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Project W-058 System Overviews

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Abstract: This documdent provides a system overview of the Replacement Cross-Site Transfer System. The major component systems are described. This information was gathered from the design media, design calculations and vendor information from the Project.

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PROJECT W-058 SYSTEM OVERVIEWS

J.L. Gilbert

April 1998

Table of Contents for W-058 System Overviews

Chapter 1

SYSTEM OVERVIEW for the W-058 MONITOR AND CONTROL SYSTEM W-058 REPLACEMENT OF CROSS SITE TRANSFER SYSTEM

1.0 INTRODUCTION

This document provides a system summary description, function and design requirements, and design description, for the Monitor and Control System, (MCS).

2.0 SYSTEM SUMMARY DESCRIPTION

2.1 System Description

The purpose of the MCS is to allow an operator, located in a remote location (the 242S control room), to control and monitor all processes associated with the cross site transfer of radioactive wastes.

2.2 System Boundaries

· 242S Building

The operator control station, OCS, is located in the 242S building. The OCS consists of 2 computers with 2 color CRTs, 2 keyboards, 2 trackballs/mice and 2 printers.

· SY Tank Farm

A process control unit, PCU-1, is located in the 252-S Switchgear Building. PCU-1 consists of a Programmable Logic Controller (PLC), thermocouple input, analog inputs and outputs and discrete inputs and outputs contained in a 48 inch high, 36 inch wide, 16 inch deep, Hoffman enclosure.

· Diversion Box 6241-A

Two process control units, PCU-2A and 2B, are located in the 6241-A diversion box. PCU-2A consists of all discrete inputs and outputs, contained in a 60 inch high, 60 inch wide, 16 inch deep, Hoffman enclosure. PCU-2B consists of a PLC and all analog inputs, analog outputs, RTD inputs and thermocouple input, contained in a 60 inch high, 48 inch wide, 16 inch deep, Hoffman enclosure.

· Ventilation Station 6241-V

A process control unit, PCU-3, is located in the 6241-V ventilation station. PCU-3 consists of a PLC, analog inputs, and discrete inputs and outputs, contained in a 60 inch high, 60 inch wide, 16 inch deep, Hoffman enclosure.

· 244-A Lift Station

A process control unit, PCU-4, is located outside, adjacent to the 244-A instrument building fence. PCU-4 consists of a PLC, thermocouple input, analog inputs, and discrete inputs and outputs, contained in a 60 inch high, 60 inch wide, 16 inch deep, Hoffman enclosure.

· Instrument Cabinet CAB-6241

A process control unit, PCU-5, is located in Instrument Cabinet CAB-6241. PCU-5 consists of a PLC and discrete inputs.

2.3 System Interfaces

The following are necessary for the W-058 Monitor and Control System to perform and function as designed;

a) 120 Vac, 60 Hz, electrical power;
b) HVAC systems to maintain an operating temperature between 40 and 104 degrees Fahrenheit.

2.4 System Classification

The Monitor and Control System does not prevent or mitigate any accidents resulting in unacceptable consequences to the public or onsite worker and is therefore classified as non safety significant. Reference HNF-SD-WM-BIO-001, Rev. 0-H.

3.0 DESIGN REQUIREMENTS

3.1 SYSTEM DESIGN REQUIREMENTS

3.1.1 Functional and Performance Requirements

The MCS will be used to monitor and control the transfer of radioactive wastes from the SY Tank Farm to treatment, storage, and disposal facilities.
The MCS will provide operator and supervisory interfaces, event logging, alarm annunciation, process graphics, current and historical data trending, formatted reports, batch/sequence control, discrete control, and continuous proportional integral derivative (PID) control.

3.1.2 Operability requirements

Operability of the Monitor and Control System is dependent on the reliability of the existing facility electrical system. Each location where electrical power is obtained is described below:

· 242S Building

Existing circuit B4 will provide power to the OCS.

- SY Tank Farm

A new 20 ampere. single pole, 120 Vac circuit, (circuit #8), of existing panelboard MPC-E-001 located in the-252-S Building will provide power to PCU-1.

- Diversion Box 6241-A

Two 20 ampere, single pole, 120 Vac circuit breakers, (circuits #12 & #14), of panelboard PP-3, located in the Electrical Room of the 6241-A Building, will provide power to PCU-2A and PCU-2B.

- Ventilation Station 6241-V

Two 20 ampere, single pole, 120 Vac circuit breakers. (circuits #12 & #14) of panelboard PP-3, located in the Electrical Room of the 6241-V Building, will provide power to PCU-3.

- 244-A Lift Station

A new 30 ampere, single pole, 120 Vac circuit breaker (circuit #9) will be installed in existing panelboard A, located in the 244-A instrument house, to provide power to PCU-4.

- Instrument Cabinet CAB-6241

A new 20 ampere, single pole, 120 Vac circuit breaker, (circuit #5), of existing mini-power center panelboard A1, located in the 2712-B building, will provide power to the instrument cabinet.

Operability of the MCS is dependent on the reliability of the GANDALF modems and the dedicated telephone lines which provides a transmission path for information between the OCS and PCU-1.

Operability of the MCS is dependent on the reliability of each facility's HVAC system. Each location of the required HVAC system is described below:

- 242S Building

The existing building HVAC system is utilized. No modifications were made by the W-058 Project.

- 252-S Switch Gear Building

Existing air handling unit AHU-E-001, with a cooling capacity of 14,100 BTUH and a 2.5 kilowatt electric heater is provided.

- Diversion Box 6241-A

A single package air conditioner AC-1 with a capacity of 48,000 BTUH is provided for cooling. A 2 kilowatt electric baseboard heater BH-2 is provided for heating.

- Ventilation Station 6241-V

A 2 kilowatt electric baseboard heater BH-5 is provided for heating. No cooling equipment is provided.

- 244-A Lift Station

A side mounted air conditioner with a capacity of 1500 BTUH is provided for cooling and two 800 watt heaters are provided for heating.

- Instrument Cabinet CAB-6241

A side mounted air conditioner with a capacity of 1200 BTUH is provided for cooling and a 100 watt heater is provided for heating.

3.1.3 System Set Points

A set point list is provided in supporting document HNF-1955, which identifies all the process variable set points.

3.1.4 System Instrumentation and alarms

An alarm list is provided in supporting document HNF-1955, which identifies all the process variable alarm set points.

3.1.5 System Interlocks

All the software-and hardware interlocks associated with the transfer system are identified on the P&ID legend drawing H-2-822400 sh 1.
Software Interlock no. 1 shuts down the operating booster pump and activates the 200-West master shutdown circuit if a leak is detected in the slurry transfer line. The MCS programming basis is derived from logic diagram ES-058-Y72 sh 1.

Software Interlock no. 2 shuts down the operating booster pump when an isolation valve is leaking as determined by a pressure signal in the branch line. The MCS programming basis is derived from logic diagram ES-058-Y73 sh 1.

Software Interlock no. 3 shuts down transfer pump P-102-SY-02A when the level of the 102-SY tank is low. The MCS programming basis is derived from logic diagram ES-058-Y75 sh 1.

Software Interlock no. 4 will not allow the sump pump in either the Diversion Box or the Ventilation Station to operate if the associated outlet valve is not open. The MCS programming basis is derived from logic diagram ES-058-Y82 sh 1.

Software Interlock no. 5 will not allow the vent valves to open if positive pressure is sensed. The MCS programming basis is derived from logic diagram ES-058-Y81 sh 1 thru 4.

Software Interlock no. 6 will shutdown the operating booster pump on any one of the following conditions:

a) high pump bearing temperature
b) high motor winding temperature
c) high pump vibration
d) pump seal failure
e) low pump lube oil level

The MCS programming basis is derived from logic diagram ES-058-Y76 sh 1.

Software Interlock no. 7 will not allow either booster pump to operate if their inlet pressure is below 10 psi. The MCS programming basis is derived from logic diagram ES-053-Y75 sh 1.

Software Interlock no. 8 will shutdown the operating booster pump if either rupture disk PSE-841 or PSE-842 is activated. The MCS programming basis is derived from logic diagram ES-058-Y78 sh 1.

Software Interlock no. 9 will not allow transfer pump P-102-SY-02A to operate if either booster pump is shutdown. The MCS programming basis is derived from lo-tic diagram ES-058-Y75 sh 1.

Software Interlock no. 10 will shutdown transfer pump P-102-SY-02A if the inlet pressure to the operating booster pump exceeds 70 psi. The MCS programming basis is derived from logic diagram ES-058-Y75 sh 1.

Hardware Interlock no. 11 will shutdown the operating booster pump-if a leak is detected in the sump of either the Diversion Box or the Ventilation Station.

Hardware Interlock no. 12 will shutdown transfer pump P-102-SY-02A if a leak is detected in the sump of either the Diversion Box or the Ventilation Station.

Hardware Interlock no. 13 will activate the 200-West master shut down circuit if a leak is detected in the sump of either the Diversion Box or the Ventilation Station.

Software Interlock no. 14 will shutdown the operating booster pump if its discharge pressure is too high. The MCS programming basis is derived from logic diagram ES-058-Y78 sh 1.

Software Interlock no. 15 will not allow either booster pump to operate if their associated vent and drain valves are open. The MCS programming basis is derived from logic diagram ES-053-Y74 sh 1 and 2.

Hardware Interlock no. 16 will activate the 200-West master shutdown circuit when an isolation valve is leaking as determined by a pressure signal in the branch line.

Hardware Interlock no. 17 will activate the 200-West master shutdown circuit when valve V-3113 is open.

Software Interlock no. 18 shuts down flush pump P-3100A if the level in flush tank TK-302-C is low. The MCS programming basis is derived from logic diagram ES-058-Y90 sh 1.

Hardware Interlock no. 19 shuts down the operating circulation heater on high temperature or low flow.

Software Interlock no. 20 shuts down the transfer pump P-102-SY-02A when an isolation valve is leaking as determined by a pressure signal in the branch line. The MCS programming basis is derived from logic diagram ES-058-Y73 sh 1.

Software Interlock no. 21 prevents the isolation valves to the diversion box and vent station sump pumps from opening when there is positive pressure in the supernate line.

3.1.6 Maintenance Requirements

Access and space requirements for the MCS equipment meet the requirements of the National Electrical Code (NFPA 70). There is no periodic maintenance required for the MCS equipment other than cleanliness. The MCS contains internal diagnostics to determine equipment malfunction or failure.

3.1.7 External hazards

Not applicable

3.1.8 Structural Requirements

PCU-4 and PCU-5 are each mounted to a structural base. The structural base as well as all component anchorages to the base were designed to withstand General Service seismic loads. The remaining MCS equipment is installed inside buildings that meet the UBC requirements for the site.

3.1.9 Inspection Requirements

There are no special inspection requirements for the MCS other than ensuring that the equipment operates as intended.

3.2 SYSTEM DESIGN BASIS

3.2.1 Authorization Basis

The authorization basis is described in HNF-SD-WM-BIO-001, Rev. 0-H. In the event of one of the following;

a) loss of power;
b) component failure of OCS or PCU;
c) communication network failure; all processors will DEFAULT to a state which utilizes the most updated process control information that was acknowledged before the failure occurred.

3.2.2 Design Inputs

DOE Order 6430.1A - 1989
NFPA 70 - National Electrical Code - 1993
S50.1 - Compatibility
FM - Factory Mutual - 1995
UL - Underwriters Laboratories. Inc. - 1995

3.2.3 Design constraints

Not applicable

3.2.4 Special material or system chemistry considerations

Not applicable

3.2.5 Design analysis and calculations

Not applicable

3.3 COMPONENT REQUIREMENTS AND BASIS

3.3.1 Major Component Descriptions

· 242S Building

Operator Control Station consisting of the following:

two computers - Gateway 2000
two monitors (CRT) - Allen Bradley 2711-M20
two printers
one Uninterruptible Power Supply (UPS) - UPSONIC SYS100EXT

· 252-S Building

PCU-1 consisting of the following:

one PLC-5/11 Processor - 1785-L11B
one 8 Channel Differential Analog Input module - 1771-IFE
one 4 Channel Isolated Analog Output module - 1771-OFE2
one 8 Channel Thermocouple Input module - 1771-NT1
one 16 Point Discrete Input module - 1771-IBD

one 16 Point Discrete Output module - 1771-OD16
one Communications Interface card - 1784-KTX

- 6241-A Building

PCU-2A consisting of the following:

seven 16 Point Discrete Input modules - 1771-IBD
five 16 Point Discrete Output modules - 1771-OD16

PCU-2B consisting of the following:

one PLC-20/11 Processor - 1785-120B
two 8 Channel Differential Analog Input modules - 1771-IFE
one 4 Channel Isolated Analog Output module - 1771-OFE2
two 8 Channel RTD Input modules - 1771-NR
one 8 Channel Thermocouple Input module - 1771-NT1
one Communications Interface card - 1784-KTX

- 6241-V Building

PCU-3 consisting of the following:

one PLC-5/11 Processor - 1785-L11B -
one 8 Channel Differential Analog Input module - 1771-IFE
one 8 Channel Thermocouple Input module - 1771-NT1
three 16 Point Discrete Input modules - 1771-IBD
two 16 Point Discrete Output modules - 1771-OD16
one Communications Interface module - 1784-KTX

- 244-A Lift Station

PCU-4 consisting of the following:

one PLC-5/11 Processor - 1785-L11B
one 8 Channel Differential Analog Input module - 1771-IFE
one 8 Channel Thermocouple Input module - 1771-NT1
two 16 Point Discrete Input modules - 1771-IBD
one 16 Point Discrete Output module - 1771-OD16
one Communications Interface module - 17R4-KTX

- Instrument Cabinet CAB-6241

PCU-5 consisting of the following:

one PLC-5/11 Processor - 1785-L11B
one 16 Point Discrete Input module - 1771-IBD
one Communications Interface module - 1784-KTX

3.3.2 Required Functions

The OCS monitors and controls the transfer of radioactive waste through a 6.5 mile, pipe-in-pipe system connecting the 241-SY Tank Farm with the 244-A Lift Station.

PCU-1 provides continuous control of the processes associated with the SY tank farm and the water flush system.

PCU-2A and PCU-2B provides continuous control of the process signals associated with the operation of booster pumps P-3125A and P-3125B, and the process signals residing in the 6241-A diversion box.

PCU-3 provides continuous control of the process signals residing in the 6241-V vent station.

PCU-4 provides continuous control of the process signals that provide an interface with the 242-A evaporator. and the process signals residing in the 244-A Lift Station.

PCU-5 provides a system tie-in for the signals associated with the continuous leak detection of the piping residing between the 6241-V vent station and Atlanta Avenue in the 200-East area.

3.3.3 Design basis

The OCS is designed to allow the operator to select displays, view process variables, perform supervisory control functions, and change set points or control strategies. It is designed to perform event logging, alarm annunciation, process graphics. current and historical data trending, batch/sequence control, discrete control, and continuous PID control. The OCS is designed to perform automatic self diagnostics after power-up or restart conditions, and is also designed to perform periodic online status diagnostics that determine if major components are operating correctly.

The PCU's are designed to provide monitoring and basic sequential control independently of another PCU, the OCS, and the communication network. The PCU's are the interface for termination of all I/O. The PCU's are designed to perform automatic self diagnostics after power-up or restart conditions, and designed to perform periodic online status diagnostics that determine if major components are operating correctly.

3.3.4 Component function

The MCS is designed to operate in either the TRANSFER mode, the FLUSHING mode, or the DRAINING mode.

3.3.5 Design basis satisfaction

The MCS satisfies the system design basis by providing the capability to monitor and control the transfer of radioactive waste between the 200-East and 200-West areas.

4.0 DESIGN DESCRIPTION

4.1 DETAILED SYSTEM DESCRIPTION

The Operator Control Station (OCS), located in the 242S control room is used as the Man-Machine-Interface (MMI) to allow the human operator to initialize the cross-site waste transfer process. The Cathode-Ray Tube (CRT) on the OCS will show a log-on screen where the operator types his/her name and his/her password using the keyboard. The display on the CRT allows the operator to choose items to control from either the keyboard or the mouse.
The items on the display are:

A) transfer schemes; four different schemes.
B) operation of transfer valves
C) operation of booster pumps.
D) back-up flushing operation
E) draining operation.
F) system status and report generation

A) Transfer Schemes:

Scheme 1: (Supernate West to East)

Transfer of supernate from the 241-SY-A valve pit to the 241-A-B valve pit is selected from the OCS. Upon selection. the following valves associated with the transfer are either opened or closed as shown:

SOV-3182A open	SOV-3165A open	SOV-3167A closed
SOV-3182B open	SOV-3185A closed	SOV-3167B closed
SOV-3173A closed	SOV-3185B closed	MOV-843 position A
SOV-3173B closed	SOV-3184 open	MOV-846 open
SOV-3166A open		

Schemes 2A and 2B: (Slurry West to East)

Transfer of slurry from the 241-SY-B valve pit to the 241-A-A valve pit is selected from a CRT-screen menu provided by the Operator Control Station (OCS). Upon selection. the following valves associated with the transfer are either opened or closed as shown:

SOV-3183A open	SOV-3163 closed	SOV-3166B open
SOV-3183B open	SOV-3165B open	MOV-845 open
SOV-3168A closed	MOV-844 position A	
SOV-3168B closed		

Once the valves are positioned correctly. a permissive signal is generated to allow operation of the booster pumps P-3125A or P-3125B, located in the 6241-A diversion box . If any of the valves are not positioned correctly within 10 seconds after transfer selection. an alarm is generated at the OCS and the booster pumps are not permitted to operate. Scheme 2A uses booster pump P-

3125A, scheme 2B uses booster pump P-3125B.

Scheme 3: (Supernate East to West)

Transfer of supernate from the 241-A-B valve pit to the 241-SY-A valve pit is selected from the OCS. Upon selection. the following valves associated with the transfer are either opened or closed as shown:

MOV-846 open	SOV-3185A closed	SOV-3173A closed
MOV-843 position A	SOV-3185B closed	SOV-3173B closed
SOV-3167A closed	SOV-3165A open	SOV-3182A open
SOV-3167B closed	SOV-3166A open	SOV-3182B open
SOV-3184 open		

When the transfer scheme is selected the display asks the operator to confirm a system reset by using either the keyboard or clicking the mouse on the display box. The system reset is a master valve reset which closes all of the valves to ensure that all of the transfer routes are isolated. If a valve fails to close or if a position switch fails to change state (e.g. a simultaneous open and a close signal) an alarm table is shown listing all of the failures. The alarm table also shows any leak detected in the system.

If the transfer route selected by the operator is a route which had either a valve or position switch or leak detector alarm. the system displays a graphical pipeline with a blinking red highlighted symbol of the device (e.g. red valve) which had alarmed in the selected pathway. If the transfer route selected by the operator is not affected by any of the alarmed devices then a graphical display of the pathway is shown in red. The selected pathway shows all of the valves, valve pits, booster pumps, and leak detector associated with the transfer route. As the valves in the selected route are opened, the color of the route changes from red-to green. If any of the valves fail to open, the system displays a blinking red highlighted symbol of the device which had alarmed in the graphical pipeline route. If there is no problem with the transfer route, the transfer route is shown in green.

All of the transfer valves will fail in the last position. The transfer valves are only interlocked during the initial transfer route scheme selection. The interlock will only prevent an operator from either opening or closing a valve that is part of an active transfer. During an active waste transfer, if a leak is detected in the transfer route, the booster pumps are automatically interlocked and will shut down: none of the transfer valves are interlocked and will remain in their last position (i.e. either open or closed). The operator can only close the transfer valves by either using the master-valve reset and closing all the valves in the system or by telling the OCS that the transfer has been completed and individually closing each valve.

After a transfer has been completed, the operator by using either the keyboard or clicking the mouse on the graphical display on the CRT releases the transfer route valves. Releasing the transfer route causes the transfer valves which were interlocked to be released from the transfer interlock. The valves will remain in their last position. The transfer valves are now available to be individually manipulated or another transfer scheme can be implemented.

B) Transfer Valve Operation:

The operator can operate any transfer valve individually by first selecting from the main menu the transfer valve operation and by using either the keyboard or clicking the mouse on the graphical display on the CRT. The OCS will not allow a transfer valve which is part of an active transfer scheme to be operated: only transfer valves which are not part of an active transfer will be allow to be individually manipulated. The master valve reset will close all the valves in the system, whether they where opened by the transfer scheme or by the individual valve operation menu.

C) Booster Pump Operation:

The operator opens both the inlet and outlet valves of the booster pump by using either the keyboard or clicking the mouse on the graphical display on the CRT. The booster pumps are interlocked to each other and to both the inlet and outlet valves. Only one booster pump can operate at a time, and the booster pump can be turned on only if both the inlet and outlet valves to the booster pump have been opened, and all interlocks have been satisfied. The operator selects the desired flow rate before starting the booster pump. The flow is increased at a programmed preset rate, then held at the selected flow rate by controlling the analog signal which adjusts the speed of the pump's variable speed drive. The booster pumps can be started once the inlet pressure reaches 10 psig. The interlocks on the booster pumps are:

1) position switches on both the inlet and outlet valves, if either of these valves are closed or if either of the position switches on these valves has failed,.the booster pump will shut down.

2) pressure switch; the booster pump can only be started if the inlet is at least 10 psig.

3) leak detector associated with transfer route; if a leak is detected in the transfer route during the transfer, the booster pump is shut down.

4) booster pump monitoring; the booster pump will shutdown if a high temperature occurs in either the inboard bearing or outboard bearing of the pump; a high temperature occurs in the pump motor winding; a high vibration occurs in the pump inboard or outboard bearing; a pump seal failure; or low pump inboard or outboard bearing oil level.

5) loss of transfer path; if the transfer path integrity is lost due to equipment failure or non-isolation due to a valve position change, the booster pump will shutdown.

6) 200 East and 200 West master pump shutdown system; any booster pump which is pumping into the control area of either the 200 West or 200

East master pump shutdown will be shutdown when an interlock signal is sent by the master pump shutdown in the receiving end of the waste transfer pipeline.

7) rupture disk failure; if the pressure in the slurry line at the 244-A Lift Station exceeds 230 psig, rupture disk PSE-841 or PSE-842 will fail.

The operator can bypass the leak detection, 244-A rupture disk failure, and master pump, shutdown interlocks by activating the OVERRIDE command from the OCS. This allows resumption of the transfer system if it is determined that the associated shutdown instrumentation has malfunctioned. The OVERRIDE command is password protected to facilitate administrative control. Once activated, a graphical display appears on each CRT screen to alert operations that the transfer system is in the OVERRIDE mode.

D) Back-up Flushing Operation:

After a transfer has been completed, the transfer path will be flushed with water. When the back-up flushing operation is selected from the main menu, the OCS displays a graphical status of the flush water system. The graphical display shows flush water tank level, temperature, and pump status (i.e. the pump is in automatic position).

The flush cycle involves monitoring and controlling the water available for flushing and priming the transfer pipeline. A 47,000 gallon water tank is used to flush the pipeline. At least twenty-four hours before the flush cycle is initiated, the 47,000 gallon water tank is heated to 100° F or greater. The discharge pump is used to recirculate the water in the tank. The heating cycle is initiated at the tank site location by having an operator:

1) manually open the valve on the tank recirculation line.

2) manually close the valve connecting the water line to the transfer pipeline.

3) using the local hand switch to start the purge water pump.

4) using the local hand switch to start the water tank heater controls.

After the water tank has reached the 100° F temperature, which is displayed both-locally and on the water tank heater controller and remotely at the OCS, the discharge pump is manually placed in remote operation, the tank recirculation line valve is closed, the valve connecting the transfer line to the water tank is open, and the water tank heater controller is turned off.

The system is now ready for remote flushing operation.

E) Draining Operation:

Following a slurry waste transfer and flush with water (at least two system volumes or approximately 24,000 gallons) the operating booster pump is shutdown, the flush water supply is isolated, and the system is allowed to drain. Once draining has commenced, the slurry line pressure at the Vent Station is monitored by utilizing pressure transmitter PT-3126B. At a zero or negative gage pressure, vent valves SOV-3168A and SOV-3168B may be opened to facilitate draining. The booster pump casing is drained by opening the casing vent valve and sequentially opening the nine casing drain valves from the OCS.

The drain valves are operated sequentially to avoid overloading the electrical circuit. After the slurry pipeline system has been drained, the vent valves, booster pump vent valve. and drain valves are closed.

Following a supernate waste transfer and flush with water (at least two system volumes or approximately 24,000 gallons) the transfer pump is shutdown, the flush water supply is isolated, and the system is allowed to drain. Once draining has commenced, the supernate line pressure at the Vent Station is monitored by utilizing pressure transmitter PT-3126A. At a zero or negative gage pressure, vent valves SOV-3185A and SOV-3185B may be opened to facilitate draining.

F) system Status And Report Generation:

The operator has the option of displaying a graphical display of:

1) active transfer routes showing all valves that are interlocked either open or closed.

2) inactive transfer routes showing all transfer routes which can not be used because they are interlocked by an active transfer route and transfer routes which can be used but are not presently active.

3) back-up flush system status showing the tank, valves, pumps, temperature, and liquid level.

4) individual booster pump sensor monitoring data.

5) leak detector status showing all leak detectors which are presently interlocked to an active transfer and leak detector status on nonactive transfer routes.

The operator can print reports based on the status of individual units such as pump status or leak detector status for the last month, week, day, and shift.

Alarm reports are automatically generated at predetermined times (i.e. when a alarm is generated and at the end of the shift).

4.2 SYSTEM PERFORMANCE CHARACTERISTICS

The cross site transfer of radioactive waste is operated as a batch process.

The most frequent mode of operation is the transfer of waste from the SY-Tank Farm to storage tanks in the 200-East area utilizing the supernate line and transfer pump P-102-SY-02A. The transfer pump can be started or stopped from the MCS. The MCS monitors the level of the 102-SY tank to prevent cavitation. The MCS also monitors the supernate line for pressure, temperature, and any line or valve leaks.

4.3 SYSTEM ARRANGEMENT

The instrument block diagram, drawing H-2-822435, shows the following;

a) general location of the OCS and each PCU
b) approximate distance between the OCS and each PCU
c) I/O quantities at each PCU.

4.4 COMPONENT DESIGN DESCRIPTIONS

· Operator Control Station (OCS)

The OCS consists of 2 computers with 2 color CRT's, 2 keyboards, 2 trackballs/mice and 2 printers mounted in a console. The individual components of the OCS are shown on drawing H-2-822422. The OCS has monitoring and control capabilities and provides supervisory control to the PCUs. It contains data storage devices with removable media for long term data storage.

· Process Control Units (PCU)

Each PCU consists of a programmable logic controller, signal conditioning, interface cards, power supplies and termination panels for both analog and discrete signals. Each PCU accepts supervisory control information (set point change, start/stop, sequence initiation, and tuning parameter changes) and configuration changes from the OCS, and Provides process status information via the communication network to the OCS and other PCU's. In the event of complete failure of the OCS or the communication network, each PCU shall independently continue to monitor and maintain control of the various processes.

4.5 INSTRUMENTATION AND CONTROL

The process signals connected to the MCS are identified in the input/output I/O list contained in supporting document HNF-1956. The I/O list itemizes the signal by type, description, device. PCU connection, and location.

4.6 SYSTEM INTERFACES

The monitoring and control system will interface with the Slurry Transfer System, the Supernate Transfer System. and the Flush System which are dependent on its operation.

4.7 SYSTEM LIMITATIONS, SET POINTS, AND PRECAUTIONS

An alarm list is provided in HNF-1955, which identifies all the process variable alarm set points. All the software and hardware interlocks associated with the transfer system are identified on the P&ID legend drawing H-2-822400 sh 1.

Chapter 2

SYSTEM OVERVIEW for the INSTRUMENT AIR SYSTEM W-058 REPLACEMENT CROSS-SITE TRANSFER SYSTEM

1.0 INTRODUCTION

This document provides a system summary description, function and design requirements, design description, and testing requirements for the Instrument Air System. This system provides instrument quality air for the booster pump seal control panels and process piping pneumatic valve operators. The system was constructed as part of Project W-058, "Replacement of the Cross Site Transfer System."

2.0 SYSTEM SUMMARY DESCRIPTION

2.1 System Description

The purpose of the instrument air system is to provide instrument quality air for the cross site transfer system booster pump seal control panels and the process piping pneumatic valve operators. The instrument air system is divided into two distinct and independent subsystems in the Diversion Box 6241-A and Vent Station 6241-V.

2.2 System Boundaries

Diversion Box 6241-A

The system is located in the 6241-A support building. The compressor package, system header, booster pump seal control panels, pressure regulator, valves and instrumentation are all located in the Compressor Room 104. The pump seals and pneumatic valve operators are located in Room 105. The connections to the pump seal control panels and pneumatic valve operators are considered the boundary of the instrument air system. The piping between the two rooms is routed underground.

Vent Station 6241-V

The system is located in the 6241-V support building. The compressor package, system header, pressure regulator, valves and instrumentation are all located in the Compressor Room 104. The pneumatic valve operators are located in Room 105. The connections to the pneumatic valve operators are considered the boundary of the instrument air system. The piping between the two rooms is routed underground.

2.3 System Interfaces

The interfacing system necessary for the instrument air system to perform its function is the 480 V ac, 60 Hz, 3-phase electrical power system. Although not required for operation the Monitoring and Control System (MCS) provides an alarm function on low receiver pressure. The instrument air system interfaces with the booster pump seal control panel and the pneumatic valve operators.

2.4 System Classification

This system does not prevent or mitigate any accidents resulting in unacceptable consequences to the public or onsite worker and is therefore classified as non safety significant, reference HNF-SD-WM-BIO-001, Rev. 0-H.

3.0 FUNCTION AND DESIGN REQUIREMENTS

3.1 FUNCTIONS

Provide instrument quality air (clean, oil-free, and dry) for:

- the cross site transfer system booster pump seals
- the process piping pneumatic valve operators

3.2 SYSTEM DESIGN REQUIREMENTS

3.2.1 Functional and performance requirements

The compressed air package shall provide compressed air at 15 SCFM at 150 psig.

The air shall be instrument quality and shall be clean, oil-free, and dry air with a -40°F dewpoint.

3.2.2 Operability requirements

The electrical power supply must be reliable for the instrument air system to operate.

Diversion Box 6241-A

The switchboard SB-1, which is located in E/I Room 102, will provide electrical power to the compressed air package. The pressure relief valve PRV 3100A, which is mounted on the air receiver, must be operational to provide overpressure protection during operation.

Vent Station 6241-V

The distribution panelboard DP-1, which is located in the E/I Room, will provide electrical power to the compressed air package. The pressure relief valve PRV 3100B, which is mounted on the air receiver, must be operational to provide overpressure protection during operation.

3.2.3 System set points

The compressed air package set points are adjustable and are initially set to maintain 125 psig in the receiver and alarm at a low receiver pressure of 115 psig.

Pressure relief valves PRV 3100A and PRV 3100B are set at 200 psig on the air receivers.

Pressure control valves PCV 3100A and PCV 3100B are set at 110 psig.

Pressure relief valves PRV 3101A and PRV 3101B are set at 120 psig.

3.2.4 System instrumentation and alarms

Operation of the compressed air package is automatic and it is started and shutdown locally. The compressor is controlled to maintain 125 psig in the receiver. The compressed air package will alarm remotely through the MCS at a low receiver pressure of 115 psig.

Pressure gauges in the distribution system indicate operating pressures of the instrument air system.

3.2.5 System interlocks

None

3.2.6 Maintenance requirements

Standard maintenance, calibration, and servicing is expected on the instrument air system. The instrument air system is not located in a radiological controlled area.

3.2.7 External hazards

The instrument air system is located indoors. The compressed air package is designed for temperature extremes of 50 to 105°F and a humidity of 20 to 95%. The design of the instrument air system considered General Service (GS) seismic events.

3.2.8 Structural requirements

All equipment and interconnecting piping on the compressed air package is mounted on a common structural base. The structural base as well as all component anchorages to the base were designed to withstand GS seismic loads.

3.2.9 Inspection requirements

There are no special inspection requirements for the instrument air system other than ensuring that the equipment operates as intended. Calibration and testing of instrumentation will be required on a regular periodic basis.

3.3 SYSTEM DESIGN BASES

3.3.1 Authorization basis

The authorization basis is described in HNF-SD-WM-BIO-001, Rev. 0-H. The instrument air system is required to provide instrument quality air to the booster pump seal control panels and the process piping pneumatic valve operators.

3.3.2 Design inputs

DOE Order 6430.1A - 1989
ASME B&PVC Section VIII - 1992
ASME B31.3 - 1996
NFPA 70 - 1993

3.3.3 Design constraints

The limiting pressure for the compressed air packages is the maximum design pressure of the air dryer which is 150 psig. The maximum operating pressure of the air compressors is also 150 psig. The air receivers are ASME Code stamped for 200 psig and the pressure relief valves on the air receivers will be set at 200 psig.

The maximum design pressure of the pneumatic valve operators is 120 psig. The pressure relief valve on the distribution line will be set at 120 psig.

3.3.4 Special material or system chemistry considerations

Not Applicable

3.3.5 Design analysis and calculations

Calculation # W058-P-003, "Instrument Air System Sizing"

3.4 COMPONENT REQUIREMENTS AND BASIS

3.4.1 Major components descriptions

The compressed air packages each consist of an oil-free compressor, aircooled aftercooler, heatless regenerative dryer, 120 gallon air receiver, filters, and interconnecting piping.

The compressed air distribution system consists of a 1 inch pipe header, a 1/2 inch pipe feeding the pump seal control panels, a 1 inch line feeding the pneumatic valve operators, and a 1 inch spare. The line feeding the pneumatic valve operators has a pressure control valve, a pressure relief valve, and pressure gauges. All lines are equipped with isolation valves.

3.4.2 Required functions

The compressed air packages are required to provide instrument quality air for the booster pump seal control panels and the pneumatic valve operators. The pump seal control panels are required to regulate the pressure of the compressed air to the booster pump seal chambers.

In the distribution piping, the pressure control valves PCV 3100A and PCV 3100B are required to regulate the pressure to the pneumatic valve operators. The pressure relief valves PRV 3101A and PRV 3101B are required to protect the pneumatic valve operators from overpressurization. The pressure gauges PI 3104A, PI 3108A, PI 3104B, and PI 3108B are required to indicate proper operation of the pressure control valves.

3.4.3 Design basis

The compressed air package is designed to provide instrument quality air at 15 SCFM and 150 psig. The compressor air flow rate was sized assuming a worst case scenario, that all pneumatic valve operators would operate simultaneously. The total air consumption of the valves dictated the minimum flow rate of compressed air that was required. The pressure of the compressor was chosen to provide a large margin above the pneumatic valve operator requirements. This margin is large enough to account for pressure drops through the distribution system and uncertainties such as increased torque requirements in the future. The pressure in the air receiver is adjustable and is initially set to maintain 125 psig.

The air requirements of the pump seal control panels are satisfied because of the lower flow rate and lower pressure requirements than the pneumatic valve operators. It was considered in the sizing of the system that the pneumatic valve operators will require air only to perform valve line-ups before transfers and not during transfers. The quality of the compressed air was chosen to be instrument quality based on the requirements of the booster pump seals and the pneumatic valve operators for clean, oil-free, and dry air.

The distribution lines to the pump seal control panels are designed only with isolation valves. The distribution line to the pneumatic valve operators is designed with a pressure control valve, pressure relief valve, and isolation valves. The pressure control valve reduces the pressure to 110 psig which is the operating pressure of the pneumatic valve operators. The pressure relief valve is set at 120 psig which is the maximum design pressure of the operators.

3.4.4 Component function

There is only one operating mode for the instrument air system. Once the instrument air system is started, the air compressor will begin to pump up the air receiver to the set pressure of 150 psig. This will take approximately 10 minutes. The compressor will shut off once this pressure is reached. Control of the compressor is automatic and it will operate as required to maintain the pressure in the receiver at a minimum of 125 psig. Before each transfer, the pneumatic valve operators will require air to perform valve line-ups. The valves will not be normally operated during transfers. After each transfer, the valves can then be positioned in their non-transfer positions. After the initial waste transfer with the booster pump(s), the pump seals will require a constant supply of instrument air. Therefore the instrument air system will be constantly in service even during the down time between transfers.

3.4.5 Design basis satisfaction

The major components of the instrument air system satisfy the system design basis. The compressor provides the compressed air at 15 SCFM and 150 psig. The compressor is oil-free, the aftercooler and regenerative dryer provide the -40°F dewpoint air, and the filters clean the air of solid particles. The compressed air is supplied to the booster pump seal control panels and the pneumatic valve operators.

4.0 DESIGN DESCRIPTION

4.1 DETAILED SYSTEM DESCRIPTION

The instrument air system is divided into two distinct and independent subsystems, in the Diversion Box 6241-A and Vent Station 6241-V. The instrument air system in Diversion Box 6241-A and Vent Station 6241-V consists of a compressed air package and the piping for the distribution system. All of the components at the two locations are identical.

Each compressed air package consists of an oil-free compressor, aircooled aftercooler, heatless regenerative dryer, 120 gallon air receiver, filters, and interconnecting piping. All the equipment in the compressed air package is mounted on a common base suitable for bolted anchorage.

The compressed air distribution system consists of a 1 inch pipe header, a 1/2 inch pipe feeding the pump seal control panels, a 1 inch line feeding the pneumatic valve operators, and a 1 inch spare. The line feeding the pneumatic valve operators has a pressure control valve, a pressure relief valve, and pressure gauges. All lines are equipped with isolation valves.

Upon start-up of the instrument air system, the air compressor will produce 15 SCFM at 150 psig. The compressor will pump up the air receiver and will be controlled automatically to maintain the pressure in the receiver at a minimum of 125 psig. The air receiver feeds the I inch pipe header. From the header, the air is distributed to the pump seal control panels (6241-A only), and also the pneumatic valve operators. The air from the air receiver is used to perform valve line-ups and to provide air to the pump seals. Once the air begins to be used up in the receiver, the pressure will drop below 125 psig which will cause the air compressor to start again to maintain the pressure in the receiver. The operating pressure for the pneumatic valve operators is controlled by pressure control valves in the distribution piping. Reference drawings H-2-822406 and H-2-822407 for the instrument air system P&IDs.

Diversion Box 6241-A

The compressed air package is located in the Compressor Room 104. The 1 inch pipe header, the pressure control valve, pressure relief valve, and pressure gauges in the distribution line are also located in the compressor room. Drawing H-2-822340 shows the plan, section, and details of the instrument air system located in the compressor room. Drawing H-2-822506 shows the routing for the buried air distribution line between Room 104 and Room 105. Drawing H-2-822336 shows the routings for the air distribution inside Room 105.

Vent Station 6241-V

The compressed air package is located in the Compressor Room 104. The 1 inch pipe header, the pressure control valve, pressure relief valve, and pressure gauges in the distribution line are also located in the compressor room. Drawing H-6-13997 shows the plan, section, and details of the instrument air system located in the compressor room. Drawing H-6-14011 shows the routing for the buried air distribution line between Room 104 and Room 105. Drawing H-6-13994 shows the routings for the air distribution inside Room 105.

4.2 SYSTEM PERFORMANCE CHARACTERISTICS

There is only one operating mode for the instrument air system. Once the instrument air system is started, the air compressor will begin to pump up the air receiver to the set pressure of 150 psig. This will take approximately 10 minutes. The compressor will shut off once this pressure is reached. Control of the compressor is automatic and will operate as required to maintain the pressure in the receiver at a minimum of 125 psig. Before each transfer, the pneumatic valve operators will require air to perform valve line-ups. The valves will not be normally operated during transfers. After each transfer, the valves can then be positioned in their non-transfer positions. After the initial operation of the booster pump, the pump seals require a constant supply of instrument air. Therefore the instrument air system will be constantly running even during the down time between transfers.

Upon start-up of the instrument air system, the air compressor will produce 15 SCFM at 150 psig. The compressor will pump up the air receiver to 150 psig which will take approximately 10 minutes. The air compressor will be controlled automatically to maintain the pressure in the receiver at a minimum of 125 psig.

Once the pressure in the air receiver is at least 125 psig, the system is ready for use. Because the booster pump seals require a constant supply of instrument air, the instrument air system will be constantly in service. Air will be used from the receiver and the compressor will automatically start to compensate for the reduced pressure in the air receiver. During the downtime between transfers, the air usage by the pump seals is insignificant so compressor cycling will be minimal.

Before each transfer valve line-ups will be performed using the air from the air receiver. The capacity of the air receiver is large enough to operate the pneumatic valves and supply air to the booster pump seals without unnecessary cycling of the compressor. However, if required, the air compressor output is sufficient to operate the pneumatic valves and supply air to the booster pump seals without the extra capacity of the air receiver. Once all transfer operations are completed, the valves can be positioned in the non-transfer positions.

4.3 SYSTEM ARRANGEMENT

Diversion Box 6241-A

The compressed air package is located in the Compressor Room 104. The compressed air package feeds the 1 inch pipe header in the compressor room. The header feeds the 1/2 inch pipe supplying the 4 pump seal control panels located in the compressor room. The header also feeds the 1 inch pipe supplying the pneumatic valve operators and also has a spare 1 inch pipe connection. The 1 inch pipe supplying the pneumatic valve operators is fitted with a pressure control valve PCV 3100A, pressure relief valve PRV 3101A, and pressure gauges PI 3104A and PI 3108A all located in the compressor room. Drawing H-2-822340 shows the plan, section, and details of the instrument air system located in the compressor room. The pipe leaving the compressor room is routed underground together with the electrical conduit to the Diversion Box Room 105 as shown on drawing H-2-822506. Once inside Room 105, the corresponding air lines are routed to the pump seal chambers and to each of the pneumatic valve operators as shown on drawing H-2-822336.

The instrument air system is started and shutdown locally at the compressed air package in the compressor room. Once started, the compressed air package will operate automatically. All valves and pressure gauges in the instrument air system are located in the compressor room.

Vent Station 6241-V

The compressed air package is located in the Compressor Room 104. The compressed air package feeds the 1 inch pipe header in the compressor room. The header feeds the 1 inch pipe supplying the pneumatic valve operators and also has a spare 1 inch pipe connection. The 1 inch pipe supplying the pneumatic valve operators is fitted with a pressure control valve PCV 3100B, pressure relief valve PRV 3101B, and pressure gauges PI 3104B and PI 3108B all located in the compressor room. Drawing H-6-13997 shows the plan, section, and details of the instrument air system located in the compressor room. The pipe leaving the compressor room is routed underground together with the electrical conduit to the Vent Station Room 105 as shown on drawing H-6-14011. Once inside Room 105, the corresponding air lines are routed to each of the pneumatic valve operators as shown on drawing H-6-13994.

The instrument air system is started and shutdown locally at the compressed air package in the compressor room. Once started, the compressed air package will operate automatically. All valves and pressure gauges in the instrument air system are located in the compressor room.

4.4 COMPONENT DESIGN DESCRIPTIONS

The compressed air package consists of an oil-free compressor, aircooled aftercooler, heatless regenerative dryer, 120 gallon air receiver, filters, and interconnecting piping. All the equipment in the compressed air package is mounted on a common base suitable for bolted anchorage.

The oil-free air compressor is air cooled, with a loadless starting system, and the crankcase is pressure lubricated with a pressure gauge to indicate proper functioning of the lubricating system. The compressor performance rating is 15 SCFM at 150 psig with a 5 HP motor.

The heatless regenerative dryer is designed to operate on 115 V, 60 Hz, 1-Phase electrical power and is pre-wired by the vendor. The dryer is designed to provide air with -40°F dewpoint. The design temperature of the dryer is 120°F and the design pressure is 150 psig which is the maximum operating pressure of the compressor. The dryer consists of two desiccant towers, one for drying while the other is being regenerated. Once drying becomes inefficient, the flow through the towers is switched and the regenerated tower is used for drying while the saturated tower is regenerated.

The air receiver is a 120 gallon horizontal air receiver ASME coded for 200 psig. The air receiver is fitted with a pressure gauge, relief valve, and a manual drain. The aftercooler is an air cooled aftercooler with moisture separator. There is a pre-filter to filter air entering the regenerative dryer and an after filter to eliminate possible desiccant dust from the dryer.

The compressed air distribution system consists of a 1 inch pipe header, a 1/2 inch pipe feeding the pump seal control panels, a 1 inch line feeding the pneumatic valve operators, and a 1 inch spare. The line feeding the pneumatic valve operators has a pressure control valve, a pressure relief valve, and pressure gauges. All lines are equipped with isolation valves.

4.5 INSTRUMENTATION AND CONTROL

The compressed air package is supplied with controllers installed by the vendor. All controllers, including on/off control, are located on the compressed air package. The compressed air package is controlled automatically to maintain a set receiver pressure and all set points are adjustable. A pressure switch is initially set at 125 psig to control the receiver pressure and has a range of 125-150 psig. There is a pressure gauge installed on the air receiver for pressure indication. The air receiver is supplied with a pressure relief valve set at 200 psig to protect the receiver from overpressurization. The air receiver is also supplied with a low air pressure switch set at 115 psig. The low pressure alarm will sound remotely through the MCS. There are two compressed air packages, both of which are identical. One compressed air package is located in the Compressor Room 104 of Diversion Box 6241-A while the other is located in the Compressor Room 104 of Vent Station 6241-V. Reference drawings H-2-822406 and H-2-822407.

The operating pressure for the pneumatic valve operators is controlled by the pressure control valves PCV 3100A and PCV 3100B which are set at 110 psig. Pressure relief valves PRV 3101A and PRV 3101B, installed downstream of the pressure control valves, are set at 120 psig to protect the pneumatic valve operators from overpressurization. Pressure gauges PI 3104A, PI 3108A, PI 3104B, and PI 3108B, installed upstream and downstream of the pressure control valves, indicate proper functioning of the pressure control valves. Each set of instrumentation and controls is located in the Compressor Room 104 of Diversion Box 6241-A and Vent Station 6241-V. Reference drawings H-2-822406 and H-2-822407.

4.6 SYSTEM INTERFACES

Interfacing system necessary for the instrument air system to perform its function is the 480 V ac, 60 Hz, 3-phase electrical power system. The compressed air package is designed to operate on this single point power connection. The instrument air system interfaces with the booster pump seal control panels and the pneumatic valve operators. The compressed air package will alarm remotely through the MCS at a low receiver pressure of 115 psig.

4.7 SYSTEM LIMITATIONS, SET POINTS, AND PRECAUTIONS

Since there is only one operating mode for the instrument air system, there is only one set point for the various controls of the system. The air compressor produces 15 SCFM at 150 psig. The control of the air compressor will be automatic to maintain the pressure in the air receiver. The pressure in the air receiver has a variable set range and is initially set at a minimum of 125 psig. Therefore the pressure in the supply header will be 125 psig. The pressure to the pneumatic valve operators are controlled by the pressure control valves installed on the line supplying the pneumatic valve operators. These pressure control valves are set at 110 psig.

There are various controls that limit the pressures in the instrument air system. The maximum operating pressure of the air compressor is 150 psig. The pressure relief valve supplied with the air receiver is set at 200 psig. The pressure relief valve protecting the pneumatic valve operators is set at 120 psig.

The range of pressure in the air receiver is 115-200 psig. This is determined by the low receiver pressure alarm and the pressure relief valve protecting the air receiver. The set range of the pressure switch on the air receiver is 125-150 psig. The range of pressure for the pneumatic valve operators is limited by the valve operator to be 100-120 psig.

5.0 OPERATIONS AND CASUALTY EVENTS

Not Applicable

6.0 MAINTENANCE, INSPECTION, AND SURVEILLANCE

Not Applicable

7.0 TESTING

Inspection and pneumatic leak testing of the instrument air system piping was in accordance with the W-058-C3 specification and ASME B31.3.

Chapter 3

SYSTEM OVERVIEW for the VENT STATION 6241-V W-058 REPLACEMENT OF CROSS SITE TRANSFER SYSTEM

1.0 INTRODUCTION

This document provides a system summary description, function and design requirements, design description, and testing requirements for the vent station facility which is part of project W-058, Replacement of Cross Site Transfer System.

Project W-058 replaces the existing cross-site transfer system with a buried pipe-in-pipe system to be used for liquid mixed waste transfers between the 200 West and 200 East Areas at the Hanford Site. The system includes underground pipelines, booster pumps, new piping jumpers, a diversion box, a vent station and associated instrumentation and electrical equipment. The system also allows for the connection of future Tank Waste Remediation System (TWRS) projects.

This document describes the vent station facility, located at the high point of the waste transfer system. The vent station facility includes two concrete structures connected by a corridor, related equipment, and the surrounding improved site. This facility is very similar in design to the Diversion Box facility which is also part of project W-058. The interior of the diversion box and vent station together with the secondary encasement pipe form the secondary confinement of the cross site transfer system.

This document is limited to the Civil, Structural, Architectural, and HVAC components of the vent station facility. Piping, electrical, and instrumentation components are covered in other System Design Descriptions.

2.0 SYSTEM SUMMARY DESCRIPTION

The facility consists of a main concrete structure which directly ties into the transfer lines and an attached support building which houses equipment required to support the operations. A connecting corridor provides controlled access to system components within each structure.

The facility is provided with gravel service roads and service yards for vehicle access and operational activity parking. The sites are similar for the diversion box and vent station.

2.1 System Description

Vent station 6241-V is located in the 600 Area between 200 West and 200 East areas, approximately 0.3 miles (0.5 km) south of Route 3. The site is accessed via a gravel road 0.5 miles (0.8 km) west of the intersection of Routes 3 and 4. Existing roads are utilized to the point of access to the facility site. The facility will not be continuously occupied so no utilities such as sanitary water or sewer are provided to the site.

This location is the hydraulic high point of the system and the pipeline slopes down continuously from here to the two ends. The station is designed to introduce air into the lines after a transfer to accommodate drainage. The lower half of the vent station main structure is below finish grade.

The reinforced concrete main structure provides an enclosure designed and constructed to Safety Class standards to house the transfer components of the piping system and other items which support operation of the waste transfer system. This structure is designed for maintenance access on an infrequent basis. The main structure is cast-in-place concrete equipped with a stainless steel floor liner, and a carbon steel shielding floor located above the interior piping.

The support building provides a General Service enclosure for normal operational activities and provides a controlled access staging area to the transfer piping system via a connecting corridor. It includes an indoor controlled area for step off pad and clothing removal, plus the compressor and electrical/instrumentation equipment rooms. The separating corridor minimizes potential contamination of the support facility area from the process area. The support building is pre-cast concrete panel construction and houses electrical, instrumentation and piping equipment necessary for the operation of the system. The building is provided with heating to protect the equipment enclosed from low temperatures.

2.2 System Boundaries

The gravel service roads and service yards define each site area. Traffic lanes provide ample space around the exterior of the structures for parking and operational activities. Guard posts provide physical barricades to protect structures and equipment from vehicle damage.

The main vent station structure is a reinforced concrete building designed to meet structural design criteria, radiological shielding requirements and sized to provide sufficient space for the system components. It provides the boundary for controlled access to the cross-site system piping and provides containment of accidental spray releases. The interior of this structure is provided with a stainless steel liner for decontaminability and containment of releases inside the structure. Interior surfaces not lined with stainless steel are coated with a decontaminable epoxy coating system.

The support building exterior walls are insulated pre-cast concrete panels. Interior walls are solid pre-cast panels, with selected walls designated as one hour fire rated. The roofs are prestressed hollow core panels. The connecting corridor is cast in place concrete.

2.3 System Interfaces

The interfaces of the electrical, instrumentation, and piping equipment housed in the facility structures are described in other system overview descriptions.

The support building includes a personnel access room for staging operational access into the main structure and a corridor connecting the support building with the main structure. It also includes a compressor room for control panels and air compressor; and an electrical/instrumentation room.

All structural system components which have exterior interface points and provide direct access to the interior environment, such as roof and wall penetrations, are provided with stamped stainless steel labels fixed to the structure walls and identify function, reference drawing number and detail reference.

The service yards provide ample space around the exterior of the structures for operational interface to external components provided as part of the structural systems described below:

A HEPA Filtered Breather Connection provides stabilization of internal air pressure due to thermal fluctuations of the internal environment during operation and for seasonal temperature changes. This connection is equipped with an isolation butterfly valve to facilitate filter change out.

An Exhaust Air Connection is provide for external use of portable exhauster equipment to create required ventilation flow rates should maintenance be required. This connection is equipped with an isolation butterfly valve and flanged end connection for exhaust equipment (by others) attachment prior to use.

An Exhaust Air Sample Connection is provide at the Exhaust Air Connection for continuous discharge sampling as required. This exhaust air system functions in concert with the HEPA filtered breather connection.

A separate Air Sample Connection is provided to verify air quality inside the structure as desired, and is equipped with an isolation ball valve and tube fitting for sample equipment attachment prior to use.

An Emergency Pump Out Connection is provided as a backup to the sump pump should it become necessary to remove liquids from the stainless steel liner area. This consists of permanent piping from the sump to the exterior of the building and is provided with closure and connection flanges. The sump pump ties directly back in to the supernate line for routing liquids from the stainless steel liner sump directly back in to the piping system.

A Liner Washdown System Connection is provided to allow connection of a water source in the event that it becomes necessary to decontaminate the area beneath the shielding floor using water sprays. This connection is capped off and is also isolated from the building interior with ball valves.

Roof Access Ports are provided to visually inspect the area above the sump and perform a washdown of the internal environment above the shielding floor should it be required. These ports may have other non-entry uses such as remote inspection of the entire interior.

A Roof Access Opening and Structural Closure Plug is provided for construction access and for use in outage conditions to remove and or replace equipment which cannot be removed via the corridors. Use of this opening is considered an unlikely event and will require cutting through the roof materials and insulation to locate the structural closure plug edges. The plug has embedded lifting inserts which are installed flush with the concrete. A swivel plate and lifting lug is attached to these inserts when plug removal is required.

2.4 System Classification

The reinforced concrete shell of the vent station main structure is designed and built to Safety Class requirements for purposes of providing containment of an accidental spray release. Any access penetrations into the main structure are also classified as Safety Class due to the potential that breach of these items could also allow a spray release.

The interior structural components of the structure, including the shield floor, and the stainless steel liner are classified as General Service. The shield floor is designed to Safety Class seismic criteria due to its potential to impact the transfer piping.

The support building is General Service for normal operational activities.

The connecting corridor is classified General Service for its function but is designed to Safety Class criteria due to its connection to the main structure.

3.0 FUNCTION AND DESIGN REQUIREMENTS

3.1 Functions

The vent station facility provides a Safety Class equivalent structural enclosure to house the components of the transfer piping system and other components which support operation of the system.

The facility also provides a General Service support building for normal operational activities, and controlled access staging area to the transfer piping system.

3.2 SYSTEM DESIGN REQUIREMENTS

3.2.1 Functional and performance requirements

Functional and performance requirements for the Safety Class components are to contain fluids and air borne particulate matter that may leak from the system components within the structures.

Facilities in which radioactive or other hazardous materials are utilized are required to be designed to simplify decontamination and decommissioning and/or increase the potential for reuse. Facilities are also required to be designed to keep radiation exposures to personnel and the public as-low-as-reasonably-achievable (ALARA).

3.2.2 Operability/Maintenance requirements

Equipment housed in the support building's compressor room and electrical/instrumentation room is available for hands on maintenance when required and no extraordinary procedures are required.

The main structure is entered through a corridor and an airtight door. This provides ready access for maintenance, yet isolates the process area from the support building and the environment, limiting the potential for contamination spread.

The vent station systems will be contact-maintained and are designed to limit the area of the facility that may become contaminated. To allow in-place maintenance, it must be possible to bring doses down to acceptable levels and decontaminability was a priority in design of the system. Surfaces inside the main structure are painted with a decontaminable coating except for instrumentation and stainless steel. A liner washdown system provides the capability for remote washdown of the stainless steel liner in case of a liquid release.

Prior to hands on maintenance of equipment within the vent station main structure, sampling of internal air quality can be verified using the air sample connection. A survey will be conducted for airborne radioactive materials, oxygen deficiency, and hazardous chemical vapors. This survey will be used to determine proper levels of personal protective clothing, respiratory protection, and forced ventilation for safe access. Sampling of collected liquids is achieved using the roof access port directly above the sump. Access for non-entry visual inspection inside the structures is provided via roof ports at various locations.

All the transfer piping is located beneath the 3" thick shield floor. All routine maintenance and inspection operations except pressure transmitter calibrations can be performed with the shielding floor plate in place, providing a spacious open work surface and continuous radiation protection. If access below the shield floor is required, the floor panels are removable using the building's hoist system and magnetic lifting device. Storage and maintenance of the portable hoist is provided by the owner outside the vent station main structure.

3.2.9 External Hazards/Structural requirements

The structures were designed to meet wind, seismic, dead and live loads as required by Hanford Plant Standards SDC 4.1 revision 12. See calculation number W058-C-001 for an evaluation of the Natural Phenomena Hazard Load Criteria

Design. See the general notes on drawing H-2-822265 for a detailed listing of the loadings used in the design of each structure or component.

3.3 SYSTEM DESIGN BASIS

3.3.1 Authorization basis

The Authorization Basis for the vent station is contained within HNF-SD-WM-BIO-001, Rev. 0-H. The design of the vent station is consistent with this Authorization Basis.

3.3.2 Design Inputs

The structures were designed in accordance with the following codes and standards:

- ACI 349 Code Requirements for Nuclear Safety Related Concrete Structures
- ACI 318 Building Code Requirements for Reinforced Concrete
- AISC ASD 9th edition Manual of Steel Construction
- AISC N690 Nuclear Facilities: Steel Safety-Related Structures for Design, Fabrication and Erection
- Uniform Building Code

3.3.3 Design Constraints

The following supporting documents provided the criteria for the design.

- Preliminary Safety Analysis Report -- WHC-SD-W058-PSAR-001 revision 1
- Functional Design Criteria -- WHC-SD-W058-FDC-001 revision 4
- Department of Energy 6430.1A -- General Design Criteria 4-6-89

3.3.4 Special Material or system chemistry consideration

The stainless steel liner provides containment of potential liquid releases and provides the same material resistance as the stainless steel primary pipe. Other interior surfaces in the main structure are coated with an epoxy coating system which is chemically resistant to the standard decontamination solutions listed in ASTM D3912, Test Method for Chemical Resistance of Coatings in Light-Water Nuclear Power Plants.

3.3.5 Design analysis and calculations

For a list of civil, structural, architectural, and HVAC design calculations see drawing H-2-822200, sheet 2. The design of the two facilities, the diversion box and the vent station, was done concurrently and calculations labeled as "diversion box" apply to the vent station as well.

3.4 COMPONENT REQUIREMENTS AND BASIS

All components were selected for a high degree of reliability to minimize maintenance requirements and personnel exposures.

Ceiling mounted electric unit heaters and wall mounted baseboard electric heaters are located in all spaces in the support building requiring temperature control. In addition, thermostatic controlled exhaust fans are provided to limit peak summer temperature in the compressor room.

Ventilation required during maintenance activities in the vent station will be provided by portable exhaust fans (by others) connected to ports in the exterior walls.

Cooling for personnel comfort in the personnel access rooms of the support building will be provided by others using portable cooling equipment. Ports are provided in the exterior walls for connection of the equipment.

4.0 DESIGN DESCRIPTION

4.1 Detailed system description

Confinement of contamination inside the main structure is achieved by the use of a stainless steel liner at a height necessary to contain standing liquid releases, plus a decontaminable coating on surfaces above the liner. Structural steel floor framework members were chosen which provide smooth surfaces avoiding shapes with interior corners where contamination could collect.

Access ports in the roof of the structure allow remote inspection and flushing of the interior for decontamination in the event of a leak. A liner washdown system is provided for flushing of the stainless steel lined floor beneath the carbon steel shield floor.

The building is provided with sump leak detection, and a connection for a portable ventilation system for maintenance.

The manual overhead bridge crane and trolley function in the movement of internal components as needed when entry is required. The hoist and magnetic load lifter are portable and will be brought into service by operational personnel.

4.2 SYSTEM PERFORMANCE CHARACTERISTICS

After a transfer is complete, the piping system will be flushed and a vent valve in the vent station opened. This permits air to enter the pipeline, allowing the flush water to drain to both ends of the system. The transfer system is designed to minimize the settling of solids in the pipes and components during and after the batch transfers. The entire system is designed to allow complete flushing of the waste to permit access to the structures in between transfers for maintenance or modifications.

Local flushing of piping and valves will be utilized as required when a piping modification or valve replacement is to be performed. Should radiation levels be too high to permit entry after a localized flush, then hydrolazing (high-pressure water cleaning) or chemical decontamination will be used.

The system is designed for gravity drainage of waste or decontamination solutions. Liquids collected in the sump will be pumped into the process piping and gravity drained to the tank farm for future processing. All equipment/materials have been selected with ease of decontamination as a consideration.

4.3 SYSTEM ARRANGEMENT

The layout of the main structure was designed to facilitate flushing, decontamination, and maintenance activities. Particular emphasis was placed on simplifying access to the main structure. This was accomplished by providing the air-tight door for floor level access rather than accessing through a cumbersome roof coverblock.

The main structure is arranged with a stainless steel liner at the base floor level. A steel shield floor is located 3.5 feet (one meter) above the base floor with the process piping underneath. Access to the main structure is through the support building via a corridor and the air-tight door. This door opens up to a shield wall labyrinth and from there directly on to the shield floor level.

4.4 COMPONENT DESIGN DESCRIPTIONS

A Stainless Steel Liner is provided below the shield floor and includes a drainage trench and collection sump for containment and collection of liquids for pump out when required.

An electric, submersible, stainless steel, Dewatering Pump is provided at the sump and is connected directly to the supernate line, providing the capability to pump liquids from the stainless steel liner area directly back into the system. Two isolation valves provide control at this connection.

A Liner Washdown System provides the capability for a remote and thorough washdown of the stainless-steel-lined area beneath the shield floor. The system consists of a network of piping with spray nozzles which are located to provide complete coverage of this area. The lines for the washdown system are routed through the east wall of the main structure, with valves mounted on the wall exterior for supply tie-in. If a washdown of this area is required, the water will be supplied by a tanker truck because no water utilities are provided to these facilities.

Movable Steel Shield Floor Panels and a Structural Support Framing system provide radiological shielding for operational personnel from system piping housed beneath the shield floor panels. The shield floor panels weigh a maximum of 1720 pounds (770 kg). The framing of the floor was designed to support removed panels stacked three high.

A fire rated Air Tight Door is provided at the entrance to the structures and functions as an enclosure barrier during normal operation of the system. the door is a hinged solid steel plate door with a perimeter neoprene gasket. The door opens with a single rotating lever at each face, which operates the perimeter latching lugs. The door does not have a lock, but does have padlock hasps to permit the door to be locked in an open or closed position. Access is controlled at the support building door.

Labyrinth Shielding Walls inside the structures provide operational personnel with ALARA radiological protection prior to entry into the interior.

An Overhead Bridge Crane provided is manually operated and includes a trolley capable of moving loads up to 4000 lbs (1800 kg). A 4000 lbs (1800 kg) manual hoist will be provided by the owner. Periodic testing requirements mandate the hoist be stored outside the operational area of the facility.

An Electric Magnet Load Lifter rated for 3000 lbs (1360 kg) is provided for lifting individual shield floor plates as required to facilitate operational access to the system below.

5.0 TESTING

A construction test was performed to demonstrate operation of the trolley and electromagnetic load lifter. The trolley test included travel to full extent of hook coverage limits. Lifting included a minimum of three different shapes of shield plates including the largest size and one with a valve opening. The results were documented. The hoist will require additional periodic inspections and so is to be stored outside the operational area of the facility.

The building was subjected to an air leakage test to verify that greater than 90% of air exhausted during a spray accident scenario will pass through the HEPA filter. Other testing was performed in accordance with requirements in the C-3 specifications.

Chapter 4

SYSTEM OVERVIEW for the DIVERSION BOX 6241-A W-058 REPLACEMENT OF CROSS SITE TRANSFER SYSTEM

1.0 INTRODUCTION

This document provides a system summary description, function and design requirements, design description, and testing requirements for the diversion box facility which is part of project W-058, Replacement of Cross Site Transfer System.

Project W-058 replaces the existing cross-site transfer system with a buried pipe-in-pipe system to be used for liquid mixed waste transfers between the 200 West and 200 East Areas at the Hanford Site. The system includes underground pipelines, transfer pumps, new piping jumpers, a diversion box, a vent station and associated instrumentation and electrical equipment. The system also allows for the connection of future Tank Waste Remediation System (TWRS) projects.

This document describes the diversion box facility, which houses the two booster pumps. The diversion box facility includes two concrete structures connected by a corridor, related equipment, and the surrounding improved site. This facility is very similar in design to the vent station facility which is also part of project W-058. The interior of the diversion box and vent station together with the secondary encasement pipe form the secondary confinement of the cross site transfer system.

This document is limited to the Civil, Structural, Architectural, and HVAC components of the diversion box facility. Piping, electrical, and instrumentation components are covered in other System Design Descriptions.

2.0 SYSTEM SUMMARY DESCRIPTION

The facility consists of a main concrete structure which directly ties into the transfer lines and an attached support building which houses equipment required to support the operations. A connecting corridor provides controlled access to system components within each structure.

The facility is provided with gravel service roads and service yards for vehicle access and operational activity parking. The sites are similar for the diversion box and vent station.

2.1 System Description

Diversion Box 6241-A is located within the 200-West Area on the east side of Beloit Ave, between 13th and 16th Streets, The main structure houses two booster pumps; this location satisfies pump function and operational access. Existing roads are utilized to the point of access to the facility site. The facility will not be continuously occupied so no utilities such as sanitary water or sewer are provided to the site.

The diversion box houses the two booster pumps for the system. The diversion box main structure is an underground building with the top of the roof approximately 2.5 feet (0.75 meters) above finish grade.

The reinforced concrete main structure provides an enclosure designed and built to Safety Class requirements to house the transfer components of the piping system and other items which support operation of the waste transfer system. This structure is designed for maintenance access on an infrequent basis. The main structure is cast-in-place concrete equipped with a stainless steel floor liner, and a carbon steel shielding floor located above the interior piping.

The support building provides a General Service enclosure for normal operational activities and provides a controlled access staging area to the transfer piping system via a connecting corridor. It includes an indoor controlled area for step off pad and clothing removal, plus the compressor and electrical/instrumentation equipment rooms. The separating corridor minimizes potential contamination of the support facility area from the process area. The support building is precast concrete panel construction and houses electrical, instrumentation and piping equipment necessary for the operation of the system. The building is provided with heating and cooling to protect the equipment enclosed from temperature extremes.

2.2 System Boundaries

The gravel service roads and service yards define each site area. Traffic lanes provide ample space around the exterior of the structures for parking and operational activities. Additional service yard area is provided for transformers serving the diversion box. Guard posts provide physical barricades to protect structures and equipment from vehicle damage.

The main diversion box structure is a reinforced concrete building designed to meet structural design criteria, radiological shielding requirements and sized to provide sufficient space for the system components. It provides the boundary for controlled access to the cross-site system piping and provides containment of accidental spray releases. The interior of this structure is provided with a stainless steel liner for decontaminability and containment of releases inside the structure. Interior surfaces not lined with stainless steel are coated with a decontaminable epoxy coating system.

The support building exterior walls are insulated precast concrete panels. Interior walls are solid precast panels, with selected walls designated as one hour fire rated. The roofs are prestressed hollow core panels. The connecting corridor is cast in place concrete.

2.3 System Interfaces

The interfaces of the electrical, instrumentation, and piping equipment housed in the facility structures are described in other system overview descriptions.

The support building incudes a personnel access room for staging operational access into the main structure and a stairway corridor connecting the support building with the main structure. It also includes a compressor room for control panels and air compressor; and an electrical/instrumentation room. An exterior ladder and handrail is provided for maintenance access to a roof mounted HVAC unit.

The main diversion box structure is a reinforced concrete structure designed to meet structural design criteria, containment requirements and radiological shielding requirements. The structure is sized to provide sufficient space for the system components. In addition, extra space and four blank wall sleeves are provided in the main structure to allow tie-in capability for future projects.

All structural system components which have exterior interface points and provide direct access to the interior environment, such as roof and wall penetrations, are provided with stamped stainless steel labels fixed to the structure walls and identify function, reference drawing number and detail reference.

The service yards provide ample space around the exterior of the structures for operational interface to external components provided as part of the structural systems described below:

A <u>HEPA Filtered Breather Connection</u> provides stabilization of internal air pressure due to thermal fluctuations of the internal environment during pump operation and for seasonal temperature changes. This connection is equipped with an isolation butterfly valve to facilitate filter change out.

An <u>Exhaust Air Connection</u> is provide for external use of portable exhauster equipment to create required ventilation flow rates should maintenance be required. This connection is equipped with an isolation butterfly valve and flanged end connection for exhaust equipment (by others) attachment prior to use.

An <u>Exhaust Air Sample Connection</u> is provide at the Exhaust Air Connection for continuous discharge sampling as required. This exhaust air system functions in concert with the HEPA filtered breather connection.

A separate <u>Air Sample Connection</u> is provided to verify air quality inside the structure as desired, and is equipped with an isolation ball valve and tube fitting for sample equipment attachment prior to use.

An <u>Emergency Pump Out Connection</u> is provided as a backup to the sump pump should it become necessary to remove liquids from the stainless steel liner area. This consists of permanent piping from the sump to the exterior of the building and is provided with closure and connection flanges. The sump pump ties directly back in to the supernate line for routing liquids from the stainless steel liner sump directly back in to the piping system.

A Liner Washdown System Connection is provided to allow connection of a water source in the event that it becomes necessary to decontaminate the area beneath the shielding floor using water sprays. This connection is capped off and is also isolated from the building interior with ball valves.

Roof Access Ports are provided to visually inspect the area above the sump and perform a washdown of the internal environment above the shielding floor should it be required. These ports may have other non-entry uses such as remote inspection of the entire interior.

Roof Access Openings and Structural Closure Plugs are provided for construction access and for use in outage conditions to remove and or replace equipment which cannot be removed via the corridors. Use of these openings is considered an unlikely event and will require cutting through the roof materials and insulation to locate the structural closure plug edges. The plugs have embedded lifting inserts which are installed flush with the concrete. A swivel plate and lifting lug is attached to these inserts when plug removal is required.

2.4 System Classification

The reinforced concrete shell of the diversion box main structure is designed and built to Safety Class requirements for purposes of providing containment of an accidental spray release. Any access penetrations into the main structure are also classified as Safety Class due to the potential that breach of these items could also allow a spray release.

The interior structural components of the structure, including the shield floor, and the stainless steel liner are classified as General Service. The shield floor is designed to Safety Class seismic criteria due to its potential to impact the transfer piping.

The support building is General Service for normal operational activities.

The connecting corridor is classified General Service for its function but is designed to Safety Class criteria due to its connection to the main structure.

3.0 FUNCTION AND DESIGN REQUIREMENTS

3.1 Functions

The diversion box facility provides a Safety Class equivalent structural enclosure to house the components of the transfer piping system and other components which support operation of the system.

The facility also provides a General Service support building for normal operational activities, and controlled access staging area to the transfer piping system.

3.2 SYSTEM DESIGN REQUIREMENTS

3.2.1 Functional and performance requirements

Functional and performance requirements for the Safety Class equivalent structural system are to contain fluids and air borne particulate matter that may leak from the system components within the structures.

Facilities in which radioactive or other hazardous materials are utilized are required to be designed to simplify decontamination and decommissioning and/or increase the potential for reuse. Facilities are also required to be designed to keep radiation exposures to personnel and the public as-low-as-reasonably-achievable (ALARA).

3.2.2 Operability/Maintenance requirements

Equipment housed in the support building's compressor room and electrical/ instrumentation room is available for hands on maintenance when required and no extraordinary procedures are required. An exterior ladder is used for access to a roof mounted HVAC unit for periodic maintenance as required.

The main structure is entered through a corridor and an airtight door. This provides ready access for maintenance, yet isolates the process area from the support building and the environment, limiting the potential for contamination spread.

The diversion box systems will be contact-maintained and are designed to limit the area of the facility that may become contaminated. To allow in-place maintenance, it must be possible to bring doses down to acceptable levels and decontaminability was a priority in design of the system. Surfaces inside the main structure are painted with a decontaminable coating except for instrumentation and stainless steel. A liner washdown system provides the capability for remote washdown of the stainless steel liner in case of a liquid release.

Prior to hands on maintenance of equipment within the diversion box main structure, sampling of internal air quality can be verified using the air sample connection. A survey will be conducted for airborne radioactive materials, oxygen deficiency, and hazardous chemical vapors. This survey will be used to determine proper levels of personal protective clothing, respiratory protection, and forced ventilation for safe access. Sampling of collected liquids is achieved using the roof access port directly above the sump. Access for non-entry visual inspection inside the structures is provided via roof ports at various locations.

All the transfer piping is located beneath the 3" thick shield floor. The pumps are at floor level and are shielded by a separate pump cover. All routine maintenance and inspection operations except pressure transmitter calibrations can be performed with the shielding floor plate in place, providing a spacious open work surface and continuous radiation protection. If access below the shield floor is required, the floor panels are removable using the building's hoist system and magnetic lifting device. The pump shield cover is designed in sections so that it also can be removed for maintenance purposes using the hoist. Storage and maintenance of the portable hoist is provided by the owner outside the diversion box main structure.

3.2.3 External Hazards/Structural requirements

The structures were designed to meet wind, seismic, dead and live loads as required by Hanford Plant Standards SDC 4.1 revision 12. See calculation number W058-C-001 for an evaluation of the Natural Phenomena Hazard Load Criteria Design. See the general notes on drawing H-2-822265 for a detailed listing of the loadings used in the design of each structure or component.

3.3 SYSTEM DESIGN BASIS

3.3.1 Authorization basis

The Authorization Basis for the diversion box is contained within HNF-SD-WM-BIO-001, Rev. 0-H. The design of the diversion box is consistent with this Authorization Basis.

3.3.2 Design Inputs

The structures were designed in accordance with the following codes and standards:

- ACI 349 Code Requirements for Nuclear Safety Related Concrete Structures
- ACI 318 Building Code Requirements for Reinforced Concrete
- AISC ASD 9th edition Manual of Steel Construction
- AISC N690 Nuclear Facilities: Steel Safety-Related Structures for Design, Fabrication and Erection
- Uniform Building Code

3.3.3 Design Constraints

The following supporting documents provided the criteria for the design.

- Preliminary Safety Analysis Report -- WHC-SD-W058-PSAR-001 revision 1
- Functional Design Criteria -- WHC-SD-W058-FDC-001 revision 4
- Department of Energy 6430.1A -- General Design Criteria 4-6-89

3.3.4 Special Material or system chemistry consideration

The stainless steel liner provides containment of potential liquid releases and provides the same material resistance as the stainless steel primary pipe. Other interior surfaces in the main structure are coated with an epoxy coating system which is chemically resistant to the standard decontamination solutions listed in ASTM D3912, Test Method for Chemical Resistance of Coatings in Light-Water Nuclear Power Plants.

3.3.5 Design analysis and calculations

For a list of civil, structural, architectural, and HVAC design calculations see drawing H-2-822200, sheet 2. The design of the two facilities, the diversion box and the vent station, was done concurrently and calculations labeled as "diversion box" apply to the vent station as well.

3.4 COMPONENT REQUIREMENTS AND BASIS

All components were selected for a high degree of reliability to minimize maintenance requirements and personnel exposures.

Ceiling mounted electric unit heaters and wall mounted baseboard electric heaters are located in all spaces in the support building requiring temperature control. In addition, thermostatic controlled exhaust fans are provided to limit peak summer temperature in the compressor room. A roof mounted 4-ton air conditioner is installed to provide cooling for electrical equipment and instrumentation in the E/I room of the support building.

Heat generated by the pumps in the diversion box is absorbed by the massive concrete structure. The ambient temperature inside the main structure will not reach 104°F before a 1,000,000 gallon transfer is accomplished. Ventilation required during maintenance activities in the diversion box will be provided by portable exhaust fans (by others) connected to ports in the exterior walls.

Cooling for personnel comfort in the personnel access rooms of the support buildings will be provided by others using portable cooling equipment. Ports are provided in the exterior walls for connection of the equipment.

4.0 DESIGN DESCRIPTION

4.1 Detailed system description

Confinement of contamination inside the main structure is achieved by the use of a stainless steel liner at a height necessary to contain standing liquid releases, plus a decontaminable coating on surfaces above the liner. Structural steel floor framework members were chosen which provide smooth surfaces avoiding shapes with interior corners where contamination could collect.

The pumps are designed to be drained from the bottom to facilitate complete flushing. Lifting lugs provided on the pumps are used for both installation and later for removal during decommissioning.

Access ports in the roof of the structure allow remote inspection and flushing of the interior for decontamination in the event of a leak. A liner washdown system is provided for flushing of the stainless steel lined floor beneath the carbon steel shield floor.

The building is provided with sump leak detection, and a connection for a portable ventilation system for maintenance. Blank penetrations have been provided in the walls and sufficient space allowed in the box for modifications for future projects.

The manual overhead bridge crane and trolley function in the movement of internal components as needed when entry is required. The hoist and magnetic load lifter are portable and will be brought into service by operational personnel.

4.2 SYSTEM PERFORMANCE CHARACTERISTICS

After a transfer is complete, the piping system will be flushed and a vent valve in the vent station opened. This permits air to enter the pipeline, allowing the flush water to drain to both ends of the system. The transfer system is designed to minimize the settling of solids in the pipes and components during and after the batch transfers. The entire system is designed to allow complete flushing of the waste to permit access to the structures in between transfers for maintenance or modifications.

Local flushing of piping and valves will be utilized as required when a piping modification, valve replacement, or pump repair is to be performed. Should radiation levels be too high to permit entry after a localized flush, then hydrolazing (high-pressure water cleaning) or chemical decontamination will be used.

The system is designed for gravity drainage of waste or decontamination solutions. Liquids collected in the sump will be pumped into the process piping and gravity drained to the tank farm for future processing. All equipment/materials have been selected with ease of decontamination as a consideration.

4.3 SYSTEM ARRANGEMENT

The layout of the main structure was designed to facilitate flushing, decontamination, and maintenance activities. Particular emphasis was placed on simplifying access to the main structure. This was accomplished by providing the air-tight door for floor level access rather than accessing through a cumbersome roof coverblock.

The main structure is arranged with a stainless steel liner at the base floor level. A steel shield floor is located 3.5 feet (one meter) above the base floor with the process piping underneath. Access to the main structure is through the support building via a corridor and the air-tight door. This door opens up to a shield wall labyrinth and from there directly on to the shield floor level.

4.4 COMPONENT DESIGN DESCRIPTIONS

A Stainless Steel Liner is provided below the shield floor and includes a drainage trench and collection sump for containment and collection of liquids for pump out when required.

An electric, submersible, stainless steel, Dewatering Pump is provided at the sump and is connected directly to the supernate line, providing the capability to pump liquids from the stainless steel liner area directly back into the system. Two isolation valves provide control at this connection.

A Liner Washdown System provides the capability for a remote and thorough washdown of the stainless-steel-lined area beneath the shield floor. The system consists of a network of piping with spray nozzles which are located to provide complete coverage of this area. The lines for the washdown system are routed through the east wall of the main structure, with valves mounted on the wall exterior for supply tie-in. If a washdown of this area is required, the water will be supplied by a tanker truck because no water utilities are provided to these facilities.

Movable Steel Shield Floor Panels and a Structural Support Framing system provide radiological shielding for operational personnel from system piping housed beneath the shield floor panels. The shield floor panels weigh a maximum of 1720 pounds (770 kg). The framing of the floor was designed to support removed panels stacked three high.

A fire rated Air Tight Door is provided at the entrance to the structures and functions as an enclosure barrier during normal operation of the system. the door is a hinged solid steel plate door with a perimeter neoprene gasket. The door opens with a single rotating lever at each face, which operates the perimeter latching lugs. The door does not have a lock, but does have padlock hasps to permit the door to be locked in an open or closed position. Access is controlled at the support building door.

Labyrinth Shielding Walls inside the structures provide operational personnel with ALARA radiological protection prior to entry into the interior.

An Overhead Bridge Crane provided is manually operated and includes a trolley capable of moving loads up to 4000 lbs (1800 kg). A 4000 lbs (1800 kg) manual hoist will be provided by the owner. Periodic testing requirements mandate the hoist be stored outside the operational area of the facility.

An Electric Magnet Load Lifter rated for 3000 lbs (1360 kg) is provided for lifting individual shield floor plates as required to facilitate operational access to the system below.

A Pump Shield Cover is provided over the wetted portion of the pump to give radiological protection to operational personnel, should entry in to the facility be required. Individual sections of the pump shield cover are interlocked with adjoining sections and the cover is secured to the floor for stability. Lifting eyes are provided on each section for installation and removal. Each circular section weighs 3000 lbs (1360 kg) and the end plate weighs 2800 lbs (1270 kg).

5.0 TESTING

A construction test was performed to demonstrate operation of the trolley and electromagnetic load lifter. The trolley test included travel to full extent of hook coverage limits. Lifting included a minimum of three different shapes of shield plates including the largest size and one with a valve opening. The results were documented. The hoist will require additional periodic inspections and so is to be stored outside the operational area of the facility.

The building was subjected to an air leakage test to verify that greater than 90% of air exhausted during a spray accident scenario will pass through the HEPA filter. Other testing was performed in accordance with requirements in the C-3 specifications.

Chapter 5

SYSTEM OVERVIEW
for the
SLURRY TRANSFER LINE
W-058 REPLACEMENT CROSS-SITE TRANSFER SYSTEM

1.0 INTRODUCTION

This document provides a system summary description, function and design requirements, design description, and testing requirements for the Slurry Transfer Line. This line provides a RCRA and WAC compliant pipeline to transfer mixed slurry waste between the SY Tank Farm in 200 West and the 244-A Lift Station in 200 East, a distance of approximately 5 1/2 miles. This line was constructed as part of Project W-058, "Replacement of the Cross Site Transfer System."

2.0 SYSTEM SUMMARY DESCRIPTION

2.1 System Description

The purpose of the slurry transfer line is to provide a RCRA and WAC compliant pipeline connecting the SY Tank Farm in 200 West with the Tank Farms in 200 East. Along the pipeline there is a Diversion Box 6241-A which houses the slurry transfer line booster pumps and has space for future tie-ins, and a Vent Station 6241-V at the high point to facilitate draining. New piping jumpers were provided in Valve Pit 241-SY-B and the 244-A Lift Station to connect the new pipeline with the existing piping in the SY Tank Farm and 200 East Tank Farms.

2.2 System Boundaries

The slurry pipeline boundaries are the 241-SY-B Valve Pit in the SY Tank Farm and the 244-A Lift Station in 200 East.

2.3 System Interfaces

System interfaces include electrical, instrument air, and the Monitor and Control System (MCS). Electrical power is required for the leak detection system, pipeline pumping, process instrumentation, and valving. Instrument air is required for the booster pump seals and remote valve operation in the Diversion Box and remote valve operation in the Vent Station. The MCS is required for leak detection monitoring, pipeline process monitoring, remote valve actuation, and booster pump operation.

2.4 System Classification

The buried portion of the pipeline and its encasement is Safety Class to mitigate any radioactive release to the environment. The portion of piping in Valve Pit 241-SY-B, Diversion Box, Vent Station and 244-A Lift Station is not safety significant because the surrounding structures provide the mitigating features to prevent a radioactive release to the environment.

3.0 FUNCTION AND DESIGN REQUIREMENTS

3.1 FUNCTIONS

The function of the pipeline is to provide a safe and reliable piping system for transport of pumped radioactive slurry waste. The pipeline is designed to meet all applicable DOE Orders, State and Federal codes and standards.

3.2 SYSTEM DESIGN REQUIREMENTS

3.2.1 Functional and performance requirements

This line transfers radioactive slurry with a range of fluid properties through the pipeline. The specific gravity of the slurry will range from 1.0 to 1.5, the viscosity will range from 1.0 to 30 centipoise, and the temperature will range from 80°F to 200°F. The maximum design pressure is 1490 psig which is limited by the pressure design of the primary pipe. Two transfer design conditions are; a slurry with 1.5 S.G., 30 cP, flowing at 4.5 ft/s (104 gpm), with the booster pump discharge pressure of 1061 psig (1633 TDH), and a slurry with 1.25 S.G., 10 cP, flowing at 6.0 ft/s (140 gpm), with the booster pump discharge of 1121 psig (2071 TDH).

3.2.2 Operability requirements

- Proper installation of applicable piping jumpers and satisfactory completion of pipeline pressure testing.
- Valve lineup completed and verified.
- Encasement and building leak detection systems operable.
- Pit cover blocks installed and diversion box and vent stations secured.
- Interfacing systems of electrical, instrument air and MCS operable.

3.2.3 System set points

Pressure regulating valves in the booster pump seal control panels, PRV 3125A1, PRV 3125A2, PRV 3125B1, and PRV 3125B2 will be set approximately 20 psig above the pump suction pressure.

3.2.4 System instrumentation and alarms

The pipeline has pressure and temperature monitoring at the Diversion Box 6241-A, Vent Station 6241-V, and 244-A Lift Station, and a continuous leak detection system.

The pump seal control panels will alarm remotely through the MCS at high air-flow or at low air pressure to the pump seal chambers.

3.2.5 System interlocks

Misroute protection interlocks are provided at two locations. The backup flush system tie-in at Valve Pit 241-SY-A is provided with a pressure interlock between the two isolation valves, V-3110 and V-3113. If during a waste transfer the first isolation valve leaks, the pressure interlock will send a signal to the 200 West Master Pump Shutdown circuits. Also if V-3113 is open, an interlock will send a signal to the 200 West Master Pump Shutdown circuits. The high point vent in the Vent Station is provided with a pressure interlock between SOV-3185A and B. If during a waste transfer the first isolation valve leaks, the pressure interlock will shutdown the operating booster pump.

At the Vent Station there is another pressure interlock which prevents opening of the vent valves SOV-3168A and SOV-3168B if a positive pressure is detected in the pipe. These valves would only be opened during a draining function at which time the pressure at the high point will be negative.

Leak detection interlocks are also provided on the slurry transfer line. If a leak is detected by the continuous leak detection cable in any segment of the encasement pipe, or either the Diversion Box or Vent Station sump, the leak detection system will shutdown the operating booster pump and send a signal to the nearest PCU which subsequently sends a signal to the 200-W Master Pump Shutdown Circuit.

Over-pressure protection interlocks are provided to shutdown the booster pump. The booster pump will shutdown on high booster pump discharge pressure, on high pressure in the slurry line in 244-A Lift Station, and if either rupture disk, PSE-841 or PSE-842, in the 244-A Lift Station leaks through or bursts.

Miscellaneous booster pump interlocks are also provided to shutdown the booster pump or the Transfer Pump P-102-SY-02A. The booster pump will not be permitted to operate if the associated vent and drain valves are not closed. The operating booster pump will shutdown on high pump bearing temperature, high motor winding temperature, high vibration, low oil level, and on pump seal failure indicated by high air-flow or low air pressure to the pump seal chamber. The booster pump will not be permitted to operate if the inlet pressure is lower than 10 psig. The Transfer Pump P-102-SY-02A will be shutdown if the booster pump inlet pressure reaches 70 psig. However, the Transfer Pump P-102-SY-02A can be reset to operate if required.

3.2.6 Maintenance requirements

Maintenance on the pipeline is expected to be required only for the leak detection system, process instrumentation, and valving. The process instrumentation and valving at the Valve Pits 241-SY-A and B and 244-A Lift Station are installed on removable piping jumpers. Removal of the jumpers will be required to perform maintenance. The instrumentation and valving at the

Diversion Box and Vent Station are located below a 3 inch thick steel shield floor. Manned access to these locations is planned. Calculated dose rate for maintenance after the pipeline has been flushed and drained is 0.09 mrem/hr above the shield floor. The valve operators protrude up through the shield floor and therefore can be maintained without removal of any shielding. If maintenance of the valve seats or seals is required the valves are top entry and can be accessed through the hole in the shield floor after removal of the valve operator. The valve bodies have flush ports which have been piped to a location at shield floor level so that flush water can be injected to further decontaminate the valve body before maintenance. The pipeline instrumentation requiring access under the shield floor are the temperature RTD's and pressure transmitters. Spare RTD's have been installed so replacement of an RTD is not anticipated. Access to a pressure transmitter requires removal of a shield plate.

The leak detection system is capable of identifying the location of breaks and shorts in the cable. Though infrequent, when either of these faults occur, and alarm signal is sent through the nearest PCU to the Operating Control Station, located in the 242S control room, which monitors the transfer system alarms. A visible display also appears on the front of the leak detection monitoring unit indicating the type of fault and its location. Pull ports are provided approximately every 300 feet to permit the removal of non-functioning cable.

In addition to the flush ports on the valves previously mentioned, the piping also has easily removable caps at strategic locations to permit hydrolyze cleaning of the piping for decontamination. This may be required for unanticipated maintenance requiring shield floor removal such as valve replacement.

Another component which will require infrequent replacement is the vent filter in the Vent Station. Periodic radiation readings should be taken to determine frequency of replacement and conform to ALARA. The filter is located above the shield floor in a bag-in/bag-out filter housing.

3.2.7 External hazards

The pipeline is either buried or housed in structures designed and built to Safety Class standards and is therefore protected from environmental hazards of wind, lightning and ashfall. The pipeline is exposed to seismic events.

3.2.8 Structural requirements

The pipeline was designed to meet the stress allowables of ASME B31.3, "Process Piping" for pressure design and flexibility design (thermal) as well as occasional loading due to seismic. The insulation jacket for the buried pipeline is designed to withstand a standard HS-20 truck loading as defined in AASHTO HB-15.

3.2.9 Inspection Provisions

The pipeline at the Diversion Box and Vent Station has the capability to be internally inspected for corrosion through the flush connections. Also, insulation has been left off the corners to facilitate NDE testing for wall thickness.

Calibration and testing of the pipeline instrumentation will be required on a regular periodic basis as determined by Operations.

Inspection of the vent filter is required periodically for aerosol testing and depending on frequency of transfers to monitor for radiation level buildup leading to filter replacement.

3.3 SYSTEM DESIGN BASES

3.3.1 Authorization basis

The Authorization Basis for the Replacement Cross-Site Transfer System is contained within HNF-SD-WM-BIO-001, Rev. 0-H.

3.3.2 Design inputs

DOE Order 6430.1A- 1989
ASME B&PVC Section VIII - 1992
ASME B31.3 Code - 1996

3.3.3 Design constraints

The designed temperature range for the pipeline is 35-200°F, which is the expected temperature extremes for the system. The designed maximum pressure for the pipeline is 1490 psig which is based on the pressure design of the primary pipe.

3.3.4 Special material or system chemistry considerations

304L stainless steel was selected as the material for the primary piping based on testing and past experience. Testing indicated no signs of abnormal or significant corrosion. Past experience of using 304L stainless steel on site has generally been successful. The only documented cases of material failures resulted from pitting corrosion due to the puddling of liquids at low points. Pitting corrosion from the standing flush water can be minimized in the primary pipe of the slurry line by using pH-adjusted flush water to inhibit corrosion. Reference WHC internal memo 7F540-94-019, "Projects W-058/W-028 Material of Construction Position Paper" for a detailed discussion.

3.3.5 Design analysis and calculations

Calculation #W058-P-006, "Rupture Disk/Relief Valve Sizing"
Calculation #W058-P-011, "Buried Pipeline Heat Loss"
Calculation #W058-P-012, "Booster Pumps TDH Determination"
Calculation #W058-P-013, "SY Valve Pit to DB#1 TDH"
Calculation #W058-P-014, "SY Valve Pit to 107-AP TDH"

Calculation #W058-P-017, "Pipeline Over-pressure Due to Waterhammer"
Calculation #W058-P-018, "Buried Pipeline Stress Analysis"
Calculation #W058-P-019, "Jumper Stress Analysis"
Calculation #W058-P-025, "Jumper Calculations 241-SY-A/B and 244-A"
Calculation #W058-P-026, "Nozzle/Pipe Anchor Analysis"
Calculation #W058-P-031, "DB#1/VS Wall Anchor Analysis"
Calculation #W058-P-032, "Process/Enc Pipe Pressure Design (ASME B31.3)"
Calculation #W058-P-036, "Total Integrated Dose for 40 yr Design Life"
Calculation #W058-P-037, "Building 6241-A, Expected Dose Rates During Transfer"
Calculation #W058-P-038, "Building 5241-V, Expected Dose Rates During Transfer"
Calculation #W058-P-039, "Building 6241-A, Expected Dose Rates for Maintenance"
Calculation #W058-P-040, "Building 6241-V, Expected Dose Rates for Maintenance"
Calculation #W058-P-041, "Buried Transfer Piping, Expected Dose Rates During Transfer"
Calculation #W058-P-043, "DB#1/VS Piping Analysis"
Calculation #W058-P-044, "Piping Pressure Drop/244-A Lift Station to 107-AP and 104-AN Tanks"
Calculation #W058-P-045, "Piping-Commercial Grade Items Evaluation"

3.4 COMPONENT REQUIREMENTS AND BASIS

3.4.1 Major components descriptions

The buried portion of the slurry transfer line consists of a pipe in pipe configuration. The primary pipe is stainless steel and the encasement pipe is carbon steel. The encasement pipe is covered with 2" of rigid polyurethane insulation. The insulation jacket is a multi-directional filament wound, polyester isophthalic resin/fiberglass reinforcement composite directly applied on the foam insulation.

The buried pipeline has a continuous leak detection cable inside the annulus space between the primary pipe and the encasement pipe. The continuous leak detection system consists of three monitoring units, one located in the electrical room of the Diversion Box, one located in the electrical room of the Vent Station, and one in an outdoor enclosure near Atlanta Ave in the 200 East area. Each monitoring unit is capable of monitoring up to 6000 feet of sensing cable in either direction, allowing it to monitor 12,000 feet of pipeline for leaks.

The valves for the slurry transfer line are all located within the previously mentioned structures; there are no buried valves. The valves in the Valve Pits 241-SY-A and B are manual valves. The valves in the 244-A Lift Station are motor operated valves. The valves in the Diversion Box and Vent Station are pneumatic operated ball valves.

The booster pumps for the slurry transfer line are located in Diversion Box

6241-A. There are two identical booster pumps, but only one pump will be used at a time. Each booster pump is a horizontal, centrifugal, multistage, axially split case slurry pump with motor and ancillary equipment mounted on a base assembly. The booster pumps are also supplied with pump seal control panels and variable speed drives.

The vent line for the slurry transfer line is located in the Vent Station. The vent line is supplied with a HEPA filter and two isolation valves.

3.4.2 Required functions

The function of the slurry transfer line is to provide a pipeline connecting the SY Tank Farm in 200 West with the Tank Farms in 200 East. This pipeline can be used to transfer slurry waste from 200 West to 200 East. The valves in the slurry transfer line are used for isolation and transfer routing. The vent line on the pipeline is required to break the vacuum at the high point of the pipeline to facilitate draining the line. The leak detection system is required to identify any leaks that may occur along the entire slurry transfer line.

3.4.3 Design basis

The slurry transfer line is designed to withstand liquid temperatures ranging from 35 to 200 °F. The maximum design pressure of the slurry transfer line primary pipe is 1490 psig which is based on the pressure design of the primary pipe. The design pressure of the encasement pipe is 50 psig. This design pressure is not based on the maximum pressure capability of the encasement pipe but is selected to minimize the required pneumatic test pressure and still accommodate the maximum pressure the encasement pipe would experience if the primary pipe leaked into the encasement and filled it. The maximum allowable pressure of the encasement pipe is 590 psig, which is based on the maximum pressure on the encasement pipe enclosure end plates.

The design of the buried pipe for the slurry transfer line incorporates expansion loops and concrete anchors. A typical expansion loop design is used to maximize the length between expansion loops thus minimizing the number of expansion loops used. The expansion loops for the transfer line are either 23 ft x 12 ft x 23 ft or 25 ft x 20 ft x 25 ft, depending on if the line is the inner or outer pipe on the loop. The encasement pipe at the loops is 12 inch standard weight pipe which reduces down to the 6 inch schedule 40 pipe for the straight runs of pipe. The larger pipe at the expansion loops is designed to accommodate the expansion of the primary pipe. The anchor between each expansion loop is designed to force the thermal expansion of the primary pipe into the expansion loop. The anchors at the corners, or change in direction of the pipeline, are designed to withstand the thrust forces developed by the encasement pipe, both thermally and seismically. The anchors outside each of the buried structures are designed to reduce the anchor forces at the wall of the structures.

The piping inside the Diversion Box, Vent Station, Valve Pits 241-SY-A and B, and the 244-A Lift Station is 3" stainless steel pipe with no encasement pipe. The encasement pipe terminates and is sealed inside each of these structures. Each segment of the encasement pipe is fitted with a drain valve at each end. Leak test ports and shut off valves are fitted at each encasement end inside the Diversion Box and the Vent Station. Rupture disks are fitted at each encasement end inside the Diversion Box and the Vent Station to protect the encasement pipe from over-pressurization. The burst pressure of the rupture disks is 60 psig which is based on 20% above the encasement pipe design pressure.

The booster pumps are designed to pump the slurry over the full range of fluid properties. The specific gravity of the slurry will range from 1.0 to 1.5, the viscosity will range from 1.0 to 30 centipoise, the temperature will range from 80 to 200°F, and the particle size will range from 0.5 to 4000 micron. Two transfer conditions are; a slurry with 1.5 S.G., 30 cP, flowing at 4.5 ft/s (104 gpm), with the booster pump discharge pressure of 1061 psig (1633 TDH), and a slurry with 1.25 S.G., 10 cP, flowing at 6.0 ft/s (140 gpm), with the booster pump discharge of 1121 psig (2071 TDH). The variable speed drive motor of the pump provides the flexibility required to cover the full range of fluid properties. The design pressure of the pump is 1490 psig.

Pump seal control panels were supplied by the booster pump vendor. The panels were designed to control the pressure to the booster pump seal chambers. The pressure regulating valve is set approximately 20 psig above the pump suction pressure. High flow and low pressure alarms were included in the design to indicate a pump seal failure and to shutdown the booster pump. A check valve was included to prevent backflow if a seal failed.

The multistage orifices were designed by the booster pump vendor. The orifices are installed on bypass lines from the pump discharges to pump suctions. The orifices are designed to provide adequate flow and differential head to protect the downstream piping from over-pressure at the maximum pump speed and worst case fluid conditions. The orifices are designed based on 1600 psig pump discharge pressure and 230 psig back pressure. They are used in conjunction with rupture disks with a 1370 psig rupture pressure.

The piping inside the Diversion Box and the Vent Station is designed with strategically located removable caps. These caps permit hydrolyze cleaning of the piping inside the structures. These caps are designed for the same pressures and temperatures as the pipe.

The pneumatic operated ball valves in the Diversion Box and the Vent Station are rated for 200°F and 1490 psig. The pneumatic valve operators were supplied with the ball valves.

The design of the pneumatic operated ball valves considered minimum radiation exposure for maintenance personnel. The valve operators protrude up through the shield floor and can be maintained without removal of any shielding. The valve bodies have flush ports so the valve body can be flushed before maintenance. If maintenance of the valve seats or seals is required the valves are top entry and can be accessed through the hole in the shield floor after removal of the valve operator.

The valves in the Valve Pits 241-SY-A and B, and 244-A Lift Station are rated for 200°F and 400 psig.

The design of the slurry transfer line incorporates a continuous slope of at least 0.25% to facilitate draining. The transfer line is also designed to minimize the settling of solids in the pipes, pipe fittings, and other components.

The relief valve and rupture disk combinations installed on the jumpers in the 244-A Lift Station are designed to protect the existing piping downstream of the 244-A Lift Station. There are two sets of relief valve and rupture disk combinations that provide redundancy. The relief valve and rupture disk combinations are set at 230 psig which is the design pressure of the existing piping. The rupture disk is installed on the process side of the relief valve to prevent the relief valve from becoming contaminated under normal operating conditions.

The leak detection system will identify the presence of a liquid at any point along its sensing cable and indicate its location within +/- five feet. The cable is designed to withstand the effects of a radioactive liquid.

3.4.4 Component function

The transfer line has two modes of operation, run and standby. The run mode consists of all activities required for a transfer. First the valves are lined up for proper transfer routing; next, the line is preheated with water if necessary; next a transfer is performed; then the pipeline is flushed and drained; and finally the valves are repositioned to a non-transfer condition. The standby mode includes all down time between transfers.

3.4.5 Design basis satisfaction

The slurry transfer line satisfies the system design basis. The system provides a RCRA and WAC compliant pipeline connecting the SY Tank Farm in 200 West with the Tank Farms in 200 East.

4.0 DESIGN DESCRIPTION

4.1 DETAILED SYSTEM DESCRIPTION

The slurry transfer line provides a pipeline to transfer mixed waste from the SY Tank Farm in 200 West to the 244-A Lift Station in 200 East. The slurry transfer line connects to the existing SY Tank Farm via new jumpers in Valve Pit 241-SY-B. The slurry transfer line connects to the existing 200 East Tank Farms via a new jumper in the 244-A Lift Station. Two new structures are a part of the slurry transfer line, the Diversion Box 6241-A, and the Vent Station 6241-V. The Diversion Box is located outside the SY Tank Farm. It houses the two booster pumps and also provides a means of future tie-ins to the slurry transfer line. The Vent Station is located approximately half way between 200 East and 200 West. The Vent Station is the high point of the slurry transfer line and will facilitate filling and draining the pipeline. The transfer line is designed with a continuous slope of at least 0.25% to facilitate draining.

The slurry transfer line can be used to transfer slurry waste from 200 West to 200 East. The slurry waste will have a range of fluid properties. The specific gravity of the slurry will range from 1.0 to 1.5, the viscosity will range from 1.0 to 30 cP, the temperature will range from 80 to 200°F, and the particle size will range from 0.5 to 4000 micron. The maximum design pressure of the pipeline is 1490 psig.

The slurry transfer line has two modes of operation, run and standby. The run mode consists of all activities required for a transfer. First the valves are lined up for proper transfer routing; next, the line is preheated with water if necessary; next a transfer is performed; then the pipeline is flushed and drained; and finally the valves are repositioned to a non-transfer condition. The standby mode includes all down time between transfers.

The buried portion of the slurry transfer line consists of a pipe in pipe configuration. The primary pipe is stainless steel and the encasement pipe is carbon steel. The encasement pipe is covered with 2" of rigid polyurethane insulation. The insulation jacket is a multi-directional filament wound, polyester isophthalic resin/fiberglass reinforcement composite directly applied on the foam insulation. The buried pipeline has a continuous leak detection cable inside the annulus space between the primary pipe and the encasement pipe. Reference VI for buried pipeline construction information.

The pipe inside the Diversion Box, Vent Station, Valve Pits 241-SY-A and B, and the 244-A Lift Station is 3" stainless steel pipe with no encasement pipe. The encasement pipe terminates inside each of these structures. Reference drawings H-2-822336 for the Diversion Box piping plan. Reference drawing H-6-13994 for the Vent Station piping plan. Reference drawings H-2-822290, H-2-822300, and H-2-822320 for the Valve Pits 241-SY-A and B, and 244-A Lift Station jumper arrangements, respectively.

The booster pumps for the slurry transfer line are located in Diversion Box 6241-A. There are two identical booster pumps, but only one pump will be used at a time. Each booster pump is a horizontal, centrifugal, multistage, axially split case, slurry pump with motor and ancillary equipment mounted on a base assembly. The booster pumps are also supplied with pump seal control panels and variable speed drives.

The valves for the slurry transfer line are all located within the previously mentioned structures, there are no buried valves. The valves in Valve Pit 241-SY-B are manual ball valves. The valves in the 244-A Lift Station are motor operated ball valves. The valves in the Diversion Box and Vent Station are pneumatic operated ball valves.

The vent line for the slurry transfer line is located in the Vent Station. The vent line is supplied with a HEPA filter and two isolation valves. Reference drawing H-6-13994.

4.2 SYSTEM PERFORMANCE CHARACTERISTICS

The slurry transfer line has two modes of operation, run and standby. The run mode consists of all activities required for a transfer. The standby mode includes all down time between transfers.

Before each transfer, the valves are lined up for the routing required by the transfer. Once the route is set, the valves will be interlocked to prevent a misrouting. The pipeline will then be filled with water to minimize vapor entrapment and water hammer. Heated water may be used if required for preheating the pipeline.

Once the proper transfer parameters are determined (ie; flow rate, pressures, and temperatures), the transfer is started. During the transfer, personnel shall monitor the system for proper operation. Parameters to be monitored include flow velocity, pump pressures, fluid temperature, primary pipe leaks, any leaks through isolation valves, etc.

After the transfer is completed, the pipeline will be flushed. The flush water will normally be supplied by the facility originating the transfer. Once flushing is completed, the pipeline will be drained. The isolation valves in the Vent Station will be opened, only if a negative pressure is detected in the pipeline at the Vent Station. The Vent Station is the high point of the pipeline, and opening the vent will break the vacuum and allow the flush water to drain to both ends of the pipeline.

Finally the valves are repositioned to a non-transfer condition. In this condition, the transfer line will remain in the standby mode until another transfer is required.

4.3 SYSTEM ARRANGEMENT

The slurry transfer line provides a pipeline to transfer hazardous waste from the SY Tank Farm in 200 West to the 244-A Lift Station in 200 East. The slurry transfer line uses two existing structures, Valve Pit 241-SY-B, and 244-A Lift Station. The slurry transfer line also uses two new structures, Diversion Box 6241-A and Vent Station 6241-V. Drawing H-2-822201 shows the civil site plan of the buried portion of the pipeline. Reference VI for construction information of the buried portion of the pipeline.

The slurry transfer line connects to the existing SY Tank Farm via new jumpers in Valve Pit 241-SY-B. The slurry transfer line connects to the existing 200 East Tank Farms via a new jumper in the 244-A Lift Station. The encasement pipe terminates inside both of these existing pits. Drawings H-2-822300 and H-2-822320 show the jumper arrangement in Valve Pit 241-SY-B and 244-A Lift Station, respectively.

The Diversion Box is located outside of SY Tank Farm. It houses the two booster pumps and also provides a means of future tie-ins to the slurry transfer line. The Vent Station is located approximately half way between 200 East and 200 West.

The Vent Station is the high point of the slurry transfer line to facilitate filling and draining the pipeline. The encasement pipe terminates inside both of these new structures. Drawings H-2-822336 and H-6-13994 show the piping plans in the Diversion Box and Vent Station, respectively.

4.4 COMPONENT DESIGN DESCRIPTIONS

The buried portion of the slurry transfer line consists of a pipe in pipe configuration. The primary pipe is stainless steel and the encasement pipe is carbon steel. The encasement pipe is covered with 2" of rigid polyurethane insulation. The insulation jacket is a multi-directional filament wound, polyester isophthalic resin/fiberglass reinforcement composite directly applied on the foam insulation. The buried pipeline has a continuous leak detection cable inside the annulus space between the primary pipe and the encasement pipe.

Straight runs of the buried pipeline consists of a 3" schedule 40 primary pipe and a 6" schedule 40 encasement pipe. The expansion loops for the slurry transfer line are either 23 ft x 12 ft x 23 ft or 25 ft x 20 ft x 25 ft, depending if the line is the inner or outer pipe on the loop. The encasement pipe at the loops is 12 inch standard weight pipe which reduces down to the 6 inch schedule 40 pipe for the straight runs of pipe. The buried pipeline is an all-welded pipeline with no flanged or mechanical joints. Reference VI for buried pipeline construction information.

The piping inside Valve Pit 241-SY-B and the 244-A Lift Station is remotely installed jumpers. The pipe is 3" stainless steel pipe with no encasement pipe, the concrete pits serve as the secondary containment. The valves in the Valve Pit 241-SY-B are manual ball valves. The valves in the 244-A Lift Station are motor operated ball valves. The encasement pipe terminates inside both pits and are sealed and fitted with manual drain valves. Reference drawings H-2-822300 and H-2-822320 for the Valve Pit 241-SY-B, and 244-A Lift Station jumper arrangements, respectively.

The piping inside the Diversion Box and the Vent Station is all-welded, 3" stainless steel pipe with no encasement pipe. The concrete structures serve as the secondary containment. The encasement pipe terminates inside both structures and is sealed. There are two separate encasement ends inside each structure. The encasement pipe at the low point leaving the Diversion Box is fitted with a leak test port and valve. The encasement pipe at the high point leaving the Diversion Box is fitted with a motor operated drain valve, and a leak test port and valve. Both encasement pipe ends in the Vent Station are fitted with leak test ports and valves. All encasement pipe ends in both structures are fitted with rupture disks. The rupture disks are set to burst at 60 psig. Reference drawings H-2-822336 and H-6-13994 for the Diversion Box and Vent Station piping plans, respectively.

The two booster pumps for the slurry transfer line are identical, but only one pump will be used at a time. The booster pump is a horizontal, 3 x 3 x 8.75A MSE, centrifugal, 9 stage, axially split case pump. The pump has 3" butt weld discharge and suction connections, a maximum speed of 3600 rpm, and is designed in accordance with API 610. The motor is rated at 300 hp at 480 V ac, 60 Hz, 3-phase electrical power and is supplied with a variable speed drive. Ancillary equipment supplied with the pump include casing drain and vent piping with valves and motor operators. The pump, motor, and ancillary equipment are mounted on a common base assembly. Reference VI for complete pump package description and drawings.

Two pump seal control panels are supplied with the booster pump, for a total of four. Each pump seal control panel consists of a coalescing air filter, pressure regulating valve, pressure gauge, flow indicator, pressure switch, flow switch, check valve, and a ball valve. All equipment is mounted in the panels with inlet and outlet connections for the air, and electrical connections for the pressure switch and flow switch. Reference VI for the complete package description and drawing H-2-822400 sheet 2 for the pump seal control panel P&ID.

A multistage orifice is also supplied with each booster pump. The multistage orifice is made of a 2 inch schedule 80, stainless steel pipe with multiple orifices stacked within the pipe. The multistage orifice will be installed between two rupture disks on the bypass line from the pump discharge to pump suction. Reference VI for orifice description and drawings.

The slurry transfer line valves in the Diversion Box and Vent Station are pneumatic operated ball valves. The valves are top entry full port ball valves, 316 stainless steel body and trim, with butt weld ends, double block and bleed, purge ports with drain, anti-fugitive emission bonnet, and pneumatic valve operator. The process valves for the slurry transfer line are 3" ANSI Class 900, while the isolation valves for the vent line in the Vent Station are 1" ANSI Class 1500.

The pneumatic valve operators are double acting piston actuators. Each pneumatic valve operator has a declutchable gear operator, 2 SPDT limit switches, and two integral solenoids. Each pneumatic valve operator has ports for air and electrical connection entry points. The operators are supplied with the ball valves along with a mounting bracket. Reference VI for the complete pneumatic operated ball valve package description and drawings.

The vent line for the slurry transfer line is located in the Vent Station. The vent line is 1" schedule 40, stainless steel pipe. The vent line is supplied with a HEPA filter and the two previously mentioned isolation valves. Reference drawing H-6-13994.

There are two sets of relief valve and rupture disk combinations on the jumper in 244-A Lift Station. The rupture disk is installed on the process side of the relief valve. There is a pressure sensor between the rupture disk and relief valve to detect if the rupture disk has burst or if the rupture disk is leaking. The rupture disk is a 1-1/2" reverse buckling, nonfragmenting, stainless steel rupture disk. The relief valve is a 1-1/2" Class 300 x 2" Class 300, stainless steel relief valve. Reference VI for the complete relief valve and rupture disk combination package description and drawings.

4.5 INSTRUMENTATION AND CONTROL

The slurry transfer line has pressure and temperature monitoring at the Diversion Box 6241-A, Vent Station 6241-V, and 244-A Lift Station. In the Diversion Box temperature sensing is provided by TE-3125A. Pressure sensing is provided by PT-3125A, B, C, and D at each booster pump inlet and outlet. In the Vent Station, temperature sensing is provided by TE-3126B and pressure sensing is provided by PT-3126B. In the 244-A Lift Station, temperature sensing is provided by TE-842. There are also pressure transmitters between isolation valves to detect valve leakage. In the Diversion Box, PT-3183 which is located between valves SOV-3183A and B, will alarm through the MCS if valve SOV-3183A is leaking. In the 244-A Lift Station, PT-842 which is located between valves MOV-844 and 845, will alarm through the MCS if valve MOV-844 is leaking and will shutdown the operating booster pump. Reference drawings H-2-822402, H-2-822403, H-2-822404, and H-2-822405.

Continuous leak detection is provided in the annulus space between the primary pipe and the encasement pipe of the buried pipeline. LDE-3160B and D, LDE-3161B and D, and LDE-3162B and D each represent a continuous leak detection cable. Reference drawings H-2-822403, H-2-822404, and H-2-822405.

Cable LDE-3160B monitors the slurry line from the 241-SY-B Valve Pit to the Diversion Box. Cable LDE-3160D monitors the slurry line extending approximately 4900 feet from the Diversion Box to the Vent Station. The cables are connected to monitoring unit LDK-3160 which is located in the E/I room of the Diversion Box (reference drawing H-2-822421). If a leak is detected, an output alarm contact wired directly from LDK-3160 to Process Control Unit, PCU-2, located in the same room, is activated. The alarm signal is transported via the MCS fiber optic communication network to PCU-1, which contains an output alarm contact that is wired directly to the 200-West Master Pump Shutdown Circuit.

Cable LDE-3161B monitors the slurry line extending approximately 4900 feet from the Vent Station to the Diversion Box from the opposite direction of cable LDE-3160D. Cable LDE-3161D monitors the slurry line extending approximately 5100 feet from the Vent Station to Atlanta Ave. These cables are connected to monitoring unit LDK-3161 which is located in the E/I room of the Vent Station (reference drawing H-6-14034). If a leak is detected, an output alarm contact wired directly from LDK-3161 to PCU-3, located in the same room, is activated, and subsequently inputs a signal to the 200-West Pump Shutdown Circuit via PCU-1.

Cable LDE-3162D monitors the slurry line extending approximately 5000 feet from Atlanta Ave. to the Vent Station from the opposite direction of cable LDE-3161D. Cable LDE-3162B monitors the slurry line extending approximately 6000 feet from Atlanta Ave. to the 244-A Lift Station. These cables are connected to monitoring unit LDK-3162 which is located in a climate controlled NEMA 4X enclosure in the vicinity of Atlanta Ave. (reference drawing H-2-822209) If a leak is detected, an output alarm contact wired directly from LDK-3162 to PCU-4, located in the same enclosure, is activated and subsequently inputs a signal to the 200-West Master Pump Shutdown Circuit via PCU-1.

Each booster pump is controlled by a variable speed drive. The variable speed drive will automatically provide the required flow through the instrumentation signals from the flow meter. The booster pumps are also supplied with instrumentation to monitor bearing temperature, TE-3125A1, A2, B1, and B2; pump vibrations, VT-3125A1, A2, B1, and B2; pump oil level, LSL-3125A1, A2, B1, and B2; and motor winding temperature TSH-3125A and B. Reference VI and drawing H-2-822400.

There are 4 identical pump seal control panels located in the Compressor Room 104 of Diversion Box 6241-A. Each pump seal control panel contains a pressure regulating valve (PCV 3125A1, 3125A2, 3125B1, and 3125B2), pressure gauge (PI 3125A1, 3125A2, 3125B1, 3125B2), pressure switch (PSL 3125A1, etc), flow indicator (FI 3125A1, etc), and a flow switch (FSH 3125A1, etc). The operating pressure for the booster pump seals is controlled by pressure regulating valves which will be set approximately 20 psig above the pump suction pressure. The flow switches and pressure switches monitor for high flow and low pressure which would indicate a pump seal failure. These are interlocked to shut down the booster pump on a pump seal failure. Reference drawings H-2-822406 and H-2-822400 sheets 2 and 3, and VI.

The manual ball valves in Valve Pit 241-SY-B provide local valve position indication. The motor operated ball valves in the 244-A Lift Station provide remote operation and valve position indication. The pneumatic operated ball valves in the Diversion Box and Vent Station provide both local and remote operation and valve position indication. Reference the drawings H-2-822400, H-2-822402, H-2-822403, H-2-822404, and H-2-822405.

Misroute protection interlocks are provided at two locations. The backup flush system tie-in at Valve Pit 241-SY-A is provided with a pressure interlock between the two isolation valves, V-3110 and V-3113. If during a waste transfer the first isolation valve leaks, the pressure interlock will send a signal to the 200 West Master Pump Shutdown circuit. Also if V-3113 is open, an interlock will send a signal to the 200 West Master Shutdown circuit. The high point vent in the Vent Station is provided with a pressure interlock between SOV-3185A and B. If during a waste transfer the first isolation valve leaks, the pressure interlock will shutdown the operating booster pump. Reference drawings H-2-822402, H-2-822403, and H-2-822404.

At the Vent Station there is another pressure interlock which prevents opening of the vent valves SOV-3168A and SOV-3168B if a positive pressure is detected in the pipe. These valves would only be opened during a draining function at which time the pressure at the high point will be negative. Reference drawing H-2-822403.

If a leak is detected in either the Diversion Box or Vent Station sump, the leak detection system will send a signal to the 200-West Master Pump Shutdown Circuit. Reference drawings H-2-822403 and H-2-822404.

Over-pressure protection interlocks are provided to shutdown the booster pump. The booster pump will shutdown on high booster pump discharge pressure, on high pressure in the slurry line in 244-A Lift Station, and if either rupture disk in 244-A Lift Station leaks or bursts. Reference drawings H-2-822403 and H-2-822405.

Miscellaneous booster pump interlocks are also provided to shutdown the booster pump or the Transfer Pump P-102-SY-02A. The booster pump will not be permitted to operate if the associated vent and drain valves are not closed. The operating booster pump will shutdown on high pump bearing temperature, high motor winding temperature, high vibration, low bearing oil level, and on pump seal failure indicated by high air-flow or low air pressure to the pump seal chamber. The booster pump will not be permitted to operate if the inlet pressure is lower than 10 psig. The Transfer Pump P-102-SY-02A will be shutdown if the booster pump inlet pressure reaches 70 psig. However, the Transfer Pump P-102-SY-02A can be reset if required. Reference drawings H-2-822400 and H-2-822403.

4.6 SYSTEM INTERFACES

System interfaces include electrical, instrument air, and the Monitor and Control System (MCS). Electrical power is required for the leak detection system, pipeline pump operation, process instrumentation, and valving. Instrument air is required for remote valve operation in the Diversion Box and the Vent Station. The MCS is required for pipeline process monitoring and remote valve actuation.

4.7 SYSTEM LIMITATIONS, SET POINTS, AND PRECAUTIONS

The operating conditions will vary depending on the fluid being transferred. The maximum operating pressure of the slurry transfer line is limited to 1490 psig by the pressure design of the primary pipe. The rupture disks immediately downstream of the pump discharges are set at 1370 psig. The operating temperature is limited to 35°F minimum to 200°F maximum. The rupture disks protecting the encasement pipe are set at 60 psig. The pressure regulating valves in the pump seal control panels will be set approximately 20 psig above the pump suction pressure

Normal operation involves transferring a radioactive slurry. Variations to the flow rate, pressure, and temperature will be dependent on the fluid being transferred.

5.0 OPERATIONS AND CASUALTY EVENTS

Not Applicable

6.0 MAINTENANCE, INSPECTION, AND SURVEILLANCE

Not Applicable

7.0 TESTING

Inspection and pressure testing of the slurry transfer line was in accordance with the W-058-C1, W-058-C2, and W-058-C3 specifications and ASME B31.3.

Calibration and testing of the pipeline instrumentation will be required on a regular periodic basis.

Chapter 6

SYSTEM OVERVIEW for the SUPERNATE TRANSFER LINE W-058 REPLACEMENT CROSS-SITE TRANSFER SYSTEM

1.0 INTRODUCTION

This document provides a system summary description, function and design requirements, design description, and testing requirements for the Supernate Transfer Line. This line provides a RCRA and WAC compliant pipeline to transfer mixed waste between the SY Tank Farm in 200 West and the 244-A Lift Station in 200 East, a distance of approximately 5 1/2 miles. This line was constructed as part of Project W-058, "Replacement of the Cross Site Transfer System."

2.0 SYSTEM SUMMARY DESCRIPTION

2.1 System Description

The purpose of the supernate transfer line is to provide a RCRA and WAC compliant pipeline connecting the SY Tank Farm in 200 West with the Tank Farms in 200 East. Along the pipeline there is a Diversion Box (6241-A) for future tie-ins and a Vent Station (6241-VS) at the high point to facilitate draining. New piping jumpers were provided in 241-SY-A Valve Pit and the 244-A Lift Station to connect the new pipeline with the existing piping in the SY Tank Farm and 200 East Tank Farms.

2.2 System Boundaries

The pipeline boundaries are the 241-SY-A Valve Pit in the SY Tank Farm and the 244-A Lift Station in 200 East.

2.3 System Interfaces

System interfaces include electrical, instrument air, the Monitor and Control System (MCS), and the sump pump outs. Electrical power is required for the leak detection system, the pipeline process instrumentation, and valving. Instrument air is required for remote valve operation in the Diversion Box and the Vent Station. The MCS is required for leak detection monitoring, pipeline process monitoring, and remote valve actuation. The sump pumps in the Diversion Box and the Vent Station are tied into the supernate line to transfer any fluid in the sump back to the tank farms.

2.4 System Classification

The buried portion of the pipeline and its encasement are Safety Class to mitigate any radioactive release to the environment. The portion of piping in the 241-SY-A Valve Pit, Diversion Box, Vent Station and 244-A Lift Station is not

Safety Class because the surrounding structures provide the mitigating features to prevent a radioactive release to the environment.

3.0 FUNCTION AND DESIGN REQUIREMENTS

3.1 FUNCTIONS

The function of the pipeline is to provide a safe and reliable piping system for transport of pumped radioactive waste. The pipeline is designed to meet all applicable DOE Orders, State and Federal codes and standards.

3.2 SYSTEM DESIGN REQUIREMENTS

3.2.1 Functional and performance requirements

Transferring a radioactive supernate with approximately the same fluid properties of water, the flow rate through the pipeline will be approximately 77 gpm at a SY-102 Tank Pump discharge pressure of 220 psig. The operating pressure is limited to 230 psig by the existing piping and pipe jumpers in both 200 West and 200 East. Operating temperatures will vary with each transfer but are bounded by 35°F for the low and 200°F for the high.

3.2.2 Operability requirements

- Proper installation of applicable piping jumpers and satisfactory completion of pipeline pressure testing.
- Valve lineup completed and verified.
- Encasement and building leak detection systems operable.
- Pit cover blocks installed and diversion box and vent stations secured.
- Interfacing systems of electrical, instrument air and MCS are operable.

3.2.3 System set points

None

3.2.4 System instrumentation and alarms

The pipeline has pressure and temperature monitoring at the Diversion Box 6241-A, Vent Station 6241-V, and 244-A Lift Station, and a continuous, full locating leak detection system.

3.2.5 System interlocks

Misroute protection interlocks are provided at four locations. The backup flush system tie-in at Valve Pit 241-SY-A is provided with a pressure interlock between the two isolation valves, V-3110 and V-3113. If during a waste transfer the first isolation valve leaks, the pressure interlock will send a signal to the 200 West Master Pump Shutdown circuit. Also if V-3113 is open, an interlock will send a signal to the 200 West Master Pump Shutdown circuit. The Diversion Box sump pump tie-in, the Vent Station sump pump tie-in, and the high point vent in the Vent Station are all provided with pressure interlocks between two isolation valves, SOV-3173A and B, SOV-3167A and B, and SOV-3185A and B, respectively. If during a waste transfer the first isolation valve leaks, the pressure interlock will shutdown the transfer pump. In addition, an interlock on the sump pump isolation valves will not allow them to open if there is positive pressure in the supernate line.

At the Vent Station there is another pressure interlock which prevents opening of the vent valves SOV-3185A and SOV-3185B if a positive pressure is detected in the pipe. These valves would only be opened during a draining function at which time the pressure at the high point will be negative.

Leak detection interlocks are also provided on the supernate transfer line. If a leak is detected by the continuous leak detection cable in any segment of the encasement pipe, or either the Diversion Box or Vent Station sump, the leak detection system will send a signal to the nearest PCU which subsequently sends a signal to the 200-West Master Pump Shutdown Circuit.

3.2.6 Maintenance requirements

Maintenance on the pipeline is expected to only be required for the leak detection system, process instrumentation, and valving. The process instrumentation and valving at the 241-SY-A Valve Pit and 244-A Lift Station are installed on removable piping jumpers. Removal of the jumpers will be required to perform maintenance. The instrumentation and valving at the Diversion Box and Vent Station are located below a 3 inch thick steel shield floor. Manned access to these locations is planned. Calculated dose rate for maintenance after the pipeline has been flushed and drained is 0.09 mrem/hr above the shield floor. The valve operators protrude up through the shield floor and therefore can be maintained without removal of any shielding. If maintenance of the valve seats or seals is required the valves are top entry and can be accessed through the hole in the shield floor after removal of the valve operator. The valve bodies have flush ports which have been piped to a location at shield floor level so that flush water can be injected to further decontaminate the valve body before maintenance. The pipeline instrumentation requiring access under the shield floor are the temperature RTD's and pressure transmitters. Spare RTD's have been installed so replacement of an RTD is not anticipated. Access to a pressure transmitter requires removal of a shield plate.

The leak detection system is capable of identifying the location of breaks and shorts on the cable. Though infrequent, when either of these faults occur, an alarm signal is sent through the nearest PCU to the Operating Control Station, located in the 242S control room, which monitors the transfer system alarms. A visible display also appears on the front of the leak detection monitoring unit indicating the type of fault and its location. Pull ports are provided approximately every 300 feet to permit the removal of non-functioning cable.

In addition to the flush ports on the valves previously mentioned, the piping also has easily removable caps at strategic locations to permit hydrolaze cleaning of the piping for decontamination. This may be required for unanticipated maintenance requiring shield floor removal such as valve replacement.

Another component which will require infrequent replacement is the vent filter in the Vent Station. Periodic radiation readings should be taken to determine frequency of replacement and conform to ALARA. The filter is located above the shield floor in a bag-in/bag-out filter housing.

3.2.7 External hazards

The pipeline is either buried or housed in safety class structures and is therefore protected from environmental hazards of wind, lightning and ashfall. The pipeline is exposed to seismic events.

3.2.8 Structural requirements

The pipeline was designed to meet the stress allowables of ASME B31.3, "Process Piping" for pressure design and flexibility design (thermal) as well as occasional loading due to seismic. The insulation jacket for the buried pipeline is designed to withstand a standard HS-20 truck loading as defined in AASHTO HB-15.

3.2.9 Inspection provisions

The pipeline at the Diversion Box and Vent Station has the capability to be internally inspected for corrosion through the flush connections. Also, insulation has been left off the corners to facilitate NDE testing for wall thickness.

Calibration and testing of the pipeline instrumentation will be required on a regular periodic basis as determined by Operations.

Inspection of the vent filter is required periodically for aerosol testing and depending on frequency of transfers, to monitor for radiation level buildup leading to filter replacement.

3.3 SYSTEM DESIGN BASES

3.3.1 Authorization basis

The Authorization Basis for Project W-058 is contained within HNF-SD-WM-BIO-001, Rev. 0-H.

3.3.2 Design inputs

DOE Order 6430.1A- 1989
ASME B&PVC Section VIII - 1992

ASME B31.3 Code - 1996

3.3.3 Design constraints

The designed temperature range for the pipeline is 35-200°F, which is the expected temperature extremes for the system. The designed maximum pressure for the pipeline is 1490 psig which is based on the pressure design of the primary pipe.

3.3.4 Special material or system chemistry considerations

304L stainless steel was selected as the material for the primary piping based on testing and past experience. Testing indicated no signs of abnormal or significant corrosion. Past experience of using 304L stainless steel on site has generally been successful. The only documented cases of material failures resulted from pitting corrosion due to the puddling of liquids at low points. Pitting corrosion from the standing flush water can be minimized in the primary pipe of the supernate transfer line by using pH-adjusted flush water to inhibit corrosion. Reference WHC internal memo 7F540-94-019, "Projects W-058/W-028 Material of Construction Position Paper" for a detailed discussion.

3.3.5 Design analysis and calculations

Calculation #W058-P-006, "Rupture Disk/Relief Valve Sizing"
Calculation #W058-P-011, "Buried Pipeline Heat Loss"
Calculation #W058-P-012, "Booster Pumps TDH Determination"
Calculation #W058-P-013, "SY Valve Pit to DB#1 TDH"
Calculation #W058-P-014, "SY Valve Pit to 107-AP TDH"
Calculation #W058-P-017, "Pipeline Over-pressure Due to Waterhammer"
Calculation #W058-P-018, "Buried Pipeline Stress Analysis"
Calculation #W058-P-019, "Jumper Stress Analysis"
Calculation #W058-P-025, "Jumper Calculations 241-SY-A/B and 244-A"
Calculation #W058-P-026, "Nozzle/Pipe Anchor Analysis"
Calculation #W058-P-031, "DB#1/VS Wall Anchor Analysis"
Calculation #W058-P-032, "Process/Enc Pipe Pressure Design (ASME B31.3)"
Calculation #W058-P-036, "Total Integrated Dose for 40 yr Design Life"
Calculation #W058-P-037, "Building 6241-A, Expected Dose Rates During Transfer"
Calculation #W058-P-038, "Building 5241-V, Expected Dose Rates During Transfer"
Calculation #W058-P-039, "Building 6241-A, Expected Dose Rates for Maintenance"
Calculation #W058-P-040, "Building 6241-V, Expected Dose Rates for Maintenance"
Calculation #W058-P-041, "Buried Transfer Piping, Expected Dose Rates During Transfer"
Calculation #W058-P-043, "DB#1/VS Piping Analysis"
Calculation #W058-P-044, "Piping Pressure Drop/244-A Lift Station to 107-AP and 104-AN Tanks"
Calculation #W058-P-045, "Piping-Commercial Grade Items Evaluation"

3.4 COMPONENT REQUIREMENTS AND BASIS

3.4.1 Major components descriptions

The buried portion of the supernate transfer line consists of a pipe in pipe configuration. The primary pipe is stainless steel and the encasement pipe is carbon steel. The encasement pipe is covered with 2" of rigid polyurethane insulation. The insulation jacket is a multi-directional filament wound, polyester isophthalic resin/fiberglass reinforcement composite directly applied on the foam insulation.

The buried pipeline has a continuous leak detection cable inside the annulus space between the primary pipe and the encasement pipe. The continuous leak detection system consists of three monitoring units, one located in the E/I room of the Diversion Box, one located in the E/I room of the Vent Station, and one in an outdoor enclosure near Atlanta Ave in the 200 East area. Each monitoring unit is capable of monitoring up to 6000 feet of sensing cable in either direction, allowing it to monitor 12,000 feet of pipeline for leaks.

The valves for the supernate transfer line are all located within the previously mentioned structures, there are no buried valves. The valves in the Valve Pit 241-SY-A are manual valves. The valves in the 244-A Lift Station are motor operated valves. The valves in the Diversion Box and Vent Station are pneumatic operated ball valves.

The vent line for the supernate transfer line is located in the Vent Station. The vent line is supplied with a HEPA filter and two isolation valves. The sump pumps for the Diversion Box and the Vent Station are tied into the supernate transfer line.

3.4.2 Required functions

The function of the supernate transfer line is to provide a pipeline connecting the SY Tank Farm in 200 West with the Tank Farms in 200 East. This pipeline can be used to transfer liquid waste in either direction between 200 East and 200 West. The valves in the supernate transfer line are used for isolation and transfer routing. The vent line on the pipeline is required to break the vacuum at the high point of the pipeline to facilitate draining the line. The leak detection system is required to identify any leaks that may occur along the entire supernate transfer line.

3.4.3 Design basis

The supernate transfer line is designed to withstand liquid temperatures ranging from 35 to 200 °F. The maximum operating pressure of the supernate transfer line primary pipe is 230 psig, based on the existing tank farm transfer piping. However, the primary pipe is designed to withstand 1490 psig which is the design pressure of the slurry transfer line. The design pressure of the encasement pipe is 50 psig. This design pressure is not based on the maximum pressure capability of the encasement pipe but is selected to minimize the required pneumatic test pressure and still accommodate the maximum pressure the encasement pipe would experience if the primary pipe leaked into the encasement and filled it. The maximum allowable pressure of the encasement pipe is 590 psig, which is based on the maximum pressure on the encasement pipe enclosure end plates.

The design of the buried pipe for the supernate transfer line incorporates expansion loops and concrete anchors. A typical expansion loop design is used to maximize the length between expansion loops thus minimizing the number of expansion loops used. The expansion loops for the supernate transfer line are either 23 ft x 12 ft x 23 ft or 25 ft x 20 ft x 25 ft, depending on if the line is the inner or outer pipe on the loop. The encasement pipe at the loops is 12 inch standard weight pipe which reduces down to the 6 inch schedule 40 pipe for the straight runs of pipe. The larger pipe at the expansion loops is designed to accommodate the expansion of the primary pipe. The anchor between each expansion loop is designed to force the thermal expansion of the primary pipe into the expansion loop. The anchors at the corners, or change in direction of the pipeline, are designed to withstand the thrust forces developed by the encasement pipe, both thermally and seismically. The anchors outside each of the buried structures are designed to reduce the anchor forces at the wall of the structures.

The piping inside the Diversion Box, Vent Station, Valve Pit 241-SY-A, and the 244-A Lift Station is 3" stainless steel pipe with no encasement pipe. The encasement pipe terminates and is sealed inside each of these structures. Each segment of the encasement pipe is fitted with a drain valve at each end. Leak test ports and shut off valves are fitted at each encasement end inside the Diversion Box and the Vent Station. Rupture disks are fitted at each encasement end inside the Diversion Box and the Vent Station to protect the encasement pipe from over-pressurization. The burst pressure of the rupture disks is 60 psig which is based on 20% above the encasement pipe design pressure.

The piping inside the Diversion Box and the Vent Station is designed with strategically located removable caps. These caps permit hydrolaze cleaning of the piping inside the structures. These caps are designed for the same pressures and temperatures as the pipe.

The pneumatic operated ball valves in the Diversion Box and the Vent Station are rated for 200°F and 1490 psig. The pneumatic valve operators were supplied with the ball valves.

The design of the pneumatic operated ball valves considered minimum radiation exposure for maintenance personnel. The valve operators protrude up through the shield floor and can be maintained without removal of any shielding. The valve bodies have flush ports so the valve body can be flushed before maintenance. If maintenance of the valve seats or seals is required the valves are top entry and can be accessed through the hole in the shield floor after removal of the valve operator.

The valves in the Valve Pit 241-SY-A and 244-A Lift Station are rated for 200°F and 400 psig.

The design of the supernate transfer line incorporates a continuous slope of at least 0.25% to facilitate draining. The transfer line is also designed to minimize the settling of solids in the pipes, pipe fittings, and other components.

The leak detection system will identify the presence of a liquid at any point along its sensing cable and indicate its location within +/- five feet. The cable is designed to withstand the effects of a radioactive liquid.

3.4.4 Component function

The supernate transfer line has two modes of operation, run and standby. The run mode consists of all activities required for a transfer. First the valves are lined up for proper transfer routing; next, the line is preheated with water if necessary; next a transfer is performed; then the pipeline is flushed and drained; and finally the valves are repositioned to a non-transfer condition. The standby mode includes all down time between transfers.

3.4.5 Design basis satisfaction

The supernate transfer line satisfies the system design basis. The system provides a RCRA and WAC compliant pipeline connecting the SY Tank Farm in 200 West with the Tank Farms in 200 East.

4.0 DESIGN DESCRIPTION

4.1 DETAILED SYSTEM DESCRIPTION

The supernate transfer line provides a pipeline to transfer mixed waste between the SY Tank Farm in 200 West and the 244-A Lift Station in 200 East. The supernate transfer line connects to the existing SY Tank Farm via new jumpers in Valve Pit 241-SY-A. The supernate transfer line connects to the existing 200 East Tank Farms via a new jumper in the 244-A Lift Station. Two new structures are a part of the supernate transfer line, the Diversion Box 6241-A, and the Vent Station 6241-V. The Diversion Box is located outside the SY Tank Farm and provides a means of future tie-ins to the supernate transfer line. The Vent Station is located approximately half way between 200 East and 200 West. The Vent Station is the high point of the supernate transfer line and will facilitate filling and draining the pipeline. The transfer line is designed with a continuous slope of at least 0.25% to facilitate draining.

The supernate transfer line can be used to transfer liquid waste in either direction between 200 East and 200 West. The liquid wastes will have approximately the same fluid properties as water. The maximum operating pressure of the pipeline is limited to 230 psig by the existing piping and pipe jumpers in 200 East and 200 West. The operating temperatures range from 35°F to 200°F.

The supernate transfer line has two modes of operation, run and standby. The run mode consists of all activities required for a transfer. First the valves are lined up for proper transfer routing; next, the line is preheated with water if necessary; next a transfer is performed; then the pipeline is flushed and drained; and finally the valves are repositioned to a non-transfer condition. The standby mode includes all down time between transfers.

The buried portion of the supernate transfer line consists of a pipe in pipe configuration. The primary pipe is stainless steel and the encasement pipe is carbon steel. The encasement pipe is covered with 2" of rigid polyurethane insulation. The insulation jacket is a multi-directional filament wound, polyester isophthalic resin/fiberglass reinforcement composite directly applied on the foam insulation. The buried pipeline has a continuous leak detection cable inside the annulus space between the primary pipe and the encasement pipe. Reference VI for buried pipeline construction information.

The pipe inside the Diversion Box, Vent Station, Valve Pit 241-SY-A, and the 244-A Lift Station is 3" stainless steel pipe with no encasement pipe. The encasement pipe terminates inside each of these structures. Reference drawings H-2-822336 for the Diversion Box piping plan. Reference drawing H-6-13994 for the Vent Station piping plan. Reference drawings H-2-822290 and H-2-822320 for the Valve Pit 241-SY-A and 244-A Lift Station jumper arrangements, respectively.

The valves for the supernate transfer line are all located within the previously mentioned structures, there are no buried valves. The valves in the Valve Pit 241-SY-A are manual ball valves. The valves in the 244-A Lift Station are motor operated ball valves. The valves in the Diversion Box and Vent Station are pneumatic operated ball valves.

The vent line for the supernate transfer line is located in the Vent Station. The vent line is supplied with a HEPA filter and two isolation valves. The sump pumps for the Diversion Box and the Vent Station are tied into the supernate transfer line. Reference drawings H-2-822336 and H-6-13994.

4.2 SYSTEM PERFORMANCE CHARACTERISTICS

The supernate transfer line has two modes of operation, run and standby. The run mode consists of all activities required for a transfer. The standby mode includes all down time between transfers.

Before each transfer, the valves are lined up for the routing required by the transfer. Once the route is set, the valves will interlock to prevent a misrouting. The pipeline will then be filled with water to minimize vapor entrapment and water hammer. Heated water may be used if required for preheating the pipeline.

Once the proper transfer parameters are determined (ie; pressures, and temperatures), the transfer is started. During the transfer, personnel shall monitor the system for proper operation. Parameters to be monitored include pump pressures, fluid temperature, primary pipe leaks, and any leaks through isolation valves.

After the transfer is completed, the pipeline will be flushed. The flush water will normally be supplied by the facility originating the transfer. Once flushing is completed, the pipeline will be drained. The isolation valves in the Vent Station will be opened, only if a negative pressure is detected in the pipeline at the Vent Station. The Vent Station is the high point of the pipeline, and opening the vent will break the vacuum and allow the flush water to drain to both ends of the pipeline.

Finally the valves are repositioned to a non-transfer condition. In this condition, the supernate transfer line will remain in the standby mode until another transfer is required.

4.3 SYSTEM ARRANGEMENT

The supernate transfer line provides a pipeline to transfer mixed waste between the SY Tank Farm in 200 West and the 244-A Lift Station in 200 East. The supernate transfer line uses two existing structures, Valve Pit 241-SY-A and the 244-A Lift Station. The supernate transfer line also uses two new structures, Diversion Box 6241-A and Vent Station 6241-V. Drawing H-2-822201 shows the civil site plan of the buried portion of the pipeline. Reference VI for construction information of the buried portion of the pipeline.

The supernate transfer line connects to the existing SY Tank Farm via new jumpers in Valve Pit 241-SY-A. The supernate transfer line connects to the existing 200 East Tank Farms via a new jumper in the 244-A Lift Station. The encasement pipe terminates inside both of these existing pits. Drawings H-2-822290 and H-2-822320 show the jumper arrangement in Valve Pit 241-SY-A and 244-A Lift Station, respectively.

The Diversion Box is located outside of SY Tank Farm and provides a means of future tie-ins to the supernate transfer line. The Vent Station is located approximately half way between 200 East and 200 West. The Vent Station is the high point of the supernate transfer line to facilitate filling and draining the pipeline. The encasement pipe terminates inside both of these new structures. Drawings H-2-822336 and H-6-13994 show the piping plans in the Diversion Box and Vent Station, respectively.

4.4 COMPONENT DESIGN DESCRIPTIONS

The buried portion of the supernate transfer line consists of a pipe in pipe configuration. The primary pipe is stainless steel and the encasement pipe is carbon steel. The encasement pipe is covered with 2" of rigid polyurethane insulation. The insulation jacket is a multi-directional filament wound, polyester isophthalic resin/fiberglass reinforcement composite directly applied on the foam insulation. The buried pipeline has a continuous leak detection cable inside the annulus space between the primary pipe and the encasement pipe.

Straight runs of the buried pipeline consists of a 3" schedule 40 primary pipe and a 6" schedule 40 encasement pipe. The expansion loop for the supernate transfer line are either 23 ft x 12 ft x 23 ft or 25 ft x 20 ft x 25 ft, depending on if the line is the inner or outer pipe on the loop. The encasement pipe at the loops is 12 inch standard weight pipe which reduces down to the 6 inch schedule 40 pipe for the straight runs of pipe. The buried pipeline is an all-welded pipeline with no flanged or mechanical joints.

The piping inside Valve Pit 241-SY-A and the 244-A Lift Station are remotely installed jumpers. The pipe is 3" stainless steel pipe with no encasement pipe, the concrete pits serve as the secondary containment. The valves in Valve Pit 241-SY-A are manual ball valves. The valves in the 244-A Lift Station are motor operated ball valves. The encasement pipe terminates inside both pits and is sealed and fitted with manual drain valves. Reference drawings H-2-822290 and H-2-822320 for the Valve Pit 241-SY-A and 244-A Lift Station jumper arrangements, respectively.

The piping inside the Diversion Box and the Vent Station are all-welded, 3" stainless steel pipe with no encasement pipe. The concrete structures serve as the secondary containment. The encasement pipe terminates inside both structures and is sealed. There are two separate encasement ends inside each structure for the supernate line. The encasement pipe at the low point leaving the Diversion Box is fitted with a leak test port and valve. The encasement pipe at the high point leaving the Diversion Box is fitted with a motor operated drain valve, and a leak test port and valve. Both encasement pipe ends in the Vent Station are fitted with leak test ports and valves. All encasement pipe ends in both structures are fitted with rupture disks. The rupture disks are set to burst at 60 psig. Reference drawings H-2-822336 and H-6-13994 for the Diversion Box and Vent Station piping plans, respectively.

The supernate transfer line valves in the Diversion Box and Vent Station are pneumatic operated ball valves. The valves are top entry full port ball valves, 316 stainless steel body and trim, with butt weld ends, double block and bleed, purge ports with drain, anti-fugitive emission bonnet, and pneumatic valve operator. The process valves for the supernate transfer line are 3" ANSI Class 900, while the isolation valves for the vent line in the Vent Station are 1" ANSI Class 1500.

The pneumatic valve operators are double acting piston actuators. Each pneumatic valve operator has a declutchable gear operator, 2 SPDT limit switches, and two integral solenoids. Each pneumatic valve operator has ports for air and entries for electrical connections. The operators are supplied with the ball valves along with a mounting bracket. Reference VI for the complete pneumatic operated ball valve package description and drawings.

The vent line for the supernate transfer line is located in the Vent Station. The vent line is 1" schedule 40, stainless steel pipe. The vent line is supplied with a HEPA filter and the two previously mentioned isolation valves. The sump pumps for the Diversion Box and the Vent Station are tied into the supernate transfer line. Reference drawings H-2-822336 and H-6-13994.

4.5 INSTRUMENTATION AND CONTROL

The supernate transfer line has pressure and temperature monitoring at the

Diversion Box 6241-A, Vent Station 6241-V, and 244-A Lift Station. In the Diversion Box, temperature sensing is provided by TE-3125B and pressure sensing is provided by PT-3125E. In the Vent Station, temperature sensing is provided by TE-3126A and pressure sensing is provided by PT-3126A. In 244-A Lift Station, temperature sensing is provided by TE-841. There are also pressure transmitters between isolation valves to detect valve leakage. In the Diversion Box, PT-3182 which is located between valves SOV-3182A and B, will alarm through the MCS if valve SOV-3182A is leaking. In the 244-A Lift Station, PT-841 which is located between valves MOV-843 and 846, will alarm through the MCS if valve MOV-843 is leaking. Reference the drawings H-2-822402, H-2-822403, H-2-822404, and H-2-822405.

Continuous leak detection is provided in the annulus space between the primary pipe and the encasement pipe of the buried pipeline. LDE-3160A and C, LDE-3161A and C, and LDE-3162A and C each represent a continuous leak detection cable. Reference the drawings H-2-822403, H-2-822404, and H-2-822405.

Cable LDE-3160A monitors the supernate line from the 241-SY-A Valve Pit to the Diversion Box. Cable LDE-3160C monitors the supernate line extending approximately 4900 feet from the Diversion Box to the Vent Station. The cables are connected to monitoring unit LDK-3160 which is located in the E/I room of the Diversion Box (reference drawing H-2-822421). If a leak is detected, an output alarm contact wired directly from LDK-3160 to Process Control Unit, PCU-2, located in the same room, is activated. The alarm signal is transported via the MCS fiber optic communication network to PCU-1, which contains an output alarm contact that is wired directly to the 200-West Master Pump Shutdown Circuit.

Cable LDE-3161A monitors the supernate line extending approximately 4900 feet from the Vent Station to the Diversion Box from the opposite direction of cable LDE-3160C. Cable LDE-3161C monitors the supernate line extending approximately 5100 feet from the Vent Station to Atlanta Ave. These cables are connected to monitoring unit LDK-3161 which is located in the E/I room of the Vent Station (reference drawing H-6-14034). If a leak is detected, an output alarm contact wired directly from LDK-3161 to PCU-3, located in the same room, is activated, and subsequently inputs a signal to the 200-West Pump Shutdown Circuit via PCU-1.

Cable LDE-3162C monitors the supernate line extending approximately 5000 feet from Atlanta Ave. to the Vent Station from the opposite direction of cable LDE-3161C. Cable LDE-3162A monitors the supernate line extending approximately 6000 feet from Atlanta Ave. to the 244-A Lift Station. These cables are connected to monitoring unit LDK-3162 which is located in a climate controlled NEMA 4X enclosure in the vicinity of Atlanta Ave. (reference drawing H-2-822209). If a leak is detected, an output alarm contact wired directly from LDK-3162 to PCU-4, located in the same enclosure, is activated and subsequently inputs a signal to the 200-West Master Pump Shutdown Circuit via PCU-1.

The manual ball valves in Valve Pit 241-SY-A provide local valve position indication. The motor operated ball valves in the 244-A Lift Station provide remote operation and valve position indication. The pneumatic operated ball valves in the Diversion Box and Vent Station provide both local and remote operation and valve position indication. Reference the drawings H-2-822400, H-2-822402, H-2-822403, H-2-822404, and H-2-822405.

Misroute protection interlocks are provided at four locations. The backup flush system tie-in at Valve Pit 241-SY-A is provided with pressure transmitters PT-3113 and PT-3113A and interlock between the two isolation valves, V-3110 and V-3113. If during a waste transfer the first isolation valve leaks, the pressure interlock will send a signal to the 200 West Master Shutdown circuits. Also if V-3113 is open, an interlock will send a signal to the 200 West Master Shutdown circuits. The Diversion Box sump pump tie-in, the Vent Station sump pump tie-in, and the high point vent in the Vent Station are all provided with pressure transmitters and interlocks between two isolation valves; PT-3173 between SOV-3173A and B, PT-3167 between SOV-3167A and B, and PT-3185 between SOV-3185A and B, respectively. If during a waste transfer the first isolation valve leaks, the pressure interlock will shutdown the transfer pump. Reference drawings H-2-822402, H-2-822403, and H-2-822404. In addition, an interlock on the sump pump isolation valves will not allow them to open if there is positive pressure in the supernate line.

At the Vent Station there is a pressure interlock which prevents opening of the vent valves SOV-3185A and SOV-3185B if a positive pressure is detected in the pipe. These valves would only be opened during a draining function at which time the pressure at the high point will be negative. Reference drawing H-2-822403.

If a leak is detected in either the Diversion Box or Vent Station sump, the leak detection system will send a signal to the 200-West Master Pump Shutdown Circuit.

4.6 SYSTEM INTERFACES

System interfaces include electrical, instrument air, the Monitor and Control System (MCS), and the sump pumpouts. Electrical power is required for the leak detection system, the process pipeline instrumentation, and valving. Instrument air is required for remote valve operation in the Diversion Box and the Vent Station. The MCS is required for pipeline process monitoring and remote valve actuation. The sump pumps in the Diversion Box and the Vent Station are tied into the supernate line to transfer any fluid in the sump back to the tank farms.

4.7 SYSTEM LIMITATIONS, SET POINTS, AND PRECAUTIONS

The operating conditions will vary depending on the fluid being transferred. The maximum operating pressure of the supernate transfer line is limited to 230 psig by the existing piping and pipe jumpers in both 200 West and 200 East. The operating temperature is limited to 35°F minimum to 200°F maximum. The rupture disks protecting the encasement pipe are set at 60 psig.

Normal operation involves transferring a radioactive supernate with approximately the same fluid properties of water. The normal flow rate through the pipeline will be approximately 77 gpm at a SY-102 Tank Pump discharge pressure of 220 psig. Variations to the flow rate, pressure, and temperature will be dependent on the fluid being transferred.

5.0 OPERATIONS AND CASUALTY EVENTS

Not Applicable

6.0 MAINTENANCE, INSPECTION, AND SURVEILLANCE

Not Applicable

7.0 TESTING

Inspection and pressure testing of the supernate transfer line was in accordance with the W-058-C1, W-058-C2, and W-058-C3 specifications and ASME B31.3.

Calibration and testing of the pipeline instrumentation will be required on a regular periodic basis.

Chapter 7

SYSTEM OVERVIEW for the BACKUP FLUSH SYSTEM W-058 REPLACEMENT CROSS-SITE TRANSFER SYSTEM

1.0 INTRODUCTION

This document provides a system summary description, function and design requirements, design description, and testing requirements for the Backup Flush System. This system provides backup flush capabilities for the cross site transfer lines. This system was constructed as part of Project W-058, "Replacement of the Cross Site Transfer System."

2.0 SYSTEM SUMMARY DESCRIPTION

2.1 System Description

The backup flush system shall provide an independent source of flush water to provide added protection in case normal flushing equipment fails. The backup flush system consists of a flush tank, flush pump, a skid mounted electric circulation heater package, and a skid mounted chemical injection package. The flush tank will be filled with water from a raw water connection. Before each transfer is started, the backup flush system must be available. If needed for a flush, the system can pump the flush water to either the slurry or the supernate transfer line.

2.2 System Boundaries

The majority of the backup flush system is located adjacent to the 242-S Building. The flush tank TK-302-C, is an existing tank, which is adjacent to the 242-S Building. The flush pump is located inside the tank containment wall. The skid mounted electric circulation heater package and the skid mounted chemical injection package are located on a concrete slab next to tank TK-302-C. The raw water connection for the supply water for the system is located in the Service Pit outside the 241-SY Tank Farm. The connection to the Cross Site Transfer System is located in Valve Pit 241-SY-A in the tank farm.

2.3 System Interfaces

Interfacing systems necessary for the backup flush system to perform its functions are the 480 V ac, 60 Hz, 3-phase electrical power supply and the 4" raw water supply. The Monitoring and Control System (MCS) will provide remote indication and control of the backup flush system.

2.4 System Classification

One component, indication of leakage through the isolation valves, is a Safety

Class component which is required to mitigate radioactive release to the environment. The remainder of the backup flush system is not safety significant because it does not mitigate any radioactive release to the environment.

3.0 FUNCTION AND DESIGN REQUIREMENTS

3.1 FUNCTIONS

- Provide an independent water source for backup flushing.
- Provide a 6 ft/sec flush velocity.
- Provide 140°F flush water to the suction of the booster pump.

3.2 SYSTEM DESIGN REQUIREMENTS

3.2.1 Functional and performance requirements

Independent water source for backup flushing.

Flow requirement of 140 gpm which corresponds to a flow velocity of 6 ft/sec in 3 inch schedule 40 pipe.

The temperature of the flush water shall be 140°F.

Conditioning of the flush water pH level.

The net positive suction head at the suction of the booster pump shall be a minimum of 20 ft.

3.2.2 Operability requirements

The electrical power supply and the raw water supply will need to be reliable for the backup flush system to operate.

3.2.3 System set points

The flush pump has a constant speed motor and shall produce a flow rate of 140 gpm for the designed system.

The normal flow rate of the skid mounted chemical injection package is approximately 12 gph corresponding to the normal flow rate of the raw water filling the flush tank.

Control valve V-3186A shall be normally set at 170 gpm to fill the flush tank.

Control valve V-3187A shall be normally set at 140 gpm when recirculating water back into the flush tank.

Temperature controllers TIC 302C-4C and TIC 302C-4D will be set at 140°F to control the temperature of the flush water.

3.2.4 System instrumentation and alarms

The flow rate of the chemical injection package is controlled automatically. A flow meter on the raw water supply line will send a signal to the flow controller on the metering pump of the chemical injection package. The flow rate of the metering pump will be adjusted based on a preset ratio of the flow rate of the raw water filling the flush tank.

The electric circulation heating package will be controlled locally. Although it has the capability and is pre-wired by the vendor to be controlled remotely, it is not connected to any remote controllers. Temperature controllers will control the temperature of the heaters and water. The high temperature alarms will alarm locally and also remotely through the MCS if the heating elements in the electric circulation heaters start to overheat.

Flow meters, pressure gauges, and temperature elements installed in the flush system piping shall indicate operating conditions of the flush system.

3.2.5 System interlocks

Water level indicators in the flush tank are interlocked with the flush pump. The flush pump will shutdown when the low water level is reached. Reference drawing H-2-822409 sheet 1 for the flush system P&ID. Temperature controllers and flow switches will be interlocked with the electric circulation heaters. The electric circulation heaters will shutdown when a high temperature is reached or a low flow is measured to protect the heating elements. Reference drawing H-2-822400 sheet 1 for the electric circulation heating system P&ID. Two redundant pressure transmitters between the two ball valves in series with a check valve will be interlocked with the booster pump. The booster pump will shutdown when a pressure is detected between the valves which indicates a valve seal leak. Reference drawing H-2-822402 sheet 1 for the SY Valve Pit P&ID.

3.2.6 Maintenance requirements

Standard maintenance, calibration, and servicing is expected on the backup flush system. The design of the flush system provides easy access to all equipment and instrumentation. The area adjacent to the 242-S Building where the flush tank is located is not a radiological controlled area. Valve Pit 241-SY-A is the only radiological area associated with the backup flush system.

3.2.7 External hazards

The backup flush system is located outdoors. The backup flush system was designed for temperature extremes of -20 to 120°F, humidity of 20 to 100%, moisture protection, snow loads, wind loads, and seismic loads. There are no provisions for fire protection, flood protection, and lighting protection.

3.2.8 Structural requirements

The flush tank, piping, pipe supports, and equipment supports were all designed to withstand seismic loads and wind loads up to 70 mph.

3.2.9 Inspection requirements

The safety class items procured as commercial grade items will be inspected prior to installation. The inspection will verify general configuration with specification and vendor data, and will also verify pressure and temperature ratings and materials.

Calibration and testing of the instrumentation will be required on a regular periodic basis. There are no special inspection requirements for the remainder of the backup flush system equipment other than ensuring that the equipment operates as intended.

3.3 SYSTEM DESIGN BASES

3.3.1 Authorization basis

The authorization basis is described in HNF-SD-WM-BIO-001, Rev. 0-H. The backup flush system is required to provide backup flushing at 6 ft/sec from an independent water source, with pH-adjusted water at 140°F.

3.3.2 Design inputs

DOE Order 6430.1A - 1989
ASME B&PVC Section VIII - 1992
ASME B31.3 Code - 1996
NEMA ICS 6 - 1993
UL Electrical Appliance and Utilization Eqmt Directory - 1996

3.3.3 Design constraints

The limiting pressure and temperature rating is based on the pressure vessels used for the electric circulation heaters. The pressure vessels will be ASME Section VIII certified and stamped for 250 psig and 180°F.

3.3.4 Special material or system chemistry considerations

Not Applicable

3.3.5 Design analysis and calculations

Calculation # W058-P-005, "Emergency Flush System LCCA"
Calculation # W058-P-033, "Tank 242-S-302C Seismic Analysis"
Calculation # W058-P-034, "Tank 242-S-302C Heater Sizing"
Calculation # W058-P-035, "Tank SW-TK-3101A vs. Tank 242-S-302C LCCA"
Calculation # W058-P-045, "Piping - Commercial Grade Items Evaluation"

Calculation # W058-P-046, "Flush System Hydraulic Analysis"
Calculation # W058-P-047, "Flush System Pipe Stress Analysis"

3.4 COMPONENT REQUIREMENTS AND BASIS

3.4.1 Major components descriptions

The water flush tank is a 20 ft diameter x 20 ft tall stainless steel tank with 2 inches of fiberglass insulation. The total volume of the tank is 47,000 gallons.

The flush pump is a horizontal end suction centrifugal pump.

The skid mounted electric circulation heater package consists of two 498 kW electric circulation heaters, associated controls and valves.

The skid mounted chemical injection package consists of a diaphragm metering pump with electronic capacity controller, pulsation dampener with pressure gauge, back pressure valve, safety relief valve, and a pressure gauge with isolation valve.

There are two ball valves in series with a check valve on the flush water jumper in Valve Pit 241-SY-A. There are two control valves in the system, one on the raw water supply line and the other on the recirculation line. The remainder of the valves are isolation valves.

The caustic drum heater is a 1500 W flexible drum heater and there is also a removable, moisture resistant insulating blanket.

3.4.2 Required functions

The water flush tank is the independent water source for the backup flush system. The flush pump will be used for recirculation back to the tank and also to provide the backup flush water to the booster pump in Diversion Box 6241-A. The skid mounted electric circulation heater package will provide the heat for the flush water and also provide freeze protection for the water in the flush tank. The skid mounted chemical injection package will provide sodium hydroxide to the flush system to increase the pH of the flush water as required. The two ball valves and the check valve in the flush water jumper are required for backflow prevention. The two control valves will be used to control the flow of the raw water into the flush tank and to control the recirculation flow back into the flush tank. The remainder of the valves are required for shut-off and flow routing. The drum heater will be used to maintain the temperature of the sodium hydroxide in the 55 gallon drum as required.

3.4.3 Design basis

The flush tank is designed to provide an independent water source for backup flushing. It is assumed that 2 system volumes of the cross site transfer system, approximately 24,000 gallons, is required for flushing. The 47,000 gallon capacity of the flush tank is more than adequate for flushing.

The design of the flush system requires the pump to produce 140 gpm at 240 ft of head. These flow conditions will provide a net positive suction head of 50 ft at the intake of the booster pump in Diversion Box 6241-A. The designed minimum net positive suction head at the booster pump is 20 ft. The net positive suction head required for the flush pump is approximately 8 ft. The minimum water level in the tank will be set at 5 ft.

The skid mounted electric circulation heater package is designed to provide a 140°F flush water temperature. The two heaters (498 kW each) are designed to produce a maximum temperature increase of 40°F for water flowing at 140 gpm. Operating at maximum capacity, the system will take 8.4 hours to heat the water in the flush tank to 100°F. The final temperature increase to 140°F will occur in-line during a flush. Each heater has a SCR temperature controller that can be adjusted as required for operation and the system can be operated with one or both heaters being on. It is anticipated that only one heater will be required for freeze protection.

The skid mounted chemical injection package is designed to condition the flush water to a pH between 11 and 12. The maximum flow rate of the chemical injection package is 14 gph of 25% sodium hydroxide solution. The flow rate of the chemical injection package is proportional to the flow rate of the raw water filling the flush tank.

The two ball valves, the check valve, and the redundant pressure tranmitters were designed to prevent backflow of radioactive wastes, during transfers, into the flush system. The two ball valves are manual and lockable valves. These ball valves will be administratively controlled and locked closed prior to any waste transfers.

Control valve V-3186A regulates the flow of the raw water into the flush tank and maintains reasonable flow velocities. The maximum flow rate is 350 gpm and the minimum flow rate is 80 gpm. Control valve V-3187A regulates the recirculation flow back into the tank and allows the flush pump to operate under design conditions. The maximum flow rate is 142 gpm and the minimum flow rate is 2 gpm. All other valves are used as isolation valves.

The flexible drum heater is designed to maintain the temperature of the sodium hydroxide in the 55 gallon drum. The rating of the heater is 1500 W at 240 V. However, the heater shall be operated on 120 V to reduce the wattage of the heater to 375 W. This low wattage is required to prevent melting of the polyethylene drum. An insulating cover shall be used to increase the efficiency of the heater. It is anticipated that the heater will only be used when the outdoor temperatures are low. The sodium hydroxide solution will only be required when filling the flush tank so the majority of the time the drum will not be required.

The raw water pipe supplying the backup flush system is designed without insulation or heat tracing. The line does not supply heated water so there is no concern for minimizing heat loss. The line is also designed to be completely drained after use so there is no concern for freeze protection of trapped water in the line.

The service water pipe above grade is insulated and heat traced to minimize heat loss and for freeze protection. The buried service water pipe, up to the existing 4" buried pipe (see Section 4.3 SYSTEM ARRANGEMENT) is encased, insulated, and heat traced. This pipe is designed with encasement piping to contain any leaks for water provided by another project that may exceed a pH of 12.5. This pipe is also designed with insulation and heat tracing to minimize heat loss and for freeze protection.

3.4.4 Component function

There are four modes of operation for the backup flush system. The initial mode is to fill the flush tank with water from the raw water source in the service pit at 241-SY. Control valve V-3186A will regulate the flow of water into the tank. The skid mounted chemical injection package will add the sodium hydroxide to the water filling the tank to increase the pH.

The next mode of operation for the backup flush system is between transfers. The flush system will be inactive for long periods of time. However, if the temperature of the water in the tank approaches freezing, the system will operate in a recirculation mode. The flush pump will recirculate the tank water with the flow back into the tank being controlled by control valve V-3187A. The skid mounted electric circulation heater package will heat the water to prevent freezing.

The next mode of operation for the backup flush system occurs before each transfer. The flush pump will recirculate the tank water with the control valve controlling flow back into the tank. The skid mounted electric circulation heater package will heat the water. The system will continue to recirculate until the water temperature in the tank reaches 100°F. Now the system is ready and a transfer can occur.

The final mode of operation for the backup flush system would occur in an emergency. The system would be used for a flush of the Cross Site Transfer System. The system would pump the flush water from the flush tank through the skid mounted electric circulation heater package to raise the temperature to 140°F. From there the flush water would continue on to the 241-SY-A Valve Pit and to the booster pump in Diversion Box 6241-A.

3.4.5 Design basis satisfaction

The major components of the backup flush system satisfy the system design basis. The flush tank provides the independent water source and the flush pump provides flushing at 6 ft/sec. The skid mounted electric circulation heater package heats the flush water to 140°F and the skid mounted chemical injection package conditions the flush water pH.

4.0 DESIGN DESCRIPTION

4.1 DETAILED SYSTEM DESCRIPTION

The majority of the backup flush system is located adjacent to the 242-S Building. The major components at this location include the flush tank, flush pump, skid mounted electric circulation heater package, skid mounted chemical injection package, two control valves, and various valves and instrumentation. The raw water connection for the supply water for the system is located in the service pit outside the 241-SY Tank Farm. The connection to the cross site transfer piping is located in Valve Pit 241-SY-A in the tank farm. The major components at this location include the two ball valves and the check valve in series.

The backup flush system provides an independent water source for backup flushing. The system pumps water at 140 gpm which corresponds to 6 ft/sec in 3 inch schedule 40 pipe. The flush water temperature is 140°F and is conditioned to a pH above 7.

The flush tank will initially be filled with water from the raw water connection. The chemical injection package will regulate the amount of sodium hydroxide to add to the raw water filling the flush tank. During periods between transfers, the flush system will be inactive. However, if required, the water from the tank will be recirculated through the electric circulation heaters for freeze protection. Before each transfer, the water will be recirculated through the heaters to bring the water up to 100°F. If the flush system is needed for a flush, the system will pump the flush water through the electric circulation heaters to raise the temperature to 140°F. From there the flush water would continue on to the 241-SY-A Valve Pit and to the booster pump in Diversion Box 6241-A. Reference drawing H-2-822409 for the flush system P&ID.

The water flush tank is a 20 ft diameter x 20 ft tall stainless steel tank with 2 inches of fiberglass insulation. The total volume of the tank is 47,000 gallons.

The flush pump is a horizontal end suction centrifugal pump. Reference CVI for pump information and drawings.

The skid mounted electric circulation heater package consists of two 498 kW electric circulation heaters, two SCR control panels, and associated instrumentation and valves. Reference CVI for package information and drawings.

The skid mounted chemical injection package consists of a diaphragm metering pump with electronic capacity controller, pulsation dampener with pressure gauge, back pressure valve, safety relief valve, and a pressure gauge with isolation valve. Reference CVI for package information and drawings.

There are two ball valves in series with a check valve on the flush water line in Valve Pit 241-SY-A. There are two control valves in the system, one on the raw water supply line and the other on the recirculation line. The remainder of the valves are isolation valves. Reference the valve list given in Appendix I.

The drum heater is a 1500 W flexible drum heater and there is also a removable, moisture resistant insulating blanket. The rating of the heater is 1500 W at 240 V, however, the heater shall be operated on 120 V to reduce the wattage of the heater to 375 W. This low wattage is required to prevent melting of the polyethylene drum.

4.2 SYSTEM PERFORMANCE CHARACTERISTICS

The backup flush system has four operating modes, the initial filling of the flush tank, standby between transfers, heat up before each transfer, and actual flushing. Each mode of operation would require a separate valve line-up.

The initial mode of operation for the backup flush system is to fill the flush tank with water from the raw water source in the service pit at 241-SY. Control valve V-3186A will regulate the flow of water into the tank. The normal filling flow rate is 170 gpm. The skid mounted chemical injection package will add sodium hydroxide to the water filling the tank to increase the pH of the water. The normal operating flow for the 25% sodium hydroxide solution is 14 gph. The sodium hydroxide solution will be provided in a 55 gallon polyethylene drum that will be transported to the chemical injection package when the flush tank is being filled. The flexible drum heater will be used when the outdoor temperatures are low.

The next mode of operation for the backup flush system is between transfers. The flush system will be inactive for long periods of time. However, if the temperature of the water in the tank approaches freezing, the system will operate in a recirculation mode. The flush pump will circulate the water from the tank, through the electric circulation heater package, then back to the tank. The flush pump is a constant speed pump sized to produce 140 gpm at 240 ft of head. However, the recirculation line does not provide 240 ft of head loss, therefore a control valve V-3187A will provide the necessary head loss for the flush pump to operate. Only one circulation heater on the heater package would be required to operate to prevent freezing.

The next mode of operation for the backup flush system occurs before each transfer. The system will operate in a recirculation mode again with the control valve controlling flow back into the tank. The electric circulation heater package will heat the water to 100°F as required before each flush. The system will continue to recirculate until the water in the tank reaches the proper temperature. Operating at maximum capacity, the system will take approximately 8.4 hours to heat the water in the flush tank. Now the system is ready and a transfer can occur.

The final mode of operation for the backup flush system would be actual flushing of the cross site transfer piping. The system would pump the flush water, which would be at 100°F, from the flush tank. The water would be circulated through the electric circulation heater package one last time to raise the temperature to 140°F. From there the flush water would continue on to the 241-SY-A Valve Pit and to the booster pump in Diversion Box 6241-A.

4.3 SYSTEM ARRANGEMENT

The majority of the backup flush system is located adjacent to the 242-S Building. The flush tank TK-302-C, is an existing tank which is adjacent to the 242-S Building. The flush tank is located inside a concrete containment wall below grade. The flush pump P-3100A is located inside the tank containment wall. Next to the tank containment wall is the concrete slab at grade that holds the remainder of the equipment at this location. This includes the skid mounted electric circulation heater package, the skid mounted chemical injection package, drum heater HTR-302C-3, and control valves V-3186A and V-3187A. Valves, instrumentation, and associated piping are also located on the pad. Drawings H-2-822350 and H-2-822351 show the plan and sections of the backup flush system located next to the flush tank TK-302-C.

The raw water connection for the supply water for the system is located in the Service Pit outside the 241-SY Tank Farm. The piping from this point is routed underground to the flush tank. The piping leaving the concrete pad is routed underground and connects to an existing 4" buried pipe adjacent to the service pit. This existing pipe extends into the SY Tank Farm. Drawing H-2-822353 shows the plan and details of these connections to the raw water line and the existing 4" buried line. Drawing H-2-822220 shows the routing of the buried piping between these connections and the flush tank. Inside the SY Tank Farm a new pipe is connected to the existing 4" buried pipe and is routed underground to Valve Pit 241-SY-A. This is shown on Drawing H-2-822210.

The connection to the Cross Site Transfer System is located in Valve Pit 241-SY-A in the tank farm. The two ball valves and the check valve in series that provides the backflow prevention is located on a jumper in the valve pit. Drawing H-2-822290 shows the jumper arrangement and drawing H-2-822293 shows the jumper assembly.

The backup flush system will be operated locally at the flush tank with only the flush pump being remotely operated through the MCS. All instrumentation will be located at the flush tank with local and some remote indication. All valves for the backup flush system are manual valves.

4.4 COMPONENT DESIGN DESCRIPTIONS

The water flush tank is a 20 ft diameter x 20 ft tall stainless steel tank with 2 inches of fiberglass insulation. The total volume of the tank is 47,000 gallons. The flush tank sits within a concrete containment wall below grade. Anchors have been designed to restrain the tank during a seismic event. Reference drawing H-2-822350 for anchor locations and H-2-822352 sheet 2 for anchor details.

The flush pump is an electrical motor-driven, horizontal, end suction centrifugal process pump designed to ASME 73.1M. The pump is designed to produce 140 gpm at 240 ft total dynamic head. Reference CVI for pump information and drawings.

The skid mounted electric circulation heater package consists of two 498 kW electric circulation heaters, two SCR control panels, and associated instrumentation and valves. All the equipment on the electric circulation heater package is mounted on a common base suitable for bolted anchorage. Reference CVI for package information and drawings.

The electric circulation heaters are each constructed of a pipe flange immersion heater inside a steel pipe pressure vessel. The heaters are rated at 498 kW with copper sheathed heating elements with 50 W/in^2 watt density, and a NEMA ICS Type 4 terminal enclosure. The pipe pressure vessel is ASME Section VIII certified and stamped for 250 psig at 180°F. A factory installed pressure relief valve provides over-pressure protection of the pressure vessel.

Each electric circulation heater is controlled by a separate SCR control panel. The control panels provide for local control. The heaters have the capability and are pre-wired by the vendor to be controlled remotely, but they are not connected to any remote controllers.

The ball valves on the electric circulation heater package are full port, carbon steel valves. The piping and pipe supports on the heater packaged are designed in accordance with ASME B31.3 Code for Normal Fluid Service.

The skid mounted chemical injection package consists of a diaphragm metering pump with electronic capacity controller, pulsation dampener with pressure gauge, back pressure valve, safety relief valve, and a pressure gauge with isolation valve. Reference CVI for package information and drawings.

The diaphragm metering pump has a hydraulically actuated diaphragm with a built in relief valve. The diaphragm pump has a 1/4 hp motor. The electronic capacity controller accepts a 4-20 mA signal to control pump speed.

The pulsation dampener dampens the pulsations of the diaphragm metering pump to produce a steady flow. The back pressure valve maintains the proper back pressure required by the diaphragm metering pump. The relief valve provides over-pressure protection for the chemical injection package.

The drum heater is a flexible drum heater rated at 1500 kW at 240 V. The heater will be operated on 120 V to reduce the wattage to 375 W (See Section 3.4.3). The heater has a built-in adjustable thermostat and a 6 foot cord with a 3 prong plug. The heater is moisture resistant and is supplied with a moisture resistant insulating blanket.

There are two ball valves and a check valve in series on the flush water line in Valve Pit 241-SY-A. This arrangement is used to provide backflow prevention of radioactive waste into the backup flush system. There are two control valves in the system, one controlling the flow of raw water filling the flush tank, and the other on the recirculation line controlling the flow of the water recirculation back into the flush tank. The remainder of the valves are isolation valves.

The raw water pipe supplying the backup flush system is 4" carbon steel pipe. The service water pipe above grade is 3" carbon steel. The flush system uses a portion of existing 4" buried, carbon steel pipe that extends into the SY Tank Farm. The buried service water pipe from the concrete pad of the flush system to the existing 4" pipe is 3" carbon steel pipe encased in 6" carbon steel pipe. The buried service water pipe from the existing 4" pipe to the Valve Pit 241-SY-A is buried 3" carbon steel pipe. All of the above grade service water piping, and the encased and buried service water pipe up to the connection to the existing 4" buried pipe, is insulated and heat traced.

4.5 INSTRUMENTATION AND CONTROL

The flush tank is equipped with new temperature indication and new level indication. The temperature element TE 302C-1 and the temperature indicator TI 302C-1 provide remote temperature indication of the water in the flush tank through the MCS. The level indication transmitter LIT 302C-1 and level indicator LI 302C-1 provide remote water level indication in the flush tank through the MCS. The level indicator is also interlocked through the MCS with the flush pump to shut down the pump on low level in the tank. Reference drawing H-2-822409.

The electric circulation heater package is supplied with instrumentation and controllers installed by the vendor. Each circulation heater is equipped with a flow switch (FSL 302C-4A or 302C-4B), temperature elements (TE 302C-4A, 302C-4C, 302C-4E, or 302C-4B, 302C-4D, 302C-4F), temperature indicating controllers (TIC 302C-4A, 302C-4C, 302C-4E, or 302C-4B, 302C-4D, 302C-4F), and high temperature alarms (TAH 302C-1A or 302C-1B). One set of temperature elements and temperature indicating controllers will be for temperature control. The other two sets of temperature controllers and the flow switches will be interlocked with the heater to shut down the heater on high temperature or low flow of water to the heater. The high temperature alarm will alarm locally and remotely through the MCS. Each heater is also equipped with a pressure relief valve (PRV-302C-1 and 302C-2) to protect the heater vessels from over-pressurization. Reference drawing H-2-822400.

The chemical injection package is supplied with instrumentation and controllers installed by the vendor. The chemical injection package is equipped with an electronic capacity controller, pressure gauges (PI 302C-3 and 302C-4), back-pressure valve PRV-302C-3, and a pressure relief valve PRV-302C-4. The electronic capacity controller will control the speed of the diaphragm pump based on the flow rate of the raw water supply line (measured by flow meter FE/FT 302C-2). There is also a manual control switch that allows the injection pump to run at full speed regardless of flow through the raw water supply line. This switch is useful during priming and flushing of the caustic feed line. The back pressure valve will maintain the required back pressure required by the diaphragm pump and the pressure relief valve will provide over-pressurization protection. The pressure gauges will indicate proper operation of the chemical injection package. Reference drawing H-2-822409.

There are two pressure transmitters, PT 3113 and PT 3113A between the two ball valves providing backflow prevention in the Valve Pit 241-SY-A. The pressure transmitters will sense a pressure between the two ball valves which will indicate a valve seal leak and are interlocked to shut off the Tank Farm Transfer pump. In addition, valve V-3113 is equipped with a limit/position switch that is interlocked with the 200 West Master Pump Shutdown. Reference drawing H-2-822402.

The remaining instrumentation on the backup flush system is located on the above ground piping at the flush tank. The instrumentation includes pressure gauges, temperature elements, and a flow meter. The instrumentation provides local and some remote indication through the MCS. Reference drawing H-2-822409.

4.6 SYSTEM INTERFACES

Interfacing systems necessary for the backup flush system to perform its functions are the 480 V ac, 60 Hz, 3-phase electrical power supply and the 4" raw water supply. The Monitoring and Control System (MCS) will provide remote indication and some control of the backup flush system. The backup flush system interfaces with the cross site transfer line by providing backup flush water.

4.7 SYSTEM LIMITATIONS, SET POINTS, AND PRECAUTIONS

For the initial mode of filling the flush tank, the control valve on the raw water line will be set at 170 gpm and the diaphragm metering pump flow rate will be 12 gph. For the recirculation mode for freeze protection and heat up, the control valve on the recirculation line will be set at 140 gpm. For freeze protection, the heaters will be set as required. For heat up, the heaters will be set at 100°F. For flushing, the pump will operate at 140 gpm, and the heaters will be set at 140°F.

The range of the control valve on the raw water line is 80 to 350 gpm. The range of the control valve on the recirculation line is 2 to 142 gpm. The temperature range of the circulation heaters is 60 to 180°F.

The limiting water level in the flush tank is 5 ft, which is determined by the net positive suction head required by the flush pump. The limiting temperature for the backup flush system is 180°F, which is determined by the maximum design temperature of the pressure vessels of the electric circulation heaters.

5.0 OPERATIONS AND CASUALTY EVENTS

Not Applicable

6.0 MAINTENANCE, INSPECTIONS, AND SURVEILLANCE

Not Applicable

7.0 TESTING

Inspection and hydrostatic testing of the backup flush system piping was in accordance with the W-058-C5 specification and ASME B31.3.

DISTRIBUTION SHEET

To	From	Page 1 of 1
Distribution	Replacement Cross-Site Transfer System	Date April 9, 1998
Project Title/Work Order		EDT No. 623671
Project W-058, Replacement Cross-Site Transfer System		ECN No. N/A

Name	MSIN	Text With All Attach.	Text Only	Attach./ Appendix Only	EDT/ECN Only
W.G. Brown	T4-07	X			
J.L. Gilbert	R3-47	X			
G.L. Parsons	R3-47	X			
G.R. Porter	R3-47	X			
M.J. Sutey	T4-08	X			
M.G. Al-Wazani	T4-07	X			
R.E. Larson	T4-07	X			
C.R. Reichmuth	T4-07	X			
Project Files	R1-29	X			