13 STA 4
DEC 28 1994

ENGINEERING DATA TRANSMITTAL

1. EDT 607711

2. To: (Receiving Organization) Distribution	3. From: (Originating Organization) DST Retrieval Engineering	4. Related EDT No.: NA
5. Proj./Prog./Dept./Div.: TWRS	6. Cog. Engr.: ED Waters/GD Bazinet 376-3059	7. Purchase Order No.: NA
8. Originator Remarks: Original release for record and reference only.		9. Equip./Component No.: NA
		10. System/Bldg./Facility: NA
11. Receiver Remarks:		12. Major Assm. Dwg. No.: NA
		13. Permit/Permit Application No.: NA
		14. Required Response Date: NA

15. DATA TRANSMITTED

(A) Item No.	(B) Document/Drawing No.	(C) Sheet No.	(D) Rev. No.	(E) Title or Description of Data Transmitted	(F) Approval Desig-nator	(G) Reason for Trans-mittal	(H) Origi-nator Dispo-sition	(I) Receiv-er Dispo-sition
1	SD-WM-TI-363	ALL	0	Descriptions and Diagrams of the Primary and Annulus Ventilation Systems of the DST Tank Farms as of January 1988	NA	3	1	

16. KEY

Approval Designator (F)	Reason for Transmittal (G)	Disposition (H) & (I)
E, S, Q, D or N/A (see WHC-CM-3-5, Sec.12.7)	1. Approval 2. Release 3. Information 4. Review 5. Post-Review 6. Dist. (Receipt Acknow. Required)	1. Approved 2. Approved w/comment 3. Disapproved w/comment 4. Reviewed no/comment 5. Reviewed w/comment 6. Receipt acknowledged

17. SIGNATURE/DISTRIBUTION (See Approval Designator for required signatures)

(G) Rea-son	(H) Disp.	(J) Name	(K) Signature	(L) Date	(M) MSIN	(J) Name	(K) Signature	(L) Date	(M) MSIN	(G) Rea-son	(H) Disp.
2	1	Cog.Eng. ED Waters	ED Waters	12/27/94	S4-58	NW Kirch			R2-11	3	
2	1	Cog. Mgr. GD Bazinet	W L Knecht for GDB	12/27/94	S4-53	DR Meyers			H3-22	3	
3		RA Dodd			S5-05	JS Schofield			R1-67	3	
3		DW Hamilton			S7-03	CA Rieck			R3-27	3	
3		JP Sloughter			T6-07	EM Nordquist			R3-27	3	
3		JJ Badden			S5-01	JE Van Beek			R3-27	3	
3		WL Knecht			S4-53	RF Eggers			R3-58	3	

Central Files L8-04 O.S.T.I. (2) L8-07

18. ED Waters 12/27/94 Signature of EDT Originator ED Waters Date	19. Authorized Representative for Receiving Organization Date	20. W L Knecht for GDB 12/27/94 Cognizant Manager GD Bazinet Date	21. DOE APPROVAL (if required) Ctrl. No. [] Approved [] Approved w/comments [] Disapproved w/comments

BD-7400-172-2 (04/94) GEF097

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

BD-7400-172-1 (07/91)

RELEASE AUTHORIZATION

Document Number:	SD-WM-TI-363, REV 0
Document Title:	DESCRIPTIONS AND DIAGRAMS OF THE PRIMARY AND ANNULUS VENTILATION SYSTEMS OF THE DOUBLE-SHELL TANK FARMS AS OF JANUARY 1988
Release Date:	12/28/94

This document was reviewed following the procedures described in WHC-CM-3-4 and is:

APPROVED FOR PUBLIC RELEASE

WHC Information Release Administration Specialist:

Kara M. Broz December 28, 1994

SUPPORTING DOCUMENT	1. Total Pages 59	
2. Title **DESCRIPTIONS AND DIAGRAMS OF THE PRIMARY AND ANNULUS VENTILATION SYSTEMS OF THE DOUBLE-SHELL TANK FARMS AS OF JANUARY 1988**	3. Number **SD-WM-TI-363**	4. Rev No. 0
5. Key Words ventilation, primary, secondary, annulus, HEPA, condensers, exhaust APPROVED FOR PUBLIC RELEASE KMB 12/28/94	6. Author Name: AE Blackman/ED Waters ED Waters 12/28/94 Signature Organization/Charge Code 71240/D2AB1	

7. Abstract

This document is a compilation of information describing the ventilation systems of the Double-Shell Tank farms (214-AN, -AP, -AW, -AW, -AY, -AZ, and -SY). A general description of the primary tank and annulus ventilation systems is given along with specific information on the high efficiency particulate air (HEPA) filters, condensers, preheaters, exhaust fans, and piping. This information is considered to be current as of January 1988.

8. RELEASE STAMP

SD-WM-TI-363 REV 0

DESCRIPTIONS AND DIAGRAMS OF THE PRIMARY AND ANNULUS VENTILATION SYSTEMS OF THE DOUBLE-SHELL TANK FARMS AS OF JANUARY 1988

Compiled by A. E. Blackman
January 1988

ABSTRACT

This document is a compilation of information describing the ventilation systems of the Double-Shell Tank farms (214-AN, -AP, -AW, -AW, -AY, -AZ, and -SY). A general description of the primary tank and annulus ventilation systems is given along with specific information on the high efficiency particulate air (HEPA) filters, condensers, preheaters, exhaust fans, and piping.

This information is considered to be current as of January 1988.

PREFACE

This report and the information herein were prepared by A. E. Blackman while he was a member of the Westinghouse Hanford Company staff in the Retrieval and Pretreatment Engineering group in 1987 and 1988. The information was reviewed by some members of that group, but then was put in the inactive file because of changing priorities and personnel.

A lot of work was put into bringing all the information regarding the ventilation systems into one report. It seems worthwhile to issue the report at this time, even without an update or full review. Because of recent and impending additional personnel turnovers and reference file transfers, the material may be lost if it were not issued now.

E. D. Waters
December 27, 1994

CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF TABLES (Cont.)

1.0 241-AY AND -AZ TANK FARM VENTILATION SYSTEM

1.1 GENERAL INFORMATION

The 241-AY and -AZ Tank Farms have a common primary tank ventilation system (located in 702-A Building), but they have separate annulus ventilation systems (DiLiberto 1982, pp. 5-20, 27-29, 32-34). There are four tanks in the 241-AY and -AZ Tank Farms (101-AY, 102-AY, 101-AZ and 102-AZ). Each tank may contain as much as 3,736,000 L (987,000 gal) of waste which corresponds to a liquid level 30.5 cm (12 in.) below the fill line (Rockwell 1983, Sec. 2.3, pp. 8, 9, 21-26).

The single primary ventilation system serving all four tanks of the 241-AY and -AZ Tank Farms is referred to as K1-Primary Tank Ventilation System. The primary ventilation system maintains the tank interior at a greater vacuum than the annulus and has operating safety limits of 0.0 to 15.24 cm (0.0 to 6.0 in. water gauge (WG) with the airlift circulators operating (Squires 1987, pp. 11-1 to 11-2).

Tanks 101-AZ and 102-AZ of the 241-AZ Tank Farm are served by a common annulus ventilation system referred to as the K2-Annulus Ventilation System. Tanks 101-AY and 102-AY of the 241-AY Tank Farm are also served by a K2-Annulus Ventilation System (not to be confused with the K2-Annulus Ventilation System of the 241-AZ Tank Farm) which is composed of two subsystems. The first subsystem, k1-Annulus Ventilation System*, serves Tank 101-AY. The second subsystem, k2-Annulus Ventilation System*, serves Tank 102-AY.

1.2 K1 PRIMARY VENTILATION SYSTEM FOR 241-AY AND -AZ TANK FARMS (702-A BUILDING)

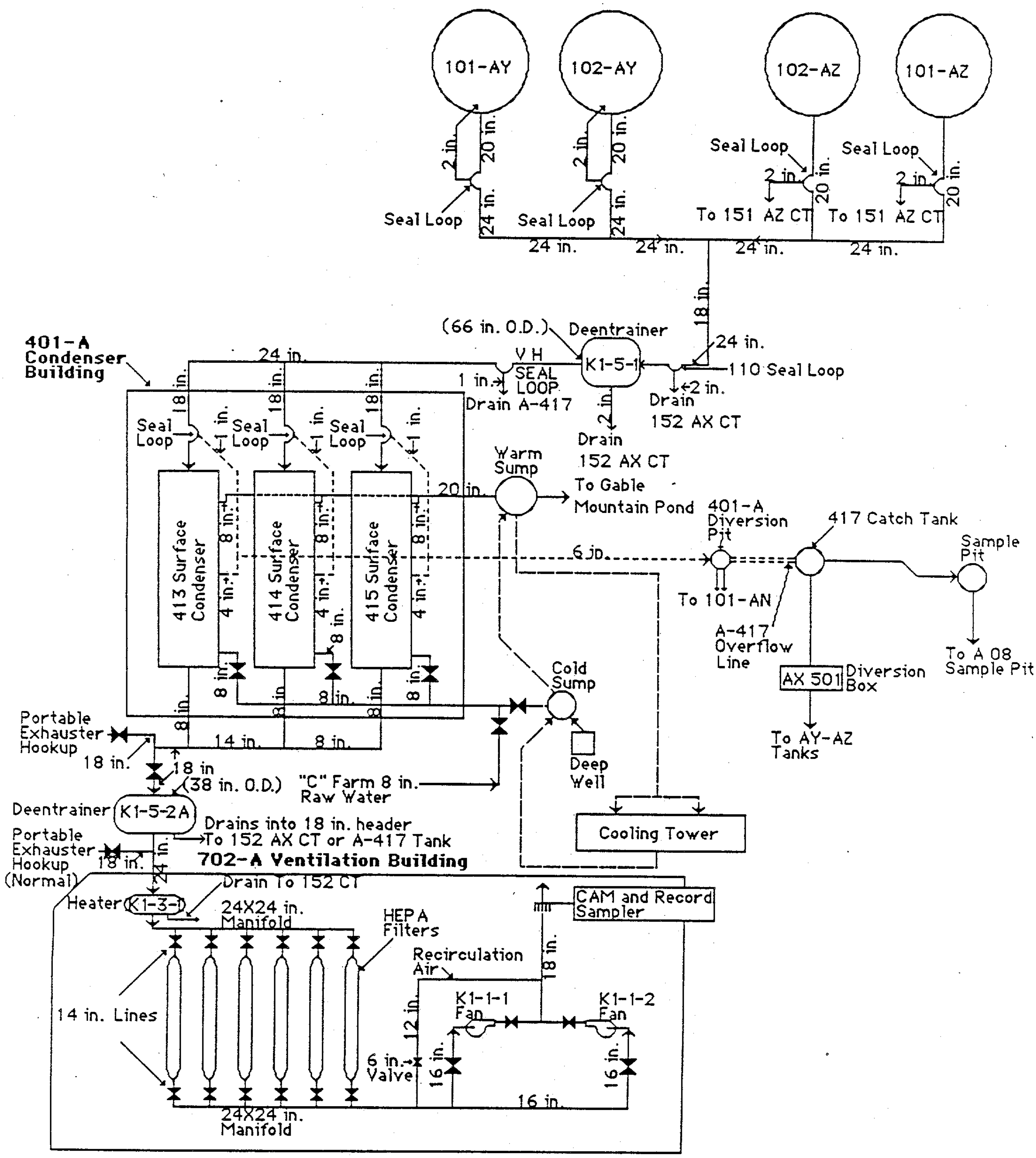
The main components of the 702-A Building ventilation system include 2 deentrainers buried in caissons, 3 surface condensers in the 241-A-401 Building, 1 steam heater, and 12 high-efficiency particulate Air (HEPA) filters in the 702-A Building. A flow diagram of the system is shown in Figure 1. This system ventilates the interior all four of the tanks in 241-AY and -AZ Tank Farms.

Tanks with open risers are normally isolated from the 702-A vent system by the use of individual tank seal loops to prevent the loss of vacuum to the system. The 101-AY and 102-AY tanks seal loops both drain back to their respective tank via a 5.1-cm (2-in.) carbon-steel line that dumps into a 10.2-cm (4-in.) carbon-steel line before entering the tank. The 101-AZ and 102-AZ tank seal loops both drain to the 151-AZ catch tank via a 5.1-cm (2-in.) carbon-steel line. The function of the seal loop is to isolate the tank from the 702-A vent system. This is accomplished by filling the loop with water (see Figure 1 for the seal loop locations).

---

*The lower case "k" is used to indicate subsystems of the 241-AY Tank Farm K2-Annulus Ventilation System.

Figure 1. 241-AY and -AZ Tank Farm Primary Ventilation System Flow Diagram



Air enters the K1 ventilation system from a 51-cm (20-in.) vent riser in each of the 241-AY and -AZ tanks. These risers vent the vapor through individual tank seal loops to a common 61-cm (24-in.) stainless steel vent header that reduces to a 46-cm (18-in.) vent header. This 46-cm (18-in.) vent header expands to a 61-cm (24-in.) vent header just upstream of the K1-5-1 deentrainer. The vapor stream is moved through the main exhaust header for all four tanks at a rate of 113 m^3/min (4,000 ft^3/min) by a 63.5-cm to 127-cm (25-in. to 50-in.) WG vacuum maintained at the system's end by one of two exhaust fans (one operating and one on standby) either K1-1-1 or K1-1-2.

The vapor continues through the 61-cm (24-in.) vent header and through a 61-cm (24-in.) seal loop (110 seal loop) to a 168-cm (66-in.) outside dia (OD) deentrainer, K1-5-1, containing wire mesh demister pads. The 110 seal loop drains to the 152-AX catch tank via a 5.1-cm (2-in.) stainless steel line. The optimum velocity through the K1-5-1 deentrainer that allows this unit to operate effectively and efficiently is ~3.1 m/s (10 ft/s). Currently the velocity through the deentrainer is .9 m/s (3 ft/s).

To prevent excessive buildup on the deentrainer pads, spray nozzles in the deentrainer are used to flush the pads periodically with raw water. (Note: Flushing can be done with the 702-A vent system operating.) The flush liquid, and the liquid that has accumulated through normal operations drain to a common seal pot that overflows and drains by gravity to the 152-AX diverter catch tank via a 5.1-cm (2-in.) stainless steel line. This common seal pot serves both the K1-5-1 and K1-5-2A deentrainers. The vapors from the deentrainers discharge through a 61-cm (24-in.) stainless steel vent header to the radioactive-pipe gallery of the 401-A surface condenser building. This portion of the vent header contains one 61-cm (24-in.) seal loop (vent header extension seal loop) that drains to the A-08 crib. This drain line is a 2.5-cm (1-in.) stainless steel line that connects to the 15-cm (6-in.) stainless steel overflow line from the A-417 Tank. This 15-cm (6-in.) line drains to A-08 Sample Pit 2, which drains to the A-08 crib.

In the radioactive-pipe gallery, the header is divided into three streams before entering three parallel shell and tube surface condensers. Each condenser feed stream passes through a 46-cm (18-in.) stainless steel seal loop. This configuration allows each condenser to be isolated from the vent header for flushing, emergency, and standby operations. These seal loops drain via a 2.5-cm (1-in.) stainless steel line that connects to a 15-cm (6-in.) carbon-steel condensate line that drains to the A-417 tank. During normal operations, two surface condensers will be on line, with the third acting on standby.

Vapor flows through the shell side of each condenser at a maximum rate of 20,000 lbm/h. The condensate falls to the bottom of each condenser and drains out through a 10.2-cm (4-in.) stainless steel jumper that connects connector "N" to nozzle "N". From nozzle "N" the condensate continues through a 0.2-cm (4-in.) carbon-steel line to a common 15-cm (6-in.) line that receives drainage from all three condensers. This 15-cm (6-in.) condensate line drains by gravity to the 151,000-L (40,000-gal) A-417 condensate hold-uptank, or is diverted to 101-AN tank via a three-way valve in the condensate diverter caisson. The condensate in the A-417 tank can be pumped to the 241-AY or 241-AZ Tank Farms via the 501-AX valve pit. The previously mentioned 10.2-cm (4-in.) jumper may also be placed on connector "P" to nozzle "P", which drains to a spare 15-cm (6-in.) condensate line that also drains to the A-417 tank, or is diverted to 101-AN tank.

The cooling water for the condensers is supplied by a 20-cm (8-in.) raw water line from "C" Tank Farm. This water is divided into four 10-cm (4-in.) carbon-steel pipes that connect to four 10-cm (4-in.) carbon-steel inlet jumpers before combining into one 20-cm (8-in.) carbon-steel header that feeds each condenser. The differential temperature across the condensers is automatically controlled to maintain a change in temperature (dT) of -9.4 °C (15 °F). The cooling water makes six passes through the condensers before exiting through a 20-cm (8-in.) stainless steel line. This 20-cm (8-in.) line connects into the common 51-cm (20-in.) carbon-steel waste water line, which drains to a warm-water sump. A sampler is located along this 9-cm (20-in.) line, which analyzes the stream for beta-particle and gamma-radiation levels and sounds an alarm if the count exceeds 80 counts per minute (c/min). In the event of an alarm, the normal raw water supply will be manually shut off, and the emergency cooling tower system will be activated.

The vapor exits at the top of each condenser through a 6-cm (18-in.) stainless steel pipe. This 46-cm (18-in.) line reduces to a 20-cm (8-in.) stainless steel pipe, which ties into a common header in the radioactive-pipe gallery. The header at condenser 415 is 20 cm (8 in.) in diameter, expands to a 36-cm (14-in.) vent header at condenser 414, and expands again to 46 cm (18 in.) at condenser 413. This 46-cm (18-in.) header continues to the second deentrainer (K1-5-2A).

This header splits into a "T" just before the second deentrainer. On each leg of the "T" is a 46-cm (18-in.) butterfly valve. One valve allows the exhaust vapor to go through the K1-5-2A deentrainer and the other allows the connection of a portable exhauster. The valve allowing flow to the K1-5-2A deentrainer is open during normal operations. The second valve is open only when the portable exhauster is in use.

The K1-5-2A deentrainer has a 1.5 cm (38-in.) outside diameter (OD) and is similar in function but different in design to the first deentrainer. The K1-5-2A deentrainer is partially buried in a caisson and equipped with a removal basket that allows the pads to be changed when necessary. The flow velocity through the K1-5-2A deentrainer is 3.1 m/s (10.2 ft/s) at flow conditions of 113 m^3/min). Liquid from normal operations and periodic flushes of the K1-5-2A drains to the inlet 46-cm (18-in.) vapor header, where it flows back to the surface condensers. All spray nozzles except the upper pad top wash may be used to flush the K1-5-2A pads while the 702-A vent system is operating. Using the upper pad top wash will cause reentrainment of liquid to occur. Therefore, it can be used only when the 702-A system is down.

Vapors exit the K1-5-2A deentrainer aboveground and continue through a 61-cm (24-in.) stainless steel vent header into the 702-A building. This 61-cm (24-in.) vent header contains a 46-cm (18-in.) stainless steel T-connection, which has a 46-cm (18-in.) butterfly valve in it. This T-connection is used as the normal portable exhauster hookup. Any liquid that may accumulate in this T-connection will drain to the K1-5-2A deentrainer via a 1.3-cm (1/2-in.) stainless steel drain line. The 61-cm (24-in.) vent header enters the radioactive side of the 702-A building and continues into the steam heater (K1-3-1) before reaching the filter banks. The relative humidity of the vapor is then lowered as the vapor passes over the two banks of staggered heater coils. This eliminates moisture buildup in the HEPA filters. The outlet vapor temperature from the heater must be maintained below 93.3 °C (200 °F) to prevent overheating the filters. A differential temperature controller adjusts the steam supply to provide a -12.2 °C (10 °F) dT between the inlet temperature of the heater and the outlet temperature of vapor from the HEPA filters. Normal steam pressure through the heater is 15 psig. Any moisture accumulated in the heater drains to a seal pot, which overflows to the 702-A floor drains. This seal-pot liquid level is maintained by the addition of water through its fill valve located in the radioactive side of the 702-A Building.

This heated vapor stream enters a 61-cm by 61-cm (24-in. by 24-in.) manifold from which vapor is drawn through the HEPA filters in the 702-A ventilation building through a 36-cm (14-in.) duct. The filters are arranged in six parallel sets. Each set contains two 61-cm by 61-cm by 29-cm (24-in. by 24-in. by 11 1/2-in.) wooden framed, 99.97% HEPA filters. The flow through the filters is balanced by regulating the 36-cm (14-in.) carbon-steel valves before and after each set of filters. The ductwork above, in between, and below each set of filters contains three 1.35-cm (1/2-in.) ports, which are used for dioctylphthalate (DOP) testing of each HEPA filter for leakage.

Differential pressure (dP) gauges are used to measure the pressure change across each filter and across both filters in each set to detect the accumulation of moisture or particulate matter. If the dP increases to 7.5-cm (3 in.) WG across any one of the filters, it is replaced. When four or more of the filters are being replaced simultaneously, the 702-A system is shut down to prevent pulling air through the remaining filters at a rate above filter capacity. During the 702-A system shutdown, a portable exhauster is operated. The ductwork from the K1-5-2A deentrainer discharge to the HEPA filter inlets is insulated and heat traced. The heat trace is operated by thermostats located in the filter side of the 702-A Building.

After passing through the HEPA filters and the 61-cm by 61-cm (24- by 24-in.) outlet manifold, the air passes through one of two 41-cm (16-in.) stainless steel ducts depending on which fan is operating. The 702-A system has two 113 m^3/min, 4,000 ft^3/min exhaust fans (k1-1-1 and k1-1-2). One operates while one is on standby. The operating fan will automatically shut off when the vacuum in the 61-cm by 61-cm (24-in. by 24-in.) filter outlet manifold is less than 38 cm (15 in.) WG. The standby fan will then be manually switched to the "on" position. Each of the 40.6 ~41-cm (16-in.) ducts contains two diaphragm-operated butterfly valves (DOV), which are located on each side of the exhaust fan. The two outlet DOVs are automatically controlled by the operation of either fan, but the inlet DOV must be manually operated. The fan selector switch position, "on" or "off," also indicates the outlet DOV valve position when opened or closed.

Air is discharged to the atmosphere from the fans via the 46-cm (18-in.) stainless steel exhaust stack. A 31-cm (12-in.) stainless steel flow bypass line leads from the exhaust stack to the 61-cm by 61-cm (24-in. by 24-in.) manifold and contains a 5-cm (6-in.) stainless steel butterfly valve, which is manually set to maintain the desired vacuum at the fan outlet. A three-nozzle probe located in the exhaust stack draws a representative sample via two vacuum pumps to an isokinetic beta-particle and gamma-radiation continuous air monitor (CAM) system and record sampler. The CAM monitors and records the radioactivity of the exiting air stream, while the record sampler collects a sample on a filter paper. The filter paper is removed and analyzed daily to check the radioactive discharge. There are two annunciator alarms, one for the CAM unit, which annunciates when 1,000 c/min are exceeded, and one if the record sampler or CAM unit fails in the 241-A-271 control room. If the high radiation alarm annunciates, indicating that the 1,000 c/min set point for radioactive emissions to the atmosphere is being exceeded, the 702-A system is manually shut down and the portable exhauster is activated. The portable exhauster is activated because of the aging process of the waste stored in the 24-AY and -AZ Tank Farms. The aging process generates a considerable amount of heat that could cause the temperature of the tank structures to rise and threaten the integrity of the tanks.

1.2.1 241-AY and -AZ Primary Ventilation Specifications

The 241-AY and -AZ tank farm primary ventilation system specifications for the HEPA filter, exhaust fan, preheater, condenser and piping are provided in Tables 1 through 5.

Table 1. High-Efficiency Particulate Air Filter Specifications.

		Flowrate (ft^3/min)			
Unit	Temp(°F)	Rates	Actual	Size (in.)	Manufacturer
702-A	<200	1,500	600	24 by 24 by 11.5	Flanders

Table 2. Exhaust Fan Specifications.

Unit	ft^3/min	Diameter (in.)	Volts	Motor Phase	Hertz
K1-1-1	4,000	41	480	3	60
K1-1-2	4,000	41	480	3	60

Table 3. Preheater Specification.

Unit	Source of heat	Duty (Btu/h)	Manufacturer	Type
K1-3-1	Steam	117,800	Buffalo Forge Co.	Areofin Coil

Table 4. Condenser Specifications.

Unit	Type	Duty (Btu/h)	Surface area (ft^2)	Size (in.)
413	Shell and tube	20,400,000	1,340	36.5 by 9
414	Shell and tube	20,400,000	1,340	36.5 by 9
415	Shell and tube	20,400,000	1,340	36.5 by 9

Table 5. Piping Specifications[a,b] (KEH 1987).

Tank number	Risers		Piping	
	Number	Diameter (in.)	Diameter (in.)	Length (ft)
101-AY	1	20	20	44
			24	80
			18	305
			24	50
102-AY	1	20	20	44
			24	80
			18	305
			24	50
101-AZ	1	20	20	35
			24	364
			18	349
			24	50
102-AZ	1	20	20	35
			24	504
			18	349
			24	50

[a]These specifications apply to tank farm ventilation piping from the primary tank exhaust risers to the K1-5-1 deentrainer of each tank.

[b]Some pipe lengths are shared, therefore, the pipe lengths listed above are not additive.

1.3 241-AY ANNULUS VENTILATION SYSTEM

The annulus ventilation system for the 241-AY Tank Farm consists of two subsystems:

1. k1-101-AY annulus ventilation system
2. k2-102-AY annulus ventilation system.

These two systems are identical; therefore, only the ventilation system for the 101-AY tank will be described.

1.3.1 K1-101-AY Annulus Ventilation System Description

Outside air is drawn into the ventilation unit [Figure 2 (Vitro 1968; Rockwell 1981)] through a 102-cm by 102-cm (40-in. by 40-in.) louver inlet by the exhaust fan (k1-3-2). Five 2.5-kW radiant heaters are mounted inside the louver inlet to prevent frost damage to the supply filters. The heater is operated either manually or automatically. In the automatic mode, the heaters are thermostatically controlled to turn on below 7.2 °C (45 °F) and shut off above 21 °C (70 °F).

The heated air then passes through two sets of filters: four 10% National Bureau of Standards filters (k1-1-1) and four 80% filters (k1-2-1). The filtered air continues through a 6.6-kW supply heater (k1-6-1), which is inoperable, before entering the annulus.

The air continues through a 31-cm (12-in.) manual butterfly valve (MK-6302) and underground into the annulus air slots via a 31-cm (12-in.) ductwork. The air is distributed at this point, with approximately 80% supplied to the bottom of the annulus and 20% supplied to air slots below the inner tank. The air is exhausted from the top of the annulus through various sizes of pipe to a common 41-cm (16-in.) duct, where it rises above grade to the remainder of the vent system. Additional 20.4-cm (8-in.) diameter vent risers are installed if other venting is found to be necessary.

As the air exits the underground duct, it passes a radiation probe, which extracts an air sample and feeds it to an Eberline CAM. If the beta particle and gamma-radiation levels exceed 800 c/min, an alarm will go off in the 271-A control room and the vent system is manually shut down.

Moisture in the annulus due to leakage in the primary vessel will contain a greater amount of radioactivity than normal. Therefore, a radiation monitor on the exhaust side of the annulus, upstream of the HEPA filters, will indicate a leak in the primary vessel wall when increased radioactivity occurs. This location allows the annulus ventilation system to be the primary leak-detection system.

The exhaust air continues through the 41-cm (16-in.) aboveground duct and passes through a 120 kW heater (k1-4-1), which is wired for a maximum output of 40 kW. The heater is controlled by an adjustable -17.8 to 10 °C (0 to 50 °F) differential temperature controller (K1-8-1) that measures the temperature upstream of the heater (K1-4-1) and downstream of the HEPA filters (K1-5-2) and is set for a differential temperature of 72.2 °C (10 °F).

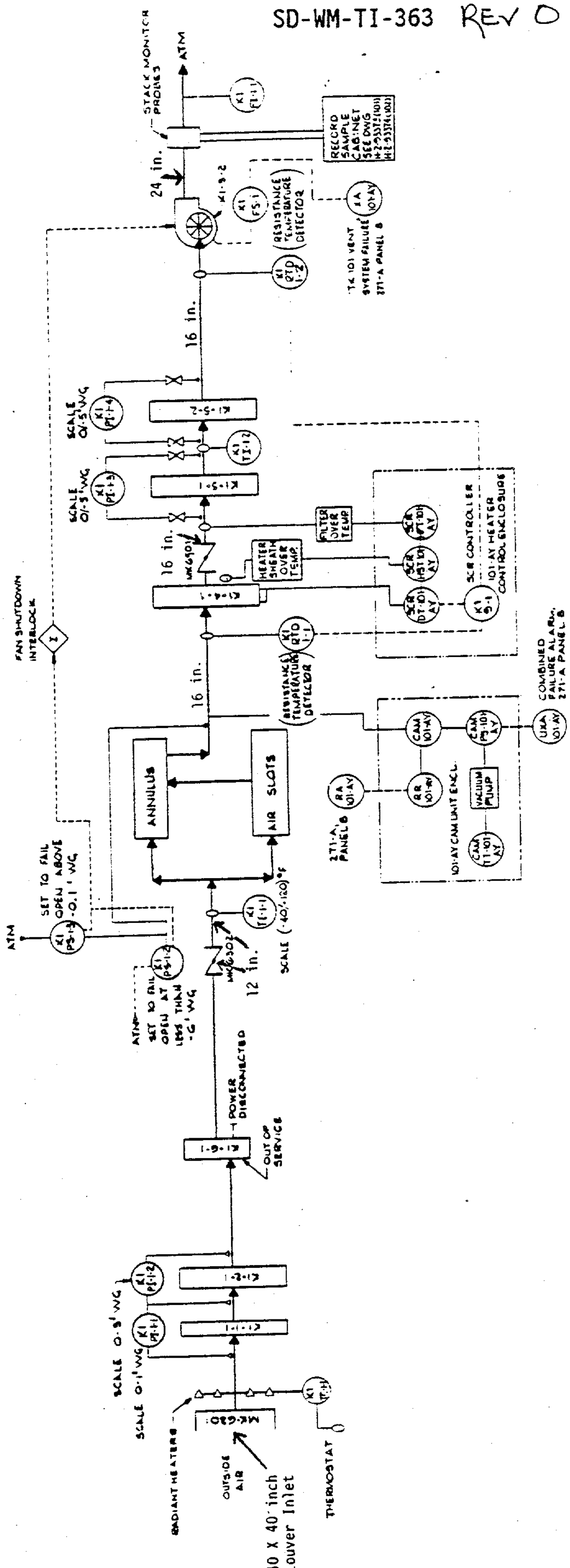


Figure 2. Annulus Air Flow Diagram for k1 Ventilation System (which is identical to the k2 ventilation system)

The temperature element (K1-TE-1-3) senses the temperature downstream of the heater and will turn the heater off if the heater reaches a temperature greater than 371 °C (700 °F). The exhaust air then continues through a 41-cm (16-in.), MK-6501, which is used to maintain the vacuum in the annulus between .25 cm to 15 cm (0.1 and 6.0-in.) WG, and into the filters, which consist of two sets of four 99.97% efficient HEPA filters per set (K1-5-1 and K1-5-2). The 41-cm (16-in.) duct then continues to the exhaust fan (K1-3-2).

The exhaust fan exhausts the filtered air at a flowrate of 3,500 ft^3/min through a 61-cm (24-in.) exhaust stack. This fan is the motive power for drawing air through the supply side of the vent system into the tank annulus and air slots and into the exhaust side of the vent system and discharging it back to the environment. The exhaust stack contains an isokinetic stack sample probe, that extracts a sample and sends it to the record sampler. A filter on the sampler is changed daily and analyzed for radioactive material buildup. Both of the radiation monitoring units, one where the air exits the annulus underground ductwork and one in the exhaust stack, are enclosed and have temperature control systems to maintain the enclosure within a certain temperature range.

1.3.2 241-AY Annulus Ventilation System Specifications (Vitro 1968; Rockwell 1981)

The 241-AY annulus ventilation system specifications for the HEPA filter, exhaust fan, preheater, and piping are provided in Tables 6 through 9.

Table 6. High-Efficiency Particulate Air Filter Specifications.

Unit	ft^3/min	Size (in.)	Air inlet temperature (°F)
K1-5-1	3,520	27 by 27 by 36	<200
K1-5-2	3,520	27 by 27 by 36	<200
K2-5-1	3,520	27 by 27 by 36	<200
K2-5-2	3,520	27 by 27 by 36	<200

Table 7. Exhaust Fan Specifications.

		Motor				
Unit	ft^3/min	Horsepower	Revolutions per minute	Phase	Volts	Hertz
K1-3-2	4,000	15	1,725	3	480	60
K2-3-2	4,000	15	1,725	3	480	60

Table 8. Preheater Specifications (Electric Heat Coils).

		Electrical Characteristics				
Unit	ft^3/min	kW	Volts	Phase	Hertz	Control
K1-4-1	2,000	40	480	3	60	SCR
K2-4-1	2,000	40	480	3	60	SCR

SCR = Silicon Controlled Rectifier

Table 9. Piping Specifications[a,b,c] (Vitro 1967, 1969).

Tank	Risers		Piping	
number	Number	Diameter (in.)	Diameter (in.)	Length (ft)
101-AY	6	8	14	46
			16	22
102-AY	6	8	14	46
			16	22

[a]These specifications apply to 241-AY Tank Farm ventilation piping from the main annulus exhaust header to the annulus ventilation system of each tank.

[b]The annulus exhaust piping on AY-Tank Farm is about to be replaced and will have pipe lengths and diameters different from those provided in this table (refer to drawings H-2-50702 and H-2-77324 for conceptual design).

[c]Some pipe lengths are shared, therefore, the pipe lengths listed above are not additive.

KEH, 1987, "Annulus Vent Piping TK-102 241-AY Tank Farm," H-2-77324, Richland, Washington.

KEH, 1988, "DWG List/Demolition Plan TK-101 241-AY Tank Farm," H-2-50702, Richland, Washington.

1.4 241-AZ TANK FARM ANNULUS VENTILATION SYSTEM

1.4.1 241-AZ Tank Farm Annulus Ventilation System Description

The 241-AZ Tank Farm annulus ventilation system is a single unit serving both 101-AZ and 102-AZ tanks. This system functions similarly to the K1 and K2 annulus ventilation systems for tanks 101-AY and 102-AY, respectively, with minor differences. These minor differences, other than the fact that the system serves both tank annuli, can be seen in the system configuration [Figure 3 (Vitro 1972a, Rockwell 1982)] and pipe lengths.

1.4.2 241-AZ Annulus Ventilation System Specifications

The 241-AZ annulus ventilation system specifications for the HEPA filter, exhaust fan, preheater, and piping are provided in Tables 10 through 13.

Table 10. High-Efficiency Particulate Air Filter Specifications[a].

Unit	ft^3/min	Size (in.)
K1-5-1	3,520	27 by 27 by 36
K1-5-2	3,520	27 by 27 by 36
K1-5-3	3,520	27 by 27 by 36
K1-5-4	3,520	27 by 27 by 36
K1-2-1	4,000	27 by 27 by 36

[a]The HEPA filters are usually procured through bids made by various vendors and have to meet specifications given in the Environmental Protection Manual, RHO-MA-139.

Table 11. Exhaust Fan Specifications.

		Motor				
Unit	ft^3/min	Horsepower	Revolutions per minute	Volts	Phase	Hertz
K1-3-1	7,040	30	1,725	460	3	60
K1-3-2	7,040	30	1,725	460	3	60

Figure 3. 241-AZ Tank Farm Annulus Air Flow and Control Diagram.

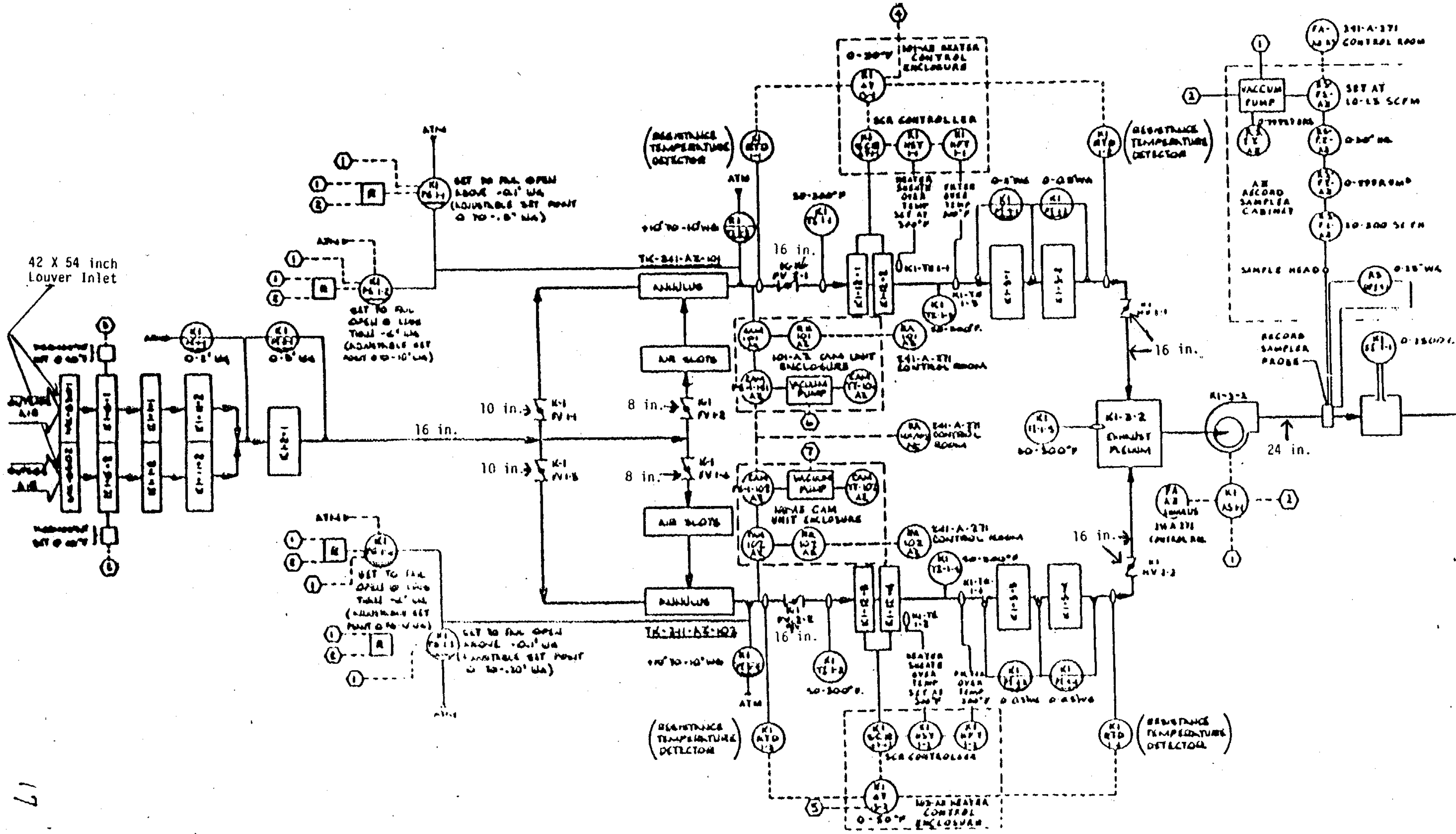


Table 12. Preheater Specifications (Electric Heat Coils).

Unit	ft^3/min	Electrical characteristics kW	Volts	Phase	Hertz
K1-6-1	2,600	8	480	3	60
K1-6-2	2,600	8	480	3	60

Table 13. Piping Specifications[a,b] (Vitro 1972b).

Tank number	Risers Number	Risers Diameter (in.)	Piping Diameter (in.)	Piping Length (ft)
101-AY	6	8	12	102
			16	84
102-AY	6	8	12	102
			16	102

[a]These specifications apply to 241-AZ Tank Farm ventilation piping from the main annulus exhaust header to the annulus ventilation system of each tank.

[b]Some pipe lengths are shared, therefore, pipe lengths listed above are not additive.

1.5 ADDITIONAL COMPONENTS IMPORTANT TO 241-AY AND -AZ TANK FARMS

1.5.1 241-AY and -AZ Tank Farm Airlift Circulators

There are 22 airlift circulators in each of the 241-AY and -AZ tanks [Figure 4 (Rockwell 1983, p. 22)]. These circulators are installed in the aging waste tanks to continuously mix and agitate the solutions and prevent temperature excursions resulting from excessive settling of the solids [Figure 5 (Rockwell 1983, p. 23)].

Circulator 1 is located at the tank center axis, circulators 2 through 8 are equally spaced on a 4.4 m (14.5-ft) radius, and circulators 9 through 22 are equally spaced on a 8.2 m (27-ft) radius. Circulators 1, 9, 12, 16, and 19 have lift risers that are 5.2 m (17 ft) in length and have a minimum air flowrate of .085 m^3/min/ unit (3 ft^3/min/unit) at a liquid level from 600 to 747 cm (236 to 294 in.) (Rockwell 1986a, p. 28). For total submergence of these airlift circulators, a solution volume of about 2,460,000 L (650,000 gal) is required. All other circulators are 6.7 m (22 ft) in length and also have a minimum air flowrate of .085 m^3/min/unit (3 ft^3/min/unit) at a liquid level of 747 cm (294 in.). These circulators require about 3,218,000 L (850,000 gal) of solution for total submergence. The maximum air

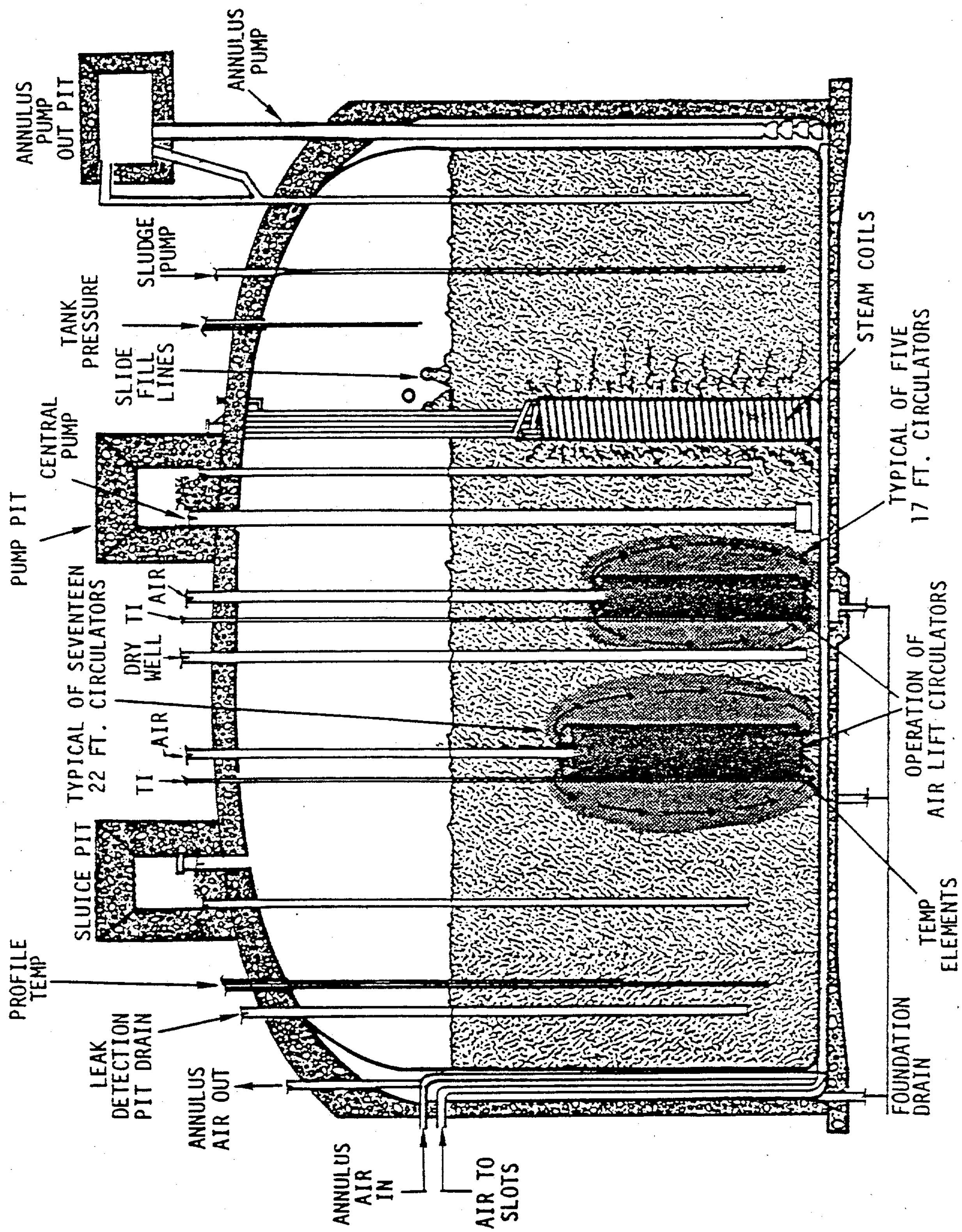
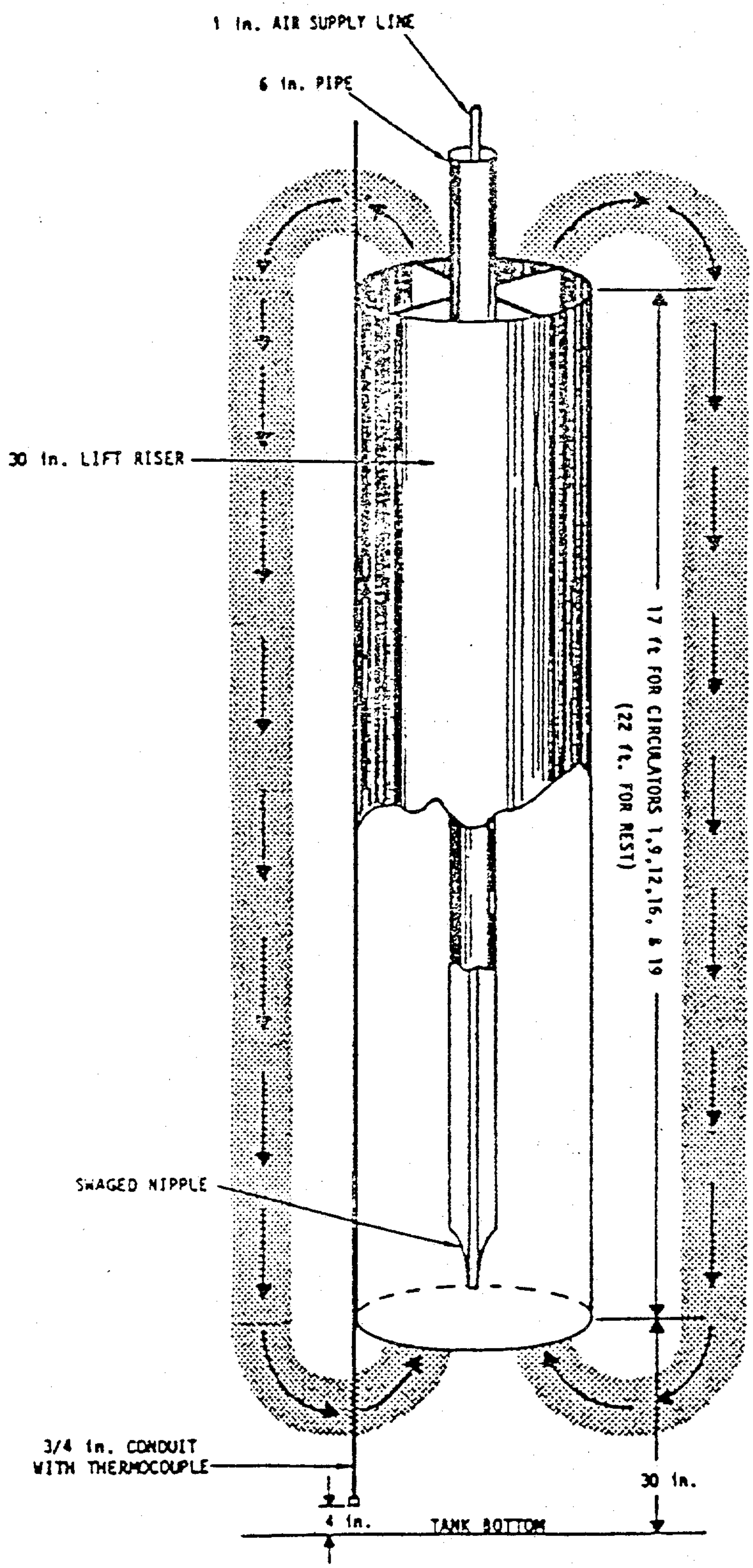


Figure 4. Aging Waste Tank with Airlift Circulators and Steam Coil in Operation.

Figure 5. Airlift Circulator Details



flowrate through each of the circulators is .57 m^3/min/unit (20 ft^3/min/unit) and the total minimum flowrate through all the circulators is 1.4 m^3/min/unit (50 ft^3/min/unit).

The 241-AY and -AZ/Tank Farms airlift circulators must be shut down prior to 702-A Building shutdown or whenever the fans are switched to prevent tank pressurization (WHC 1987, p. 1).

2.0 241-AN TANK FARM VENTILATION SYSTEM

The ventilation system for the 241-AN Tank Farm (WHC 1982, pp. 19, and 40-51) ventilates both the primary tank and annulus of the tank. The ventilation equipment (HVAC) pad for the 241-AN Tank Farm is located on the north side of the 241-AN Tank Farm between tanks 104-AN and 105-AN. The ventilation system is composed of four subsystems:

1. K1-1 primary tank ventilation system
2. K1-2 standby tank ventilation system
3. K2-1 annulus ventilation system
4. K2-2 annulus ventilation system.

The K1 primary tank ventilation system vents all seven primary tanks located in the 241-AN Tank Farm (Figures 6 and 7 [Rockwell 1986b, pp. 28-31]). The K2-1 annulus ventilation system ventilates the annuli of tanks 101-AN through 103-AN. The K2-2 annulus ventilation system ventilates the annuli of tanks 104-AN through 107-AN [Figures 8 and 9 (Rockwell 1986b, pp. 28-31)]. The combined annulus and primary tank ventilation systems are capable of removing up to 100,000 Btu/h/tank (Koontz 1986, p. A-3).

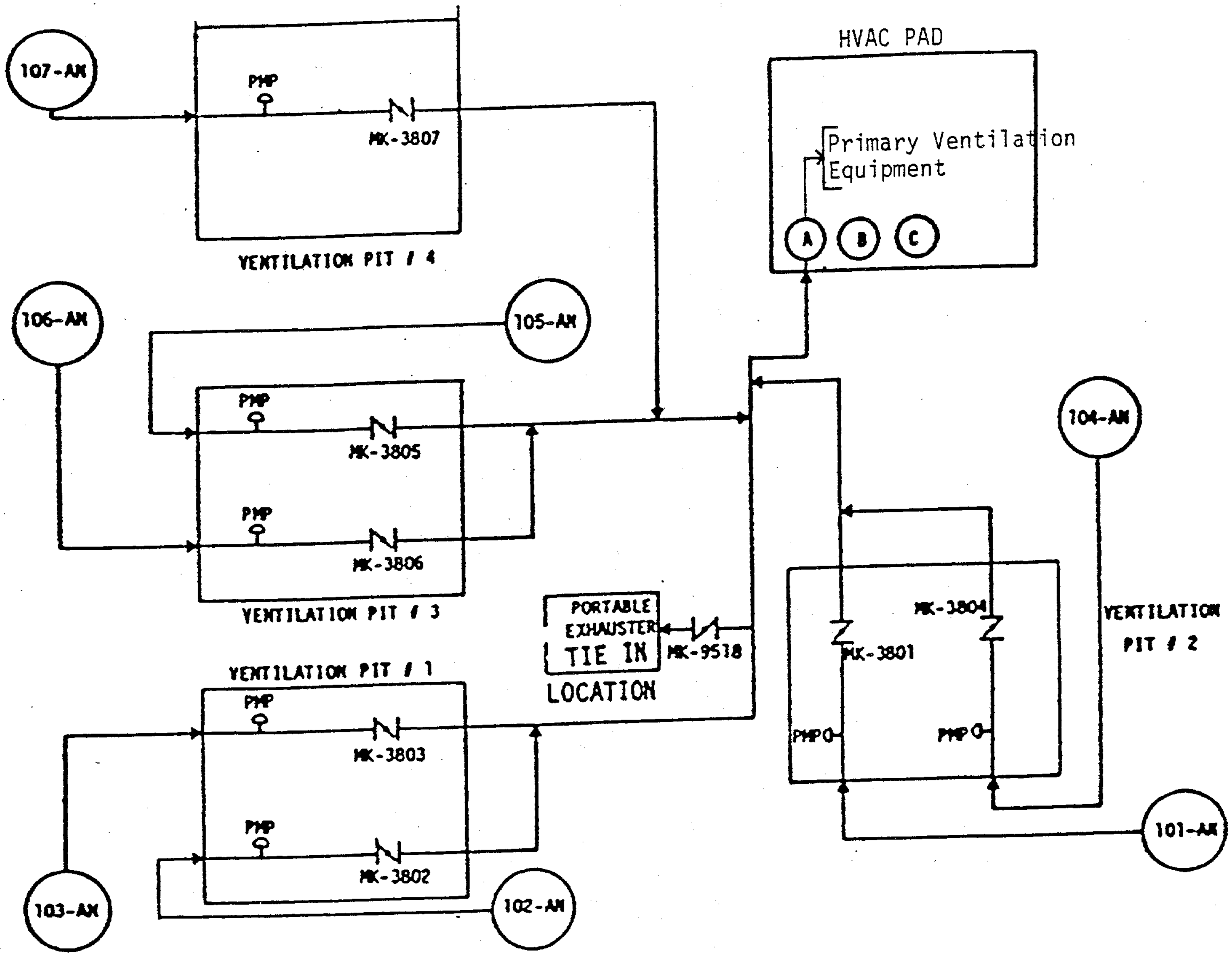
2.1 K1-1 PRIMARY TANK VENTILATION SYSTEM

The K1 primary ventilation system creates a vacuum in each tank ranging from 2.5 to 3.8 cm (1.0 to 1.5 in.) water gauge (WG) when the K1-1 exhauster is processing 28.3 m^3/min (1,000 ft^3/min), which is the maximum total flowrate. The vacuum's specified range is .64 to 10.2 cm (0.25 to 4-in.) WG in each tank. The ventilation system normally maintains a greater vacuum in the tank than in the annulus, which is required for vapor containment (Rockwell 1986c, p. 18).

The K1 system (K1-1 and K1-2) exhausts air infiltrating through pit cover blocks, then through riser flange gaskets, gases generated by radiological decay of the tank's contents, and air introduced into the tank vapor space through instrument air purges.

The exhaust gases leave the tank through a 30.5-cm (12-in.) dia duct. The primary exhaust ducts have air volume control a butterfly valves located in four vents pits (see Figure 6) that after leaving the vent pits combine into a 30.5-cm (12-in.) dia duct before entering the HVAC pad.

Figure 6. 241-AN Tank Farm K1 Primary Ventilation System Field Piping (Rockwell 1986b, pp. 28-31)



Legend:

PMP = Psychrometric Measuring Port
MK-3801 through Mk-3807 are butterfly control valves
All valves and piping are 12-inches in diameter

Figure 7. 241-AN Tank Farm Primary Tank Exhaust System on the Heating, Ventilation, and Air Conditioning Pad (Rockwell 1986b)

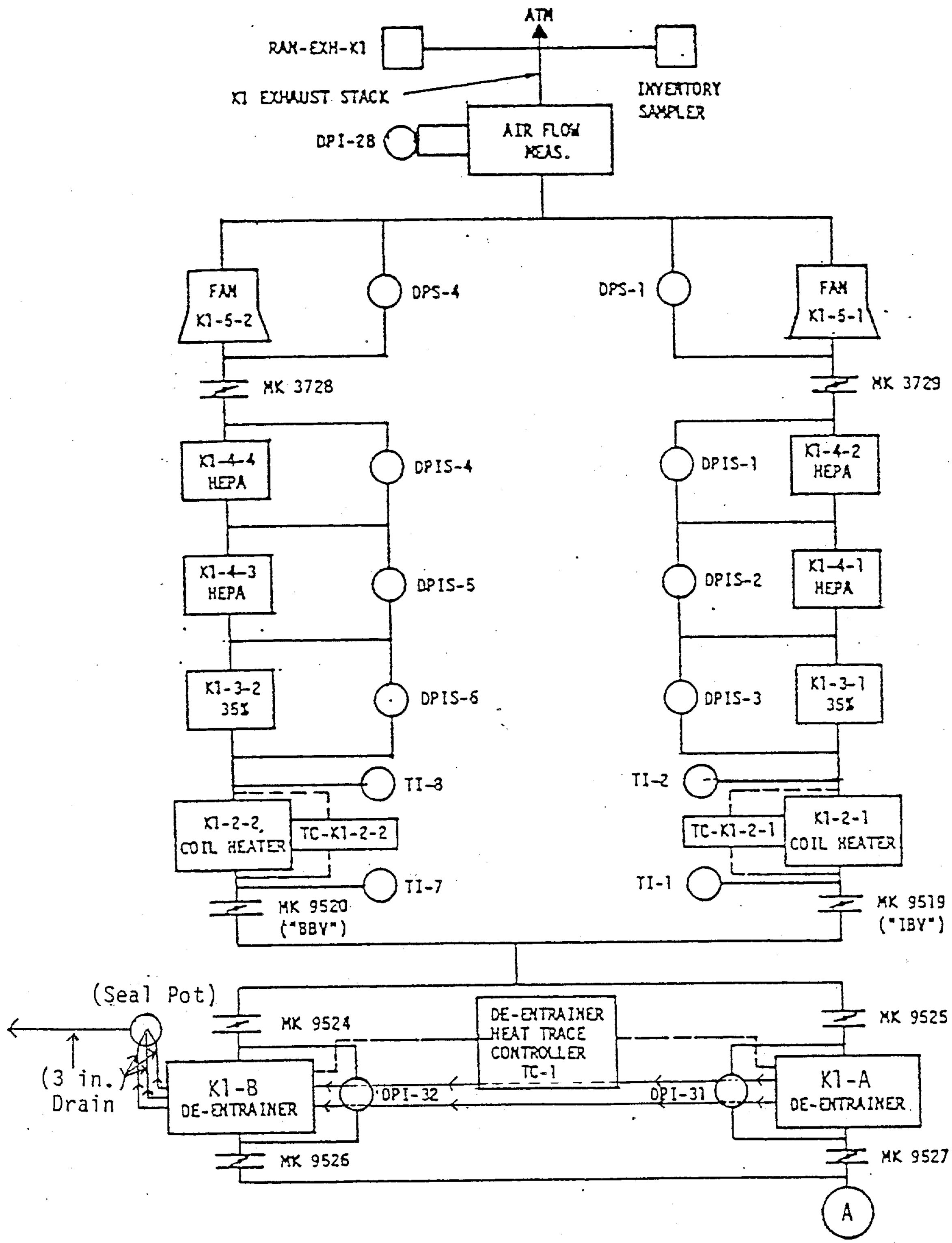
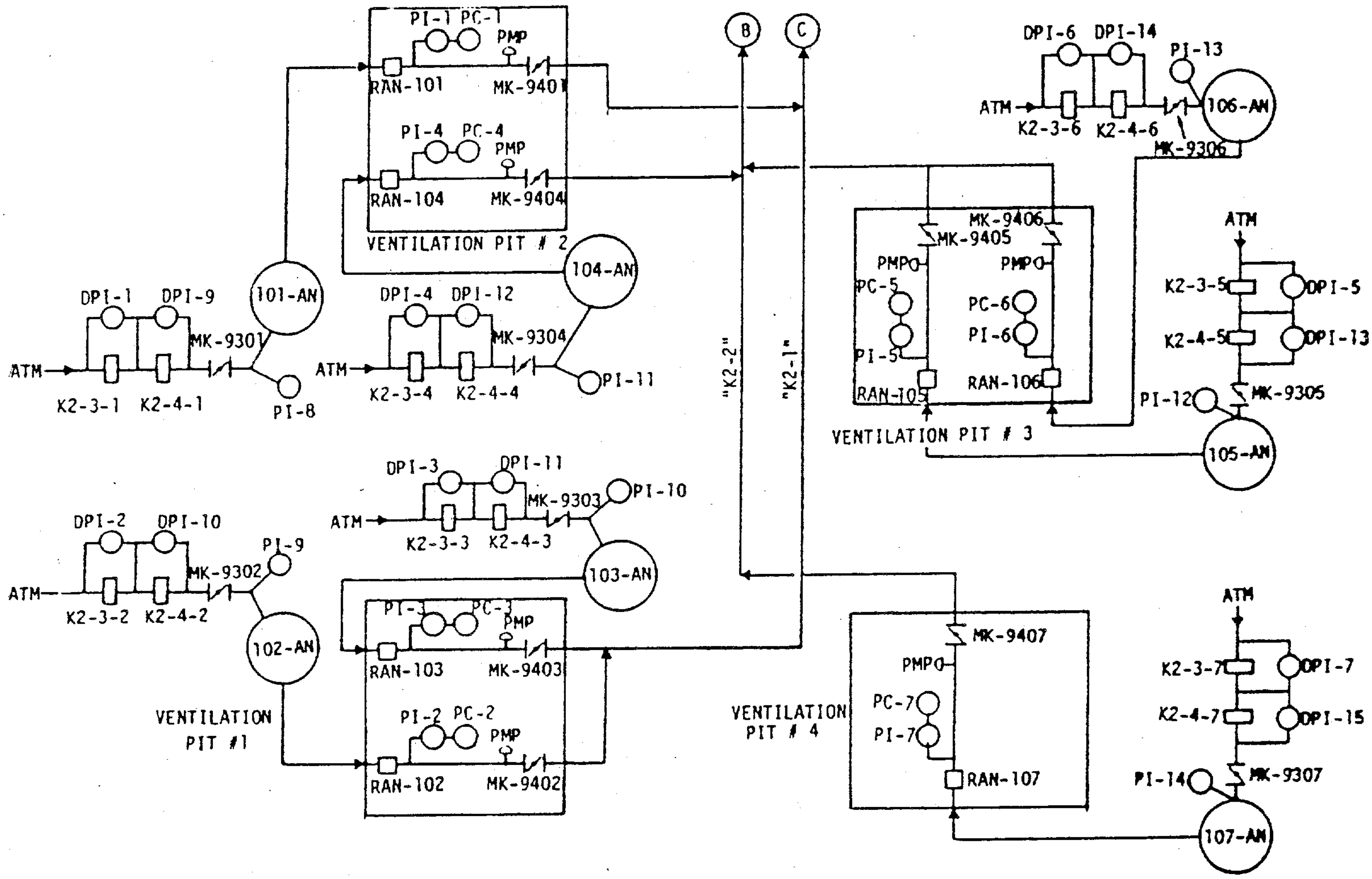


Figure 8. 241-AN Tank Farm K2 Annulus Field Piping System



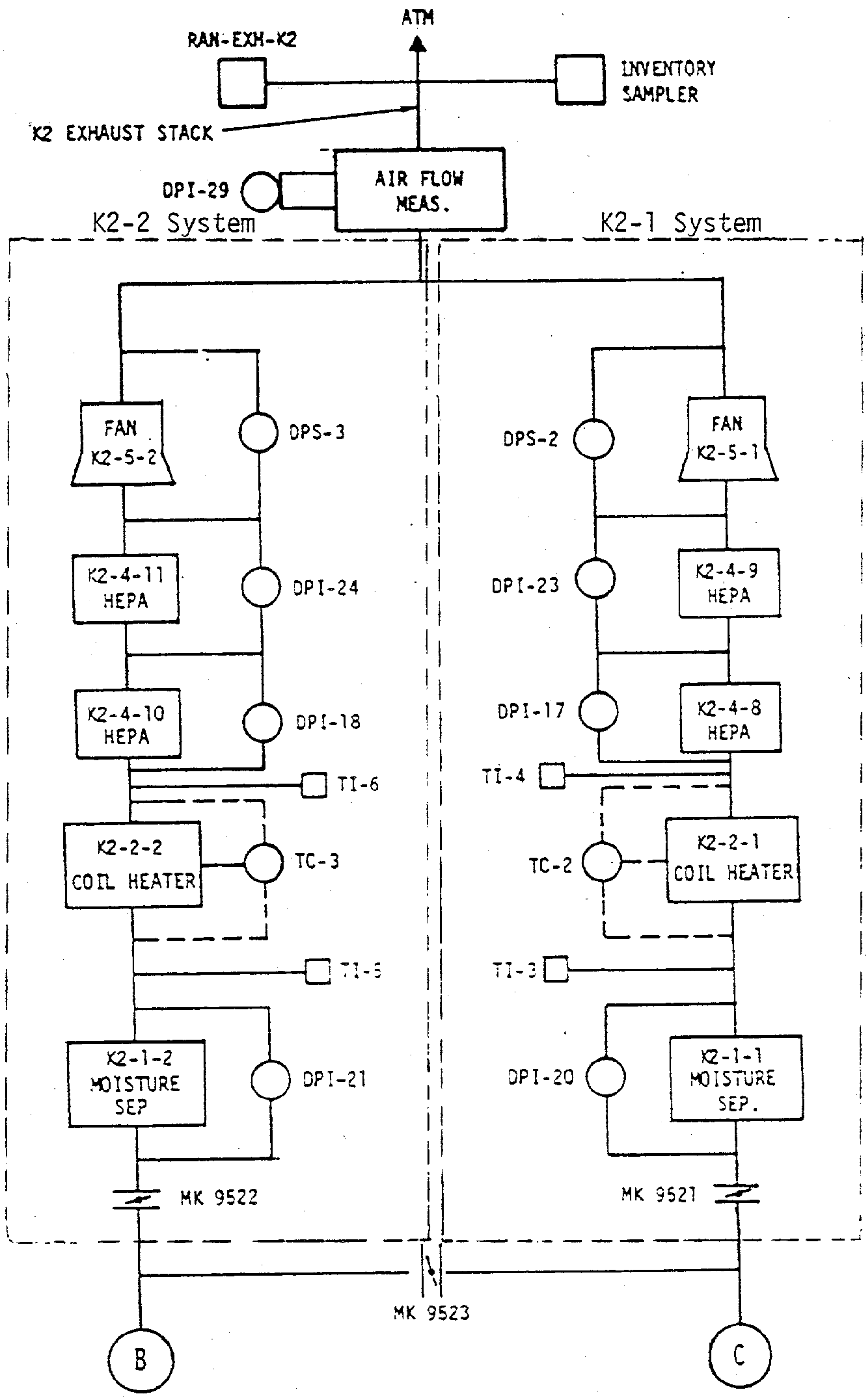
Legend:

PMP = Psychrometric Measuring Port

Valves MK-9301 through MK-9307 are 12 inch diameter air inlet valves to the annulus of each tank

Valves MK-9401 through Mk-9407 are 12 inch diameter vapor outlet valves located in the vent pits.

Figure 9. 241-AN Tank Farm Annulus Exhaust System on the Heating, Ventilation, and Air Conditioning Pad



2.2 K1-1 EXHAUSTER OPERATION

The following description assumes that the exhaust gases pass through the K1-A deentrainer and continue through the K1-1 ventilation system.

After reaching the HVAC pad, exhaust gases pass through the deentrainer K1-A. The deentrainer is constructed of a wire-mesh pad. The wire-mesh pad separates entrained moisture and large particles from the primary tank's vapor stream. The moisture that collects on the pad drains off the pad and back to the feed tank via a seal pot. Large particles also collect on the pad, causing the dP across the pad to increase. The pads are flushed when the dP value or radiation level becomes unacceptably high. The flushing drains back to the feed tank via the seal pot used during normal operations of the deentrainer.

Once the vapor passes through the deentrainer, it then passes through the open motorized MK-9519 valve. The valve position is determined by dP switch (DPS) DPS-1. This switch measures the across the K1-5-1 fan and is set for pressure-drop limits of 1.3 to 5 cm (0.1 to 2-in.) WG. Unless the K1-5-1 fan is not running, the MK-9519 valve should be in the open position. When the MK-9519 valve is in the open position, vapor enters the finned tube, blast coil, and electric heater (K1-2-1), which raises the vapor stream temperature by -12.2 °C (10 °F). Warming the air until its relative humidity is below 100% prevents moisture condensation within the filter and prevents ice formation. Temperature indicators upstream and downstream from the heater, elements TI-1 and TI-2, measure the temperature differential (dT) created by the operation of the heater. The minimum temperature change across the heater is $\geq$15 °C (5 °F). The temperature controller unit (TC-K1-2-1) then varies the voltage reaching the heater coils in proportion to the measured and preset (desired) dTs to maintain sufficient heating of the air stream.

The air then passes through a 35% NBS filter (K1-3-1), which removes particulates larger than 5 m. The operating conditions of the filters are monitored by a dP indicator switch (DPIS) DPIS-3, which has operating limits (pressure drop across the filters) of 0 to 5.1 cm (0 to 2-in.) WG.

The vapor then passes through two HEPA air filters [K1-4-1 and K1-4-2 (at least 99.95% efficient)], which are mounted in series. These are used to remove particulates 0.3 m or larger. To monitor the operating conditions of the HEPA filters, radiation readings are checked routinely by Radiation Protection Technologists (RPTs), and two dP indicators are connected across HEPA filters DPIS-2 and DPIS-1. A low dP indicates low air flowrate or a collapsed filter, and a high dP indicates a blockage resulting from accumulated solids or ice formation. If the dP across the NBS or HEPA filters rise to a preset value, DPIS-1, -2, or -3 automatically shuts down the K1-5-1 exhaust fan. The pressure-drop limits across K1-4-1 and K1-4-2 HEPA filters are 1.3 to 10.2 cm (0.5 to 4 in.) WG and 1.3 to 7.6 cm (0.5 to 3 in.) WG, respectively, with a total pressure drop across the sum of K1-4-1 and K1-4-2 units of 2.5 to 10.2 cm (1 to 4 in.) WG.

The RPTs make daily radiation surveys of the K1 system's 35% NBS and HEPA filters and report radiation readings of 100 mrem/h to the shift manager. This prompts the shift manager to schedule a filter changeout before the readings reach 200 mrem/h.

After passing through the NBS and HEPA filters, the exhaust gases are then drawn into the K1-5-1 exhaust fan and exhausted through the K1 exhaust stack. The exhaust stack gases are monitored by a CAM and inventory sampler. If the K1-5-1 exhaust fan stops for any reason, the DPS-1 senses losses in vacuum and automatically sends an electrical signal closing MK-9519 and opening MK-9520. Ventilation is resumed by the standby system.

The K1-1 primary and K1-2 standby exhaust systems are essentially the same. If the K1-5-1 standby fan is operating, then fails, the K1-5-2 fan will start automatically, closing MK-9519 and opening MK-9520. The primary ventilation system then becomes the K1-2 system and the standby system is the K1-1 system.

2.3 K2-1 AND K2-2 ANNULUS VENTILATION SYSTEMS

The K2-1 unit exhausts annulus air from three of the seven tanks and the K2-2 unit exhaust the annulus of the other four tanks (see Figures 8 and 9). If only one of these systems is to ventilate all seven annuli, then crossover valve MK-9523 is opened and the valve allowing flow through the inoperable system should be closed.

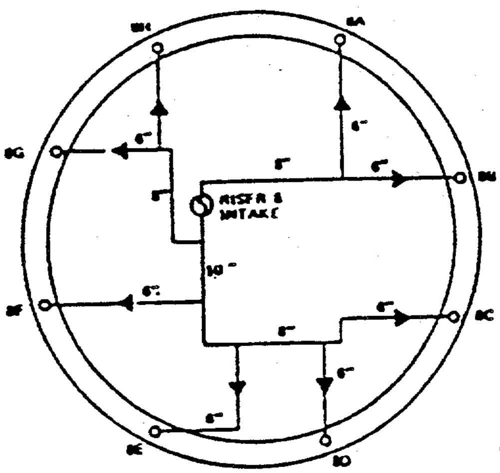
Air enters the annulus through an air intake station near each central pump pit. Intake air enters through a short stack, protected by a weather cover, then passes through a 35% NBS filter, a single HEPA filter (no preheating), and an annulus inlet butterfly control valve.

Eight 15.2-cm (6-in.) air delivery pipes split the airflow and reduce to four 10.2 cm (4-in.) pipes just before entering the annulus [Figure 10 (WHC 1982, p. 49)]. These delivery pipes terminate in an air distribution chamber in the insulating concrete pad. When the air reaches the distribution chamber, it flows into slots in the insulating concrete pad. These slots terminate in the annulus of the tank. Since the primary tank rests on top of the pad, the air cools the bottom of tank before entering the annulus chamber [Figure 11 (WHC 1982, p. 19)]. Air is drawn out of the annulus of each tank through four 20.3-cm (8-in.) risers located 90° apart and penetrating the annulus air space. These four ducts merge into a 30.5-cm 12-in.) duct called the annulus vent header.

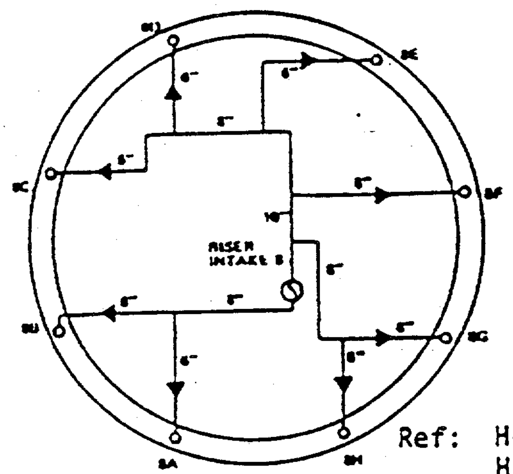
The vent header passes through a vent pit before reaching the HVAC equipment pad. The vent pit allows air to be sampled and controlled. Inlet and outlet butterfly valves are located in the vent pit. By adjusting the inlet and outlet butterfly valves, the volume of air passing through the annulus, and the pressure in the annulus, can be set to the desired values. The annulus vent header has penetrations for a pressure gauge and pressure switch, sampling tubes (where air is withdrawn and forwarded to a CAM), and a psychometric port (where air volume, temperature, and humidity can be measured by ventilation balance personnel).

Two 30.5-cm (12-in.) vent ducts are on either side of each pit. Lower ducts are annulus vent ducts; upper ducts are primary tank ducts. Those ducts

Figure 10. 241-AN Tank Farm Air Intake System (Vitro 1976, 1978e).



TANKS 101,102,104, &105-AN

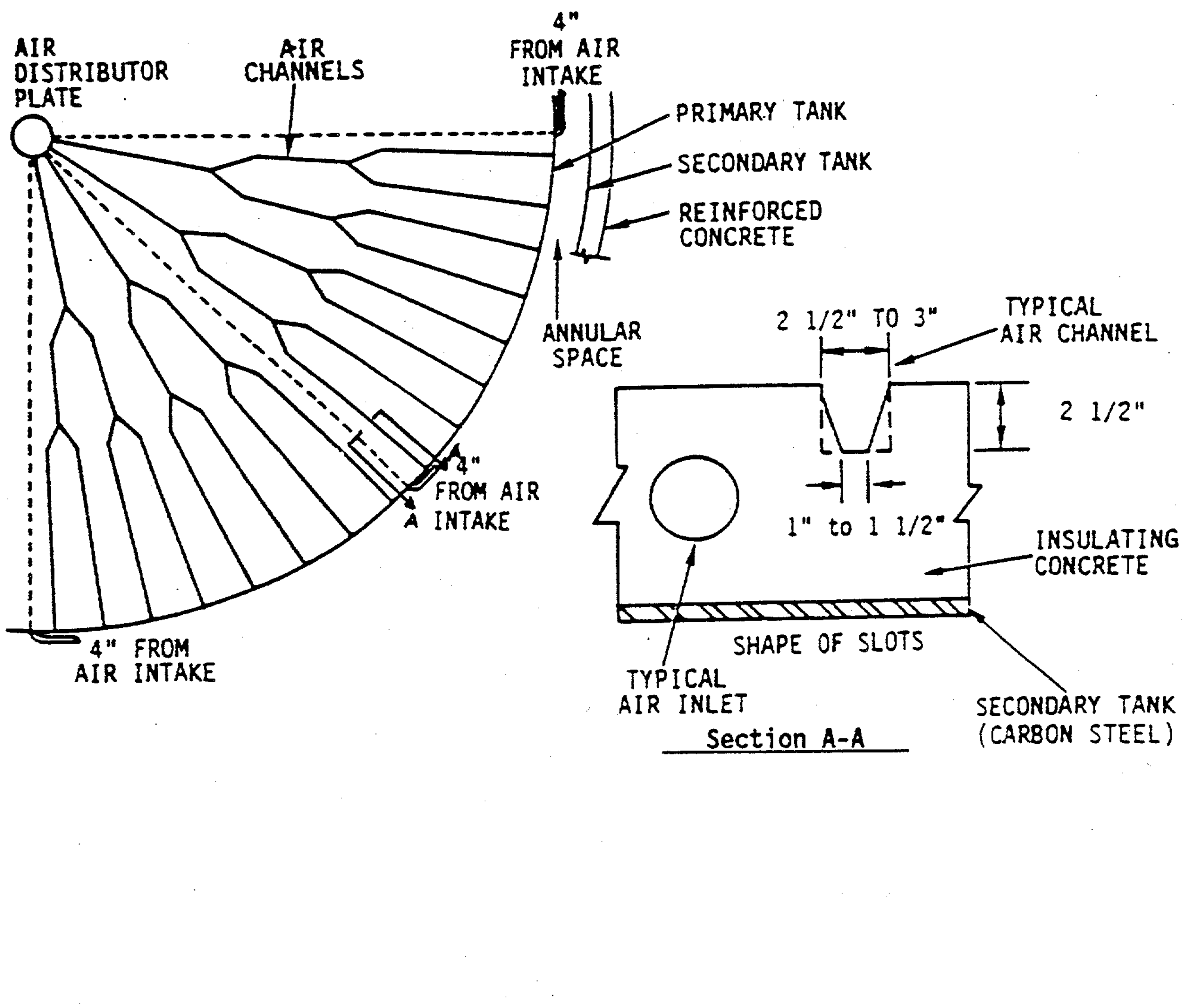


TANKS 103,106, & 107-AN

Ref: H-2-71989
H-2-71976

Note: Risers 8A through 8H are 4-inches in diameter

Figure 11. Typical Annulus Air Flow Through Insulating Concrete.



on the same side of the pit originate at the same tank. Annulus air reaching the K2-1 and K2-2 units passes through the following:

A manual butterfly valve

A moisture separator (deentrainer)

A finned tube, blast coil, and electric heater

Four HEPA filters (mounted two deep and two high)

Four more HEPA filters (mounted the same as the first)

A motor-controlled fan inlet damper

A centrifugal fan

A motor-controlled fan outlet damper

A common exhaust stack.

The K2 exhaust stack has a unit to measure airflow. The measurement is read on DPI-29 (see Figure 9). Annulus air is sampled by RAN-EXH-K2. The system is designed to operate a maximum air flowrate of 22.7 m^3/min (800 ft^3/min) airflow through each annulus and a dP, relative to the atmosphere, of -8.9 to -10.2 cm (-3.5 in. to -4.0 in.) WG in each annulus. However, the system can be adjusted to different airflow and dP values.

2.4 241-AN TANK FARM VENTILATION SYSTEM SPECIFICATIONS

The 241-AN Tank Farm ventilation system specifications for the HEPA filter, exhaust fan, preheater, and piping (Vitro 1978a) are provided in Tables 14 through 17.

Table 14. High-Efficiency Particulate Air Filter Specifications.

Unit	ft^3/min[a]	Size (in.)	Manufacturer	Model
K1-4-1	1,000	24 by 24 by 11.5	Flanders	7C85-NE
K1-4-4	1,000	24 by 24 by 11.5	Flanders	7C85-NE
K2-4-1	800	24 by 24 by 20	MSA	Self Contained
K2-4-7	800	24 by 24 by 20	MSA	Self Contained
K2-4-8	655	24 by 24 by 11.5	MSA	U Ultra Lok
K2-4-9	655	24 by 24 by 11.5	MSA	U Ultra Lok
K2-4-10	875	24 by 24 by 11.5	MSA	U Ultra Lok
K2-4-11	875	24 by 24 by 11.5	MSA	U Ultra Lok

[a]Temperature of vapor entering the HEPA filter has to be ≤121 °C (250 °F).

Table 15. Exhaust Fan Specifications.

Unit	Standard ft^3/min	Temp(°F)	Horse-power	Revolutions per minute	Volts	Phase	Hertz
K1-5-1	1,170	70	5	3,450	480	3	60
K1-5-2	1,170	70	5	3,450	480	3	60
K2-5-1	8,600	70	50	1,765	480	3	60
K2-5-2	8,600	70	50	1,765	480	3	60

Table 16. Preheater Specifications.

Unit	Standard ft^3/min	Watts	Hertz	kW	Volts	Phase	Hertz	Manufac-turer	Model
K1-2-1	1,000	24	24	10	460	3	60	INDEECO	Finned Tube Flanged Unit
K1-2-2	1,000	24	24	10	460	3	60	INDEECO	Finned Tube Flanged Unit
K2-2-1	2,625	24	42	9	460	3	60	INDEECO	Blast Coil Finned Tube
K2-2-2	2,625	24	42	12	460	3	60	INDEECO	Blast Coil Finned Tube

Table 17. 241-AN Tank Farm Ventilation System Piping from Each Tank Main Annulus Exhaust Header and Primary Tank Exhaust Riser to the Central Exhaust Station (Vitro 1978b, 1978c, 1978d).[a]

	Primary Exhaust				Annulus Exhaust			
	Riser		Piping		Riser		Piping	
Tank	Number of risers	Diameter (in.)	Diameter (in.)	Length (ft)	Number of risers	Diameter (in.)	Diameter (in.)	Length (ft)
101	1	12	12	140	4	8	12	165
102	1	12	12	275	4	8	12	329
103	1	12	12	342	4	8	12	230
104	1	12	12	161	4	8	12	139
105	1	12	12	160	4	8	12	141
106	1	12	12	237	4	8	12	270
107	1	12	12	247	4	8	12	242

[a]Some pipe lengths are shared, therefore, the pipe lengths listed above are not additive.

3.0 241-AP TANK FARM VENTILATION SYSTEM

The 241-AP Tank Farm's HVAC system is located in the central exhaust station on the east side of the 241-AP Tank Farm behind concrete shielding walls. This system services all eight tanks in the 241-AP Tank Farm. The HVAC system consist of four subsystems (WHC 1986, pp. 61 to 74):

1. K1-1 Primary Tank Ventilation System
2. K1-2 Standby Tank Ventilation System
3. K2-1 Annulus Ventilation System
4. K2-2 Annulus Ventilation System.

Each 241-AP Tank Farm primary tank is exhausted through a 30.5-cm (12-in.) carbon-steel pipeline connected to the appropriate riser [Figure 12 (WHC 1986a, p. 62)]. The volume of vapor removed from each tank is regulated by manually operated 30.5-cm (12-in.) butterfly valves located in vent pit 1 (tanks AP-101, -102, -103, -104) and Vent Pit 2 (tanks AP-105, -106, -107, and -108). The eight 30.5-cm (12-in.) primary exhaust pipelines exiting the ventilation pits are then combined into one 41-cm (16-in.) primary vent header. The 41-cm (16-in.) vent header splits into two 30.5-cm (12-in.) dia pipes and enters the central exhaust station [Figure 13 (WHC 1986a, p. 63)].

The vent headers are then routed to two parallel deentrainers (K1-1-1 and K1-1-2), with one operating and the other on standby. The deentrainer to be used is determined by motor-operated butterfly valves.

3.1 K1 PRIMARY TANK VENTILATION SYSTEM

This system functions exactly the same as the AN Tank Farm primary tank ventilation system, except the 241-AP Tank Farm system vents eight tanks. Therefore, the reader is referred to Section 2.1 of this document for the system functional description, (also see Figure 13). The HEPA filter change-out criteria and limits are also identical. The airflow through the K1 system is 33.1 standard m^3/min (1,170 Standard ft^3/min) and maintains a vacuum of 1.3 to 12.7 cm (0.25 to 5 in.) WG in each of the eight tanks in the 241-AP Tank Farm (Rockwell 1986c, p. 18).

3.2 K2 ANNULUS VENTILATION SYSTEM

Referring to Figure 14 (WHC 1986a, p. 69), air enters the tank annuli through one of four inlet stations, where it is heated [if below 4.4 °C (40 °F)] by one of the K2-4-1 through K2-4-4 heaters, then filtered by their respective 35% NBS and HEPA filters. The air then enters the annuli from eight 10.2-cm (4-in.) dia pipes that receive air supply from a 25.4-in (10-in.) header containing a 25.4-cm (10-in.) manually operated butterfly control valve. The air follows the same general path as the 241-AN Tank Farm air intake for the annulus [Figure 15 (WHC 1986a, p. 70)].

Figure 12. 241-AP Tank Farm Primary Exhaust Piping

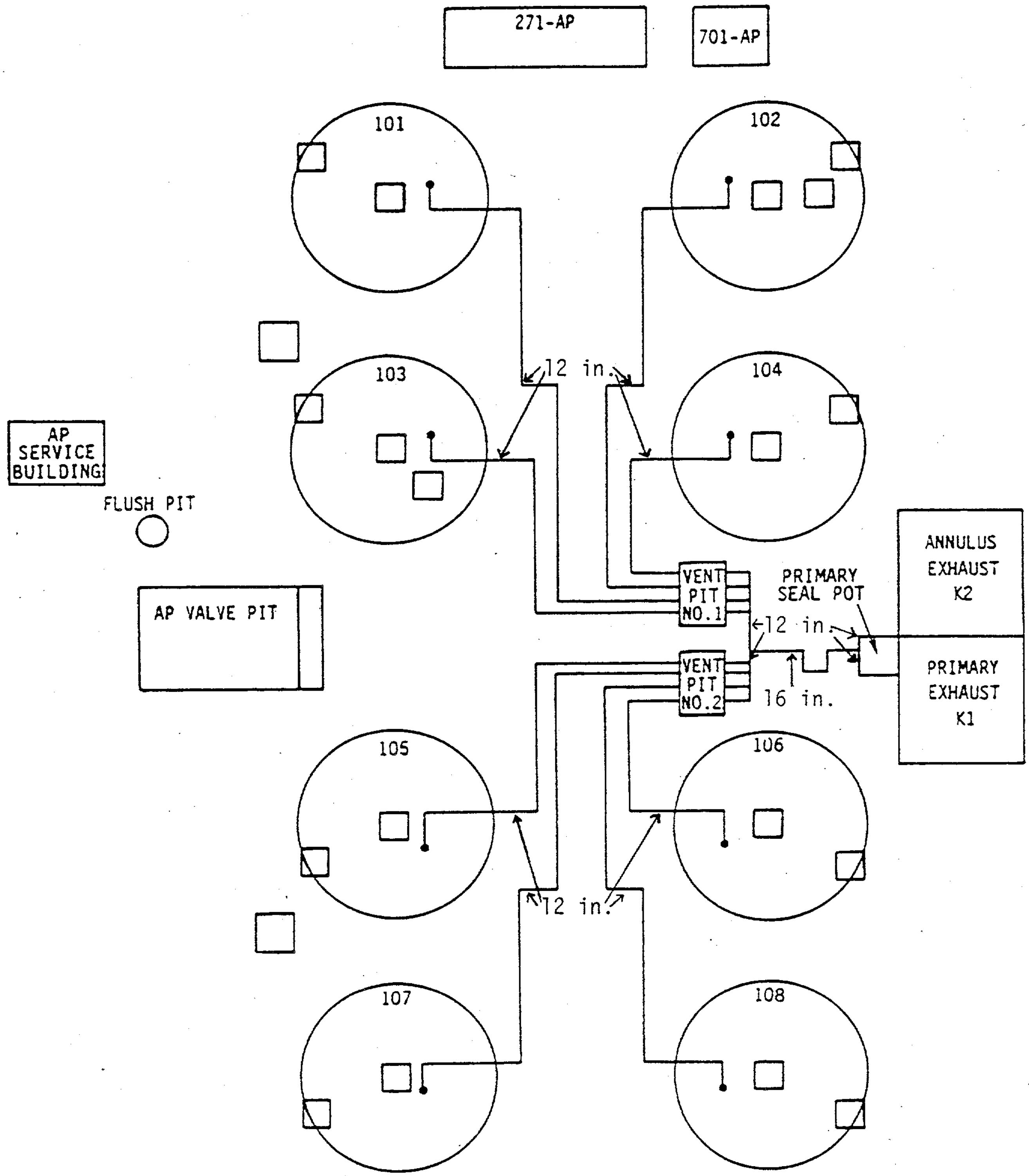


Figure 13. 241-AP Tank Farm Primary Exhaust Flow Diagram

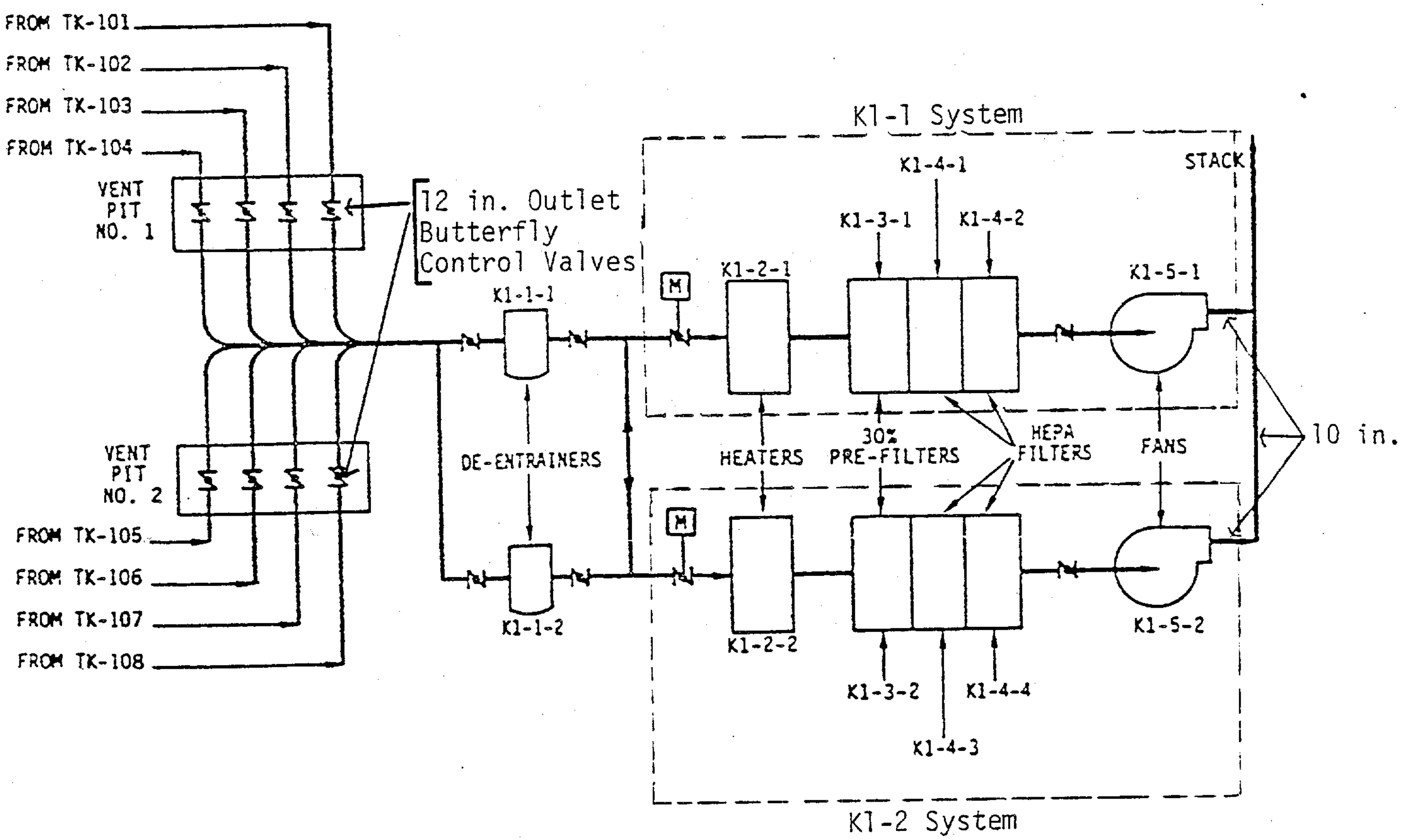


Figure 14. 241-AP Tank Farm K2 Annulus Intake Piping

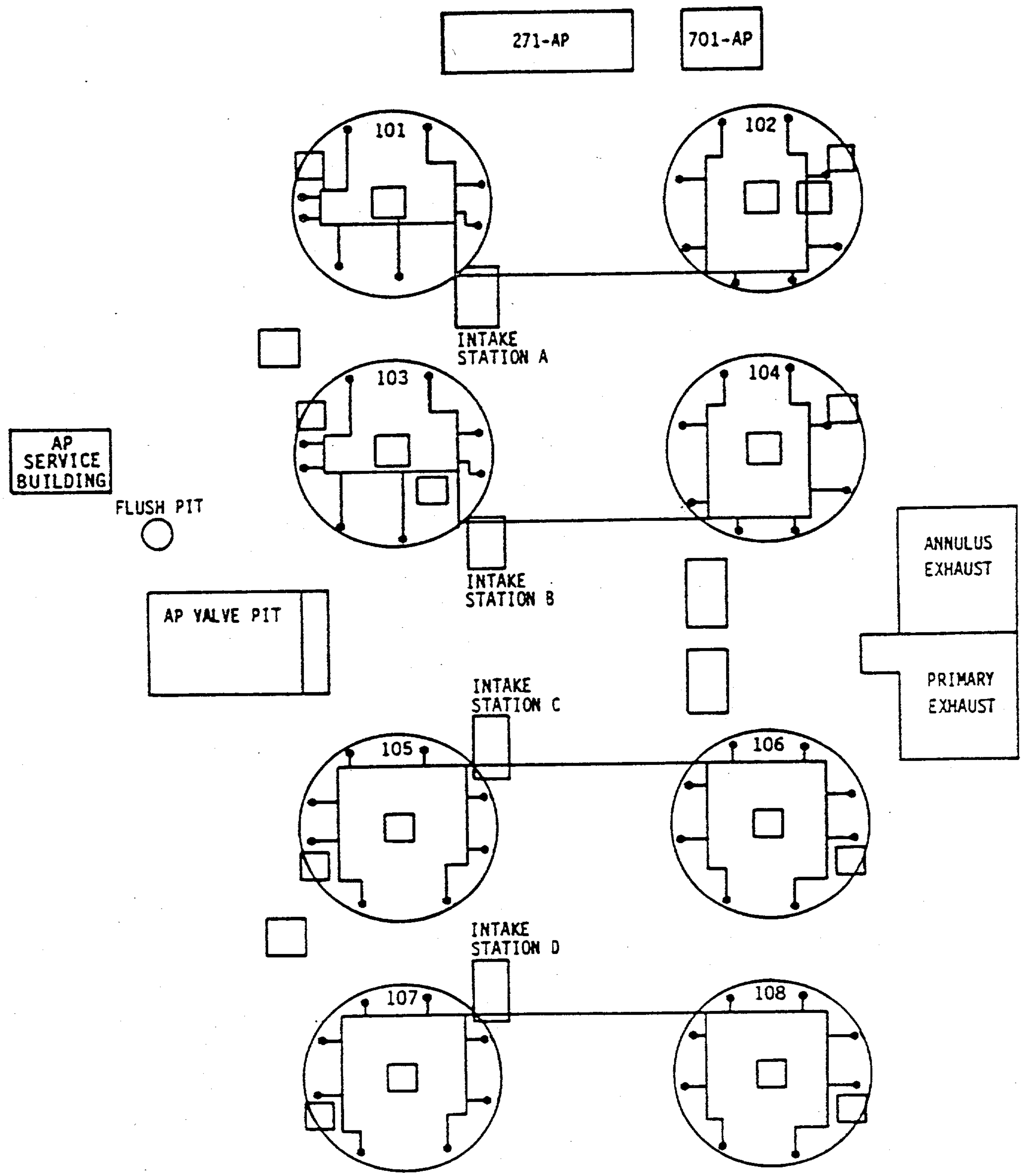
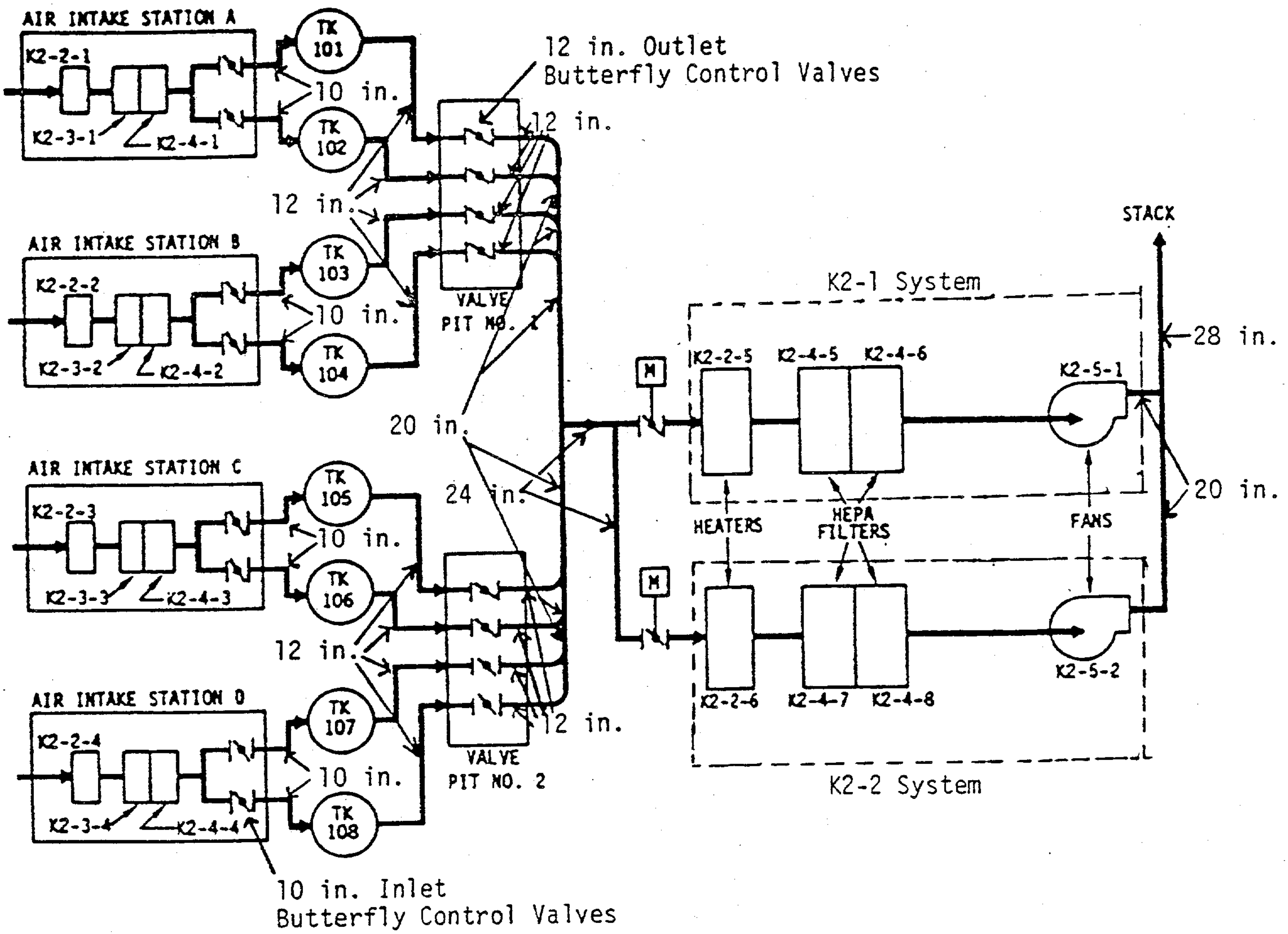


Figure 15. 241-AP Tank Farm Annulus Exhaust Flow Diagram



Exiting the annulus from four 20.3-cm (8-in.) risers on each tank [Figure 16 (WHC 1986a, p. 73)], the pipelines from these risers are combined into one 30.5-cm (12-in.) pipeline for each tank. These annulus ventilation pipelines travel through their respective 30.5-cm (12-in.) manually operated butterfly valves located in the ventilation pits and are combined into one 61-cm (24-in.) annulus exhaust header after exiting the ventilation pit. This combined exhaust header is directed to the K2 ventilation area.

In 241-AP Tank Farm there are two leak detection pits, AP-03C and AP-05C, one for each of four tanks. The wells below the leak detection pits receive drainage from the concrete foundation of each tank, and the liquid levels in these wells are monitored for the purpose of detecting leaks in the primary tank. A 5-cm (2-in.) line with a 5-cm (2-in.) ball valve is connected to the annulus ventilation system for the purpose of ventilating the leak-detection wells (Koontz 1986, pp. 5-15 to 5-18).

The K2 annulus ventilation system located on the HVAC pad functions exactly the same as the K2 system on the HVAC pad for 241-AN Tank Farm (Section 2.3). The HEPA filters also have the same change-out criteria. The 241-AP Tank Farm uses either the K2-1 or K2-2 system as a standby system, whereas the 241-AN Tank Farm uses both systems for ventilating the tank annuli under normal operating conditions. Therefore, the functioning system, whether K2-1 or K2-2, exhausts annulus air from all eight tanks.

3.3 241-AP TANK FARM VENTILATION SYSTEM SPECIFICATIONS (KEH 1983a)

The 241-AP Tank Farm ventilation system specifications for the HEPA filter, exhaust fan, preheater, and piping are provided in Tables 18 through 21.

4.0 241-AW TANK FARM VENTILATION SYSTEM (WHC 1986b, pp. 43-45)

The 241-AW Tank Farm ventilation system, also known as the HVAC system, performs the same primary functions as the HVAC systems for the 241-AN and 241-AP Tank Farms. The HVAC pad is located on the east side of the 241-AW Tank Farm.

The ventilation system consists of the following two subsystems (Figure 17, WHC 1986b p. 43):

1. K1-Primary Tank Ventilation System
2. K2-Annulus Ventilation System.

The K1 primary tank (vessel) ventilation system vents air and vapor from all six tanks located in the 241-AW Tank Farm at a maximum total flowrate of 28.3 m^3/min (1,000 ft^3/min). The K2 annulus ventilation system consist of two subsystems, K2-1 and K2-2 [Figure 18 (WHC 1986b p. 43)]. Each of these subsystems is responsible for venting the annuli of three tanks each at a maximum flowrate of 22.7 m^3/min (800 ft^3/min) through each tank annulus.

Figure 16. 241-AP Tank Farm Annulus Exhaust Piping

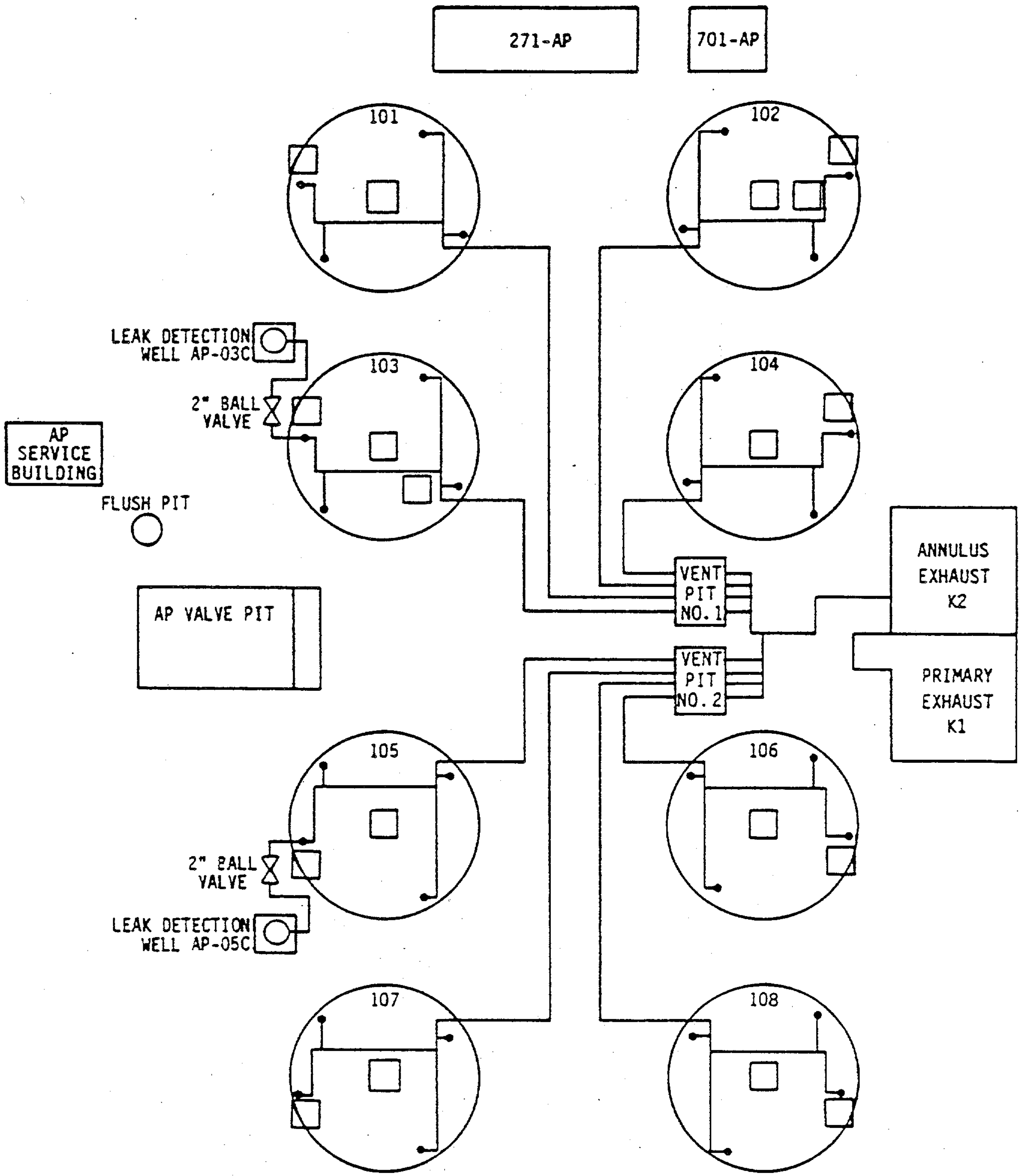


Table 18. High-Efficiency Particulate Air Filter Specifications[a] (KEH 1983a).

Unit	ft³/min	Size (in.)	Manufacturer	Model
K1-4-1	1,170	24 by 24 by 11.5	Flanders	007-0-02-05-NU-GGF
K1-4-2	1,170	24 by 24 by 11.5	Flanders	007-0-02-05-NU-GGF
K1-4-3	1,170	24 by 24 by 11.5	Flanders	007-0-02-05-NU-GGF
K1-4-4	1,170	24 by 24 by 11.5	Flanders	007-0-02-05-NU-GGF
K2-4-1	717	24 by 24 by 11.5	Flanders	007-0-02-05-NU-GGF
K2-4-2	717	24 by 24 by 11.5	Flanders	007-0-02-05-NU-GGF
K2-4-3	717	24 by 24 by 11.5	Flanders	007-0-02-05-NU-GGF
K2-4-4	717	24 by 24 by 11.5	Flanders	007-0-02-05-NU-GGF
K2-4-5	956	24 by 24 by 11.5	Flanders	007-0-02-05-NU-GGF
K2-4-6	956	24 by 24 by 11.5	Flanders	007-0-02-05-NU-GGF
K2-4-7	956	24 by 24 by 11.5	Flanders	007-0-02-05-NU-GGF
K2-4-8	956	24 by 24 by 11.5	Flanders	007-0-02-05-NU-GGF

[a]Temperature of vapor entering the HEPA filter has to be ≤121.1 °C (250 °F).

Table 19. Exhaust Fan Specifications.

Unit	Standard ft³/min	Temp(°F)	Horse-power	Revolutions per minute	Volts	Phase	Hertz
K1-5-1	1,170	70	5	3,450	480	3	60
K1-5-2	1,170	70	5	3,450	480	3	60
K2-5-1	8,600	70	50	1,765	480	3	60
K2-5-2	8,600	70	50	1,765	480	3	60

Table 20. Preheater Specifications.

Unit	Standard ft³/min	kW	Volts	Phase	Hertz	Control System Manufacturer	Control System Model
K1-2-1	1,170	10	480	3	60	United Electric	120A Type 122
K1-2-2	1,170	10	480	3	60	United Electric	120A Type 122
K2-2-1	2,150	20	480	3	60	Honeywell	T673A-1508
K2-2-2	2,150	20	480	3	60	Honeywell	T673A-1508
K2-2-3	2,150	20	480	3	60	Honeywell	T673A-1508
K2-2-4	2,150	20	480	3	60	Honeywell	T673A-1508
K2-4-5	8,600	32	480	3	60	United Electric	120A Type 122
K2-4-6	8,600	32	480	3	60	United Electric	120A Type 122

Table 21. 241-AP Tank Farm Ventilation System Piping from Each Tank Main Annulus Exhaust Header and Primary Tank Exhaust Riser to the Central Exhaust Station (KEH 1983b, 1983c, 1983d).

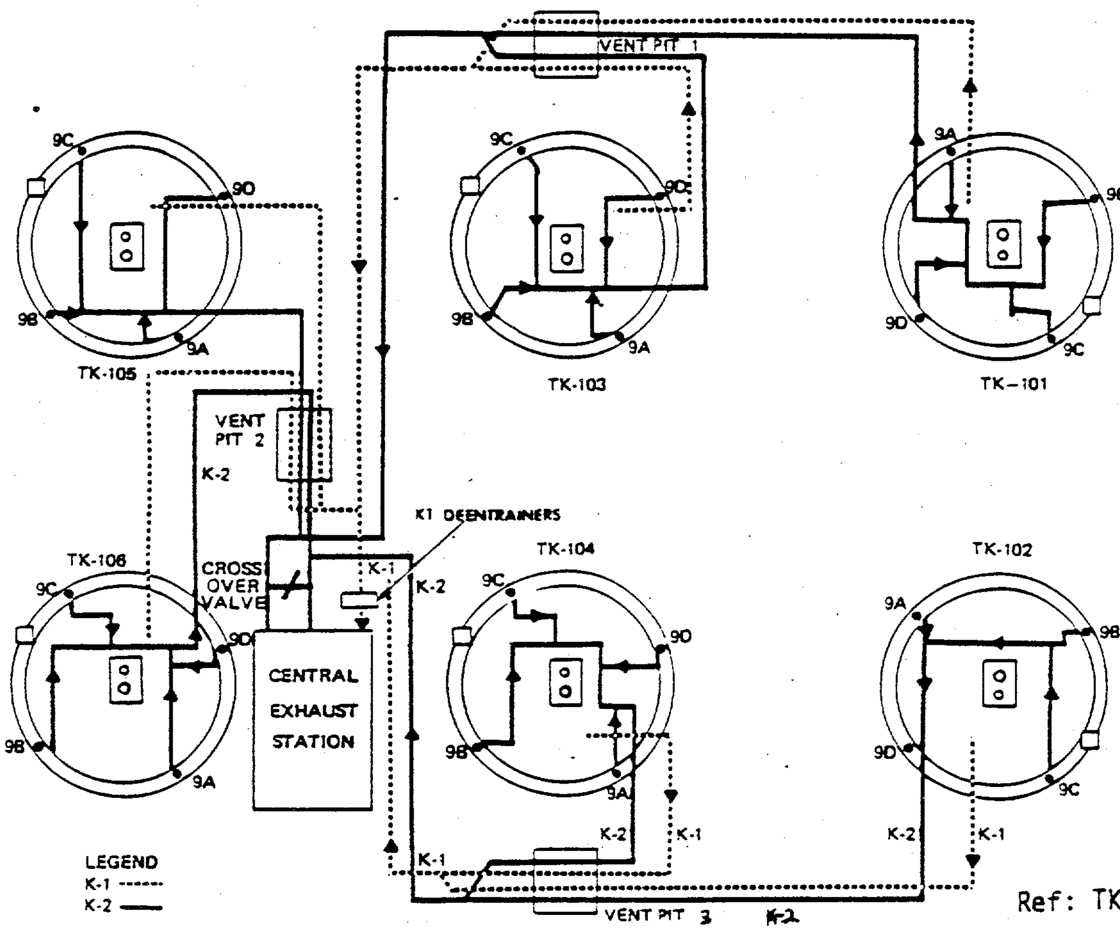
	Primary Exhaust				Annulus Exhaust			
	Riser		Piping		Riser		Piping	
Tank No.	Number of risers	Dia (in.)	Dia (in.)	Length (ft.)	Number of risers	Dia (in.)	Dia (in.)	Length (ft.)
101	1	12	12	282	4	8	12	257
			16	70			20	49
			18	5			24	32
			12(2)[a]	10,12[b]				
102	1	12	12	245	4	8	12	218
			16	77			20	60
			18	5			24	32
			12(2)	10,12				
103	1	12	12	187	4	8	12	157
			16	60			20	43
			18	5			24	32
			12(2)	10,12				
104	1	12	12	131	4	8	12	102
			16	77			20	60
			18	5			24	32
			12(2)	10,12				
105	1	12	12	172	4	8	12	155
			16	57			20	10
			18	5			24	32
			12(2)	10,12				
106	1	12	12	126	4	8	12	131
			16	65			20	26
			18	5			24	32
			12(2)	10,12				
107	1	12	12	284	4	8	12	261
			16	57			20	16
			18	5			24	32
			12(2)	10,12				
108	1	12	12	266	4	8	12	236
			16	65			20	26
			18	5			24	32
			12(2)	10,12				

[a]The 12(2) indicates there are two pipes 30.5 cm (12 in.) in diameter.

[b]The 10,12 indicates that of the two (12 in.) 30.5 cm (12 in.) diameter pipes, one is 3.1 m (10 ft) long and the other is 3.7 m (12 ft) long.

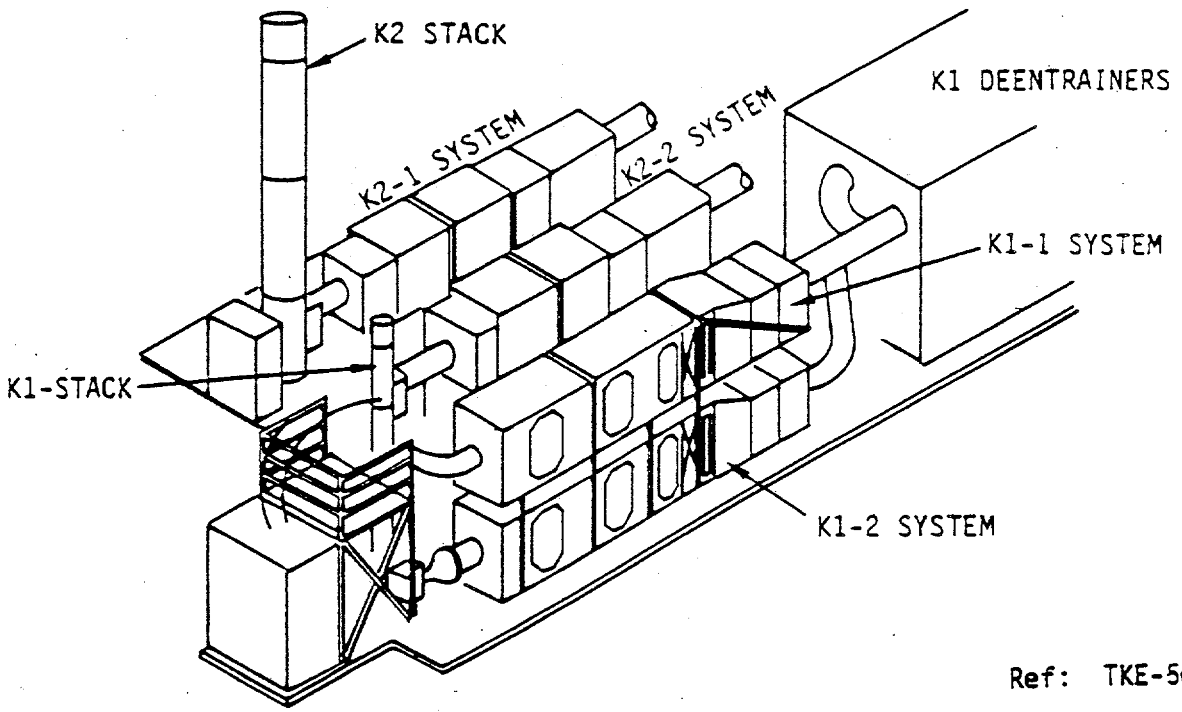
[c]Some pipe lengths are shared, therefore, the pipe lengths listed above are not additive.

Figure 17. 241-AW Tank Farm Primary and Annulus Piping Configuration
(All piping in this K1 system is 12-inch diameter.)



Ref: TKE-6056

Figure 18. 241-AW Tank Farm Central Exhaust Station.



Ref: TKE-5082

4.1 K1 PRIMARY TANK VENTILATION SYSTEM

This system functions exactly the same as the 241-AN Tank Farm primary tank ventilation system and has the configuration shown in Figure 17 (K-1). (Note: see Section 2.1 and use Figure 17 for the system configuration.) The primary tank exhaust system on the HVAC pad is the same as shown in Figure 7 for 241-AN Tank Farm primary tank exhaust system.

4.2 ANNULUS VENTILATION SYSTEM

This system has the configuration as shown in Figure 17 (K-2), and the ventilation unit located on the HVAC pad is the same as shown in Figure 9. It functions similarly to the K2 annulus ventilation system for the 241-AN Tank Farm, except that the 241-AW Tank Farm has one less tank and one less vent pit. The reader is referred to the description in Section 2.3 and also to Figure 17 while reading the description.

4.3 241-AW TANK FARM VENTILATION SYSTEM SPECIFICATIONS (Vitro 1977a; KEH 1983e)

The 241-AW Tank Farm ventilation system specifications for the HEPA filter, exhaust fan, preheater, and piping are provided in Tables 22 through 25.

5.0 241-SY TANK FARM VENTILATION SYSTEM DESCRIPTION

The vessel and annulus ventilation and HVAC systems are located on the southwest end of 241-SY Tank Farm. The vessel, primary tank, and ventilation unit are located on the west side of the ventilation equipment pad and the annulus ventilation unit is on the east side of the HVAC pad.

The subsystems of the ventilation system are as follows:

1. K1 primary tank ventilation system
2. K2 annulus ventilation system.

The combined annulus and primary tank ventilation systems are capable of removing up to 50,000 Btu per tank (Koontz 1986, p. A-7).

5.1 K1 PRIMARY TANK VENTILATION SYSTEM (Rockwell 1987b, pp. 1-4)

The K1 primary tank ventilation system performs the same function of exhausting air as the K1 primary tank ventilation system on the 241-AN Tank Farm (Section 2.1). The K1 system consists of a deentrainer (K1-1-1), steam heating coil (K1-2-1), 8% NBS rockstopper filter (K1-5-1), two HEPA filters (K1-3-1 and K1-3-2), exhauster fan (K1-4-1), exhaust stack, and exhaust

Table 22. High-Efficiency Particulate Air Filter Specifications.

Unit	ft^3/min[a]	Size (in.)	Manufacturer	Model
K1-4-1	1,000	24 by 24 by 11.5	Flanders	7C25-NL-GGF
K1-4-2	1,000	24 by 24 by 11.5	Flanders	7C25-NL-GGF
K1-4-3	1,000	24 by 24 by 11.5	Flanders	7C25-NL-GGF
K1-4-4	1,000	24 by 24 by 11.5	Flanders	7C25-NL-GGF
K2-4-1	800	24 by 24 by 11.5	Cambridge	IEA-1000
K2-4-2	800	24 by 24 by 11.5	Cambridge	IEA-1000
K2-4-3	800	24 by 24 by 11.5	Cambridge	IEA-1000
K2-4-4	800	24 by 24 by 11.5	Cambridge	IEA-1000
K2-4-5	800	24 by 24 by 11.5	Cambridge	IEA-1000
K2-4-6	800	24 by 24 by 11.5	Cambridge	IEA-1000
K2-4-7	875	24 by 24 by 11.5	Flanders	7C25-NL-GGF
K2-4-8	875	24 by 24 by 11.5	Flanders	7C25-NL-GGF
K2-4-9	875	24 by 24 by 11.5	Flanders	7C25-NL-GGF
K2-4-10	875	24 by 24 by 11.5	Flanders	7C25-NL-GGF

[a]Air going into the HEPA filters has to be $\leq$121.1 °C (250 °F).

Table 23. Exhaust Fan Specifications.

Unit	ft^3/min	Air Temperature (°F)	Horsepower	Revolutions per minute	Volts	Phase	Hertz	Manufacturer	Model
K1-5-1	1,000	70	3	3,600	480	3	60	Aladdin	2000-MR
K1-5-2	1,000	70	3	3,600	480	3	60	Aladdin	2000-MR
K2-5-1	2,625	120	3	1,800	480	3	60	Aladdin	2000-BR
K1-5-1	2,625	120	3	1,800	480	3	60	Aladdin	2000-BR

Table 24. Preheater Specifications.

Unit	ft^3/min	Electrical				Controls	
		kW	Volts	Phase	Hertz	Manufacturer	Model
K1-2-1	1,000	10	480	3	60	United Electric	B110
K1-2-2	1,000	10	480	3	60	United Electric	B110
K2-2-1	2,625	9	480	3	60	Honeywell	AV310AB210
K2-2-2	2,625	9	480	3	60	Honeywell	AV310AB210

Table 25. 241-AW Tank Farm Ventilation System Piping from Each Tank Main Annulus Exhaust Header and Primary Tank Exhaust Riser to the Central Exhaust Station (Vitro 1977b).[a]

Tank No.	Primary Exhaust				Annulus Exhaust			
	Risers		Piping		Risers		Piping	
	Number of risers	Diameter (in.)	Diameter (in.)	Length (ft)	Number of risers	Diameter (in.)	Diameter (in.)	Length (ft)
101	1	12	12	375	4	8	12	324
			16	4		16	25	
102	1	12	12	225	4	8	12	211
			16	4		16	15	
103	1	12	12	302	4	8	12	341
			16	4		16	25	
104	1	12	12	190	4	8	12	155
			16	4		16	15	
105	1	12	12	160	4	8	12	108
			16	4		16	25	
106	1	12	12	150	4	8	12	132
			16	4		16	15	

[a]Some pipe lengths are shared, therefore, the pipe lengths listed above are not additive.

stack radiation monitor [Figure 19 (Vitro 1974a)]. This system maintains the tank at a greater vacuum than the annulus, which is required of all double-shell tanks, with a specified operating range of 64 to 15 cm (0.25 to 5.9 in.) WG.

The operating dP across the various units in the K1 system is given in Table 26. The negative from the inlet of the K1-1-1 unit and to the exit of the K1-3-2 unit must be less than .5 cm (6 in.) WG or the K1-4-1 fan will not operate. The air passing across the steam heating coil is raised approximately -6.7 °C (20 °F). The steam heater is on as long as the heater exhaust temperature is less than 93.3 °C (200 °F) and is off when the exhaust heat temperature reaches 96.1 °C (205 °F). The 241-SY Tank Farm does not have a backup vessel ventilation system.

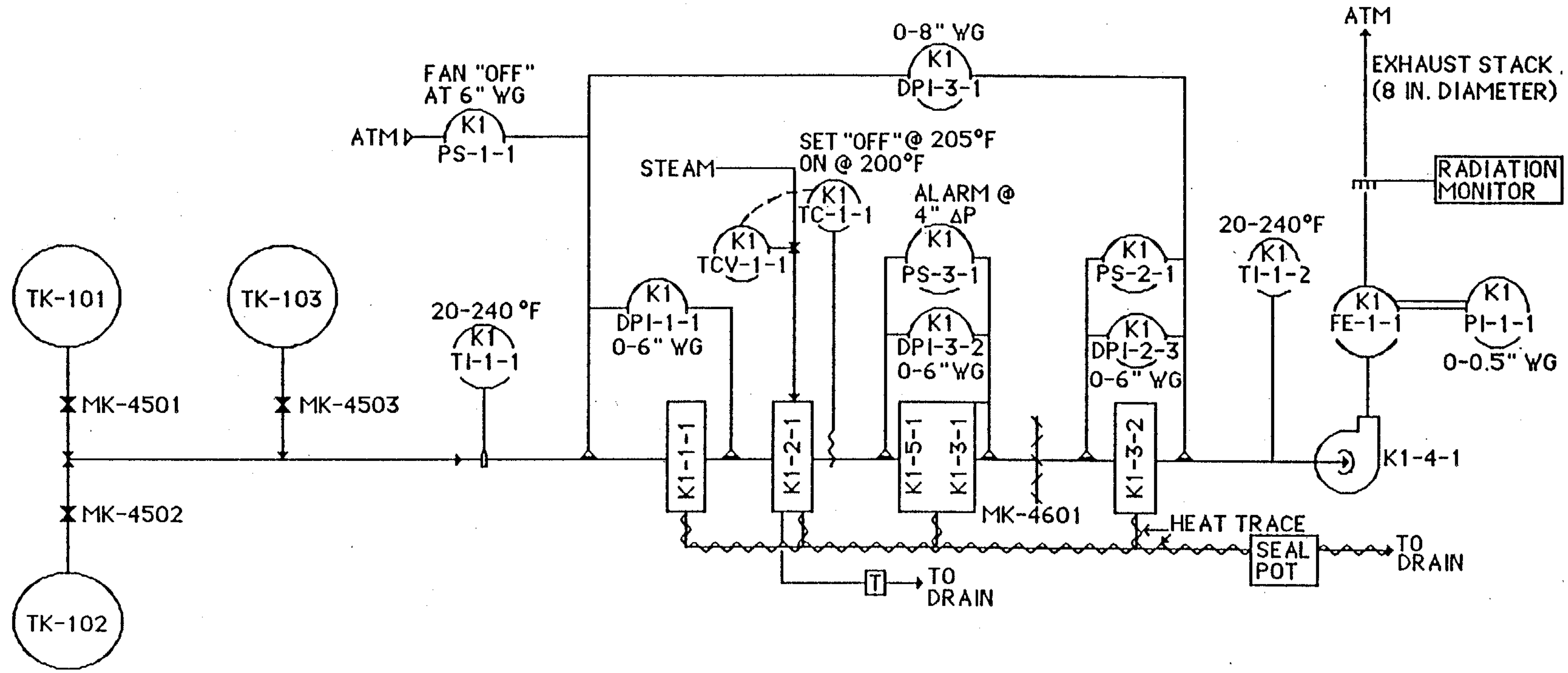
Table 26. Differential Pressure Limits Across the Various Units in the K1 System.

Unit	-dp (in. WG)
K1-1-1	0.05 to 1.5
K1-3-1	0.25 to 5.0
K1-3-2	0.25 to 3.0
K1-5-1	0.25 to 5.0

5.2 K2 ANNULUS VENTILATION SYSTEM (Rockwell 1986d, pp. 1-2)

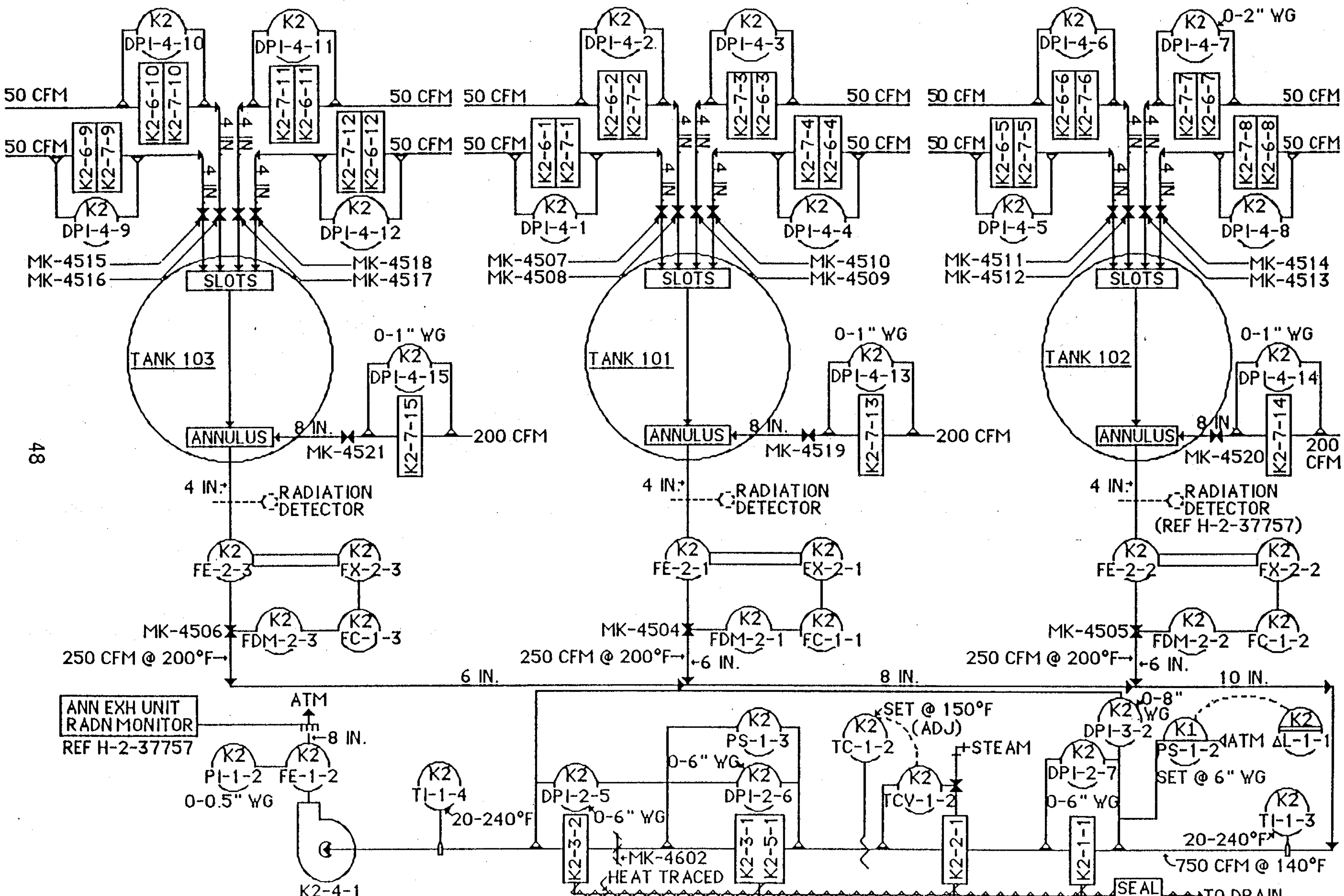
Outside air enters each tank annulus from five air intake stations [Figure 20 (Vitro 1974a)]. Air enters through four 10.2-cm (4-in.) risers, which send air to the distribution center at the base of the tank, and one 20.3-cm (8-in.) riser that opens directly to the annulus of the tank. The path the air takes from the distribution center at the base of the tank and back to the annulus is the same as that shown in Figure 11. The four air intake stations going to the distribution center of each tank have a 40% NBS and a HEPA filter in series. The fifth intake station going directly to the annulus has one HEPA filter.

Figure 19. 241-SY Tank Farm K1 Primary Tank Air Flow and Control Diagram



NOTES: NORMAL FLOW FROM ALL TANKS IS MINIMUM INFILTRATION, MAXIMUM FLOW FROM ANY ONE TANK IS 700 CFM.
ALL PIPING FROM STORAGE TANKS TO K1-1-1 DEENTRAINER IS 12-INCHES IN DIAMETER.
VALVES MK-4501 THRU MK-4503 ARE 12-INCH OUTLET BUTTERFLY CONTROL VALVES.
ALL WATER GAUGE (WG) VALUES ARE VACUUM MEASUREMENTS IN INCHES.

Figure 20. 241-SY Tank Farm K2 Annulus Air Flow and Control Diagram



NOTE: Valves MK-4507 thru MK-4517 and MK-4519 thru MK-4521 are 4-inch and 8-inch inlet butterfly control valves respectively. Valves MK-4504 thru MK-4506 are 4-inch outlet butterfly control valves.

Air is exhausted from the annulus through a 20.3-cm (8-in.) riser, which is reduced to 10.2 cm (4 in.) in diameter and connected to a 90.2-cm (4-in.) pipeline. This 10.2-cm (4-in.) pipeline connects to a 15.2-cm (6-in.) pipeline. The 15.2-cm (6-in.) pipeline from each tank, after expanding from 15.2 cm (6-in.) to 20.3-cm (8 in.) and from 20.3 cm (8 in.) to 25.4 cm (10 in.), connects to a 30.5-cm (12-in.) main vent header (see Table 30), which goes to the HVAC pad. The flow from each tank annulus is monitored by flow L 241-SY annulus exhaust and is controlled by control valves located in the air ducts coming from the individual tanks. If the airflow through any of the tank annuli drops 4.24 m^3/min (150 ft^3/min), the flow L 241-SY annulus exhaust alarm is activated in the instrument building and adjustments are made to the annulus outlet control valves to bring the flowrate up to acceptable limits. The airflow from each tank annulus is typically maintained between 5 to 7 m^3/min (175 and 250 ft^3/min) at 200 °F (93.3 °C).

The annulus exhaust from the three tanks is combined into a 25.4-cm (10-in.) duct and enters the HVAC pad at a flowrate of 21.2 m^3/min (750 ft^3/min) and temperature of 60 °C (140 °F).

5.3 241-SY TANK FARM VENTILATION SYSTEM SPECIFICATIONS

Refer to Tables 27 through 30 for HEPA filter, exhaust fan, preheater, and piping specifications (Vitro 1974b).

Table 27. High-Efficiency Particulate Air Filter Specifications.[a]

Unit	ft^3/min	Size (in.)	Manufacturer	Model
K1-3-1	700	24 by 24 by 11.5		
K1-3-2	700	11.75 dia	MSA	15-85175
K2-7-1	50	11.75 dia	MSA	15-85175
K2-7-12	50	11.75 dia	MSA	15-85175
K2-7-13	200	11.75 dia	MSA	15-85175
K2-7-15	200	11.75 dia	MSA	15-85175

[a]Air inlet temperature to HEPA filters has to be ≤121.1 °C (250 °F).

Table 28. Exhaust Fan Specifications.

Unit	ft^3/min	Air temperature (°F)	Horse-power	Revolutions per minute	Volts	Phase	Hertz
K1-4-1	700	200	2	1,800	480	3	60
K2-4-2	750	150	2	1,800	480	3	60

Table 29. Preheater Specifications.

Unit	Heat source	Leaving air temperature (°F)	ft^3/min	Differential temperature across unit (°F)
K1-2-1	Steam	<200	700	20
K2-2-1	Steam	150	750	20

Table 30. 241-SY Tank Farm Ventilation System Piping from Each Tank Main Annulus Exhaust Header and Primary Tank Exhaust Riser to the Central Exhaust Station (Vitro 1974c).[a]

	Primary Exhaust				Annulus Exhaust			
	Risers		Piping		Risers		Piping	
Tank No.	Number of risers	Diameter (in.)	Diameter (in.)	Length (ft)	Number of risers	Diameter (in.)	Diameter (in.)	Length (ft)
101	1	12	12	205	1	8	4	3
							6	8
							8	82
							10	71
102	1	12	12	130	1	8	4	3
							6	4
							8	13
							10	71
103	1	12	12	301	1	8	4	3
							6	107
							8	78
							10	7

[a]Some pipe lengths are shared, therefore, the pipe lengths listed above are not additive.

6.0 REFERENCES

DiLiberto, A. J., 1982, *241-A-702 Vessel Ventilation System Information Manual*, SD-RE-SS-001, Rockwell Hanford Operations, Richland, Washington.

KEH, 1983a, *HVAC Equipment Schedules and Notes*, H-2-90522, Kaiser Engineers Hanford, Richland, Washington.

KEH 1983b, *Piping Support Plan #4*, H-2-90581, Kaiser Engineers Hanford, Richland, Washington.

KEH, 1983c, *Piping Support Plan #5*, H-2-90582, Kaiser Engineers Hanford, Richland, Washington.

KEH, 1983d, *Piping Support Plan #6*, H-2-90583, Kaiser Engineers Hanford, Richland, Washington.

KEH, 1983e, *HVAC Equipment Schedules and Notes*, H-2-90909, Kaiser Engineers Hanford, Richland, Washington.

KEH, 1987, *Electric Cathodic Protection Anode Installation*, H-2-77321, Kaiser Engineers Hanford, Richland, Washington.

Koontz, R. L., 1986, *Double-Shell Tank Farm Facility (241-AN, -AW, -AP, and -SY) Safety Analysis Report*, SD-WM-SAR-016, Rev 1, Rockwell Hanford Operations, Richland, Washington.

Rockwell, 1981, *Ventilation Equipment Schedules and Control Diagram Modifications*, H-2-92066, Rockwell Hanford Operations, Richland, Washington

Rockwell, 1982, *Modifications-Ventilation Equipment Schedules and Control Diagram*, H-2-92964, Rockwell Hanford Operations, Richland, Washington.

Rockwell, 1983, *Aging Waste Tank Facility Description Manual*, FDM-T-200-00003, Rev/Mod A-0, Rockwell Hanford Operations, Richland, Washington.

Rockwell, 1986a, *Operations Specifications for Aging Waste Operations in 241-AY and 241-AZ*, OSD-T-151-00017, Rev/Mod B-5, Rockwell Hanford Operations, Richland, Washington.

Rockwell, 1986b, *241-AN Vessel Vent and Annulus Vent Systems*, SOP-TO-060-101, Rev/Mod A-15, Rockwell Hanford Operations, Richland, Washington.

Rockwell, 1986c, *241-AN, -AP, -AW, -AY, -AZ, and -SY Farms*, OSD-T-151-00007, Rev/Mod G-4, Rockwell Hanford Operations, Richland, Washington.

Rockwell, 1986d, *SY Tank Farm Annulus Vent System*, SOP-TO-060-240, Rev/Mod B-3, Rockwell Hanford Operations, Richland, Washington.

Rockwell, 1987a, *241-AW Primary Tank Ventilation System*, SOP-TO-060-104, Rev/Mod B-9, Rockwell Hanford Operations, Richland, Washington.

Rockwell, 1987b, *241-SY Tank Farm Vessel Vent System*, SOP-TO-060-230, Rev/Mod B-9, Rockwell Hanford Operations, Richland, Washington.

Squires, D. J., 1987, *Aging Waste Facility Safety Analysis Report*, SD-HS-SAR-010, Rockwell Hanford Operations, Richland, Washington.

Vitro, 1967, *Annulus Vent Piping TK-101, 241-AY Tank Farm*, H-2-64459, Vitro Engineering Corporation, Richland, Washington.

Vitro, 1968, *Ventilation Equipment Schedules and Control Diagram*, H-2-64462, Vitro Engineering Corporation, Richland, Washington.

Vitro, 1969, *Annulus Vent Piping TK-102, 241-AY Tank Farm*, H-2-64460, Vitro Engineering Corporation, Richland, Washington.

Vitro, 1972a, *Ventilation Equipment Schedule and Control Diagram Annulus*, H-2-67284, Vitro Engineering Corporation, Richland, Washington.

Vitro, 1972b, *Ventilation Ductwork - Lower Level Plan and Details*, H-2-67287, Vitro Engineering Corporation, Richland, Washington.

Vitro, 1974a, *Ventilation Air Flow and Control Diagram*, H-2-37744, Automation Industries Inc., Vitro Engineering Division, Richland, Washington.

Vitro, 1974b, *Ventilation Equipment Schedules*, H-2-37747, Automation Industries Inc., Vitro Engineering Division, Richland, Washington.

Vitro, 1974c, *Ventilation Ductwork Plan*, H-2-37745, Automation Industries Inc., Vitro Engineering Division, Richland, Washington.

Vitro, 1976, *Plan Tank Penetration 241-AN Tanks*, H-2-71976 Vitro Engineering Corporation, Richland, Washington.

Vitro, 1977a, *HVAC Equipment Schedules, Details, and General Notes*, H-2-70340, Vitro Engineering Corporation, Richland, Washington.

Vitro 1977b, *HVAC Piping/Vent Piping Plan 241-AW Tank Farm*, H-2-70337, Vitro Engineering Corporation, Richland, Washington.

Vitro, 1978a, *HVAC Equipment Schedules, Details, and General Notes*, H-2-71937, Vitro Engineering Corporation, Richland, Washington.

Vitro, 1978b, *Piping Plan 241-AN Tank Farm*, H-2-72038, Vitro Engineering Corporation, Richland, Washington.

Vitro, 1978c, *Piping Plan 241-AN Tank Farm*, H-2-71986, Vitro Engineering Corporation, Richland, Washington.

Vitro, 1978d, *Piping Plan 241-AN Tank Farm*, H-2-71987, Vitro Engineering Corporation, Richland, Washington.

Vitro, 1978e, *Piping Plan Valve Pits 241-AN A and B*, H-2-71989, Vitro Engineering Corporation, Richland, Washington.

WHC, 1982, *241-AN Tank Farm Facility Description Manual*, FDM-T-200-00002, Rev/Mod A-0, Westinghouse Hanford Company, Richland, Washington.

WHC, 1986a, *241-AP Tank Farm Facility Description Manual*, FDM-T-270-00001, Rev/Mod A-0, Westinghouse Hanford Company, Richland, Washington.

WHC, 1986b, *241-AW Tank Farm Facility Description Manual*, FDM-T-200-00001, Rev/Mod B-0, Westinghouse Hanford Company, Richland, Washington.

WHC, 1987, *AY and AZ Airlift Circulator Operation*, SOP-TO-200-030, Rev/Mod C-14, Westinghouse Hanford Company, Richland, Washington.

REFERENCES GROUPED BY TANK FARM

AN Tank Farm References

1. Field Description Manual, FDM-T-200-00002, Revision/Modification A-0, pp. 40-51.

2. Standard Operating Procedure, TO-060-101, Figures 1-4, pp. 28-31.

3. Supporting Document, "Double-Shell Tank Farm Facility (241-AN, AW, AP, and SY) Safety Analysis Report", SD-WM-SAR-016, Rev 1, Appendix A, page A-3.

4. Operation Specifications Document, OSD-T-151-00007, Rev/Mod G-4, page 18.

5. HVAC Equipment Schedules, Details, & General Notes, Drawing H-2-71937.

6. Piping Plan 241-AN Tank Farm, Drawings H-2-72038, H-2-71986, and H-2-71987. All piping lengths were computed from these drawings.

AP Tank Farm References

1. Field Description Manual, FDM-T-270-00001, Rev/Mod A-0, pages 61-74.

2. Operating Specifications Document, OSD-T-151-00007, Rev/Mod G-4, page 18.

3. HVAC Equipment Schedules & Notes, Drawing H-2-90522.

4. Piping Support Plan #4, #5, #6, Drawings H-2-90581, H-2-90582, H-2-90583 respectively.

AW Tank Farm References

1. Field Description Manual, FDM-T-200-00001, Rev/Mod-B-0, pages 43-50.

2. Standard Operating Procedure, TO-060-104, Rev/Mod-B-9, page 32.

3. HVAC Equipment Schedules Details & General Notes and HVAC Equipmnent Schedules & Notes, Drawings H-2-70340 and H-2-90909 respectively.

4. HVAC/Piping-Vent Piping Plan 241-AW Tank Farm, Drawing H-2-70337.

SY Tank Farm References

1. Supporting Document, "Double-Shell Tank Farm Facility)241-AN, AW, AP, and SY) Safety Analysis Report",SD-WM-SAR-016, Rev 1, Appendix A, page A-7.

2. Standard Operating Procedure, TO-060-230, Rev/Mod B-9, pages 1-4.

3. Ventilation Air Flow And Control Diagram, H-2-37744.

4. Standard Operating Procedure, TO-060-240, Rev/Mod B-3, pages 1-2.

5. Ventilation Equipment Schedules, Drawing H-2-37747.

6. Ventilation Ductwork Plan, Drawing H-2-37745. All piping lengths were computed from this drawing.

AY-AZ Tank Farm References

1. Supporting Document, "241-A-702 Vessel Ventilation System Information Manual", SD-RE-SS-001, section I, pages 5-20, 27-29, and 32-34.

2. Supporting Document, "Aging Waste Facility Safety Analysis Report", SD-HS-SAR-010, June 1983, pages 11-1 through 11-2.

3. Field Description Manual, FDM-T-200-00003, Rev/Mod-A-0, section 2.3, pages 8, 9, and 21-26.

4. Ventilation Equipment Schedules and Control Diagram and Ventilation Equipment Schedules and Control Diagram Modifications, Drawings H-2-64462 and H-2-92066 respectively.

5. Ventilation Equipment Schedule and Control Diagram Annulus and Modifications Ventilation Equipment Schedules & Control Diagram, Drawings H-2-67284 and H-2-92964 respectively.

6. Electrical Cathodic Protection Anode Installation, Drawing H-2-77321. All primary ventilation piping lengths for AY and AZ Tank Farms were computed from this drawing.

7. Annulus Vent Piping TK-101 and TK-102, 241-AY Tank Farm, Drawings H-2-64459 and H-2-64460 respectively.

8. 241-AZ Ventilation Ductwork-Lower Level Plan and Details, Drawing H-2-67287.

9. Operating Specifications, Document No. OSD-T-151-00017, Rev/Mod B-5, page 17.

10. Standard Operating Procedure, Document No. TO-200-030, Rev/Mod C-13, page 1.

[THIS PAGE INTENTIONALLY LEFT BLANK.]