FINAL

SYSTEM DESCRIPTION
(Index No. 8)

CONDENSER AIR EXTRACTION SYSTEM
(B&R Dwg. No. 2010, Rev. 13)

JERSEY CENTRAL POWER & LIGHT COMPANY

THREE MILE ISLAND NUCLEAR STATION

UNIT NO. 2

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CONDENSER AIR EXTRACTION SYSTEM

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CONDENSER AIR EXTRACTION SYSTEM

1.0 INTRODUCTION

1.1 System Functions

The function of the condenser air extraction system is to remove air and noncondensible gases from the hot and cold surface condensers to which the main turbine exhausts, thereby increasing the overall efficiency of the power generating plant. The exhausted air is expelled ultimately to the atmosphere via the unit vent.

The following systems have an interface with this system. (Drawing numbers refer to Burns and Roe, Inc. flow diagrams):

a. Heating and Ventilation, Auxiliary Building (Dwg.No.2042)
b. Demineralized Service Water (Dwg.No.2007)
c. Decay Heat Removal Sump (Dwg.No.2045)
d. Circulating Water System (Dwg. No. 2023)
e. Feed and Condensate (Dwg. No. 2005)

1.2 Summary Description of System (Ref. B&R Dwg. No. 2010, Rev. 13)

The air extraction system is designed to reliably remove air and noncondensible gases from within the hot and cold condensers to prevent back pressure buildup. The air removal system consists of three vacuum pumps, two of which are normally in operation for routine purging and a third maintained in standby with automatic starting capabilities should either one of the two normally operating pumps fail. The extracted gases are routed to the Auxiliary Building Ventilation System where they are monitored and filtered, if necessary, prior to release to the atmosphere. Refer to System Description, Index No. 36, Auxiliary Building - Heating and Ventilation System.

The air removal system primarily consists of three Ingersoll-Rand AXI-VAC vacuum pump assembly units, capable of taking suction from a common header that is connected to two (hot and cold) condenser shells, operating at different vacuum levels. Normally, two pumps are used for holding operation with the third pump performing the standby and hogging functions. Operation of the standby pump is initiated automatically by failure of one of the operating pumps or if a low vacuum condition appears in either condenser shell.

Each vacuum pump unit contains a cooler that uses water available from the Circulating Water System at maximum temperature of 95F and maximum pressure of 75 psig. An inlet accumulator (separator) in the unit is equipped with internal baffles to control the rate of water carry-over to the first stage and to safeguard the unit against water slugs of greater than normal magnitude.

The moisture separator and condensate reservoir of this unit is in the cavity section of the base, which serves as a receiver-separator for the extracted air and vapor mixture discharged from the condenser vacuum pump.

Two gland steam exhausters extract noncondensible gases from the gland steam condenser and exhaust into this system. Two knockout drums provided in the exhaust lines remove condensate from the system piping prior to final exhaust. Each drum contains a drain off for the condensate. Final exhaust lines are routed to Auxiliary Building ventilation system.

The system is designed with instrumentation to continuously monitor condenser vacuum and radiation levels of the exhausted air. Alarms are provided for low condenser vacuum (High pressure), vacuum pump trip, and high radiation level.

1.3 System Design Requirements

All system piping and accessories are designed for Class II seismic conditions and for Zone 1 loads. All system piping up to interfaces with associated systems is designed for 150 psig and 200F (Symbol J) and is classified Conventional (Class C), designed, fabricated, inspected and erected in accordance with ANSI B31.1.0, Power Piping.

In combined operation, with all three air removal units running, a total volume of 150,000 cubic feet from 0 to 26 inches of Hg (vacuum) can be evacuated from the condensers within 60 minutes.

Monitoring of system performance and pump control is provided in the Control Room on the Turbine Auxiliary Monitoring Panel No. 17 and the Turbine Control Panel No. 5.

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Provisions are made to drain condensate and remove suspended radioactive solids by filtration. Two knockout drums in the exhaust line provide for condensate removal from system piping to final exhaust. Each drum contains a drain-off for the condensate. Filtering for radioactivity removal is described in System Description No. 36, Auxiliary Building - Heating and Ventilating System.

2.0 DETAILED DESCRIPTION OF SYSTEM

2.1 Components

The design of the condenser air extraction system incorporates redundant equipment where failure of a major component could affect normal operation of air removal from the condensers. Three air removal units are provided. Two are normally in use and the third serves as backup to ensure system reliability and to permit periodic change-over. Indication and/or alarm of system parameters such as air flow, pressure, and radiation level are provided to monitor system performance and to alert operating personnel of any abnormal conditions during system operation. The components described consist of the air removal units and major system valves.

2.1.1 Air Removal Units: VA-P-1A, 1B and 1C

Each air removal unit (see Table 1) consists of a vacuum pump, motor driver, cooler, moisture separator, reservoir, intake

accumulator, interconnecting piping, valves, gages, switches, solenoids and automatic valves. The air removal units are physically located in the basement area of the Turbine Building (Elevation 281'-6").

The vacuum pumps are fully automatic, two-stage, rotary, positive-displacement, helical-lobe, screw-type, water-sealed and water-cooled. The pumps are furnished as a packaged unit. The pumps, of ferrous construction, are rated at 20 scfm holding capacity with an inlet pressure of 1 inch Hg (absolute). The performance at this pressure is based on cooling water to the seal water cooler being maintained at least 7.5°F below air vapor inlet temperature (71.5°F).

The air removal unit's intake separator (accumulator) is equipped with a vertical baffle for separating large volumes of liquid from the inlet gas. The separator allows water carried over from the condenser to collect and drain at a controlled rate into the vacuum pump inlet. The unit contains a diaphragm operated butterfly valve at the inlet to the moisture separator which prevents air from flowing backward through the pump rotors on shutdown and permits a pump to be idle under full system vacuum. The discharge port of the unit enables compressed gas to be discharged into the reservoir when the predetermined pressure and volume have been reached. The condensate reservoir, which serves as the receiver-separator for the gas mixture, contains several cavities, a float valve, an overflow, and a discharge port to store and control the flow of air and condensate.

Heavy duty sleeve bearings and tapered land thrust bearings are provided and sized to carry both radial and thrust loads under all operating conditions. The sleeve bearings on the vacuum pumps are furnished with dual-element, 100-ohm, platinum-resistance, temperature detectors. A self-contained, forced-feed lubrication system distributes cleaned and cooled oil to the bearings of the vacuum pump.

The lubrication system for each vacuum pump consists of a main (shaft driven) oil pump, a ½ hp auxiliary oil pump, an oil cooler with bypass valve, an oil filter, oil level gauge, a dual pressure switch and a relief valve. The auxiliary pumps are driven by 1725 RPM, 460 volt, 3-phase, 60 hz motors with Thermotector*-type stator winding temperature detectors (thermal switches), and are powered from MCC 2-31A & 2-41A, and are controlled by the vacuum pump control switches.

The Auxiliary Oil Pump is self-priming and is utilized to draw lubricating oil from the reservoir, and circulate it through the filter and the temperature controlled by-pass valve, to the bearings and gears of the vacuum pump prior to start-up of the unit. After the vacuum pump is started, the shaft driven oil pump will supply all of the lubrication requirements, the relief valve will maintain lube oil pressure between 15 and 25 PSIG, and the temperature controlled by-pass valve will control oil flow through the cooler to maintain oil inlet temperature at approximately 110°F. The dual pressure switch functions in the control of both the auxiliary oil pump and the vacuum pump as

*Thermotector - General Electric trade name for this type of temperature detector. Thermoguard is Westinghouse trade name for their type of temperature detector.

follows: by shutting down the Auxiliary oil pump when demand is being met by the shaft driven oil pump (14 PSIG); starting the Auxiliary oil pump when, during vacuum pump operation, the shaft driven pump fails to meet lubrication requirements (12 PSIG); preventing the vacuum pump from starting until oil pressure is established by the auxiliary oil pump (12 PSIG); and by shutting down the vacuum pump if there is insufficient lube oil pressure (10 PSIG). A description of the lube oil pump operation and control system and interaction with the vacuum pump control circuit is given in Table 2.

The three vacuum pump drivers are GE 200 HP, 3600 RPM, squirrel-cage, induction-type motors. The motors are self-ventilated and contain open drip-proof enclosures with screened openings. The motors are powered from the 480V 2-31A and 2-41A motor control centers as indicated in Table 1. Operation of the motors is controlled from switches located in the Control Room, Turbine Auxiliary Monitoring Panel No. 17.

To prevent ambient air from entering the vacuum pump, cooled seal water is drawn from the water reservoir and passed through labyrinth seals located at each end of both rotor shafts. The seal water cooler of the air removal unit maintains the seal water temperature at 7.5°F above the cooling water inlet temperature. Cooling water is obtained from the circulating water system and flows through the cooler at 300 gpm, maximum. The use of circulating water for cooling insures that seal water temperature will always be lower than saturation temperature of the condenser. For additional information on the air removal units, refer to Ingersoll-Rand AXI-VAC Instruction Manual (27.00).

2.1.2 Condenser; CO-C-1A, 1B

For a description of the condenser, refer to Circulating Water System Description , Index No. 15.

2.1.3 Gland Steam Exhausters GS-E-1A, B and Gland Steam Condenser GS-C-1

The gland steam exhausters and the gland steam condenser are located in the Turbine Building at El. 305'-0". The gland steam condenser condenses turbine gland steam and is exhausted by two motor-driven suction pumps to the air extraction exhaust line. Gland Steam Exhauster GS-E-1A is powered from MCC 2-31A, and GS-E-1B is powered from MCC 2-41A. Both exhausters are controlled from panel 17. Operating lights and alarms are also on panel 17. For additional data on the exhausters and condenser, refer to the Westinghouse Instruction Manual (1.00).

2.1.4 Major System Valves

VA-P-1B Suction Valves VA-V2A, V2B

Two 12-inch, 150 lb., 125F, CS air-cylinder operated, butterfly valves with adjustable rubber seats and vacuum seal are located in the condenser air extraction line (VA-V2A-cold condenser, CO-C-1A; VA-V2B hot condenser CO-C-1B). The two valves control the intake to pump VA-P-1B.

Valves V2A and V2B are interlocked with motors 1B and 1C or 1A. Pump and valve operation are covered in paragraph 3.2. Each valve can be closed by means of a control switch (VA-PHS-3483 for valve V2A, VA-PHS-3482 for valve V2B) located on Turbine Auxiliaries Panel 17 in the Control Room.

Condenser Vacuum Pump Inlet Valves VA-V4A, V4B, and V4C

Three 14-inch, 150 lb. 125F, diaphragm operated, butterfly valves are located on each separator assembly of the Air Removal Unit (V4A - Unit VA-P-1A, V4B - Unit VA-P-1B, and V4C - Unit VA-P-1C). The three valves control the intake to the three vacuum pumps. The valves are furnished with the pumps and are interlocked with the respective pump motors 1A, 1B and 1C to open or close the inlet extraction line to the separator of the pump unit. The valves are closed when the pumps are not operating. Upon pump start, the intake valve opens to permit air extraction from the condenser into the separator. If, for example, pumps VA-P-1A and VA-P-1C are selected for normal duty, then valves VA-V4A and VA-V4C will open. With pump VA-P-1B inoperative, valve VA-V4B remains closed until the pump is started. Pump and valve operation under various modes of operation are described in paragraph 3.2.

Condenser Vacuum Breaker Valves VA-V7A, VA-V7B

Two 6-inch, 150 lb., 125F, CS, motor operated, gate valves are located in the 6-inch piping lead to nozzle number 52 on both condensers. The valves are filled with demineralized water prior to startup in order to create a vacuum seal for the condenser. The valves function to break condenser vacuum

when required. Both valves are opened simultaneously by operating manually controlled pushbutton switch VA-FHS-3158 on Panel No. 5 in the Control Room. As the valves open, the amount of water in the valve reservoir discharges through the 6-inch, 3.5 foot long piping, through inlet 52, and into the condenser to release vacuum. When the valves are open, alarm VA-KA-3158 annunciates on Panel 17 in the Control Room. The valves VA-V7A and VA-V7B are electrically powered from motor control center 2-41A and 2-31A, respectively.

2.2 Instruments, Controls, Alarms and Protective Devices

Instrumentation is provided for the condenser air extraction system (Table 3) to monitor overall system operation and equipment performance. Monitoring of the air removal units is accomplished locally by providing flow control indicators measuring discharge air from the vacuum pumps, temperature indicator for measuring operating temperature of the pumps, water level indicator, and level indicators for the oil reservoir. These air removal unit indicators are located on the assembly. Monitoring of condenser vacuum exhaust beta-gamma radiation levels is accomplished by means of a plastic scintillation detector (located in the exhaust line), logarithmic count rate meter and logarithmic count rate recorder (both located on Radiation Monitoring Panel 12). Manual and automatic controls are provided for operation of the air removal units and for protective purposes. Each vacuum pump unit is manually controlled for starting and stopping, with automatic operation from the Control Room by a selector switch on the Turbine Auxiliary Monitoring Panel No. 17. Interlock controls are provided for automatic valve operation during vacuum pump starting and stopping in order to open and close extraction paths to the

condensers. Low condenser vacuum switches, one on each "H" and "C" condenser shell, serve to start the pump on standby if the vacuum falls below 22 and 24 inches Hg, respectively. The turbine is set to trip between 18 and 22 inches Hg (vacuum), as specified in Volume 1 of the Westinghouse Instruction Book. Switches are provided for closing valves V2A and V2B if the need arises or the appropriate valve will function when the standby pump is set into operation. A vacuum breaker switch is provided to open the condenser vacuum breaker valves to break condenser vacuum should it be required. Other controls for the air removal unit include the flow valve that admits air to each pump, air temperature-indicator switch control that shuts down the vacuum pump above 185F, oil pump pressure relief valve, and dual oil pump pressure switch for operating the auxiliary (oil) pumps and shutting down the air removal unit on low oil pressure.

Panel mounted annunciators are listed in Table 4. Alarm conditions are provided for low vacuum in either condenser shell, open condenser vacuum breaker valves, tripping of any of the vacuum pumps, tripping of the vacuum pump unit auxiliary oil pump and excessive radiation level in the exhausted air. All annunciators are located in the Control Room on the Turbine Auxiliaries Monitoring Panel No. 17 except the radiation level, which is located on Radiation Monitoring Panel No. 12.

3.0 PRINCIPAL MODES OF OPERATION

3.1 Startup

Prior to startup, the turbine gland sealing system must be in operation and valves VA-V7A and VA-V8B must be closed and sealed with demineralized water. The valves remain closed during normal operation. Any continuous air leakage through the glands

and/or vacuum valves while in normal operation may cause a loss or reduction in vacuum. The pumps are started by means of switches on the Turbine Auxiliary Monitoring Panel No. 17 in the Control Room. There are four switches on the panel. The positions are START, AUTO, STOP and PULL-TO-LOCK. To start the pump, switch is positioned to START and will spring-return to AUTO. Table 2 specifies the actions performed with the switch at each position. At least two pumps are needed for startup with the third available if required. To start all three pumps (hogging) for simultaneous running, each of the switches must be set to START and valves VA-V2A and V2B will open automatically, provided switches VA-PHS-3482 and 3483 are in ON. In combined operation, all three pumps will evacuate a total volume of 150,000 cubic feet from 0 to 26 inches of Hg vacuum within 60 minutes. Once condenser vacuum reaches the preset level, the condensers are ready for steam admission.

3.2 Normal Operation

The sequence of flow during normal plant operation and the function of each of the various components are described herein.

The system is arranged with three 50% duty vacuum pumps connected to a common header which, in turn, connects the two condenser shells. The two shells operate at different vacuum levels because the condenser is a dual pressure unit. Although two operating pumps and one backup pump are furnished, any two of the three pumps can serve the requirements for normal operation.

Operation of the backup pump is initiated automatically by failure of one of the two operating pumps or upon either condenser shell reaching low vacuum.

Pump and valve operation occurs in the following manner. Assume it is desired to run pumps VA-P-1A and 1C and that VA-P-1B pump is to serve as backup or placed on standby. The two pumps VA-P-1A and VA-P-1C are started by setting the switches for VA-P-1A and VA-P-1C in START. Each switch (CS-7) will spring return to AUTO from the START position. The switch for pump VA-P-1B is set in AUTO. Control switches VA-PHS-3482 and 3483 (electrically designated CS-8) are set in the OFF position. In this condition, pump VA-P-1A takes suction from cold surface condenser CO-C-1A through connection number 3, butterfly valves VA-V6C and V6D and a 12-inch line. Suction from the condenser is through a 12-inch inlet valve VA-V1A and a 14-inch, diaphragm-operated butterfly valve VA-V4A (furnished as part of Air Removal Unit VA-P-1A). Valve VA-V4A is interlocked with pump motor 1A so that upon starting of the pump motor the valve opens to permit suction from the CO-C-1A condenser into the VA-P-1A separator. The 12-inch line leading to backup pump VA-P-1B is closed by valve VA-V2A during this operation. This condition permits the extraction line to the backup pump to be shut while pump VA-P-1A takes suction.

With pump VA-P-1C operating, suction is taken from the hot surface condenser CO-C-1B through connection number 3, butterfly valves VA-V6A and V6B, and a 12-inch suction line. Suction from the hot condenser is through a 12-inch inlet valve VA-V1C and a 14-inch butterfly valve VA-V4C (furnished as part of Air Removal Unit VA-P-1C). Valve VA-V4C is interlocked with pump motor 1C so that upon starting of the pump motor the valve

opens to permit suction flow from the CO-C-1B condenser into the VA-P-1C separator. The 12-inch line leading to the backup pump VA-P-1B is closed by valve VA-V2B during this operation. This condition permits the extraction line to the backup pump to be shut while pump VA-P-1C takes suction.

Refer to Table 2 for service status of pumps and valves in other modes of operation, results of pump failure, and corresponding conditions of pumps and valves due to condenser low vacuum. The table lists and specifies possible situations that may be encountered with two pumps continually in service and the consequent switching process to activate the pump placed on standby and to open and close the VA-V2A and VA-V2B valves.

Air extracted from condenser CO-C-1A enters pump unit VA-P-1A at the intake separator. Air is admitted to the separator through diaphragm operated valves VA-V4A through C for pumps A through C respectively. These valves are interlocked with their respective units such that they open when the unit is started and spring shut when it is stopped. This arrangement permits the pump to be idle under full system vacuum by preventing air from flowing backwards through the pump rotors on shutdown. Essentially, the separator allows water carried over from the system to collect and drain at a controlled rate into the vacuum pump inlet. The moisture separator and condensate reservoir, in the cavity section of the base, serve as a receiver-separator for the extracted air and vapor mixture discharged from the condenser vacuum pump. During normal condenser operation, air in-leakage is indicated by an air flow indicator, which gives a continuous reading of any leakage.

Air is discharged from the air removal unit VA-P-1A through the reservoir tank discharge port which is connected to a 10-inch line through outlet valve VA-V3A. Air flow proceeds through a 12-inch line through two knockout drums in series with the exhaust line. Radiation monitoring (detector VA-RE748) is located in the 12-inch line between the air extraction units discharge and the Gland Steam Exhauster discharge to detect beta-gamma levels from $1x10^{-6}$ to $1x10^{-1}$ uCi/cc for ^{85}Kr. Radioactivity exhaust level is indicated on VA-RIA-748, which provides continuous logarithmic indication, and is recorded on recorder VA-UR-3263. This unit also contains the alarm circuits. The Gland Steam Exhausters GS-E-1A and 1B, through two valves VA-V5A and V5B, exhaust noncondensible gases into the exhaust system.

The knockout drums remove condensate from the system piping prior to final exhaust. The two drums are 18-inch pipes each with separate drainoffs. The first drum contains a drainoff at the bottom of the pipe that extends to the Turbine Building floor drain system. The second drum is similar except it drains into the decay heat removal pump room sump. The exhausted air is discharged via the Auxiliary Building exhaust system through a combination by-pass line and filter system containing automatic damper control actuated by its radiation monitoring detector. (Refer to System Description, Index No. 36, Auxiliary Building - Heating and Ventilation.)

3.3 Shutdown

If the condenser air extraction system is not required to be in service, it can be shut down by stopping the air removal units from the Control Room and placing the control switch in

the Pull-to-Lock position. If maintenance or inspection is required on the condensers, it is necessary to break the vacuum seal at connection 52 on the condenser by operating switch VA-FHS-3158 on Panel 5. This opens valves VA-V7A and V7B simultaneously.

3.4 Special or Infrequent Operation

If one Air Removal Unit is shut down for equipment maintenance, another unit can be substituted. Two of the three vacuum pumps are normally in operation with the third serving as standby. To employ three pumps simultaneously (e.g, hogging operation for startup) the third pump is merely started in the Control Room.

4.0 HAZARDS AND PRECAUTIONS

Release of radioactivity to the environment is the only hazard associated with the system. It should be prevented by means of continuous monitoring and/or filtering of the exhausted air.

TABLE 1

VACUUM PUMPS AND ACCESSORIES

Pump Details

Identification	VA-P-1A, VA-P-1B, VA-P-1C
Number Installed	Three
Vendor	Ingersoll-Rand Co.
Model No.	AXI-VAC-20
Type	Helical Rotor Positive Displacement
Hogging capacity, scfm, at 15 inches Hg (absolute)	2700
Holding capacity, scfm, at 1 inch Hg (absolute), 71.5°F	20 (free dry air)
Pump Speed, RPM	3550
Air-vapor inlet pressure, inch Hg (absolute), Design	1.5
Air vapor inlet temperature °F, Design	71.5
Lubricant/Coolant	Oil/Seal Water

Motor Details

Manufacturer	General Electric
Type	Squirrel Cage
Enclosure	Open, drip-proof
Rated Horsepower, hp	200
Speed, rpm	3600
Power	460V, 114 amp (full load) 60 hz, 3 phase
Source (for each pump motor)	VA-P-1A 480 MCC 2-41A VA-P-1B 480 MCC 2-41A and 31A VA-P-1C 480 MCC 2-31A
Lubricant/coolant	Oil/Air

TABLE 1 (CONTINUED)

VACUUM PUMPS AND ACCESSORIES

Seal Water Cooler (Heat Exchanger)

Manufacturer	Patterson-Kelly
Model No.	FH-4
Type	Shell and Tube
Water Capacity, gpm (max.)	300
Tube size	3/4 inch. O.D.
Gauge	18 BWG
Pressure drop, psig tube and shell side	2
Source of Cooling	River Water from the Circulating Water System
Inlet Temperature of Cooling Water	7.5F below inlet temperature of vacuum pump

Auxiliary Oil Pump

Manufacturer	Tuthill
Model No.	1 LPF
Rated Horsepower, hp	½
Speed, rpm	1725
Power	460V, 60 hz, 3 phase
Source	480V MCC 2-31A 2-41A

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TABLE

PUMP AND VALVE CONDITIONS IN VARIOUS MODES OF OPERATION

MODES OF OPERATION				PUMP FAILURE CONDITION				CONDENSER LOW VACUUM CONDITION			
Pump In Service	Pump In Standby	V2A Valve Position	V2B Valve Position	Pump Failed	Pump Starting	V2A Valve Position	V2B Valve Position	Lo VAC Cond.	Starts Standby Pump	V2A Valve Position	V2B Valve Position
1A & 1C	1B	Closed	Closed	1A	1B	Open	Closed	"A"	1B	Open	Open
				1C	1B	Closed	Open	"C"	1B	Open	Open
1A & 1B	1C	Closed	Open	1A	1C	Open	Closed	"A"	1C	Open	Open
				1B	1C	Closed	Closed	"C"	1C	Open	Open
1B & 1C	1A	Open	Closed	1B	1A	Closed	Closed	"A"	1A	Open	Open
				1C	1A	Closed	Open	"C"	1A	Open	Open

SINGLE PUMP OPERATION

1. Control Switch CS7 for VA-P-1A, VA-P-1B and VA-P-1C is a PULL-TO-LOCK, STOP-AUTO-START w/spring return to Auto. The switch controls vacuum pump and auxiliary lube oil pump.

   A. Switch in Start Position: Starts Aux. lube oil pump - upon lube oil pressure rise and low temp. permissive start for vacuum pump closed. Vacuum pump starts.

   B. Switch returned to Auto Position: Shaft driven oil pump delivers oil pressure. Aux. oil pump shuts down. Upon falling oil pressure, aux. oil pump restarts. At low oil pressure, vacuum pump shuts down.

   C. Switch in Stop Position: Stops vacuum pump and aux. lube oil pump. Switch spring returns to Auto.

   D. Switch in Pull-to-Lock. Prevents auto start. Stops the pump.

2. AUTOMATIC OPERATION: All pumps similar

   A. Switch CS7 in Auto Position and CS8 in ON Position (Pump 1A or 1C fails: Pumps 1A and 1C in service. Pump 1B is initially off in the AUTO position and valves VA-V2A and V2B are in the auto position (closed). A trip of pump "1A" or "1C" will start pump "1B" and open respective valve VA-V2A or 2B, providing aux. oil and temp. conditions are fulfilled for permissive start. Pump will run until shut down manually by setting pump control switch to STOP.

   B. Switch in Auto Position (Condenser low vacuum): Pumps 1A and 1C in service. Pump 1B is off and valves VA-V2A and 2B are in the auto position (closed). A low vacuum alarm in either condenser will initiate a permissive start and the aux. oil pump starts, providing aux. oil and temp. conditions are fulfilled, and pump will start. This will open both valves and all three pumps will be in service. The condenser may be isolated if desired by manual switching of the appropriate PMI or Panel 11 to "OFF".

   C. Switch in Stop Position: Stops vacuum pump and aux.oil pump. Switch spring returns to auto.

   D. Hogging: Pumps 1A and 1C are started. Pump 1B is started. This opens valves V2A and V2B..

   E. Valve Selector Switch operation: In the OFF position, closes valves V2A and V2B. In the ON position, allows the valve to open or close depending on electrical signal from the pumps. VA-PHS-3482 operates VA-V2B. VA-PHS-3481 operates VA-V2A.

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TABLE 3

INSTRUMENTATION AND CONTROLS

NOTE: For reference to I and C Logic System See I and C Schematic Dwg. 3090

Identification	Description	Function	Location	Type	Input Range	Output Range	Setpoint
VA-RE-748	Detector Element	Measures beta-gamma levels of exhausted air in Condenser Air Extraction exhaust header.	On 12-inch condenser vacuum pump outlet header	Plastic scintillation detector	80 kev to 3 mev	0-3 V	N/A
VA-UR-3263	Recorder	Provides continuous recording of radiation activity of exhausted air from VA-RE-748 element	Panel 12	Multi-point	0-10MVDC	10 to 10^6 cpm	N/A
VA-RIA-748	Radiation Activity Indicator	Indicates beta-gamma activity and provides alarm	Panel 12	Analog	0-3V	0-10MV (Recorder)	N/A
VA-FCV-3452, 3453, 3454	Air Admission Control Valve Actuation solenoid valves.	Controls vacuum pump inlet air valves and is interlocked with corresponding pump motor	Separator Unit, inlet port	3v. Cont. A/C Solenoid Valves	Air to Regulator: 30 PSIG Min. 40 PSIG Max.	Air to Valve Diaph. 30 PSIG Min. 40 PSIG Max.	N/A
VA-FI-3455, 3456, 3457	Flow Indicator	Indicates flow of outlet air of vacuum pump	Air Removal unit, between pump motor and discharge port	Rotometer	1.2 to 35 SCFM	1.2 to 35 SCFM	N/A
VA-LI-3461, 3462, 3463	Level Indicator	Indicates water level in base	Air Removal unit, next to make-up water valve	Tubular	N/A	N/A	N/A
VA-TIC-3458, 3459, 3460	Temperature-Indicator control	Indicates air temperature of pump and trips pump on high temp.	Air Removal Unit, above oil cooler	Thermostatic	0-250F	N/A	185°F set for pump shutdown
None	Oil level indicator	Indicates level of oil in the system	Air Removal Unit, above base oil drain	Gauge glass	N/A	N/A	N/A
VA-PHS-746	Low vacuum pressure switch	Actuates standby pump at low vacuum (high pressure) in condenser CO-C-1B	Rack 410	Diaphragm	0-30" Hg. (Vacuum)	N/A	22.5inches Hg (vacuum)
VA-PHS-747	Low vacuum pressure switch	Actuates standby pump at low vacuum (high pressure) in condenser CO-C-1A	Rack 412	Diaphragm	0-30" Hg. (Vacuum)	N/A	24.5 inches Hg (vacuum)
VA-LCV-3464, 3465, 3466	Control Valve	Controls water level in base.	Air removal unit next to level indicator	Float Operated	N/A	N/A	N/A

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TABLE 3 (Continued)

Identification	Description	Function	Location	Type	Input Range	Output Range	Setpoint
VA-PBS-3482, 3483	VA-P-1B Suction valve switch	Actuates valves VA-V2B and V2A to close or open if required	Panel 17	Manual On-Off Maintained Contact	N/A	N/A	N/A
VA-PBS-3158	Condenser Vacuum Breaker Switch	Operates valves VA-V7A and V7B simultaneously to break condenser vacuum.	Panel 5	Cutler-Hammer E-30 push-button switch with red-green indicators	N/A	N/A	N/A
VA-PS-3387, 3388	Pressure Switch	Monitors Condensers CC-C-1A, 1B pressure and signal alarms VA-PAL-3467, 3468 for low vacuum (high pressure)	Nozzle 51, each condenser Rack 419 Rack 418	Diaphragm	0-30" Hg (Vacuum)	Open/Closed	6" & 8" Hg. Abs.
VA-PS-3858-1	Low Pressure Switch	Monitors gland steam condenser CS-C-1 pressure and signal alarms VA-PAH-3858 for low vacuum (high pressure)	Rack 410	Diaphragm	1"-60" H_2O (Vacuum)	N/A	10" H_2O Vac.
VA-PS-3358-2	Low Pressure Switch	Spare	Back 410	Diaphragm	1"-60" H_2O (vacuum)	N/A	N/A
VA-ZS-3158-1, 2, 3, 4	Limit Switch	Monitors valve position and alarms VA-ZA-3158 for OPEN valve.	On valve VA-V7A, V7B	Limit	N/A	N/A	N/A
VA-PSV-3482, 3483	3 Way Valve	Operates to actuate valves VA-V2A and V2B as required.	On Valve VA-V2A, V2B	Solenoid 3Way	110V AC	Air to valve diaphragm 70 PSI Min.	N/A
VA-LS-7090	Level Switch	Monitors Condensate Drain Tank VA-T-1 Level and Signals Alarm VA-LAL-7090.	On top of VA-T-1	Displacer:	N/A	N/A	16" from bottom
VA-LC-7091	Level controller	Monitors level in VA-T-1 and actuates control valve VA-LCV-7091	On VA-T-1	Pneum.	14" Displacer	3-15 psig	3'4" from bottom
VA-LCV-7091	Control valve	Maintain level in VA-T-1	EPG	Diaphgram	3-15 PSIG	0-100%	N/A
VA-LG-7092	Gage Glass	Visual indication of level in VA-T-1.	On VA-T-1	Tubular Gage Glass.	0-15½"	N/A	N/A

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Title _____

TABLE 4

PANEL MOUNTED ANNUNCIATORS AND COMPUTER LIST

PANEL MOUNTED ANNUNCIATORS

Ident.	Measured Variables, Units	Alarm Setpoint High	Alarm Setpoint Lo	Input Source	Variable Range	Panel Name and No.
VA-ZA-3158 (Condenser Vacuum Breaker Valves Open)	Alarms when condenser vacuum breaker valves V7A and V7B are not fully closed.	NA	NA	VA-V7A,B	NA	Turbine Auxiliaries Panel No. 17 C7
VA-PAL-3467 (Cold Condenser Low Vacuum)	Alarms when the cold condenser reaches low vacuum. Measured in inches Hg (vacuum).	NA	24	MS-PS-3387	0-30" Hg (vacuum)	Turbine Auxiliaries Panel No. 17 A7
VA-PAL-3468 (Hot Condenser Low Vacuum)	Alarms when the hot condenser reaches low vacuum. Measured in inches Hg (vacuum).	NA	22	MS-PS-3388	0-30" Hg (vacuum)	Turbine Auxiliaries Panel No. 17 B7
VA-PAH-4641 Condenser Vacuum Lo	Alarms when the condenser vacuum approaches the low level setting, which is slightly above the level to annunciate alarm VA-PAL-3467 or VA-PAL-3468. Measured in inches Hg (vacuum).	NA	25	63/LV	0-30" Hg (vacuum)	Turbine Auxiliaries Panel No. 17 E32
CO-ZA-4653 Condenser Vacuum Pump Trip	Alarms when any vacuum pump (VA-P-1A, 1B, or 1C) trips.	NA	NA	OLX/VA-P-1A, 1B, 1C	N/A	Turbine Auxiliaries Panel No. 17 E7
CO-ZA-4655 Condenser Vacuum Pump Auxiliaries Oil Pump Trip.	Alarms when any auxiliary oil pump trips.	NA	NA	OLX/AOP-A,B,C	N/A	Turbine Auxiliaries Panel No. 17 E7
VA-RIA-748 VA-UR-3263	Alarms when the VA-UR-3263 recorder on Panel 12 and VA-RI-748 indicator reach 2x Background uCi/cc for 85 Kr beta-gamma level measured in micro curies per cubic centimeter.	2x Backgrd.		VA-RE-748		Radiation Monitor Panel No. 12
VA-PAH-3858 Gland Steam Condenser Vacuum Lo	Alarms when Gland Steam Condenser Vacuum drops to 10" H_2O.		10" H_2O Vac.	VA-PS-3858-1	1"-60" H_2O (Vacuum)	Turbine Auxiliaries Panel No. 17 E29
GS-ZA-4623 Gland Steam Exhauster Trip	Alarms when either Gland Steam Exhauster (GS-E-1A, 1B) trips.	NA	NA	OLX-GS-E-1A,1B	N/A	Turbine Auxiliaries Panel No. 17 B30
VA-LAL-7090 Condensate Drain Tank VA-T-1 Level Lo.	Alarms when the level in VA-T-1 drops to a predetermined point.	N/A	16" from bottom	VA-LS-7090	N/A	Turbine Auxiliaries Panel No. 17 F7

Form BR 8002 3A

TABLE 4

COMPUTER LIST (DIGITAL)

INPUT NO.	DESCRIPTION	INSTURMENT TAG NO.	INPUT CONDITION FOR OUTPUT STATUS CHANGE	USES
3073	Cond. Vac. Pump VA-P-1A	OLX-1A/VA-P-1A	Trip	Alarm Seq. Mon.
3074	Cond. Vac. Pump VA-P-1B	OLX-3A, OLX-3B/ VA-P-1B	Trip	Alarm Seq. Mon.
3075	Cond. Vac. Pump VA-P-1C	OLX-1C/VA-P-1C	Trip	Alarm Seq. Mon.
2710	Aux. Oil Pmp. for cond. Vac Pmp 1A	OLX-1A	Trip	Alarm
2711	Aux. Oil Pmp. for cond. Vac Pmp 1B	OLX A, OLX B	Trip	Alarm
2712	Aux. Oil Pmp. for cond. Vac Pmp 1C	OLX-1C	Trip	Alarm
3235	Cond. Vac. Pmp. VA-P-1A	M2/VA-P-1A	Off	Control
3236	Cond. Vac. Pmp. VA-P-1B	M3A/M3B/VA-P-1B	Off	Control
3237	Cond. Vac. Pmp. VA-P-1C	M1/VA-P-1C	Off	Control

TABLE 4

COMPUTER LIST (ANALOG)

INPUT NO.	DESCRIPTION	INSTRUMENT TAG NO.	ALARM LIMITS LO	ALARM LIMITS HI	USES
0152	Cond. C Cold Press. (In. HG)	MS-PT-3899	24		Log, Alarm Post Trip
0153	Cond. H Hot Press (In. HG)	MS-PT-3898	22		Log, Alarm Post Trip
1674	Vac. Pmp 1A Not Inbd. Brg.	VA-TE-7570		180F	Alarm
1675	Vac. Pmp 1A Not Outbd Brg.	VA-TE-7571		180F	Alarm
1676	Vac. Pmp 1B Not Inbd. Brg.	VA-TE-7572		180F	Alarm
1677	Vac. Pmp 1B Not Outbd Brg.	VA-TE-7573		180F	Alarm
1678	Vac. Pmp 1C Not Inbd. Brg.	VA-TE-7574		180F	Alarm
1679	Vac. Pmp 1C Not Outbd Brg.	VA-TE-7575		180F	Alarm

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Wilda R. Mullinix, NRC