheating nozzles is at a minimum.

Both the process steam supply lines from the desuperheating stations are installed with high temperature alarms and the alarms will sound on both the Mechanical Vertical Board and Process Auxiliary Board.

The process steam supply lines are installed with relief valves for protection against over-pressure in the system. The desuperheating stations deliver back-up process steam to two 18" process steam headers at the east-west pipeway.

A second 235# Pressure Reducing and Desuperheating Station is located near No. 4 Boiler Chemical Feed System. It is identical in operation to the No. 1 Station except that it has only one desuperheating nozzle and a different make of controls are used. The remote manual controllers are located on No. 1 Process Auxiliary Board.

where the moisture condenses out as H_2O and acid. The sample then passes through two cells (dual, in event one fails) which measure the specific conductance of the liquid. If an organic is present, the recorder will give a higher than normal conductance reading.

A 10" line delivers demineralized water from the Water Treating Plant to the equalizing line between tanks 1 and 2. A flow orifice on the demin line transmits the rate of flow through a transmitter to a condensate return flow recorder on the No. 1 process auxiliary board. Flow through the orifice is also totalized by a DP cell and two integrators. A solenoid-operated switch located on the automatic two-way air-operated dump valve determines whether the "take" or "dump" integrator is in service. Two conductivity cells are located in the demin line. The signal from one cell goes to the condensate conductivity recorder in No. 1 auxiliary room. Conductivity higher than 4 MMOHS will be alarmed on the alarm panel. The other cell transmits a signal to the automatic demin dump controller, also on the No. 1 process auxiliary board. Conductivity higher than 6 MMOHS (adjustable) causes two air-operated valves on the demin line to re-position. One of these valves is located on the line just inside the Power Block and when operated, opens and the demin water flows into the dump line to the ditch. The other valve is located at the tee where the demin line joins the condensate tank equalizing line. This valve simultaneously closes, thus forcing all demin flow through the dump line. When conductivity reaches an acceptable limit, demin dump controller can be manually reset and both air-operated valves will reposition to allow demin flow to be returned to the equalizing line.

In addition to the east return and demin lines, the condensate from the Caustic Plant can be put in this tank as well as No. 2 tank. Flow is transmitted from an orifice located in the north pipeway just behind the Power warehouse. Flow is indicated on the condensate return flow chart in No. 1 auxiliary room. Another orifice is located just north of No. 2 tank. It totalizes flow by means of integrators, a "dump" and "take" which are connected to the solenoid on the automatic dump valve. For water quality detection, there are three conductivity cells. One cell is located where the 10" caustic return turns to leave the pipeway into No. 1 tank. Conductivity from this cell is transmitted to the condensate conductivity recorder in No. 1 auxiliary control room and is alarmed at 4 MMOHS. Two more conductivity cells are located in the pipeway just north of No. 3 gas turbine. The westernmost cell transmits a signal to the condensate conductivity recorder in No. 2 auxiliary room and is alarmed in both No. 2 auxiliary room and the main control room. The remaining cell transmits to a dump controller located in No. 2 auxiliary room which is identical to the controller on the east return line except that it operates two air-operated dump valves. One is located at the caustic condensate line before it goes into No. 2 tank and the other just before No. 1 tank. At 6 MMOHS (adjustable), the controller opens both dump valves and condensate goes to the ditch. The dump valve for No. 2 tank also activates the solenoid for putting the appropriate integrator in service. "Dump Valve Open" is alarmed in the main control room. When conductivity is again acceptable, dump controller can be manually reset to reposition both dump valves to normal. A manual "Dump-Tank" switch is located on No. 1 process auxiliary board for testing the dump valve to No. 1 tank. All dump valves are tested once each shift to insure proper operation.

No. 2 Tank (West Tank)

This tank is connected to No. 1 tank by a 12" underground equalizing line. For this reason, the two tanks will "float" on the line together with near equal levels. This tank receives condensate from several sources. One line from the Caustic Plant, one line from Chlor-Alkali, Chlorinated Methanes and Glycol II Plants, and one line from LHC I and LHC II Plants. This tank can be isolated completely from the system with no ill effects. Condensate from the Caustic and LHC Plants enters the tank on the east side while condensate from Chlor-Alkali enters on the west side. Metering orifices for all three of these lines are located in the pipeway just north of No. 2 tank and flow is indicated on charts on the No. 2 process auxiliary board with the exception of Caustic. Each line has two conductivity cells which transmit conductivity to the condensate conductivity recorder in No. 2 auxiliary room and to the automatic dump controllers. These controllers are identical to those on the caustic return line and the east return line.

Condensate Make-up System - Pumps 1, 2 and 3

Three Allis-Chalmers centrifugal, single-state pumps rated at 1750 gpm at 175 foot head are installed to take suction from No. 1 tank and to discharge the make-up into the parallel-operated deaerators. A low-pressure switch installed at the pump discharge header will start the standby pump(s) upon receiving a low-pressure signal due to failure of one of the operating pumps or load increase. A low-pressure alarm is also provided to annunciate on both the process auxiliary board No. 1 and mechanical vertical board. These three make-up pump motors receive power from two separate sources - 480V Bus 1 and 480V Bus 2 - thus preventing a significant reduction in condensate flow to the deaerators should any one of the buses fail. Locally mounted pressure gauges are installed at each pump discharge outlet. High conductivity will be annunciated on the No. 1 process auxiliary board.

No. 1 make-up pump also has block valve provisions for taking suction directly out of the demin line and discharging to a separate 4" line to each boiler for fill and washing purposes.

The condensate flow to the deaerators is measured through a flow orifice and is recorded on the make-up flow recorder on No. 1 process auxiliary board. Locally mounted pressure gauges and thermometers are provided on the discharge header. The condensate (or make-up, as it is generally called at this point) passes through the control valves of the level control stations, thus completing the condensate return cycle to the deaerators.

T. PROCESS CONDENSATE RETURN SYSTEM (CONTD.)

Condensate Make-up Pumps 4, 5, 6, and 7

Four Ingersoll-Rand centrifugal, single-stage pumps rated at 2000 gpm at 175 foot head are installed to take suction from No. 2 tank via the 14" equalizing line between the two storage tanks. All four pumps discharge into the condensate make-up discharge header which is common to all deaerators. These pumps also have automatic low pressure starting provisions and separate power supply sources (480V Bus 3 and 480V Bus 4).

Power II Condensate Pumps

Two Goulds centrifugal, single-stage pumps rated at 2000 gpm at 175 foot head are installed to take suction from the west side of No. 2 tank. They discharge into the condensate line to Power II.

Power supply for the two 2400 volt, 125 volt, 125 HP motors is from the Power II system.