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7. Abstract

THIS DOCUMENT IS WRITTEN FOR THE 242-A EVAPORATOR VACUUM CONDENSER SYSTEM(VCS), DESCRIBING ITS PURPOSE AND OPERATION WITHIN THE EVAPORATOR. THE DOCUMENT ESTABLISHES THE OPERATING PARAMETERS SPECIFYING PRESSURE, TEMPERATURE, FLOW RATES, INTERLOCK SAFETY FEATURES AND INTERFACING SUB-SYSTEMS TO SUPPORT ITS OPERATION.

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242-A EVAPORATOR

Vacuum Condenser
System Design Description
(SDD)

WHC-SD-WM-SDD-024
REV 0

Prepared by,
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Waste Treatment Systems Engineering

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September 28, 1994

Written by

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10/3/94
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12/15/94
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Appendix A:	List of 242-A Evaporator Systems and SDDs
Appendix B:	VCS MCS Faceplate
Appendix C:	Vacuum Condenser System Manual Valves
Appendix D:	Instrument Index
Appendix E:	Major Components
Appendix F:	VCS Faceplate Index

REFERENCES:

- (1) Clarification of dialogue:
 - "Hard-wired", means a physical wire connects the instruments or components.
 - "Soft-wired", means the instruments or components are connected by an internal MCS computer program commands and are not hard-wired.

REFERENCE DRAWINGS:

- (1) H-2-98999, PAID Vacuum Condenser System
- (2) H-2-99085, Electrical Elementary Diagrams
- (3) H-2-78281, Surface Condenser Assembly E-C-1
- (4) H-2-98994, PAID Used Raw Water System
- (5) H-2-98988, PAID Evaporator Loop

SUMMARY

The 242-A Vacuum Condenser System (VCS) is a sub-system within the 242-A Evaporator System and is used to draw off hot vapors through the 42 inch (1.1 meter) vapor line from the Vapor Liquid Separator, (C-A-1), condense the vapors through a series of three condensers with raw cooling water, discharging the condensed vapors (process condensate) in the condensate collection tank, TK-C-100 and discharging the remaining uncondensed vapors through the Vessel Vent Stack to the atmosphere.

This SDD is specifically written for the VCS and is one of twenty five sub-systems which make up the total 242-A evaporator systems listed in Appendix A.

The VCS is comprised of the following major components, all of which are located above the 40 foot, 6 inch level of the condenser room depicted in Figure 1.1.

- Primary condenser, E-C-1
- Inter-condenser, E-C-2
- After-condenser, E-C-3
- Steam jet ejector, J-EC1 and J-EC2-1.

The VCS interfaces with sub-systems used to perform specific function to maintain the vapor and the process condensate flow through the system. These interfacing sub-systems include the Raw Water System, Used Raw Water System, Steam System, Process Loop, Vessel Vent System, Compressed Air System and the Condensate Collection Tank, shown schematically in Figure 1-2.

This SDD is a supporting document for the 242-A evaporator and reflects the latest Project B-534 upgrades to the evaporator facility. Specifically, the upgrades to the VCS include:

- Replacement of the E-C-1 Primary Condenser
- Replacement and installation of new instruments and valves
- Links all required instruments and valves associated with the VCS to the Monitoring Control System (MCS).

242-A Evaporator General Description

The 242-A Evaporator is a waste treatment system consisting of a process vessel and supporting systems used for heating, evaporating, and condensing low-heat-generating liquid waste from double shell tanks (DSTs) generated by the Hanford Site operations. The 242-A Evaporator is used to reduce the liquid volume by evaporative concentration and return the treated slurry back into the DSTs for storage. The process makes the waste more manageable for future treatment and disposal. The main components of the 242-A Evaporator are shown in Figure 1-2 and consist of a reboiler, vapor-liquid separator,

recirculation pump and pump loop, slurry product pump, condenser system, steam jet vacuum system, condensate collection tank, ion exchange system and vessel vent system.

242-A Evaporator Process Condensate System
Figure 1-1

Piping Abbreviations

AF	Anti-Foam	PS	Process Sewer
AS	Air Sample	PW	Process Water
DECON	Decontamination	RW	Raw Water
DR	Drain	SC	Steam Condensate
EF	Evaporator Feed	SL	Slurry
EL	Eluent	STM	Steam
FRW	Filtered Raw Water	SW	Sanitary Water
I	Instrument	U	Utility
IA	Instrument Air	URW	Used Raw Water
OVFL	Overflow	V	Vent
PL	Process Air	VAC	Vacuum
PC	Process Condensate	VV	Vessel Vent

Stream Number Used In
Flow Sheet Calculation

Process Sample

242-A Evaporator Process Flow Diagram
Figure 1-2

The Vacuum Condenser System (VCS) is located within the 242-A Evaporator main process building. The building is located in the 200 East Area of the Hanford Site (see Figures 1-3 and 1-4) consisting of four principal structures:

- 242-A Building, the main process building
- 242-AB Building, the adjacent control room building
- 242-A-81, the water service building
- 207-A Retention Basins (including 207-A Building)

The Evaporator is connected to storage tanks and valve pits through underground piping used for transferring feed and product slurry solution and miscellaneous drainage. Utilities and service supplied to the Evaporator include electrical power, pneumatic pressure, water and steam.

The principal process components of this SDD are located in the 242-A Building. The 242-A Building is comprised of two adjoining, structurally independent structures. One structure houses the processing and service areas shown in Figure 1-5, and is designed and constructed to withstand a 0.25 g seismic event.

The other structures shown in Figure 1-5, house operating and personnel support areas (e.g., change rooms, supply rooms, etc.). Under Project B-534, a new building, the 242-AB Building, was constructed to house the upgraded Evaporator control room, and an electrical room.

The Evaporator originally was designed and constructed in 1977 to Hanford Plant Standard Design Criteria (SDC) 4.1, Rev. 6, (Based on DOE Order 6430.1), which established the design loads and acceptance criteria for all permanent facilities at the Hanford Site at the time; however, the standard was revised in September 1989 (SDC-4.1 Revision 11; DOE-RL 1989). The Evaporator was designed to withstand a 0.25 g earthquake [safe shutdown earthquake (SSE)], a 100-mi/h high wind/tornado, and wind-generated missiles, criteria which actually exceeds those required by the current SDC-4.1, Rev. 11, for moderate hazard facilities.

Location Of The 200 East Area Within Hanford Site
Figure 1-3

Location Of The 242-A Evaporator Within The 200 East Area
Figure 1-4

1. Note: Other areas of facility maintained at positive pressure relative to atmospheric.
2. Arrows indicate direction of airflow.

Building 242-A And 242-AS Floor Plan
Figure 1-5

1.0 PRIMARY FUNCTION

The primary function of the 242-A evaporator VCS is to receive the vapors drawn off through the 42 inch (1.1 meter) vapor line from the Vapor Liquid Separator, (C-A-1), condense the vapors through a series of three condensers using raw cooling water as the cooling media and transfer the resulting process condensate (PC) to the condensate collection tank, TK-C-100. Down stream from the Primary Condenser steam is added to the process vapors through two steam jet ejectors, J-EC-1-1 and J-EC-2-1, used to create a vacuum in the process lines and the space above the deentrainment pads in the liquid vapor separator, C-A-1, to boil off the vapors and draw the vapors through the vacuum condenser system.

The remaining non-condensed vapors flow past the VCS to the Vessel Vent System (VVS) where the vapors are filtered through HEPA filters, monitored for Gamma radiation, and ammonia and finally discharged to the atmosphere.

The PC is pumped from the process condensate collection tank, treated in the Ion Exchange Column and finally discharged to Liquid Effluent Retention Facility (LERF) for storage until an effluent treatment system becomes operational.

2.0 VCS FUNCTIONAL DESCRIPTION AND OPERATING DESIGN REQUIREMENTS

2.1 General

The 242-A evaporator has been operational in the past years and has since been upgraded and undergone complete operational testing, therefore, the following general requirements reflect objective evidence that was obtained and demonstrated during operational tests to support the requirements specified in this SDD.

The basis for the specific operating requirements and ranges was obtained from the Monitoring and Control System (MCS) faceplates. These operating requirements and ranges were verified during 242-A Evaporator tests and were determined to be consistent with the requirements specified in the Operating Specification Document (OSD), the FSAR, and the Component Based Recall System (CBRS) as applicable to the specific parameter.

The following " VCS FUNCTIONAL DESCRIPTION AND OPERATING DESIGN REQUIREMENTS " document is written in a format which follows the flow of the PC through the system, starting from the 42" vapor line from the Vapor Liquid Separator, C-A-1, through the three condensers E-C-1, E-C-2 and E-C-3 to the process condensate tank, TK-C-100 and the Vessel Vent Stack. To maintain a consistent and complete description of the system, the format describes the components, and associated monitoring instruments and controls as applicable

in a succeeding order of the PC flow direction through the VCS, as depicted on P&ID Drawing H-2-98999.

2.1.1 Monitoring and Control System (MCS)

The MCS was installed into the 242-A Evaporator system as a result of the B-534 upgrades of the 242-A Evaporator. Its purpose is to remotely control the operation of the 242-A Evaporator, provide operating limits and alarm information for automatic control and shutdown of the evaporator system in the event the operating limits are exceeded.

Specification WHC-SD-534-CSWD-005 Rev 0, 242-A Control System Device Logic, Software Documentation and Drawing H-2-99949, provides the documentation for the software for the 242-A Monitor and Control System (MCS) interlock and control logic.

The Vacuum Condenser System is controlled by 38 faceplates shown on Faceplate Group Sheets 14, 15, and 16 on the MCS monitor (see Appendix B for Faceplate Group Sheets). Each faceplate provides a readout of the instruments monitoring parameters such as valve positions, interlock engagements, pressure, temperature, vacuum and radiation readings. The status of the faceplates is managed by the MCS keyboard commands to open or close valves and provide instantaneous readings of pressures, flow rates, fluid levels, temperature and radiation levels.

A faceplate can be seen on the MCS monitor screen, which shows the limits of the operating requirements and set points for a specific valve and/or instrument; Drawing H-2-99949, Sheet 3, provides an illustration of a typical faceplate for a device; Appendix B, are copies of the Vacuum Condenser Faceplate Group Sheets as they appear on the MCS monitor and is presented for information. Appendix D is an index of the instruments, Appendix E is an index of the major components, Appendix F is an index of the faceplates all of which are discussed in the body of this document.

2.1.2 Interlock Sequence Control

The Vacuum Condenser System (VCS) affects five interlock control events, specifically No's 2, 4, 14, 20 and 39 as shown on P&ID Drawing H-2-98986, Sheet 2. The primary function in these interlock events is to SHUT OFF THE P-B-1 PUMP, OPEN THE VACUUM BREAKER VALVE, SHUT OFF THE VESSEL VENT EXHAUSTER FAN, SHUT OFF DESUPERHEATER STEAM AND WATER, AND PRESSURIZE REBOILER CHEST.

The VCS interlock events are discussed in the body of this SDD and will be initiated upon a LOW weight factor of the C-A-1, LOW seal water and/or seal water pressure to P-B-1 Pump, high differential pressure across the filters in Vessel Vent System, excessive differential pressure across the De-Entrainment

pads in the Evaporator C-A-1, excessive radiation level in the Vessel Vent System, and the opening of the Vacuum Breaker Valve.

The MCS Logic Diagram (H-2-99949), Electrical Elementary Diagram, (H-2-99085), and the 242-A CONTROL SYSTEM DEVICE LOGIC SOFTWARE DOCUMENTATION (WHC-SD-534-CSWD-005), pages 16 and 25 provide a detailed description of the interlock device logic.

2.2 VCS Major Components

The P&ID Drawing H-2-98999 shows the Vacuum Condenser System. Major components include the Primary Condenser, (E-C-1), Inter-Condenser, (E-C-2), After-Condenser, (E-C-3), Jet Ejector, (J-EC1-1) and (J-EC2-1), valve control system, air intake supply system, the monitoring control systems (MCS) faceplates and associated interlock parameters.

A description of the operation at these components and the specific operating limits, setpoints and alarms are presented in this SDD.

The drawings depicting the VCS piping and instrumentation are:

- H-2-69335 Piping Arrangement Plans above elevation of 742 foot - 0 inch of the condenser room;
- H-2-69342 and H-2-69343 Piping Arrangement Condenser Room Section;
- H-2-98999 P&ID Vacuum Condenser System;
- H-2-99032 Piping Condenser Room Plans and Sections.

2.2.1 Monitoring Instrument

Vapor from the Vapor-Liquid -Separator, C-A-1, enters the VCS through a 42 inch pipe and is monitored for temperature.

- TE-CA1-9, Vapor Inlet Temperature Sensor

The temperature transducer senses the vapor temperature entering the VCS.

2.2.1.1 Faceplate

The faceplate monitoring the temperature sensor

- TI-CA1-9, E-C-1 Vapor Inlet Temperature

Faceplate indicates vapor inlet temperature flowing to the VCS.

Range 80°F - 180°F

- The faceplate has a setpoint of 65°F and does not incorporate an alarm.

2.2.2 Manual Valve, 5-68

A 3/4 inch manual valve, 5-68, located just down stream from temperature sensor, TE-CA1-9, at nozzle "H" on the 42 inch vapor pipe, is closed and is opened only for decontamination of the 42 inch pipe and down-stream condensers.

2.2.3 E-C-1 Primary Condenser Design Requirements

The Primary Condenser, E-C-1, is located in the Condenser Room between elevation 742'-6" and 732'-6" as shown on Dwg. H-2-69343. Vapors from the Vapor-Liquid Separator, C-A-1, located in the Evaporator Room enter the Primary Condenser, E-C-1, for the first phase of condensing the vapors as shown on P&ID Dwg. H-298999.

E-C-1, is a surface condenser type that does not permit the cooling media (raw-water) and the vapors from coming into contact with each other. The condenser consists of a cylindrical vessel through which pass numerous carbon steel tubes. The cooling water circulates through the tubes, and the vapors are brought into contact with the outer surfaces of these tubes, thus condensing the vapors by lowering the temperature. The condenser is a "four-pass" design in which the cooling water flows in one direction through part of the tubes and then returns through another section of the tubes making "one-pass." The process is repeated four times ("four-pass") within the condenser before the cooling water is drained into a catch pond where the heat absorbed in the water is dissipated. Vapors flowing through the condenser must pass across a series of baffles increasing the flow path of the vapors through the condenser, thus, augmenting the exposure of the vapors with the cooling tubes, increasing the condenser efficiency.

2.2.3.1 Construction

The construction drawing for the Primary Condenser, E-C-1, is shown on Drawing H-2-78281, depicting a tube-in-shell design with a 17-foot, 6-inch long and 8.5-foot diameter carbon steel shell containing 2,950 feet of equally spaced 3/4 inch carbon steel tubing, making four passes in the shell through which the cooling water passes.

2.2.3.2 Vapor Flow Path

Vapors enter the primary condenser through a 42 inch vapor line from the Vapor Liquid Separator, C-A-1, and contact the cooling tubes. The condensed vapors fall by gravity and collect in a 20 inch diameter x 3 1/2 feet long Hot Well at the bottom of the condenser shell and finally drain into the Condensate Collection Tank, TK-C-100; the process condensate is monitored for radiation prior to entering the Tank, (TK-C-100). The uncondensed vapor exit the primary condenser via a 6 inch vacuum line to a Steam Jet Ejector, (J-EC1-1), and the cooling water enters the primary condenser through a 12 inch raw water line and exits through a 12 inch line routed to the 216-B-3 collection pond.

- Condenser vapor inlet pipe size 42" diameter.
- Condenser vapor outlet pipe size 6" diameter.
- Condenser inlet and outlet cooling water pipe 12" diameter.

2.2.3.3 Operating Requirements

The operation of the primary condenser requires the specific control of pressure, flow and temperature of the process vapors, the cooling water and air flow in the vapor vacuum line during operation. Monitoring the process vapors and the controlling parameters is essential to the safe and successful operation of the system.

- The primary condenser has a surface cooling area of 6,700 square feet and removes heat from the process vapors at a rate of 2.2×10^7 British Thermal Units (BTU) (6,447 kilowatts) per hour.
- The vacuum developed in primary condenser is generated by two Steam Vacuum Jets J-EC1-1 and J-EC1-2 which are described in the paragraphs that follow.
- The vacuum in the Vacuum Condenser System is decreased and controlled by injecting air from the atmosphere, by modulating the Bleed-In Valve, PV-CA1-7 as shown on the VCS P&ID Drawing.

2.2.3.4 Monitoring E-C-1 Process Condensate

The condensed vapors (Process Condensate) fall by gravity and collect in a 20 inch diameter x 3 1/2 feet long Hot Well welded to the bottom of the E-C-1 condenser shell and flow through a 4" drain pipe to the Condensate Collection Tank, TK-C-100. The PC flow and temperature is monitored prior to draining into the TK-C-100 Tank as shown on the P&ID Process Condensate System, Drawing H-2-98990.

Instrument:

- FIT-EC1-2: Flow Indicator Transmitter

Faceplate:

- FI-EC1-2: E-C-1 Condenser PC Flow

Measures PC flow to Condensate Collection Tank, TK-C-100 and is hardwired to Flow Indicator, FIT-EC1-2.

Range:

0 - 90 GPM

- FQI-EC1-2: PC to TK-C-100 Totalizer (X10)

Displays the total gallons of PC produced within a 24 hour period. The Totalizer is hardwired to FI-EC1-2 faceplate.

Range:

0- 10,000 GAL

Instrument:

- TC-EC1-2: E-C-1 PC Outlet Temperature

Measures E-C-1 PC outlet temperature.

Faceplate:

- TIC-EC1-2: E-C-1 PC Outlet Temperature

The faceplate displays the E-C-1 PC outlet temperature and is hardwired to temperature indicator, TIC-EC1-2.

Range:

50°F - 150°F

2.2.4 TK-C-500, Corrosion Inhibitor Tank

The uncondensed vapors exit the Primary Condenser through two 6 inch diameter pipes located at nozzles "D" and "E" on the Primary Condenser as

shown on drawing H-2-98999. The 6 inch pipe leading from nozzle "E" is tapped into the Corrosion Inhibitor Tank System, TK-C-500, and is used only during extended maintenance outages to atomize a corrosion inhibitor fluid for injection into the VCS piping for minimizing corrosion in the pipes and components. The system consists of the following components.

- Three gallon Tank for the corrosion inhibitor.
- Manual Valve 4-27 and 4-28.
- 1/2" Air Atomizing Nozzle.
- Pressure control valve, PCV-C500-1.
- Pressure Indicator, PI-C100-1

2.2.4.1 Operation, TK-C-500

The corrosion inhibitor is released and atomized with compressed air at the 1/2" Atomizing Nozzle and injected into the piping system under pressure. Its purpose is to inhibit corrosion of the internal surfaces of the system exposed to the flow of the process condensate (PC).

2.2.5 PV-CA1-7, Air Bleed In Valve and F-C-2, Air Intake Filter

The Air Intake Filter, F-C-2 and Air Bleed In Valve, PV-CA1-7 are used to decrease the vacuum in the condenser system by regulating the air flow from the atmosphere through the filter, F-C-2, into the vacuum condenser system.

Controlling the vacuum is necessary to regulate the flow between the process condensate discharged from the evaporator, C-A-1, with the process condensate flowing into the Condensate Collection Tank, TK-C-100. These flows are controlled to be equal.

The 3" pipe from the Air Bleed In Valve and Air Intake Filter are connected by a reducer tee to the 6" Process Condensate pipe extending from nozzle "E" of the Primary Condenser to the Inter Condenser, E-C-2.

2.2.5.1 F-C-2, Air Intake Filter

Air is drawn in from the atmosphere through the F-C-2 Filter into the 6" vapor pipe during normal operation of the evaporator. The filter is used to prevent particulate matter larger than 5 microns from entering the VCS. The F-C-2 Air-Maze (Rockwell International), Model No. DN5SGN, dry type air filter consists of a single disposable cartridges and is rated at 4 PSID at 60 CFM. Air from the atmosphere flows into the system as a result of the vacuum created in the condenser system by the Steam Jets J-EC1-1 and J-EC2-1 in the second phase of condensing the vapors. The air flow is regulated by modulating Air Bleed In Valve, PV-CA1-1 (a normally open valve) to control the process condensate flow through system. The normal operating vacuum is set for 100 TORR.

2.2.5.2 PV-CAI-7, Air Bleed in Valve

The Air Bleed in Valve, PV-CAI-7, is a normally open pneumatically operated valve, controlled by positioner, PY-CAI-7. The positioner is hardwired and controlled by the signal from Faceplate PIC-CAI-7 found on P&ID Evaporator Circulation System, Drawing H-2-98988.

2.2.5.2.1 Monitoring Instruments

The instruments monitoring the position of the Air Bleed in Valve follows.

- ZI-CAI-7, Position Transducer

2.2.5.2.2 Faceplate

The Faceplates monitoring and controlling the position of the Air Bleed in Valve follow.

- ZI-CAI-7, Air Bleed in Valve % Open

Faceplate Display:

0% - Valve is fully open (normally open valve)

100% - Valve is fully closed

- PIC-CAI-7, Evaporator Absolute Pressure

The faceplate is found on P&ID Evaporator Circulation System, Drawing H-2-98988, it is hardwired and monitors the vapor pressure above the liquid level in the C-A-1, Vapor Liquid Separator shown on P&ID Drawing H-2-98988.

Faceplate Display:

0 to 200 TORR

Setpoint 100 TORR

- Alarm Response: None

2.2.6 HV-EC1-1, Vacuum Breaker Valve

The purpose of the Vacuum Breaker Valve is to break the vacuum in the vacuum condenser system in the event of an emergency. Breaking the vacuum returns the vacuum in the condenser system back to atmospheric pressure, thus, stopping the vapor flow. The 3" Vacuum Breaker Valve connects to the 6" pipe extending from nozzle "E" of the Primary Condenser and is linked with Interlocks No. 2, 4, 14, 20 and 39. The upstream side of the valve is open to the evaporator room.

2.2.6.1 Valve Description

The valve is a pneumatically actuated 3" gate valve, held open with a spring, actuated closed with "Instrument Air" and piloted by a 1/2" three-way-two-position solenoid valve, HY-EC1-1. Energizing the Pilot Solenoid Valve, closes the breaker valve. De-energizing the solenoid valve vents the pressure in the actuator and opens the valve under the force of the actuator spring. The valve is fail safe to open.

2.2.6.2 HY-EC1-1, Solenoid Valve

HY-EC1-1, is a 1/2", three-way two position solenoid valve. Energizing the solenoid valve will supply instrument air to the actuator of the Vacuum Breaker Valve, HV-EC1-1, to CLOSE the valve. De-energizing the solenoid valve vents the instrument air pressure in the breaker valve actuator, permitting the actuator spring to OPEN the Breaker Valve.

The solenoid valve is interconnected by hard-wire to Interlock No. 20, Interlock No.4, Interlock No.14 and Vacuum Breaker Valve faceplate, HV-EC1-1. The signal to energize the solenoid valve can originate from any of the three interlocks or by a manual command from the Vacuum Breaker Valve faceplate. (see P&ID Dwg. H-2-98999).

2.2.6.2.1 Faceplates

■ HV-EC1-1, Vacuum Breaker Valve

The Faceplate, HV-EC1-1, confirms both full-open and full-closure of the Vacuum Breaker Valve, HV-EC1-1, by signals received from the Faceplates, ZS-EC1-1-1N and ZS-EC1-1C and RESET status.

Faceplate Command:

CO CLOSE: Valve closes, provided no interlock is engaged.

C1 OPEN: Valve is open

C2 CS-RESET: Resets the CHGSTATE status of the faceplate and causes the OPEN command to follow. If the faceplate status is in an alarm mode, the RESET will clear the alarm.

Faceplate, HV-EC1-1, is soft-wired to device faceplates EX-C-1, EXC1-INLK and PB-1-BYPASS which are shared equipment devices displays. These displays are programmed to prevent the Vacuum Breaker Valve, HV-EC1-1, from receiving a CLOSE command unless specific conditions of the faceplates are satisfied (see P&ID Dwg. H-2-98999).

- EX-C-1; Vessel Vent Exhauster.

The Vessel Vent Exhauster Fan must be ON before Vacuum Breaker Valve, HV-EC1-1, is permitted to CLOSE.

- EXC1-INLK; Vessel Vent Interlock Device.

This device is soft-wired to the Vessel Vent Exhauster, EX-C-1 and is used to pass the interlocks to the exhauster control device EX-C-1 (see P&ID Dwg. H-2-98999).

Faceplate Display:

NORMAL

INTERLOCK status of Interlock No.20.

Range:

10 - 2000 CPM

Faceplate Display:

The faceplate is soft-wired to the Vessel Vent Interlock Device, EXC1-INTLK, displaying a NORMAL or INTERLOCK status of Interlock No.20.

- PB-1-BYPASS;

The device is used to bypass the PB-1 shutdown status as determined by the contactor YS-PB-1. The Vacuum Breaker Valve, HV-EC1-1, is permitted to CLOSE only when the command for PB1-BYPASS display is "CO BYPA OFF", activating the interlock condition.

Interlock No. 2 changes PB1-BYPASS faceplate display to "BYPA OFF" thus opening the Vacuum Breaker Valve, HV-EC1-1. See Drawing H-2-98986, sheet 2 for all interlock action.

2.2.6.2.2 Interlock No. 20

- Interlock No. 20: This interlock device shuts down the evaporative process by opening the Vacuum Breaker Valve; the slurry will continue to circulate through Evaporator Recirculating System as a result of the PB-1 Pump still running.

Interlock No. 20 is initiated by signal from Radiation Monitor, RM-VV-2, upon a high radiation reading of the process condensate vapors in the Vessel Vent Stack monitored by Vessel Vent Exhaust Stack BETA/GAMA radiation device RI-VVB/G, called out on Drawing H-2-92505, Sheet 4.

Interlock Event:

- Excessive radiation level in the Vessel Vent System.

Interlock Action:

- Shuts off supernatant feed pump and associated Feed Block Valve, HV-CA1-1
- Closes valve FV-EA1-1 to the Reboiler.
- Open 20 psig Air Supply Valve HV-EA1-3 to pressurize Reboiler Chest.

- Closes valve HV-EC2/EC3-1 to Vacuum Ejector J-EC1-1 and J-EC2-1.
- Opens Vacuum Breaker Valve HV-EC1-1.

2.2.6.2.3 Interlock No. 4

The actions of Interlock No.4 are the same as Interlock No.20. The interlock device shuts down the process, however, the slurry will continue to circulate through Evaporator Recirculating System as a result of the PB-1 Pump still running.

PDSHL-FC5-1, Vessel Vent Delta Pressure across the 1st HEPA filter will initiate Interlock No. 4 when the pressure is HI, which will initiate Interlock No. 20.

Interlock Event:

- Excessive high differential pressure detected across the first HEPA filters in Vessel Vent.

Interlock Action:

- Shuts off supernatant feed pump and associated Feed Block Valve, HV-CA1-1
- Closes valve FV-EA1-1 to the Reboiler.
- Opens 20 psig Air Supply Valve HV-EA1-3 to pressurize Reboiler Chest.
- Closes valve HV-EC2/EC3-1 to Vacuum Ejector J-EC1-1 and J-EC2-1.
- Opens Vacuum Breaker Valve HV-EC1-1.

2.2.6.2.4 Interlock No.14

The interlock is initiated by a Pressure Differential Switch, PDSH CA1-1, and is hardwired to the Solenoid Valve, HY-EC1-1.

Interlock Event:

- HI-HI differential pressure of lower or upper de-entrainment pad in evaporator C-A-1 (PDI-CA1-1 or PDI-CA1-2) software (PDSH-CA1-1) hardware except P-AW-102.

Interlock Action:

- Shuts off the supernatant feed pump P-AW-102 and associated feed block valve HV-CA1-6.
- Opens air bleed valve HV-EC1-1.
- Initiates Interlock NO. 39.

2.2.6.3 Instruments

- ZS-EC1-1-1, Position Switch.
When the switch is ON the Breaker Valve is OPEN.
- ZS-EC1-1-2, Position Switch.
When the switch is OFF the Breaker Valve is NOT OPEN but is not CLOSED. The valve is in transition or has failed in position.

2.2.6.4 Faceplates

- ZS-EC1-1N, Condenser Vacuum Breaker Valve OPEN
The faceplate is hardwired to Position Switches, ZS-EC1-1-1 and displays A WHITE alarm when the Vacuum Breaker Valve is OPEN.
Faceplate Display:
OPEN

Indicating the Breaker Valve is OPEN.

NOT OPEN

Indicating the Breaker Valve is OPEN but is not CLOSED. The valve is in transition from OPEN to CLOSE or it has failed in a partially OPEN position.

- ZS-EC1-1C, Condenser Vacuum Breaker Valve CLOSED

The faceplate is used to confirm the breaker valve position and is hardwired to Position Switches ZS-EC1-1-2.

Faceplate Display:

CLOSED:

Indicates the Breaker Valve is CLOSED.

NOT CLOSED:

Indicates the Breaker Valve is OPEN, but is not fully CLOSED. A WHITE alarm is displayed when the Vacuum Breaker Valve is NOT CLOSED.

Soft-wired to faceplate , ZS-EC1-1C, is Interlock No. 39.

2.2.6.5 Interlock No. 39

The interlock is soft-wired to device faceplate, ZS-EC1-1C.

Interlock Event:

- Vacuum breaker valve HV-EC1-1 is OPEN

Interlock Action:

- Closes valve HV-EC2/EC3-1 to vacuum ejector J-EC1-1 & J-EC2-1.
- Closes valve FV-EA1-1 to reboiler.

- Open 20 psig air supply valve HV-EA1-3 to pressurize reboiler chest.

2.2.7 FO-EC1-1, Orifice Plate

The orifice plate is attached to the upstream flange of vacuum breaker valve, HV-EC1-1. It is a stainless steel plate with a calibrated 1/8" diameter hole in the center of the plate used to control the maximum air flow into the vacuum condenser system, when Breaker Valve is OPEN to break the vacuum in the condenser system.

2.2.8 PSV-EC1-2, Pressure Relief Valve

The PSV-EC1-1, Pressure Relief Valve is connected into the 6 inch pipe leading from nozzle "D" of E-C-1, Primary Condenser and is set to relieve (limit) pressure in the VCS at 15 psig; venting to the evaporator room.

2.2.9 TE-EC1-3, Temperature Indicator

The TE-EC1-3, Temperature Indicator is located in the 6" vacuum condenser line downstream of the condenser, E-C-1, and breaker valve, HV-EC1-1. The temperature indicator is hardwired from thermocouple, TE-EC1-3, and is used to measure the process condensate vapor outlet temperature.

2.2.9.1 Faceplate

- TI-EC1-3: E-C-1 Vapor Outlet Temperature

Displays the instantaneous vapor outlet temperature reading of the process condensate on the MCS as measured by Temperature Indicator, TE-EC1-3. The faceplate is not connected to any alarms or interlocks and is used by the operators to verify operating temperatures of the PC as it enters the Inter Condenser, E-C-2.

Range:

80°F - 180°F

2.2.10 Vapor Outlet Pressure

The two 6" pipes leaving nozzles "D" and "E" of the E-C-1 Primary Condenser reconnect and lead to a single Vapor Vacuum Indicator, PI-EC1-1, and the first of two Steam Jets, J-EC1-1, used to develop the vacuum in the condenser system.

2.2.10.1 PI-EC1-1, Pressure Indicator

The pressure indicator is a visual indicator that continuously displays the pressure in the 6" vacuum pipe. The normal operating pressure is 0.80 psia.

2.2.10.2 PT-EC1-4, Pressure Transmitter

The Pressure Transmitter, PT-EC1-4, continuously monitors the pressure in the 6" vacuum pipe and transmits the mV signal generated to Faceplate PI-EC1-4.

2.2.10.2.1 Faceplate

- PI-EC1-4: E-C-1 Vapor Outlet Pressure

PI-EC1-4, Vapor Outlet Pressure faceplate receives its signal from the Pressure Transmitter, PT-EC1-4, and displays the pressure on the MCS. No alarms or interlocks are associated with the faceplate.

Range:

20 - 120 MMHG

2.2.10.2.2 FIC-EC1-4, Variable Area Flow Indicator With Integral Needle Valve

The Variable Area Flow Indicator, FIC-EC1-4, is used to produce a low constant pressure in the 1/4" instrument tubing extending from the 6" vacuum line to prevent vapors from entering the instruments. The pressure is maintained slightly above the operating vapor pressure range; instrument air is supplied at 20 psig and reduced to slightly above 120 MMHG as it flows across the needle valve.

2.2.11 Two Stage Steam Jet Ejector System

The Two Stage Steam Jet Ejector System is an integrated sub system consisting of Steam Jet Ejector, J-EC1-1, Inter Condenser, E-C-2, Steam Jet Ejector, J-EC2-1, and the After Condenser, E-C-3. The system was manufactured by SCHUTTE & KOERTING CO. and placed in service in the 242-A Evaporator in 1976. The two stage steam ejector system is located in the Condenser Room under the Primary Condenser, E-C-1 between elevation 742'-6" and 732'-6" as shown on Dwg. H-2-69343. Vapors from the Primary Condenser, E-C-1, enter the

two stage condenser system for the second and third phase of condensing the vapors as shown on P&ID Dwg.H-298999.

2.2.11.1 Steam Jet Ejectors, J-EC1-1 and J-EC2-1

The two Steam Jet Ejectors, J-EC1-1 and J-EC2-1, have basically the same design, however J-EC2-1 is smaller in size. The steam jets are used to create a delta pressure in the vacuum condenser system to cause process vapors to flow through the system. The steam jets create a vacuum downstream of the Primary Condenser, E-C-1, and the Inter Condenser, E-C-2, to cause process condensate vapors to flow from the higher pressure side of the Vapor Liquid Separator, C-A-1, to the low pressure side of the Inter Condenser, E-C-2.

The steam jet ejector works on the principal of an aspirator to create a partial vacuum. It consists of a steam jet nozzle placed concentric within its housing, and is arranged such that a steam jet at a high velocity exiting the nozzle, expands, to create a partial vacuum within the annular space around the nozzle, and hence within the 6" pipe. The partial vacuum in the 6" pipe causes the vapors to flow from the Vapor Liquid Separator, C-A-1, through the Primary Condensers, E-C-1, and into the Inter Condenser, E-C-2. The condensed vapors, called the process condensate (PC) are subsequently discharged from three 3/4" diameter tubes leading from each of the three condensers to the Process Condensate Tank, TK-C-100.

Vapors discharged from the primary condenser, enter the first stage vacuum steam jet ejector, J-EC1-1, where the PC vapors are mixed with 90 psig steam flowing at a high velocity through the steam jet ejector prior to entering the inter condenser. The uncondensed vapors and steam exiting the Inter Condenser, E-C-2, enter the second stage Vacuum Steam Jet, J-EC2-1, where the vapors are again combined with steam at 90 psig to further increase the vacuum prior to PC entering the After Condenser, E-C-3.

Vapors are drawn through the After Condenser, E-C-3, as a result of the low pressure created by Vessel Vent Exhauster, EX-C1, shown on Vessel Vent P&ID Dwg. 98998, located down stream from the After Condenser, E-C-3. The resulting uncondensed vapors flow through the After Condenser into the Vessel Vent System. The vapors are then filtered through a series HEPA filters, monitored for radiation and finally discharged to the atmosphere (see WHC-SD-WM-SDD-02/3 for a system description of the Vessel Vent System).

2.2.11.2 E-C-2 Inter Condenser Design Requirements

Referring to P&ID Drawing H-2-98999, non-condensed vapors from the primary condenser and steam from the steam jet ejector, J-EC1-1, enter the Inter Condenser. As the non-condensed vapor contacts the cooling tubes in the inter-condenser, the raw water flow provides additional vapor cooling and the resulting Process Condensate drains into the Condensate Collection Tank, TK-C-

100 and the non-condensed vapor and steam mixture flow to the second steam Jet Ejector, J-EC2-1.

E-C-2, is a surface condenser type that prevents the cooling media (raw-water) and the vapors from coming into contact with each other. The condenser consists of a cylindrical vessel through which pass several stainless steel tubes. The cooling water circulates through the tubes, and the vapors are brought into contact with the outer surfaces of these tubes thus condensing the vapors by lowering the temperature.

The condenser is a "four-pass" tube-in-shell, water cooled condenser design in which the cooling water flows through the tubes and, returning, making "one-pass". The process is repeated four times ("four-pass") within the condenser before the cooling water is passed on to the After Condenser, E-C-3, through a 3" pipe.

2.2.11.2.1 E-C-2 Construction

The carbon steel inter-condenser vessel is a tube-in-shell design measuring 87 inches long with a 15.375 inch inside diameter and contains 144 stainless steel tubes, 0.9375 inch pitch. The tubes have a 0.75 inch outside diameter and are 66 inches long making four passes in the shell through which the cooling water passes.

- Inter condenser PC inlet pipe size 10" diameter
- Inter condenser PC outlet pipe size 4" diameter

2.2.11.2.2 E-C-2 Operating Design Requirements

Operation of the Inter Condenser requires the specific control of pressure, flow and temperature of the process vapors, the cooling water and air flow in the vapor vacuum line during operation. Monitoring the process vapors and the controlling parameters is essential to the safe and successful operation of the system.

- The inter condenser, E-C-2, is a four-pass, tube-in-shell water cooled condenser with a design heat duty of 1.8×10^6 Btu/h at 150 gallons per minute (GPM) raw water flow.

2.2.11.2.3 E-C-2 Monitoring Instruments & Faceplate

Instrument:

- TE-EC2-2: PC Out Temperature sensor measuring process condensate temperature flowing from E-C-2 to the Collection Tank, TK-C-100.

Faceplate:

- TI-EC2-2, PC Outlet Temperature

Display:

90°F - 190°F.

Faceplate is hardwired to temperature sensor
TE-EC2-2.

Instrument:

- PI-EC2-1: Visual pressure indicator, measuring exiting vapor pressure. Manual valve 4-31 must be opened before pressure can be read.

Instrument:

- TE-EC2-3, temperature sensor measuring vapor exiting the inter condenser and flowing to the After Condenser, E-C-3.

Faceplate:

- TI-EC2-3, Vapor Outlet Temperature

Displays E-C-2 vapor outlet temperature.

Display:

90°F - 190°F.

Faceplate is hardwired to temperature sensor TE-EC2-3.

- Instrument:

PT-EC2-2: Pressure Transmitter.

The transmitter continuously monitors the pressure in the 2 1/2" E-C-2 vapor discharge pipe and transmits a mV signal generated to Faceplate PI-EC2-2.

■ Faceplate:

PI-EC2-2: E-C-2 Vapor Outlet
Pressure.

The faceplate displays the E-C-2 vapor outlet pressure on the MCS and receives its signal from the Pressure Transmitter, PT-EC2-2. No alarms or interlocks are associated with the faceplate.

Range:

50 - 250 MMHG

Instrument:

FIC-EC2-1: Variable Area Flow Indicator With Integral
Needle Valve.

The Variable Area Flow Indicator, FIC-EC2-1, is used to produce a low constant pressure in the 1/2" instrument tubing extending from the 2-1/2" E-C-2, discharge vacuum pipe to prevent condensed vapors from E-C-2, from entering the instruments. The pressure is maintained slightly above the operating vapor pressure range; instrument air is supplied at 20 psig and reduced to slightly above 250 MMHG as it flows across the needle valve.

2.2.11.3 E-C-3 After-Condenser

Uncondensed vapors mixed with steam from the Vacuum Steam Jet, J-EC2-1, flow into the After Condenser, E-C-3, for the third phase of cooling the vapors from the evaporator. The condensed vapors flow to the condensate collection tank, TK-C-100, and the uncondensed vapors flow to the Vessel Vent System. The uncondensed vapors are filtered through HEPA filters and finally discharged to the atmosphere through the Vessel Ventilation System shown on drawing H-2-98998.

The used raw water flowing from the after condenser drains into the used R/W system, and is monitored for radiation before draining into the 216-B-3 Pond System.

2.2.11.3.1 E-C-3 Operating and Requirements

- The after condenser has a design heat transfer duty of 7×10^5 British thermal units per hour.

2.2.11.3.2 E-C-3 Construction

The After Condenser is constructed of A-36 carbon steel and measures 7 feet 4-7/8 inches long with a 8 inch inside diameter, containing 45 carbon steel tubes, with a 0.937 inch pitch and 72 inches long with a 0.75 inch outside diameter.

- The after condenser inlet pipe size 4 inch diameter
- The after condenser outlet pipe size 3 inch diameter

2.2.11.3.3 E-C-3 Monitoring Instruments & Faceplate

Instrument:

- TE-EC3-2, PC Outlet Temperature Sensor.

Faceplate:

- TI-EC3-2, PC Outlet Temperature

Display:

100°F - 200°F.

Instrument:

- TE-EC3-3, Vapor Outlet Temperature Sensor

Senses vapor outlet temperature exiting the after condenser via Vessel Vent.

Faceplate:

- TI-EC3-3, Vapor Outlet Temperature

Display:

100°F - 200°F.

Instrument:

- PI-EC3-2, Pressure Sensor

Measures vapor pressure flowing to the Vessel Vent System see P&ID Dwg. H-2-98998.

Faceplate:

- PI-EC3-2, Vapor Outlet Vacuum

Display:

0 - 40 mmHg.

Instrument:

- FIC-EC3-2, Variable Area Flow Indicator With Integral Needle Valve

The Variable Area Flow Indicator, FIC-EC3-2, is used to produce a low constant pressure in the 1/4" instrument tubing extending from the 1/2" vacuum line to prevent vapors from entering the instruments. The pressure is maintained slightly above the operating vapor pressure range; instrument air is supplied at 20 psig and reduced to slightly above 120 MMHG as it flows across the needle valve.

2.2.12 Steam Supply to Steam Jet Ejector

Steam at 90 psig is supplied from the Steam System P&ID Dwg. H-2-98992 through a 3" pipe to operate the Steam Jet Ejector. The steam passes through the FE-EC2/EC3-1, Fixed Orifice; SS-C-1, Steam Separator, SS-C-1; and the HV-EC2/EC3-1, Pneumatic Operated Shutoff Valve prior to entering the steam Jet Ejector, J-EC1-1, and J-EC2-1. The steam mixes with the process vapors and the resulting condensate drains to the Condensate Collection Tank, TK-C-100.

2.2.12.1 FE-EC2/EC3-1, Fixed Orifice

Steam entering the Vacuum Condenser System passes through a calibrated orifice, FE-EC2/EC3-1, used to measure the steam flow to steam jets by means of a delta pressure reading.

2.2.12.2 FT-EC2-EC3-1, Flow Transmitter

The flow transmitter convert the pressure differential readings across the fixed orifice and transmits the signal to Faceplate ,FI-EC2/3.

2.2.12.2.1 Faceplate

- FI-EC2/3: Vacuum Jets Steam Flow

The faceplate is hardwired to the flow transmitter and measures steam flow to vacuum jets.

Display:

0 - 2000 LB/HR

2.2.12.3 SS-C-1, Steam Separator

The steam separator removes vapor droplets from the steam and drains the accumulated water to drain funnel through a two inch pipe.

2.2.12.4 PI-EC2/EC3-1, Pressure Indicator

The indicator is a visual type, displaying the pressure in the 3" steam pipe.

2.2.12.5 HV-EC2/EC3-1, Steam Control Valve

The vacuum jet steam control valve is a Rockford full bore 3", two-way two position ball valve with an Automax actuator (model A125SR). The valve requires an actuation pressure of 80 psig.

2.2.12.5.1 ZS-EC2/3-1-2, Valve Position Indicator

The positioner is a linear type and provides a signal to faceplate ZS-EC2/31N indicating the vacuum jet steam valve is OPEN.

2.2.12.5.2 Faceplate

- ZS-EC2/31N: Vacuum Jets Steam Valve Open

The faceplate is hardwired to the Valve Position Indicator, HV-EC2/EC3-1, and provides a visual display of the opening sequence of vacuum jet steam valve.

Display:

OPEN: Valve is Open

NOT OPEN: This display indicates the valve is in transition from CLOSE to OPEN.

The following faceplates and interlocks are soft-wired to ZS-EC2/3IN Faceplate above.

- EX-C-1, receives a signal from faceplate EXC1-INLK is hardwired to it.
- Faceplate, EXC1-INLK
- Interlock No. 39

The interlock is described in Para. 2.2.6.5 of this document.

- Faceplate, ZS-EC1-1C
- HV-EC2/3-1, Vacuum Jets Steam Valve status indicator.

Display:

CF-CLOSED: Valve is closed as confirmed by the full close limit switch.

CF-OPEN: Valve is open as confirmed by the full open limit switch.

CS-RESET: Temporary status during resetting of the CHGSTATE status.

CHGSTATE: A loss of CF-OPEN occurred without a close command

INTERLOK: Interlock is present preventing valve operation.

CLOSING: Valve is closing but full confirmation is not confirmed.

OPENING: Valve is opening but full confirmation is not confirmed.

- Interlock No.4 and No.20

The interlocks are interconnected see description in PARA 2.2.6.2.1 of this document.

Interlock No.20 is soft-wired and interconnected to

RM VV-2 and interlock No. 4 is soft-wired interconnected to PDSHL-FC5-1. These interlocks are soft-wired to solenoid valve HY-EC2/EC3-1.

2.2.12.5.3 ZS-EC2/3-1-1, Valve Position Indicator

The positioner is a linear type and provides a signal to faceplate ZS-EC2/31C that the valve is CLOSED.

2.2.12.5.4 Faceplate

- ZS-EC2/31C: Vacuum Jet Steam Valve Closed

Display:

CLOSED

NOT CLOSED

2.2.12.6 HY-EC2/EC3-1, Solenoid Pilot Valve

The valve is a 1/2" three-way two position solenoid operated valve used to supply instrument air to OPEN or CLOSE the Steam Valve HV-EC2/EC3-1. The solenoid is hardwired and interconnected to Interlock No. 20, and No. 4.

2.2.12.7 HV-PA--EC2/EC3-2, Needle Valve

Hand operated needle valve used for opening and closing of HV-EC2/EC3-1 steam control valve.

2.2.13 Raw water cooling-Primary Condenser E-C-1

Raw Water (RW) entering the primary condenser is supplied from the Raw Water (R/W) System (see drawing H-2-98991) to cool the vapors flowing through the condensers. As the R/W exits the primary condenser it becomes Used R/W and is discharged to the Used R/W system (see drawing H-2-98994) where it is monitored for radiation and finally discharged to the B-Pond (216-B-3).

R/W enters the primary condenser tubes at nozzle "C" through a 12 inch diameter pipe at 100 psig and 3,500 GPM and exits at nozzle "B" through a 12 inch diameter pipe to the Used R/W system Drawing H-2-98994.

2.2.13.1 Monitoring R/W

As raw water enters the VCS it is monitored for temperature and pressure.

Instrument:

- TE-EC1-4, Temperature Indicator, measures the R/W temperature entering the condensers E-C-1, E-C-2 and E-C-3.

Faceplate:

- TI-EC1-4: RW Inlet Temperature

Range:

30°F-80°F

The faceplate is hardwired to Temperature Indicator, TE-EC1-4.

Instrument:

- PT-EC1-5, Pressure Indicator, measures the R/W pressure entering the condenser E-C-1, E-C-2, and E-C-3.

Faceplate:

- PI-EC1-5: Displays the RW Inlet Pressure prior to entering Condenser, E-C-1,

Range:

0 psig-100 psig.

The faceplate is hardwired to PT-EC1-5 pressure indicator.

Instrument:

- PSV-EC2/EC3-1, Up-Stream Relief Valve.

Set relief pressure 105 PSIG $\pm$ 10%.

2.2.13.2 Raw Water Cooling: E-C-2, Inter Condenser and E-C-3 After Condenser

Used raw-water (UR/W) is used to cool the vapors in the condensers and is supplied from the UR/W system shown on drawing H-2-98991. A 3-inch line connected to the 12 inch (supply line to E-C-1 as shown on drawing H-2-98999, supplies UR/W to cool the Inter Condenser, E-C-2, and After Condenser, E-C-3. The UR/W to cool E-C-2, is also used to cool E-C-3. The UR/W is monitored for

flow and temperature and finally discharged to the UR/W system as shown on drawing H-2-98994.

Instrument:

- TE-EC2-1, Temperature Sensor, measures the Inter Condenser, E-C-2, UR/W outlet temperature.

Faceplate:

- TI-EC2-1: Raw Water Outlet Temperature

Range: 40°F - 140°F.

Faceplate is hardwired to temperature sensor TE-EC2-1 and soft-wired to faceplate CI-EC2-Q1.

- CI-EC3-Q1: E-C-2 HT XFER RATE KBTU/HR

The faceplate is programmed to automatically compute the heat transfer rate of the vapors by comparing the RW inlet temperature with faceplate TI-EC1-4 and TI-EC2-1 with respect to time and displaying the result in BTU/HR.

Range:

0 - 1000 KBTU/HR

2.2.13.3 Used Raw Water System Instruments and Faceplates

Used Raw-Water exiting E-C-3 is monitored for flow and temperature and finally sent to the UR/W System shown on Drawing H-2-98994.

Orifice:

- FE-EC3-1, Fixed Calibrated Orifice to measure UR/W flow.

Instrument:

- FT-EC3-1, Flow Transmitter down-stream of the After-Condenser, E-C-3, converts the pressure differential reading across the fixed orifice and transmits the signal to Faceplate, FIC-EC3-1.

Faceplate:

- FIC-EC3-1, E-C-3 Condenser UR/W Flow Controller.
The faceplate is hardwired to
FT-EC3-1, Transmitter and measure the UR/W
flow to the Used Raw Water System.
Faceplate Range:

0 - 150 GPM.

Instrument:

- FY-EC3-1, Flow Converter

FY-EC3-1 is hard wired to Faceplate FIC-
EC3-1 providing feedback to control
position of flow control valve, FV-EC3-1
to control raw water flow through VCS.

Valve:

- FV-EC3-1, diaphragm operated flow control valve
with positioner, is used to control UR/W flow
through the Inter and After Condenser. The
feedback signal to the valve positioner is from
the fixed orifice flow indicator, FIC-EC3-1.

Instrument:

- TE-EC3-1, Used R/W Outlet Temperature Indicator.

Faceplate:

- TI-EC3-1, RW Outlet Temperature

Range:

40°F - 140°F.

2.2.14 Manual Valves

There are 36 manually operated valves in the VCS identified on the P&ID Drawing H-2-98999 which perform specific functions such as isolating, bypassing and purging of the system piping. Appendix C: is a listing of the VCS manual valves showing the specific function of each and the location of

the valve on the P&ID Drawing. The valves are set to the open or closed position as specified in the operating procedures.

2.2.15 Electrical System

The VCS valves and instruments are controlled by the MCS which receives its electrical power from the Motor Control Center (MCC) No.2, located in the 242-A Evaporator building. In the event of a loss of normal power from the substation, power from the standby generator will switch on to maintain the Evaporator mechanically and environmentally safe, as well as assuring personnel safety.

One Line Electrical Diagram Drawing H-2-100096 shows the power distribution for the 242-A Evaporator and the backup power generator.

2.3 System Interfaces

The VCS interfaces with the following systems that support its operation:

- Evaporator Process Loop System...Dwg. H-2-98988
- Used raw-system...Dwg. H-2-98994
- Raw water-system...Dwg. H-2-98991
- Steam system...Dwg. H-2-98992
- Vessel vent system...Dwg. H-2-98998
- Instrument Air Supply System...Dwg. H-2-99001
- Process Condensate System...Dwg. H-2-98990.

2.4 Quality Assurance and Safety

2.4.1 Facility Quality Assurance

The quality assurance requirements of the VCS are based on applicable paragraphs of B-534-C1 As-Built Rev 1, Construction Specification for the 242-A Building Evaporator/Crystallizer Upgrades. Among the applicable paragraphs include SECTION 13440, INSTRUMENTATION, SECTION 15491, POWER PIPING SYSTEMS, SECTION 15493, CHEMICAL PROCESS PIPING SYSTEM, and SECTION 16400 SERVICE AND DISTRIBUTION.

2.4.1.1 Operations and Maintenance Quality Assurance

The Quality Assurance approvals for all jobs related to the VCS job work packages for up-grading, maintenance, test and operation procedures will be specified by Waste Treatment Engineering. Quality Assurance approval shall be specified in accordance with the impact level of specific VCS component as defined in the 242-A Evaporator Safety Analysis Report (FSAR) WHC--SD-WM-SAR-023 Rev. 1.

2.4.2 Safety

The VCS shall accommodate normal conditions and operation without jeopardizing safety to personnel or plant. The design, operation, and maintenance of all equipment shall be in accordance with applicable safety standards and good plant operation practices. Application of the As Low As Reasonably Achievable (ALARA) Program shall be maintained at all times to assure compliance with DOE Order 5480.11.

The 242-A Evaporator Safety Analysis Report (FSAR) WHC-SD-WM-SAR-023 REV.1, Chapter 9 identifies and evaluates hazards, analyzes selected scenarios, and determines risk acceptability. Specifically, the VCS preliminary hazards assessment identifies two (2) potential accidents and sequences, and categorizes the safety level as depicted in Table 9-5 of the FSAR.

Following are the two potential accidents analyzed and their corresponding safety levels:

1. Failure of primary condenser tube(s) will cause contamination of condenser cooling water. Safety Level IV. Frequency, extremely unlikely.
2. Slurry, carry-over from evaporator to failed tubes in the primary condenser, will cause contamination of the condenser cooling water. Safety Level IV. Frequency, incredible.

2.5 Applicable Documents, Specifications and Standards

This SDD is a supporting document for the 242-A evaporator and reflects the latest system upgrades as described in the following documents:

- 242-A Evaporator Safety Analysis Report (FSAR) WHC-SD-WM-SAR-023 Rev. 1.
- 242-A Evaporator Dangerous Waste Permit Application, Dated June 1991, DOE/RL-90-42 Revision 0, Volume 1 and 2.

- Construction Specification For 242-A Evaporator/Crystallizer Upgrade WHC: V-B534-C4-028, Rev. 0. (Water Service Building, Raw Water System).
- Construction Specification For 242-A Building Evaporator/Crystallizer Upgrade (Process Upgrades) KEH Specification B-534-C1, Rev. 2, V-B534-C1-026.

Summary of the work performed as a result of Project B-534 As-Built Specification V-B534C1-026 as applicable to the VCS.

- Construction of a new control room
- Relocation of the process control system to the new control room (MCS)
- Addition of some safety-related and non-safety-related interlocks on the process control system
- Replacement of E-C-1 condenser
- Replacement and installation of new instrument and valves
- Installation of MCS console and MUX cabinets.

2.6 Original Construction Specification

The following standards and specifications are for reference purposes, since they were already imposed and specified in the original construction and the Project B-534 As Built Specification, V-B534C1-026, for the 242-A Evaporator/Crystallizer. The documents referenced herein, form part of this section to the extent that they apply to the Vacuum Condenser System.

2.6.1 American National Standards Institute (ANSI)

ANSI A13.1-1981	Scheme for Identification of piping systems.
ANSI B16.3-1985	American National Standard Malleable Iron Threaded Fittings, Class 150 and 300.
ANSI B16.5-1981	American National Standard Pipe Flanges and Flange Fittings.
ANSI B16.9-1986	American National Standard Factory-Made Wrought Steel Butt-welding Fittings.

- ANSI B16.9-1986 American National Standard Factory-Made Wrought Steel Butt-welding Fittings.
- ANSI B16.22-1980 American National Standard Wrought Copper and Copper Alloy Solder-Joints Pressure Fittings.
- ANSI B31.1 - 1986 Edition, American National Standard Code for Pressure Piping -- Power piping w/Addenda ANSI B31.1a and B31.1b.

2.6.2 American Society of Mechanical Engineers (ASME)

- 1986 Edition, ASME Boiler and Pressure Vessel Code.
- Section IX Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators.

2.6.3 American Society for Nondestructive Testing (ASNT)

- NO. SNT-TC-1A Recommended Practice Personnel Qualification and Certification in Nondestructive Testing.
(1984) Edition

2.6.4 American Society for Testing and Materials (ASTM)

- A 53-87b Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
- A 105-87a Standard Specification for Forging, Carbon Steel, for Piping Components.
- B 32-83 Standard Specification for Solder Metal.
- B 75-84 Standard Specification for Seamless Copper Tube.
- B 280-83 Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.

2.6.5 American Welding Society (AWS)

- AWS QC1-86 Standard for Qualification and Certification of Welding Inspectors.

2.6.6 Hanford Plant Standard (HPS)

E-14-35, Rev.2 15 Ampere, 120 Volt Receptacle and Plugs for Instrumentation.

I-2-7, Rev.3 Equipment Nameplates.

2.6.7 Instrument Society of America (ISA)

ISA RP 7.1-1956 Recommended Practice Pneumatic Control Circuit Pressure Test.

2.6.8 National Fire Protection Association (NFPA)

NFPA National Electrical Code, 1987 Edition.

2.7 DOE ORDERS

DOE Orders applicable to the Vacuum Condenser System follow.

Order 6430.1A Seismic, Radiation Protection Requirements, ALARA.

Order 5480.11 Ensure ALARA is being followed.

3.0 DESIGN DESCRIPTION

3.1 VCS Operational Description

The VCS is shown on drawing H-2-98999 shows the primary condenser (E-C-1), inter-condenser (E-C-2), after-condenser (E-C-3), jet ejector (J-EC1-1) and (J-EC2-1), valve control system, air intake supply system, the valves and instruments monitored by the MCS and the interlocks.

During a normal start-up, vapors from the vapor liquid separator, C-A-1, enter the VCS through a 42 inch vapor line coming from the vapor liquid separator (C-A-1). The vapors pass through a series of three condensers that use raw cooling water to condense the vapors, the condensed vapors (process condensate) flow to the bottom of the condensers and to the condensate collection tank, TK-C-100. The treated process condensate (PC) is discharging to LERF where it is stored until an effluent treatment system becomes operational.

condensed vapors from the vacuum condenser are filtered and discharged to the atmosphere via the vessel ventilation system.

Controlling the vacuum in the condensers and process lines is accomplished by metering air into vacuum system from the atmosphere through a flow control valve, PV-CA1-7, to decrease the vacuum. The control valve position and system vacuum are controlled and monitored at the MCS to assure its proper operation. To shut down the process, the system vacuum is dumped by opening the pneumatically controlled breaker valve, HV-EC1-1, and steam to the steam jets is shut off.

4.0 MAINTENANCE

4.1 Maintenance Approach

Maintenance of the 242-A Evaporator Vacuum Condenser System is managed and controlled by the following WHC administrative requirements.

- Component Base Recall System (CBRS) per WHC-CM-8-7.

The system program uses a computerized database to document, forecast, and recall plant installed instrument and equipment calibration and preventive maintenance.

- Preventive Maintenance (PMs) per WHC-CM-8-2.

The program requires the inspection of components on a routine controlled frequency. Equipment requiring repair and restoration, or which does not perform its intended function will be serviced or replaced.

- Job Control System (JCS) per WHC-CM-8-8.

The system program is used to provide guidance, information and scheduling to be incorporated into a detailed breakdown of the system operational and maintenance activity.

The types of work included in the JCS include corrective maintenance, modification, preventive maintenance (Predictive, Periodic, and Planned) and, maintenance as a result of a periodic surveillance of equipment.

5.0 VCS Operations

The start-up and shutdown of the VCS is based on a sequence of events which must occur involving the total 242-A Evaporator System. During start-up

5.0 VCS Operations

The start-up and shutdown of the VCS is based on a sequence of events which must occur involving the total 242-A Evaporator System. During start-up of the VCS the slurry circulation in the Vapor Liquid Separator, C-A-1, must be established, PB-1 and PB-2 Pumps must be running, and the steam, instrument air, raw-water and used raw-water systems are in operation as well as the MCS.

5.1 Start-up

As a minimum the start-up for the VCS shall meet the following sequence of events:

- Verify MCS is ON and all face plate readings are within specified limits
- Verify Vacuum Breaker Valve HV-EC1-1 is closed
- Verify raw-water is flowing through all three condensers
- Open steam valve HV-EC2/EC3-1

5.2 Shutdown

As a minimum the shutdown of the VCS shall meet the following sequence of events.

- Open Vacuum Breaker Valve HV-EC1-1: This event will return the vacuum to atmospheric pressure.
- Close steam valve HV-EC2/EC3-1: This event will shut off the effect of the steam jets.

APPENDIX A
242-A Evaporator Systems & SDD

APPENDIX A
242-A Evaporator Systems & SDD

SYSTEM	DRAWING	SDD	SAFETY CLASS
ELECTRICAL DISTRIBUTION	H-2-10096	WHC-SD-WM-SDD-008	3
STANDBY POWER	H-2-10096 H-2-79519	WHC-SD-WM-SDD-009	3
RAW WATER/USED RAW WATER	H-2-98991	WHC-SD-WM-SDD-010	3
SANITARY WATER	H-2-69287 H-2-69300	WHC-SD-WM-SDD-011	3
STEAM	H-2-98992	WHC-SD-WM-SDD-012	3
STEAM CONDENSATE	H-2-98993	WHC-SD-WM-SDD-013	2
COMPRESSED AIR	H-2-99001	WHC-SD-WM-SDD-014	3
HVAC - BUILDING VENTILATION	H-2-69294 H-2-99421	WHC-SD-WM-SDD-015	2 (INCLUDES STACK MONITOR)
FIRE PROTECTION	H-2-85087 H-2-79865	WHC-SD-WM-SDD-016	3
EVAPORATOR LOOP	H-2-98988	WHC-SD-WM-SDD-017	2
SLURRY	H-2-98989	WHC-SD-WM-SDD-018	3
PROCESS CONDENSATE	H-2-98990	WHC-SD-WM-SDD-019	3
DRAIN	H-2-98995	WHC-SD-WM-SDD-020	3
DECONTAMINATION	H-2-98996	WHC-SD-WM-SDD-021	3
ELUENT	H-2-98997	WHC-SD-WM-SDD-022	3
VESSEL VENT	H-2-98998	WHC-SD-WM-SDD-023	3 (INCLUDES STACK MONITOR)
VACUUM CONDENSER	H-2-98999	WHC-SD-WM-SDD-024	3
ANTI-FOAM	H-2-99000	WHC-SD-WM-SDD-025	3
JET GANG VALVE	H-2-99002	WHC-SD-WM-SDD-026	3
207-A BASINS	H-2-69332	WHC-SD-WM-SDD-027	3
MONITORING AND CONTROL	N/A	WHC-SD-WM-SDD-028	3
PERSONNEL PROTECTION DEVICES	H-2-69330	WHC-SD-WM-SDD-029	3
TRANSFER LINES	H-2-70398 H-2-70399	WHC-SD-WM-SDD-030	2
FILTERED RAW WATER	H-2-99003	WHC-SD-WM-SDD-031	3
BUILDING STRUCTURE	N/A	WHC-SD-WM-SDD-032	2

APPENDIX B

VCS MCS Faceplates

APPENDIX B
VCS MCS Faceplates

PIC-EC1-2	1 ZI-EC1-2	2 TIC-EC1-2	3 FIC-EC1-1	4 FIC-EC3-1	5 HV-EC1-1	6 HV-EC2/3-1	7 FI-EC2/3
V 1.31 S 25.00 50.00-	V 10.73 100.0-	V 62.0 150.0-	V 0.0 4000 -	V 0.00 S 125.00 150.0-	MANUAL	MANUAL	V 215.2 2000 -
PSIG M 0.00- OUT: 0%	PCT 0.0-	DEGF 50.0-	GPM M 0 -	GPM M 0.0- OUT: 100%	CF-CLOSD CF-OPEN CS-RESET CHGSTATE INTERLOK CLOSING OPENING	CF-CLOSD CF-OPEN CS-RESET CHGSTATE INTERLOK CLOSING OPENING	LB/H 0 -
URW BACK PRESSURE CONTROLR	URW TO B POND VALVE 0 = OPEN	E-C-1 PC OUTLET TEMP	E-C-1 CONDENSR URW FLOW CONTROLR	E-C-3 CONDENSR URW FLOW CONTROLR	VACUUM BREAKER VALVE	VACUUM JETS STEAM VALVE	VACUUM JETS STEAM FLOW
8 PIC-CA1-7	9 ZI-CA1-7	10 PI-CA1-11	11 PSH-CA111	12 RI-CA1-1	13 RSH-CA1-1	14 FI-EC1-2	15 FOI-EC1-2
V 249.58 S 100.00 200.0-	V -2.46 100.0-	V 0.027 30.00-	DIGITAL INPUT	V 299 10000-	DIGITAL INPUT	V 0.000 90.00-	V 0 10000-
TORR M 0.0- OUT: 0%	PCT 0.0-	INHG 0.00-	NORMAL PRESS HI	CPS 0 -	NORMAL RAIN HI	GPM 0.00-	GAL A 0- OUT: 0%
EVAP ABSOLUTE PRESSURE	AIR BLEED-IN VALVE 0 = OPEN	EVAP VACUUM 0-30 IN HG	EVAP VESSEL PRESSURE HIGH	E-C-1 CONDENSR PC RADN	E-C-1 CONDENSR PC RADN HIGH	E-C-1 CONDENSR PC FLOW	PC TO TK-C-100 TOTALIZER (X10)

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COPY

APPENDIX B
VCS MCS Faceplates

TI-CA1-9	1 PI-EC1-5	2 TI-EC1-4	3 TI-EC1-1	4 TI-EC1-3	5 PI-EC1-4	6 TI-EC2-3	7 PI-EC2-2
V 65.0	V 53.69	V 65.5	V 65.4	V 65.1	V 0.00	V 65.1	V 297.84
180.0	100.0	80.00	140.0	180.0	120.0	190.0	250.0
DEGF	PSIG	DEGF	DEGF	DEGF	MMHG	DEGF	MMHG
80.0	0.0	30.00	40.0	80.0	20.0	90.0	50.0
E-C-1 VAPOR INLET TEMP	E-C-1 RW INLET PRESSURE	E-C-1 RW INLET TEMP	E-C-1 RW OUTLET TEMP	E-C-1 VAPOR OUTLET TEMP	E-C-1 VAPOR OUTLET PRESSURE	E-C-2 VAPOR OUTLET TEMP	E-C-2 VAPOR OUTLET PRESSURE
8 TI-EC2-2	9 TI-EC2-1	10 TI-EC3-1	11 TI-EC3-2	12 TI-EC3-3	13 PI-EC3-2	14 FQI-EC2/3	
V 61.5	V 65.4	V 65.6	V 65.9	V 65.6	V -4.416	V 0.0	
190.0	140.0	140.0	200.0	200.0	40.00	6000	
DEGF	DEGF	DEGF	DEGF	DEGF	MMHG	GAL	
90.0	40.0	40.0	100.0	100.0	0.00	0	
E-C-2 PC OUTLET TEMP	E-C-2 RW OUTLET TEMP	E-C-3 RW OUTLET TEMP	E-C-3 PC OUTLET TEMP	E-C-3 VAPOR OUTLET TEMP	E-C-3 VAPOR OUTLET VACUUM	STEAM JETS TOTALIZER	

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APPENDIX B

VCS MCS Faceplates

0	1	2	3	4	5	6	
ZS-EC1-1C	ZS-EC1-1N	ZSEC2/31C	ZSEC2/31N	CI-EC1-U1	CI-EC2-Q1	CI-EC3-Q1	
DIGITAL INPUT	DIGITAL INPUT	DIGITAL INPUT	DIGITAL INPUT	V -0.0 1000 - UNOT A 0 - OUT: 0% C . . . 0	V 0.0 1000 - KB/H A 0 - OUT: 0% C . . . 0	V 0.0 1000 - KB/H A 0 - OUT: 0% C . . . 0	
CLOSED NOT CLSD	OPEN NOT OPEN	CLOSED NOT CLSD	OPEN NOT OPEN				
CONDENS VACUUM BREAKER CLOSED	CONDENS VACUUM BREAKER OPEN	VACUUM JETS STM VALV CLOSED	VACUUM JETS STM VALV OPEN	HT XFER COEFF BTU/HR/ FT ² /DEGF	E-C-2 HT XFER RATE KBTU/HR	E-C-3 HT XFER RATE KBTU/HR	

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APPENDIX C

VACUUM CONDENSER MANUAL VALVES

APPENDIX C

VACUUM CONDENSER MANUAL VALVES

<u>VALVE</u>	<u>FUNCTION</u>	<u>ZONE</u>
4-19	HV-EC2/EC3-1 ISOLATION	H298999/1/A5"
HV-PA-EC2/EC3-2	PA TO HV-EC2/EC3-2	H298999/1/A5"
4-12	STEAM TRAP BYPASS/PURGE	H298999/1/A6"
4-13	STEAM TRAP ISOLATION	H298999/1/A6"
4-15	STEAM TRAP ISOLATION	H298999/1/A6"
4-30	STEAM TRAP STRAINER	H298999/1/A6"
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