DOE/RL-97-09
Revision 3

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Radioactive Air Emissions Notice of Construction Use of a Portable Exhauster on Single-Shell Tanks During Salt Well Pumping

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United States
Department of Energy
Richland, Washington

Approved for Public Release

DOE/RL-97-09
Revision 3

S UC-630

Radioactive Air Emissions Notice of Construction Use of a Portable Exhauster on Single-Shell Tanks During Salt Well Pumping

Date Published
June 1999

United States
Department of Energy
P.O. Box 550
Richland, Washington 99352

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Document Number:	DOE/RL-97-09, Rev. 3
Document Title:	Radioactive Air Emissions Notice of Construction Use of a Portable Exhauster on Single-Shell Tanks During Salt Well Pumping

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Christine Willingham — 7/14/99

C. Willingham — Date

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A-6001-400.2 (09/94)

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TERMS

ALARA	as low as reasonably achievable
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
BARCT	best available radionuclide control technology
Bq	becquerel
CFR	Code of Federal Regulations
Ci	curie
DCRT	double-contained receiver tank
DF	decontamination factor
DST	double-shell tank
EPA	U.S. Environmental Protection Agency
Ecology	Washington State Department of Ecology
GEMS	generic effluent monitoring system
HEPA	high-efficiency particulate air
ISVS	in-situ vapor sampling
LFL	lower flammability limit
LANL	Los Alamos National Laboratory
MEI	maximally exposed individual
ND	not detected
NEPA	*National Environmental Policy Act of 1969*
NOC	notice of construction
PCM	periodic confirmatory measurement
RCRA	*Resource Conservation and Recovery Act of 1976*
SAD	safety analysis document
SEPA	*State Environmental Policy Act of 1971*
SST	single-shell tank
TEDE	total effective dose equivalent
Tri-Party Agreement	Hanford Federal Facility Agreement and Consent Order
VSS	vapor sampling system
WAC	*Washington Administrative Code*
WDOH	Washington State Department of Health

METRIC CONVERSION CHART

Into metric units			Out of metric units		
If you know	Multiply by	To get	If you know	Multiply by	To get
Length			**Length**		
inches	25.40	millimeters	millimeters	0.0393	inches
inches	2.54	centimeters	centimeters	0.393	inches
feet	0.3048	meters	meters	3.2808	feet
yards	0.914	meters	meters	1.09	yards
miles	1.609	kilometers	kilometers	0.62	miles
Area			**Area**		
square inches	6.4516	square centimeters	square centimeters	0.155	square inches
square feet	0.092	square meters	square meters	10.7639	square feet
square yards	0.836	square meters	square meters	1.20	square yards
square miles	2.59	square kilometers	square kilometers	0.39	square miles
acres	0.404	hectares	hectares	2.471	acres
Mass (weight)			**Mass (weight)**		
ounces	28.35	grams	grams	0.0352	ounces
pounds	0.453	kilograms	kilograms	2.2046	pounds
short ton	0.907	metric ton	metric ton	1.10	short ton
Volume			**Volume**		
fluid ounces	29.57	milliliters	milliliters	0.03	fluid ounces
quarts	0.95	liters	liters	1.057	quarts
gallons	3.79	liters	liters	0.26	gallons
cubic feet	0.03	cubic meters	cubic meters	35.3147	cubic feet
cubic yards	0.76456	cubic meters	cubic meters	1.308	cubic yards
Temperature			**Temperature**		
Fahrenheit	subtract 32 then multiply by 5/9ths	Celsius	Celsius	multiply by 9/5ths, then add 32	Fahrenheit
Force			**Force**		
pounds per square inch	6.895	kilopascals	kilopascals	1.4504×10^{-4}	pounds per square inch

Source: *Engineering Unit Conversions*, M. R. Lindeburg, PE., Second Ed., 1990, Professional Publications, Inc., Belmont, California.

REVISION HISTORY

Changes made in the current revision are noted by a vertical bar in the left margin, adjacent to the lines that were revised.

Revision 3

Revision 3 was presented to the WDOH on a Hanford Facility NOC Revision Form. The WDOH approved the revision on 06/17/99. The revision was made to incorporate passively vented tanks 241-T-104 and 241-T-110 into the NOC. The characteristics, source terms and emissions of these two tanks are similar to and consistent with the tanks currently described in the NOC. No measurable increase in approved emissions (AIR 98-1207) is expected due to the addition of these two tanks. 241-T-104 and 241-T-110 are not actively ventilated and do not require the use of a standby portable exhauster.

Changes to the NOC include: adding 241-T-104 and 241-T-110 entries to Table 1-1, *Single-Shell Tanks Covered by this Notice of Construction;* Table 2-1, *Single-Shell Tank Locations*; Table 7-1, *Waste Tank Characteristics;* Appendix A, *Tank Radionuclide Inventories;* Appendix B, *Emission and Dose Calculations—Salt Well Pumping Under Passive Ventilation;* Appendix C, *Emission and dose Calculations—Salt Well Pumping Under Active Ventilation;* and Appendix D, *Emission and Dose Calculations—Water Lancing*; and changing the maximum abated dose for pumping all tanks identified in Table 1-1 at the same time from 6.47 E-07 mrem/yr to 6.51 E-07mrem/yr (page 11-2, second paragraph). Changes also include removal of redundant references in the text to specific counts of tanks identified in the NOC. These changes were made to Page 1-1, Introduction; Page 11-1, sixth paragraph; Page 11-2, second paragraph.

Revision 2

Revision 2 changes were made to update the NOC the latest operational Authorization Basis and to include descriptions of activities that were previously done under routine activity status but were in question because WDOH rescinded their approval of the Routine Activity List. The changes included: requiring the use of portable ventilation during salt well pumping only if the flammable gas levels in a tank were at 25% of the LFL; removing the SX Tanks from the NOC. These tanks are actively ventilated and were to be addressed under a separate NOC; describing and requiring a compliant monitoring system for all exhausters used on any of the tanks listed in the NOC, regardless of their offsite dose being greater or less than 0.1 mrem/yr. Adding a process description and PTE calculation for water lancing to install equipment; and adding process descriptions for adding water to a tank, flushing and removing plugs from transfer lines.

Revision 1

Revision 1 reflects WDOH concerns presented in Letter AIR 97-710, A.W. Conklin, WDOH, to J.E. Rasmussen, RL, no subject, dated July 29, 1997. Revision 1 also incorporates changes agreed to by the WDOH in the August 12, 1997 meeting. Sections 6, 9, 10, 11, and Appendix C were revised.

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RADIOACTIVE AIR EMISSIONS NOTICE OF CONSTRUCTION USE OF A PORTABLE EXHAUSTER ON SINGLE-SHELL TANKS DURING SALT WELL PUMPING

1.0 INTRODUCTION

This document serves as a notice of construction (NOC), pursuant to the requirements of Washington Administrative Code (WAC) 246-247-060, and as a request for approval to construct, pursuant to 40 Code of Federal Regulations (CFR) 61.07, portable exhausters for use on single-shell tanks (SSTs) during salt well pumping. Table 1-1 lists SSTs covered by this NOC. This NOC also addresses other activities that are performed in support of salt well pumping but do not require the application of a portable exhauster. Specifically this NOC analyzes the following three activities that have the potential for emissions.

- Salt well pumping (i.e., the actual transferring of waste from one tank to another) under nominal tank operating conditions. Nominal tank operating conditions include existing passive breathing rates.

- Salt well pumping (the actual transferring of waste from one tank to another) with use of a portable exhauster.

- Use of a water lance on the waste to facilitate salt well screen and salt well jet pump installation into the waste. This activity is to be performed under nominal (existing passive breathing rates) tank operating conditions.

The use of portable exhausters represents a cost savings because one portable exhauster can be moved back and forth between SSTs as schedules for salt well pumping dictate. A portable exhauster also could be used to simultaneously exhaust more than one SST during salt well pumping.

The primary objective of providing active ventilation to these SSTs during salt well pumping is to reduce the risk of postulated accidents to remain within risk guidelines. It is anticipated that salt well pumping will release gases entrapped within the waste as the liquid level is lowered, because of less hydrostatic force keeping the gases in place. Hanford Site waste tanks must comply with the Tank Farms authorization basis (DESH 1997) that requires that the flammable gas concentration be less than 25 percent of the lower flammability limit (LFL). Safety analyses indicate that the LFL might be exceeded in some tanks during certain postulated accident scenarios. Also, the potential for electrical (pump motor, heat tracing) and mechanical (equipment installation) spark sources exist. Therefore, because of the presence of ignition sources and the potential for release of flammable gases, active ventilation might be required in some SSTs to reduce the 'time at risk' while salt well pumping. For this reason, portable exhausters will be installed as a precautionary measure and used when flammable gas concentrations exceed 25 percent of the LFL during salt well pumping.

Table 1-1. Single-Shell Tanks Covered by this Notice of Construction.

Tank number
241-AX-101
241-BY-105
241-BY-106
241-S-101
241-S-102
241-S-103
241-S-106
241-S-107
241-S-109
241-S-111
241-S-112
241-T-104
241-T-110
241-U-103
241-U-105
241-U-106
241-U-107
241-U-108
241-U-109
241-U-111

2.0 FACILITY IDENTIFICATION AND LOCATION (REQUIREMENT 1)

The SSTs covered in this NOC are located at:

U.S. Department of Energy, Richland Operations Office
Hanford Site
200 East and 200 West Areas
Richland, Washington 99352

Table 2-1 lists the area location and geodetic coordinates for tanks covered by this NOC.

Figure 2-1 shows the location of the 200 West and 200 East Areas within the Hanford Site. Figures 2-2, 2-3, and 2-4 show the location of each tank farm within the respective area.

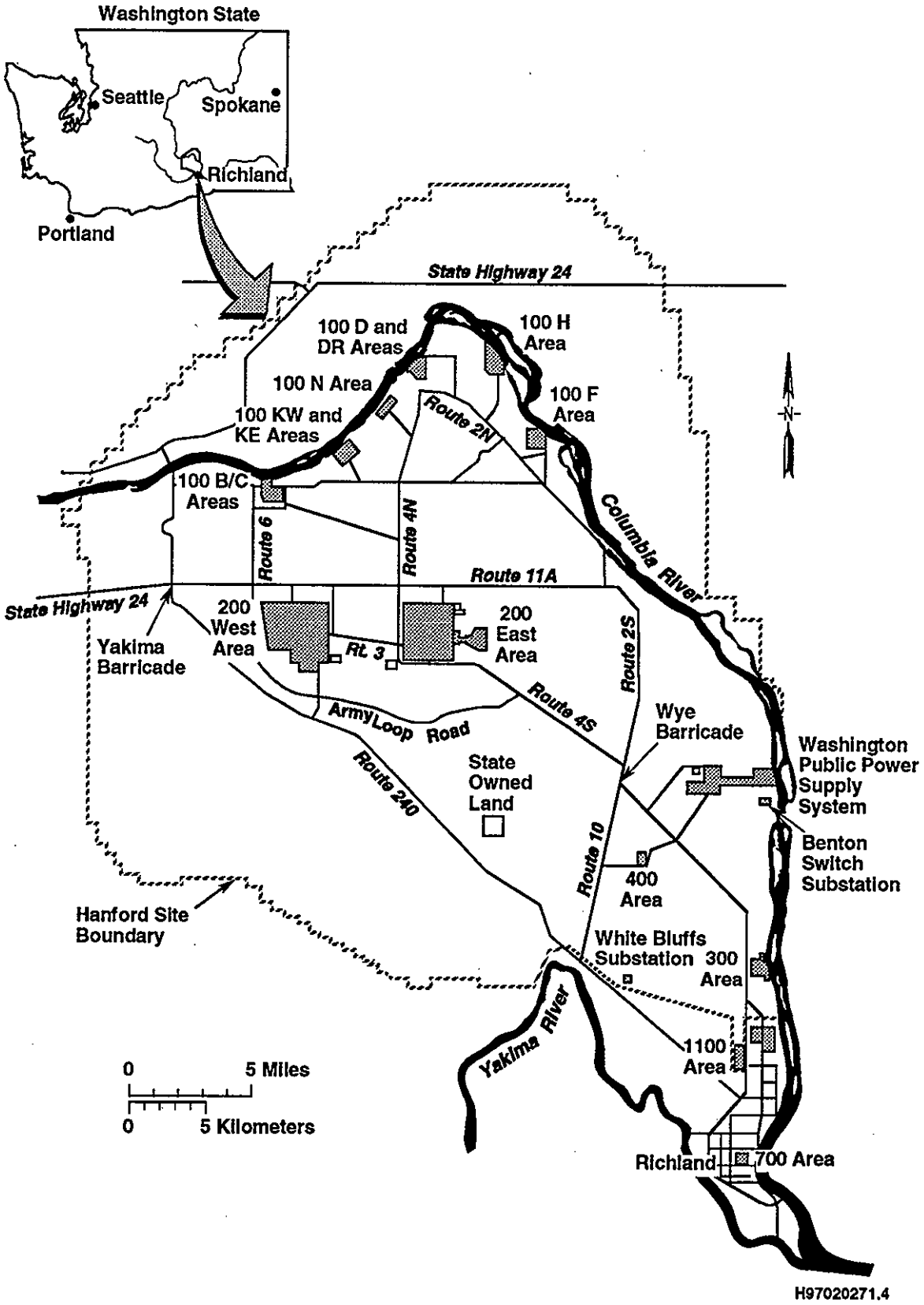

Figure 2-1. Hanford Site.

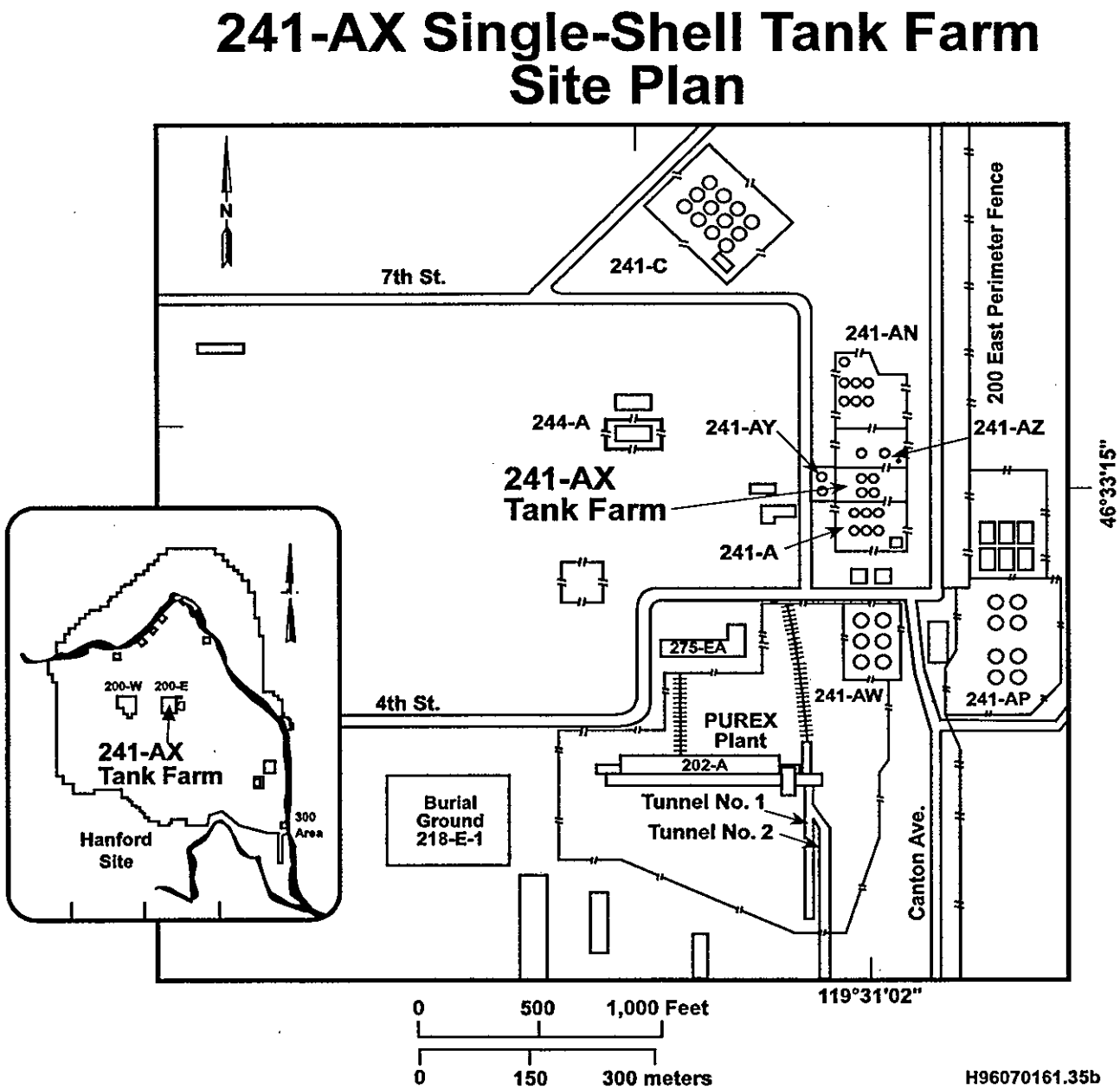

Figure 2-2. Location of the 241-AX Tank Farm Within the 200 East Area.

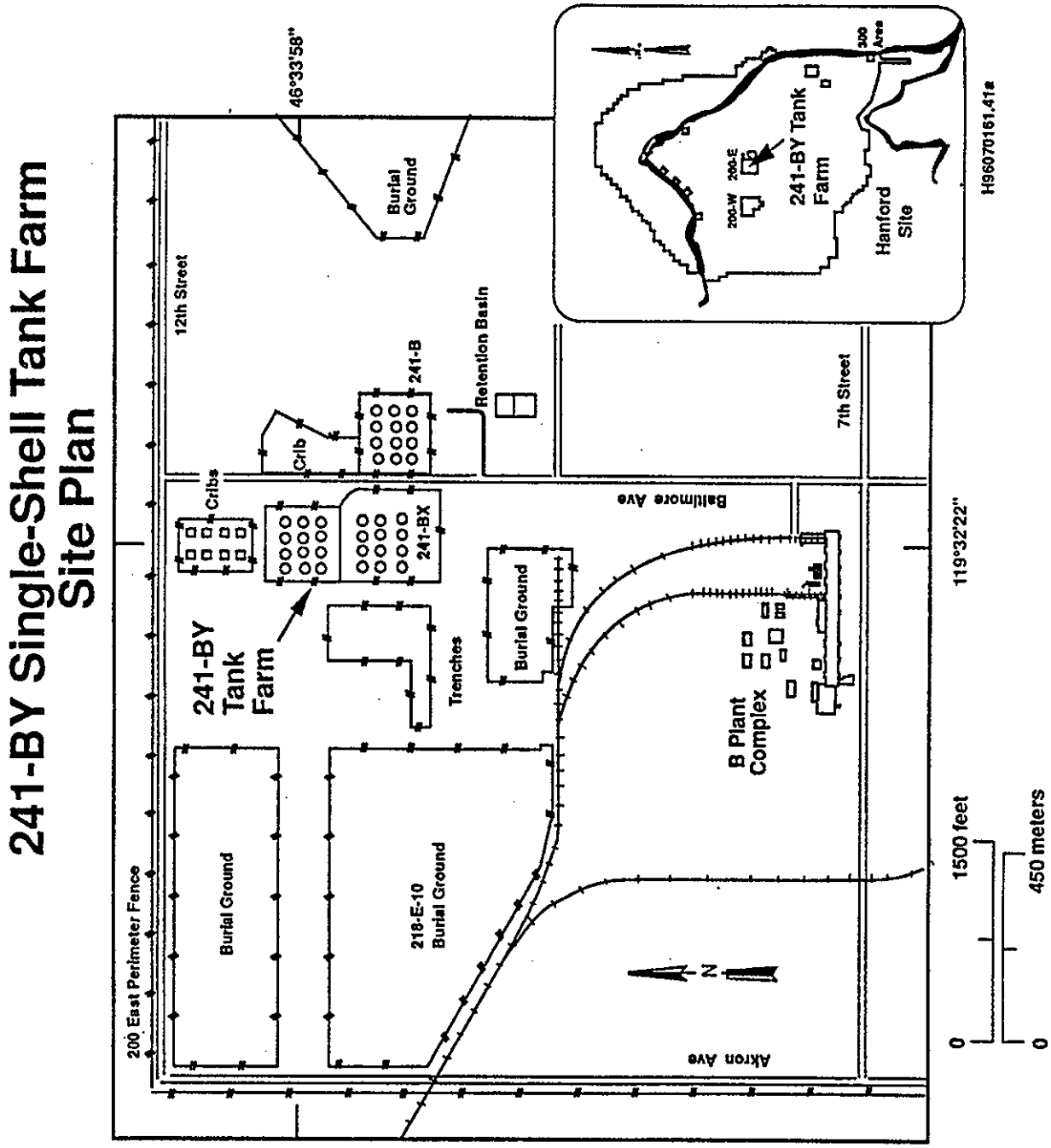

Figure 2-3. Location of the 241-BY Tank Farm Within the 200 East Area.

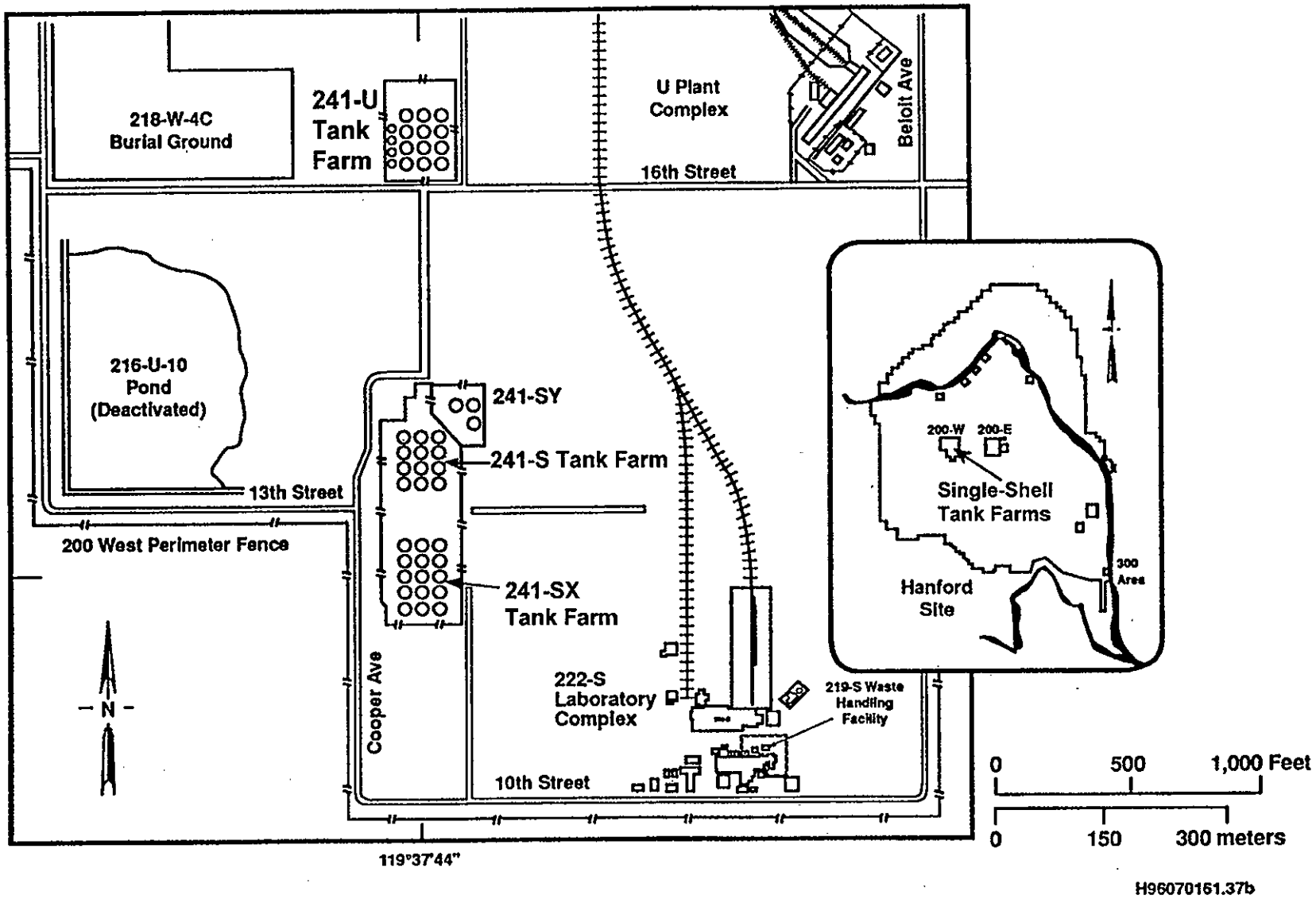

Figure 2-4. Location of Tank Farms Within the 200 West Area.

Table 2-1. Single-Shell Tank Locations.

Tank number	200 Area location	Geodetic coordinates	
		North latitude	West longitude
241-AX-101	East	46°33'16"	119°30'59"
241-BY-105	East	46°33'58"	119°32'22"
241-BY-106	East	46°33'60"	119°32'22"
241-S-101	West	46°32'24"	119°37'43"
241-S-102	West	46°32'24"	119°37'44"
241-S-103	West	46°32'24"	119°37'46"
241-S-106	West	46°32'23"	119°37'46"
241-S-107	West	46°32'22"	119°37'43"
241-S-109	West	46°32'22"	119°37'46"
241-S-111	West	46°32'21"	119°37'44"
241-S-112	West	46°32'21"	119°37'46"
241-T-104	West	46°33'37"	119°37'42"
241-T-110	West	46°33'35"	119°37'42"
241-U-103	West	46°32'44"	119°37'45"
241-U-105	West	46°32'43"	119°37'44"
241-U-106	West	46°32'43"	119°37'45"
241-U-107	West	46°32'42"	119°37'42"
241-U-108	West	46°32'42"	119°37'44"
241-U-109	West	46°32'42"	119°37'45"
241-U-111	West	46°32'41"	119°37'44"

3.0 RESPONSIBLE MANAGER (REQUIREMENT 2)

The responsible manager's name and address are as follows:

Mr. J. E. Kinzer, Director
Tank Waste Remediation Division
U.S. Department of Energy, Richland Operations Office
P.O. Box 550
Richland, Washington 99352
(509) 376-7591.

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4.0 TYPE OF PROPOSED ACTION (REQUIREMENT 3)

The proposed action represents an insignificant modification to an existing emission unit for all SSTs listed in Table 1-1, except for SST 241-S-103, 107,and 112. The proposed action for these three tanks represents a significant modification in accordance with WAC 246-247-030. All SSTs discussed in this NOC are passively ventilated. The proposed modification is to install a portable exhauster on SSTs during salt well pumping. The exhausters will be used when flammable gas levels exceed 25 percent of the LFL. This NOC also addresses other activities that are performed in support of salt well pumping but do not require the application of a portable exhauster.

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5.0 STATE ENVIRONMENTAL POLICY ACT (REQUIREMENT 4)

The *National Environmental Policy Act* (NEPA) documentation for this project is adopted to satisfy the *State Environmental Policy Act* (SEPA) process. Salt well pumping activities documented under NEPA are as follows:

- *Waste Tank Safety Program, Hanford Site, Richland Washington, Environmental Assessment*, DOE/EA-0915, February, 1994, and

- *Tank Waste Remediation System, Hanford Site, Richland Washington, Final Environmental Impact Statement*, DOE/EIS-0189, August 1996, Volume 1.

Washington State Department of Ecology (Ecology) is the lead agency and Mr. Geoff Tallent (206-407-7112) of that office coordinates all SEPA activities for the Hanford Site.

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6.0 PROCESS DESCRIPTION (REQUIREMENTS 5 AND 7)

Salt well pumping is a method used to interim stabilize SSTs. Interim stabilization is commenced once a salt well screen has been installed with its respective jet pump. Salt well pumping removes the gravity drainable liquid from the interstitial space between the solids that drain to the salt well screen. Salt well pumping uses pre-established routes to transfer the liquid either directly to a double-shell tank (DST) or to a staging double-contained receiver tank (DCRT) and subsequently to a DST.

Before transferring waste, several activities are performed that include:

- Verifying the waste chemistry to ensure that the waste to be transferred is compatible with the receiving tank waste
- Performing criticality safety analyses to ensure that stored waste will remain in a subcritical state
- Verifying equipment operability
- Developing a baseline material balance for both sending and receiving tanks. (The material balance also is reviewed periodically during the transfer to provide early leak detection and to avoid filling tanks above safe levels.).

Salt well pumping the drainable liquid waste includes the following activities:

- Initial planning including waste compatibility studies, criticality analysis, equipment specification, and tank material balance determinations as discussed previously
- Installation of salt well screen
- Jet pump assembly installation
- Transferring the liquid waste (via salt well pumping)
- Occasionally, additions of limited amounts of water are made to prevent plugging of the salt well screen and transfer line
- Flushing and cleaning plugs from transfer lines.

The jet pump intake is located at the bottom of the salt well screen and is suspended by supply and return lines connected to a centrifugal pump unit located above the tank in the pump pit. The motive power for the pumping process is provided by the centrifugal pump unit. The motor and centrifugal pump assembly are hermetically sealed and thus designed for pumping hazardous material. Pump pits are equipped with leak detectors to help detect any possible waste leakage. Salt well pumping is accomplished at very slow rates, approximately 15 liters per minute or less. Slow collection of liquid in the well often requires pumping at less than 4 liters per minute. After salt well pumping is complete, the jet pump will remain in the pit and the screen will remain in the tank for the foreseeable future.

A detailed description of the salt well pumping process and equipment is presented in HNF-DS-WM-BIO-001, "Tank Waste Remediation System Basis For Interim Operation", which is only referenced for additional information.

6.1 INSTALLATION OF THE SALT WELL SCREEN

A salt well screen is a mechanical device, approximately 11 inches in diameter, which normally extends from the top of the waste to within 2 inches of the tank bottom. The 400-mesh size holes in the screen allow liquid waste to pass through the screen (enter the pump cavity) while preventing solid waste from migrating to the jet pump.

Water lancing of the waste could be necessary to facilitate installation of the salt well screen. Water lancing normally uses up to 1,895 liters of hot (93°C) water at low pressure (1,034 kilopascals) to penetrate the crust on the waste and create a circular entry area large enough for the screen. The water lance is a long pipe, up to 7.62 centimeters in diameter with a nozzle at the end that is lowered into the tank, through a riser, via a mobile crane attached to a truck. A hose from a portable water tank is connected to the other end of the water lance. The flushing water to the water lance is turned on just before the lance reaches the waste surface to minimize water additions to the tank. The water lance withdrawal steps are essentially the reverse of the insertion sequence. The use of this water lance requires that the lance be raised and lowered into the waste multiple times so that a large enough hole can be formed in the waste to accommodate the screen. Alternately, a newer water lance design to accomplish the same task could be used. The new lance has an 28-centimeter diameter and multiple nozzles on the bottom to facilitate waste penetration, and is designed to create a hole in the waste large enough to accommodate the salt well screen with one insertion of the lance into the waste. This design requires less water volume and operates at higher pressure (20,685 kilopascals). During removal of a lance from a tank, portable water wands are used to wash waste residue from the outside of the water lance until radiation readings are within specified limits. The water lance is placed in a protective bag during the removal process.

The salt well screen is connected to a source of flushing water by a hose at the top of the screen. The screen also is rigged for lift by a mobile crane. The salt well screen assembly is lowered slowly into the pit and riser until the screen flange rests on the riser opening. The riser is capped until jet pump assembly is scheduled for installation.

The entire operation of installing a salt well screen, including water lancing, generally takes less than 8 hours. Radionuclide control is maintained mechanically by use of a spray ring that rests on top of the riser and allows the water lance to telescope through the ring. Although there is no physical contact between the lance outside diameter and the spray ring inside diameter, control of radionuclides is achieved by spraying water over this interface as the lance is lowered, which also helps to minimize the potential for sparking as well as controlling radionuclides. Additional radionuclide control is achieved by lowering the lance at a maximum speed of approximately 1 foot per second. Also, this operation is performed in accordance with formal procedures and radiation surveys during the actual work activity to ensure containment of radionuclides. Pre-job and post-job surveys are performed to verify containment. The actual water lancing time usually takes approximately 30 minutes to 2 hours.

As noted in Section 11.0, the analysis assumes water lancing operations will be performed under passive tank breathing rates for a period not to exceed 72 hours of actual water lancing. The 72-hour period will be controlled administratively.

6.2 JET PUMP INSTALLATION

Water lancing of the salt screen and waste inside the salt well screen might be necessary to facilitate jet pump assembly installation within the screen. If water lancing is required, this will be performed as discussed previously. The salt well pump assembly is brought to the tank farm in several pieces, and is assembled and tested before installation. Following preoperational checks of the complete jet pump assembly, the pump assembly will be raised to a vertical position by a mobile crane and slowly lowered into the salt well screen until the pump support plate rests on top of the salt well screen flange. A small amount of water is passed through the dip tubes while the pump is lowered into the screen to prevent plugging the dip tubes. The dip tubes are half-inch carbon steel tubes used as instrumentation to monitor waste level and specific gravity. Similarly, small amounts of water also are passed through the dilution tube to prevent plugging. The dilution tube allows water to be added to the tank to prevent plugging of the screen (discussed in Section 6.3). In some cases, instrumentation lines are installed as part of the salt well pump assembly; in other cases, instrumentation lines are installed after the assembly is installed.

The entire operation of installing a jet pump assembly generally takes less than 4 hours.

6.3 TRANSFERRING THE WASTE (SALT WELL PUMPING)

The discharge of the jet pump assembly will be connected to the tank farm transfer system by use of a flexible jumper assembly located within the pit. The pump pits are equipped with leak detectors to help detect liquid waste leaks. If leaking is detected, pumping automatically is stopped . Occasionally water will be added to the tank via a pipe from an outside storage tank to prevent plugging of or to remove plugs from the salt well screen and pump equipment. The water will be piped from a storage tank through a metering system at a rate of 280 liters per minute or less. Entry into the tank is made through the pump pit via an existing port on the pit cover and into the salt well screen.

The concrete or steel cover block is reinstalled before starting the pumping operation. The cover contains penetrations for the various valve handles, electric cables, and air, water, and sample lines. Following testing of the equipment, salt well pumping begins and could continue for several months to several years depending on the initial volume of waste to be pumped and the rate liquid drains to the salt well. Periodic surveillances and operational checks will occur during salt well pumping. A portable exhauster will be available for use during the entire waste transfer period as a precautionary measure and will operate in the event that flammable gas levels exceed 25 percent of the LFL during the pumping campaign. The portable exhauster will be isolated from the tank by an isolation valve when the exhauster is not in use.

6.4 FLUSHING AND CLEANING PLUGS FROM TRANSFER LINES

The waste transfer operations involve the pumping of liquid waste that contains dissolved solids. These solids can precipitate out of solution anywhere in the transfer path and cause blockage. If blockage is detected in the system, flushing the affected components with hot water will be necessary. Other techniques to free blockages could include pressurization, and the use of heat tracing, temporary jumpers, and hydraulic scouring. The hot water will be introduced to the system to be flushed through a pressure manifold by piping connected directly to the jet pump, or bypassing the jet pump and connected directly to a jumper or nozzle. All piping connections are designed to be leak tight and the pit cover block will be installed before pressurization. If pressurization beyond that obtained from the tank farms water system or supply truck (i.e., approximately 1,034 kilopascals) is necessary to remove blockage, an

engineering evaluation will be performed to determine the maximum allowable pressure for operation. At a minimum, flushing will be performed when the system is shut down for any length of time and at the end of a salt well pumping campaign.

As in the case of water lancing, flushing of the transfer lines and/or plug removal will be performed in accordance with operating procedures and radiation surveys during the actual work activity to ensure containment of radionuclides. Pre-job and post-job surveys will be performed to verify containment. This activity has been conducted previously without incident during and after waste transfers in actively and passively ventilated SSTs and actively ventilated DSTs.

Flushing of transfer lines could be performed with or without an operating portable exhauster.

As discussed in Section 1.0 portable exhausters will be installed on SSTs during salt well pumping as a precautionary measure and will be used when flammable gas levels exceed 25 percent of the LFL.

7.0 ANNUAL POSSESSION QUANTITY AND PHYSICAL FORM
(REQUIREMENTS 8, 10, 11, AND 12)

Table 7-1 summarizes the major characteristics for waste tanks covered by this NOC.

There are multiple sources of tank waste inventory information. Each of the inventory reports contain the best inventory knowledge available at the time of publication. Some reports were based on previous work established by others and incorporated current operational practices at the time, some were updated to reflect sampling data, and others only updated inventories with respect to specific constituents being studied at that time. There also exist computer models, based on historical data, that do not directly correspond to any of the more recent inventory reports.

A task was initiated in 1996 to establish a standard inventory for chemicals and radionuclides in the tank waste. The goal was to resolve differences among the many reported inventory values and to provide a consistent, technically defensible and reproducible, inventory basis for all waste management and disposal activities. Typical data sources reviewed included sample analyses, process flow sheets, waste transaction records, computer modeling, reactor fuel data, and essential material records. The reconciliation process resulted in inventories for 46 radionuclides and 30 nonradioactive components. The radionuclide inventories for each tank covered in this NOC were obtained through this reconciliation process and are presented in Appendix A.

The physical form of each radionuclide listed in Appendix A is a particulate solid, except for tritium and carbon-14 that are liquids.

The source term used as a basis for this NOC is the radionuclide particulates present in the vapor space of each tank expressed in terms of total alpha, total beta, and cesium-137. All the radionuclides contributing 10 percent or more of the potential offsite exposure are in particulate form. Emission estimates are based on the vapor space source term for each tank and are presented in Sections 10.0 and 11.0.

Table 7-1. Waste Tank Characteristics.

Tank number	Date in service	Date inactivated	Total waste[a] (thousands of liters)	Pumpable waste[a] (thousands of liters)	Maximum waste temperature (°C)	Tank integrity[a]	Watch list tank[a]
241-AX-101	1965	1980	2,827	1,281	54	Sound	Flammable gas
241-BY-105	1951	1974	1,906	819	44	Assumed leaker	No
241-BY-106	1953	1977	2,433	618	49	Assumed leaker	No
241-S-101	1953	1980	1,618	481	48	Sound	No
241-S-102	1953	1980	2,081	906	42	Sound	Flammable gas and organic salt
241-S-103	1953	1977	940	368	30	Sound	No
241-S-106	1953	1976	1,815	637	27	Sound	No
241-S-107	1952	1980	1,425	334	42	Sound	No
241-S-109	1952	1982	2,221	451	30	Sound	No
241-S-111	1952	1978	2,259	508	33	Sound	Flammable gas and organic salt
241-S-112	1952	1976	1,982	406	29	Sound	Flammable gas
241-T-104	1946	1976	1,338	95	32	Sound	No
241-T-110	1944	1976	1,425	136	33	Sound	Flammable gas
241-U-103	1947	1978	1,774	777	30	Sound	Flammable gas and organic salt
241-U-105	1947	1979	1,584	728	32	Sound	Flammable gas and organic salt
241-U-106	1948	1977	857	322	27	Sound	Organic salt
241-U-107	1948	1980	1,539	694	27	Sound	Flammable gas and organic salt
241-U-108	1949	1979	1,774	792	31	Sound	Flammable gas
241-U-109	1949	1980	1,565	777	28	Sound	Flammable gas
241-U-111	1947	1980	1,316	489	27	Sound	Organic salt

[a] Reference: HNF-EP-0182-116.

8.0 CONTROL SYSTEM (REQUIREMENT 6)

Three types of exhausters will be available for use during salt well pumping.

- One type is rated for 17 cubic meters per minute. Three units of this design currently are available.
- Another type is rated for 34 cubic meters per minute. Two currently are planned for use.
- The third type is the existing portable exhauster currently located on tank A-101. This 17-cubic meter per minute exhauster was approved for salt well pumping use on tank A-101 in March 1996 (DOE/RL-96-24). This exhauster will be available for use on other tanks when no longer needed on tank A-101. The monitoring system will be updated to the requirements specified in Section 9.0 after use on tank A-101 but before use on any other tank covered by this NOC.

Portable exhauster designs essentially are identical with two notable exceptions: the absence of a demister in the 17-cubic meter per minute design and high-efficiency particulate air (HEPA) filter design, depending on flow capacity. The 17-cubic meter per minute exhauster HEPA filter size is 60.96 wide by 60.96 long by 14.92 centimeters thick and the 34-cubic meter per minute exhauster filter size is 60.96 wide by 60.96 long by 29.21 centimeters thick.

The major system components of a portable exhauster are listed as follows. The abatement technology for the emission unit will undergo routine maintenance, repair, and replacement-in-kind as defined in WAC-246-247-030(22) and (23)(a) and (b).

- Ductwork
- Isolation valves
- Glycol heaters and associated components
- Demister (34-cubic meter per minute design only)
- 1 prefilter and housing
- 2 HEPA filter test sections
- 2 HEPA filter and filter housing
- 1 exhaust fan
- Stack
- Condensate drain and seal pot system
- Insulation
- Instrumentation and controls
- Electrical system
- Support skid.

When a portable exhauster is required for salt well pumping or the performance of supporting activities, the exhauster will draw warm moist air from the tank, heat and filter the air, and release the air to the environment. During active ventilation, fresh air, drawn into the tank vapor space through a breather filter, will dilute and disperse any flammable gases present. During passive ventilation, the portable exhauster will be valved off and air will enter or exit the tank through the breather filter, depending on tank internal pressure relative to atmospheric pressure. Each breather filter will consist of a housing that contains a HEPA filter, an outlet screen, and a small seal loop. During passive ventilation, an isolation valve normally will be open to allow air flow between the tank vapor space and the outside atmosphere through the filter. Air flowing to and from the tank will pass horizontally through the filter and vertically through the downward-facing exit weather hood. Seal loops, installed in the exhaust lines, are designed

as a safety feature to prevent a highly unlikely accident in which an over pressurization occurs when the HEPA filter is isolated for occasional (infrequent) maintenance. Figure 8-1 shows breather filter configuration on a typical SST. Figure 8-2 shows components of a typical breather filter.

Air from the tank will be heated to reduce the relative humidity to less than 70 percent before passing through the prefilter. The air will pass through the prefilter, two HEPA filters in series, a fan and discharge through a stack. The stack will contain a section that allows for the installation of air flow measuring and temporary sampling devices. Any moisture that might accumulate inside the exhauster will be collected in a drain system, routed to a seal pot, and returned to the tank.

All components and materials that are in direct contact with the air stream will be designed in accordance with the applicable authorization basis requirements (HNF-DS-WM-BIO-001) for flammable gas issues.

Flexible or rigid ductwork (depending on the design at each tank farm) will be used to connect the exhauster inlet to the tank riser. Precautionary measures to protect the air pathway during connection of the ductwork to the tank riser will include installation of an isolation valve in the riser to minimize the time tank contents are exposed to the air, and will take into account abrasion, leakage, tear strength, tensile strength, air stream temperature, and outdoor exposure conditions. All flexible ductwork will be bonded to ensure electrical conductivity.

The prefilter will increase the life of the HEPA filters by trapping the larger airborne particles allowing for a more economical operating system. As low as reasonably achievable (ALARA) concepts will be applied to allow less frequent change out of the HEPA filters, thereby reducing exposure of personnel to radiation sources.

The HEPA filters will meet the requirements of ASME AG-1, Section FC and will be tested annually to requirements of ASME N510. The HEPA filters will be nuclear grade throw-away extend-media dry-type in a rigid frame having minimum particle collection efficiency of 99.95 percent for 0.3 micrometer median diameter, thermally-generated dioctylphthalate particles or other specified challenge aerosols. Pressure drop of a clean filter will be a maximum of 1 inch water gauge at rated flow. The frame will be corrosion resistant for the air stream design conditions. Each filter will have a gelatinous seal gasket material that will be on the air inlet gasket surface.

The HEPA filter housing will provide a sealed barrier for the confinement of airborne radionuclides and will serve to encapsulate and hold the HEPA filter. The filter housing will provide for the attachment of pressure differential measurement components. Each filter housing will meet the applicable sections of ASME N509 and the test requirements of ASME N510. The filter housings will be leak tested using the pressure decay method in accordance with ASME N510. Leakage will not exceed 0.3 percent of the housing volume per hour.

The test sections will provide a means for in place testing of the HEPA filters. Testing will confirm that any airborne radionuclide particles are captured to the level of efficiency of the installed HEPA filter. One test section will be placed downstream of the prefilter section and upstream of the first HEPA filter section. The second test section will be placed between the first stage HEPA filter housing and the second stage HEPA filter housing.

The exhaust fan will be constructed of non-sparking materials and will meet AMCA Standard 99-0401-86 and be Type A construction. The fan will be a centrifugal type and be statically and dynamically balanced as an assembly.

The exhaust stack houses the air velocity probe (for measurement of stack velocity) and the air sampling probe. Flexible ductwork will be used to connect the fan outlet to the stack. The stack will be approximately 3 meters high from the fan outlet and will be flange connected to facilitate removal during transportation.

Stack identification will be assigned before startup and will be reported in the notification of pre-operational testing per WAC 246-247-060 paragraph 4, and the notice of anticipated startup date provided in accordance with 40 CFR 62.09.

Figures 8-3 and 8-4 show plan and elevational views of a portable exhausters' components. Figure 8-3 shows the general arrangement of SST components including HEPA inlet breathing filters.

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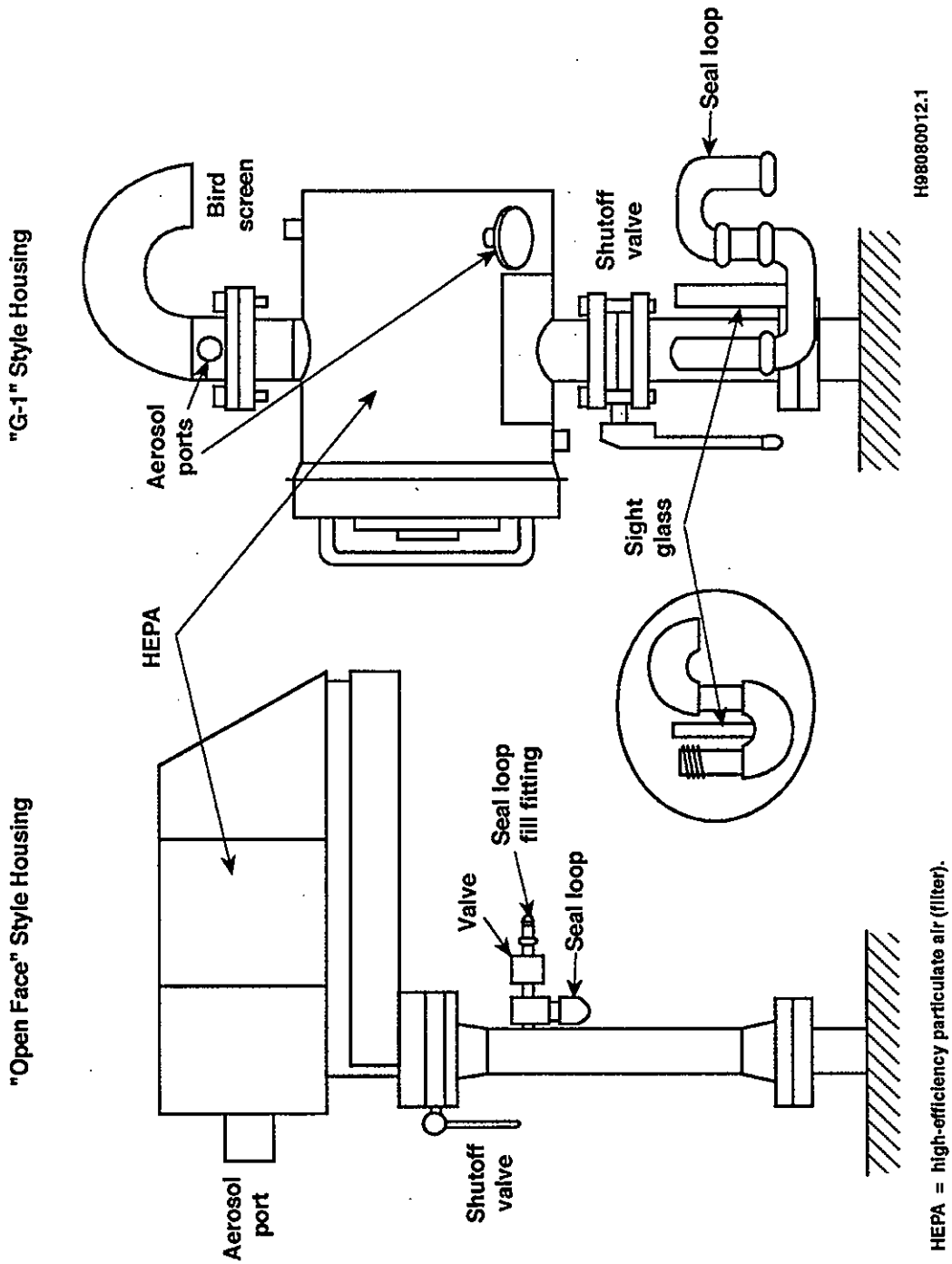

Figure 8-2. Single-Shell Tank Breather Filter Components.

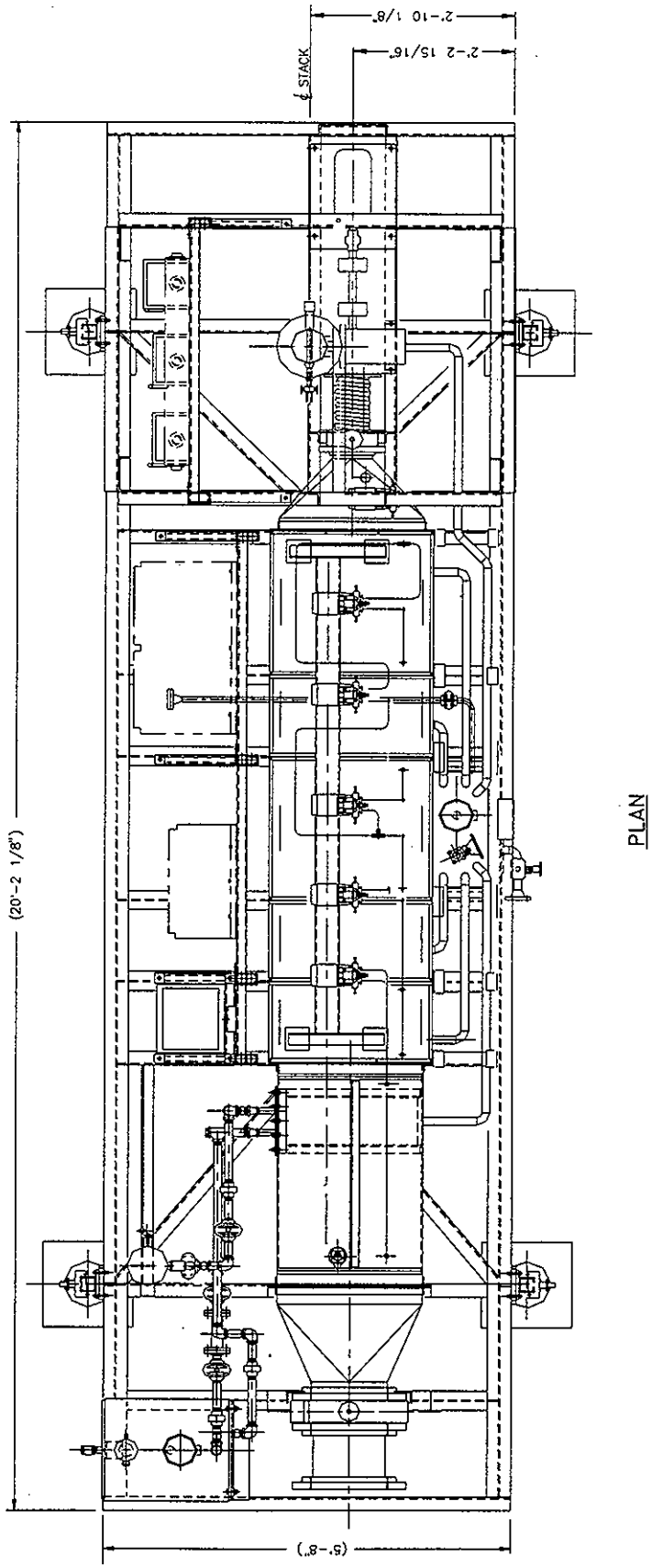

Figure 8-3. Ventilation Control System Diagram--Plan View.

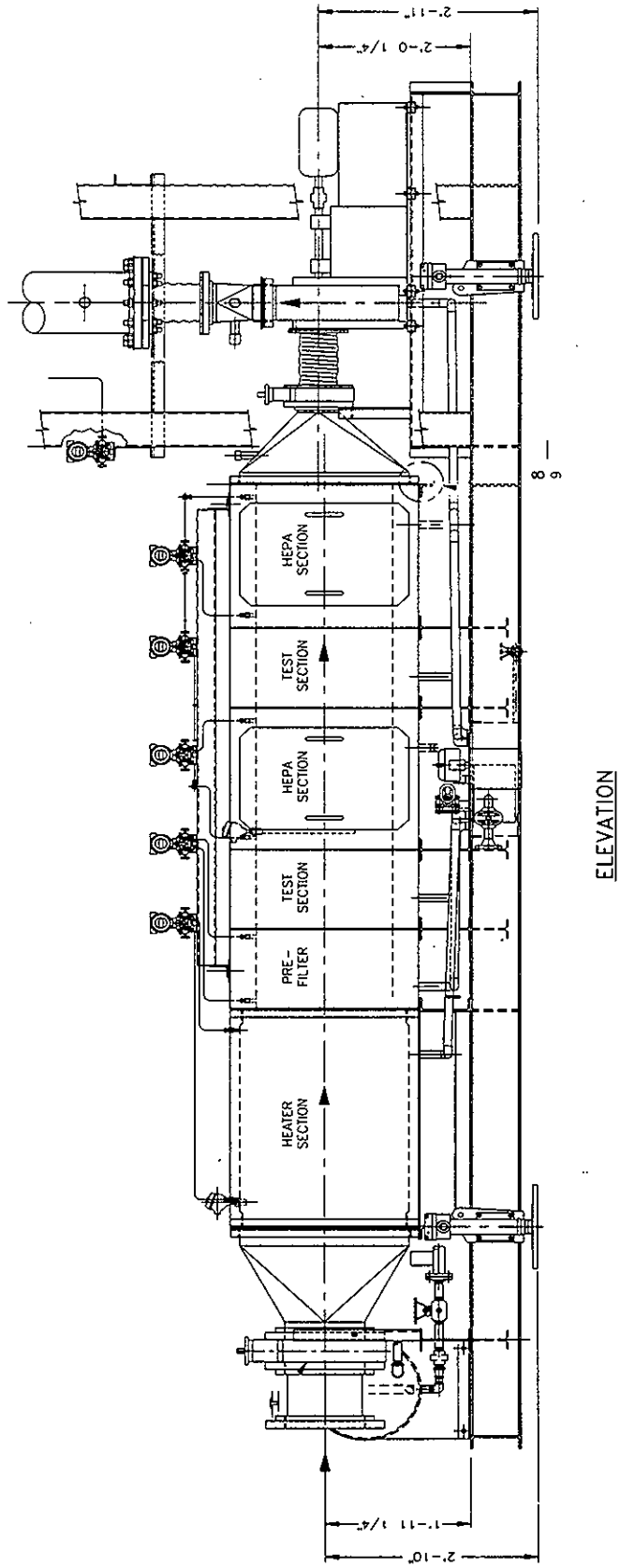

Figure 8-4. Ventilation Control System Diagram--Elevation View.

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9.0 MONITORING SYSTEM (REQUIREMENT 9)

The monitoring system used on all portable exhausters employed in the salt well pumping program will meet the regulatory compliance requirements specified in 40 CFR 61, Subpart H and its referenced requirements, for all tanks covered by this NOC regardless of whether each tank (stack) is designated as major or minor.

The system, identified as the generic effluent monitoring system (GEMS), has been subject to extensive testing (PNNL-11701) and shown to meet all applicable regulatory criteria for air sampling at nuclear facilities. The performance criteria addressed both the suitability of the air sampling probe location and the transport of the sample to the collection devices.

The system includes a stack section containing the sample probe and another stack section containing the airflow, temperature, and humidity sensors. The GEMS design features a probe with a single shrouded sampling nozzle, a short sample delivery line, and a sample collection system. The collection system includes a filter holder to collect the record sample and an in-line detector head for monitoring beta and gamma radiation-emitting particles. The record sampler will operate continuously during exhauster operation. The beta/gamma sensor could operate continuously in accordance with the authorization basis (HNF-SD-WM-BIO-001), but there is no environmental regulatory requirement to do so. An interlock is installed to shut down the exhaust fan if the beta/gamma sensor detects elevated emissions. Both the record sampler and the beta/gamma sensor will be calibrated and audited routinely.

Figures 9-1 and 9-2 show details of the stack and shrouded nozzle, respectively.

On those tanks salt well pumped in the passive ventilation mode, the current requirement for periodic comfirmatory measurement (PCM) as specified in the draft air operating permit shall be performed. PCM will be conducted annually by verifying the levels of smearable contamination on the inside surface of the ducting downstream of the HEPA filter or on the outside of the screen covering the outlet of the vent, should one exist. Confirmation of levels below 10,000 disintegrations per minute per 100 square centimeters beta/gamma and 200 disintegrations per minute per 100 square centimeters alpha will be used to verify low emissions. Detected levels above these thresholds would result in further investigation and reporting if the cause was due to an airborne emission. The radiological survey reports will become the record for the PCM.

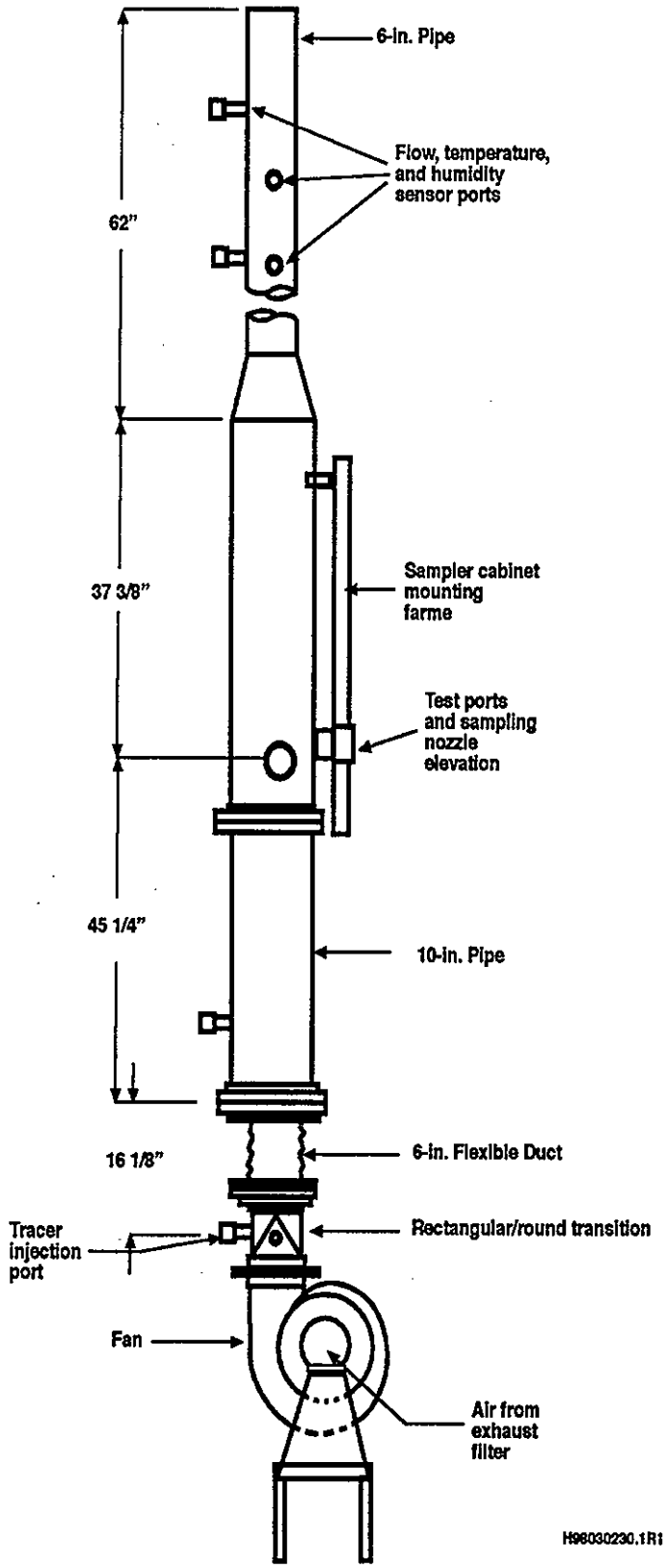

Figure 9-1. Components of Salt Well Exhauster Stack.

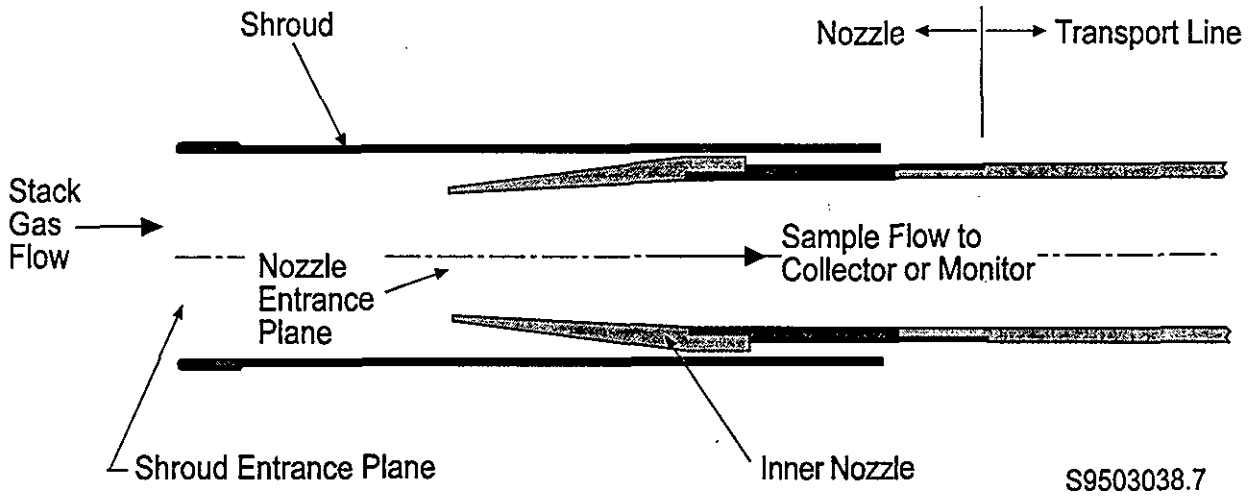

Figure 9-2. Configuration of Shrouded Nozzle.

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10.0 RELEASE RATES (REQUIREMENT 13)

As discussed in Section 1.0, portable exhausters will be installed on SSTs during salt well pumping as a precautionary measure, for use when flammable gas concentrations exceed 25 percent of the LFL. This NOC also addresses other activities that will be performed in support of salt well pumping, but do not require the application of a portable exhauster. In the past, these support activities have been considered routine in accordance with WAC 246-247. This section evaluates the potential for emissions to occur during salt well pumping and also during performance of the support activities.

10.1 BACKGROUND INFORMATION

A primary question in determining the unabated emissions that would result from salt well pumping and performance of the support activities involves the mechanism for formation of aerosols in the tank vapor space. Two mechanisms have been postulated to occur should operation of the exhausters become necessary during salt well pumping: the release of trapped gas and associated aerosol generation, and resuspension of dry particulate material because of air currents created by the exhausters. Information available to date shows that salt well pumping minimally disturbs the tank waste and vapor space.

This position is supported by modeling designed to predict gas release during intrusive activities, analysis of release scenarios conducted for the Tank Farm Final Safety Analysis Report, and operational experience gained from tanks SY-101 and AN-104. The following is a discussion of results from these activities.

Numeric modeling designed to predict gas release during salt well pumping is documented (PNNL-11310 and TWSFG 96.14). Results state that, as the retreating liquid exposes the trapped gas bubbles, the trapped gas is released by diffusing through the connected gas channels to the surface of the salt cake or sludge. Thus, during salt well pumping, gas release is characterized as a continuous, slow release process. The generation of additional aerosol radionuclides under these conditions is not foreseen.

Intrusion into the waste by water lancing, as described in Section 6.2, to install the salt well screen or the jet pump assembly offers the possibility of increased concentrations of aerosol radionuclides because of the initial action of high pressure water from the lance on the waste and the potential for more rapid gas release from intrusion of the lance into the waste. A conservative gas release analysis, based on release scenarios including salt well pumping, intrusion into the waste, and waste rollover, was performed (WHC-SD-WM-EMP-031). This study addressed flammable gas concentration changes in the vapor space as a function of release rates, and concluded that a rollover will release the largest amount of gas in a short time. The study also concluded that although a rollover is possible, a rollover is unlikely because changes in waste levels in SSTs have been small, which implies gas generation rates are balanced by gas release rates. The study also concluded that intrusion into the waste will release relatively small volumes of gas as compared to a rollover. The lowest gas release rates are characteristic of salt well pumping. Considering the operational experience gained during May 1990 to December 1994 for SY-101 tank, it is considered unlikely that salt well pumping or its support activities that intrude into the waste will cause gas releases that measurably will increase the radiological aerosol in the tank vapor space.

Operational experience with SY-101 tank suggests that more aggressive waste intrusive activities involving intermittent mixer pump operation and rollover would not contribute significantly to an increase in radionuclide aerosol concentration in the vapor space, due to the release of trapped gas to the

surface. This is demonstrated by nondestructive assay analysis of HEPA filters in service on the SY-101 tank from May 1990 to December 1994. The analysis indicates the potential offsite cumulative dose of 1.5 E-03 millirem for the 4.5-year period (WHC-SD-WM-EMP-031). The type of gas releases experienced from SY-101 is not expected to occur during salt well pumping or the performance of support activities. However, assuming a very conservative position that a rollover would occur, the experience with the SY-101 tank suggests a maximum increase in an annual dose of only 3.3 E-04 millirem per year, which has an insignificant affect on the dose analysis presented in Section 11.0.

Operational experience with the AN-104 tank shows episodic gas (hydrogen) release events occur approximately every 133 days. Although no monitoring of unabated emissions within the tank has occurred during these events, there is no evidence that abated emissions increased during these events.

Another potential source of an increase in the radiological aerosol concentration in the tank vapor space might be attributed to the dry waste surface believed to be present in several tanks. This scenario for potential increased emissions assumes a radiological source, in the form of dry particulates, has been deposited or has formed on top of the dry waste surface. When the exhauster is turned on, these particulates could become airborne. In-tank photography is not considered sensitive enough to verify the presence or absence of dry particulates. However, no mechanism is known for the generation or formation of such a condition. It is believed the dry surface in these tanks was formed by evaporation of liquid waste, which is expected to result in a hard surface on the resulting salt cake. Also considered unlikely is that air flow into the tank, because of exhauster operation, could generate sufficient turbulence to disturb particulates even if the particulates were present.

The action of a water lance on a potentially dry waste surface is not expected to contribute measurably to increased aerosols, as water from the water lance will wet the dry waste surfaces that might exist before lancing begins. As noted in Section 10.5, the resultant dose due to water lancing activities on a waste surface (wet or dry) has been increased by a conservative factor of 10. This accounts for the uncertainty regarding a potential increase in vapor space radionuclide particulates because of the use of the water lance on or in the waste.

Additional mechanisms for a potential increase in aerosol concentration in the tank vapor space include accident conditions associated with a flammable gas burn in the vapor space, waste collapse, and equipment drop scenarios. These mechanisms are not addressed in this NOC because the likelihood of occurrence is less than 1 E-06 per year (WHC-SD-WM-EMP-031).

10.2 DISCUSSION OF SOURCE TERM USED TO CALCULATE EMISSIONS

The emission estimates in this NOC are based on analyses of filter papers in sampling equipment used for vapor space sampling in support of worker health and safety issues. The vapor sample analysis did not include radionuclide analytes; therefore, analyses of the filter papers were used for this estimate.

Two types of vapor sampling systems were used: a truck mounted vapor sampling system (VSS) and/or a cart mounted in-situ vapor sampling system (ISVS). In both systems, filter papers were used to provide protection against radioactive contamination from reaching the sampling apparatus in the cart or truck. The filter papers have a minimum aerosol retention of 99.98 percent for particles of 0.3 micron median diameter. In the case of the VSS, the filters are mounted outside the tank while for the ISVS, the filters are mounted in the tank. In both cases, the filter papers are upstream from the sampling apparatus. Additional details of the sampling effort are documented (PNNL 1997).

10.3 POTENTIAL ANNUAL UNABATED EMISSIONS DURING SALT WELL PUMPING

Potential annual unabated emissions for each tank during salt well pumping were estimated using the measured total alpha, total beta, and cesium-137 concentrations collected on filter papers used during vapor sampling of undisturbed vapor space in each tank (PNNL 1997). Most of the filter papers were analyzed from 1 to 4 days after the sampling occurred. Subsequent tests and analysis of the activity on the filter papers showed a half-life of approximately 10 days. Therefore, the activities measured on the filter papers are believed to be attributed to radon progeny (PNNL 1997 and WHC 1982).

10.3.1 Potential Annual Unabated Emissions During Salt Well Pumping Under Passive Ventilation Rates

Unabated emissions currently attributed to the tanks covered in this NOC are not expected to increase measurably as a result of salt well pumping because the act of lowering the waste level by slowly removing the liquid wastes minimally disturbs the tank vapor space and waste. An estimate of those emissions, using the measured total alpha, total beta, and cesium-137 concentrations noted previously is presented in Appendix B. This estimate assumes a tank (passive) breathing rate of 0.28 cubic meter per minute to calculate potential unabated emissions. The methodology justifying this breathing rate was developed and used to estimate emissions from SSTs (DOE/RL-95-07).

10.3.2 Potential Annual Unabated Emissions During Salt Well Pumping With a Portable Exhauster In Operation

During salt well pumping, the potential to emit would increase during operation of the exhauster. For conservatism, the emission calculations in Appendix C assume the exhauster was run at its maximum output of 34 cubic meters per minute, 24 hours per day, 365 days per year. (Planning schedules include a 60 percent pumping efficiency, which makes these calculations conservative.) The following is a sample calculation using the 241-S-109 tank alpha concentration data from the filter papers. (This tank was selected for exemplary purposes only, there is nothing unique about the tank.)

Unabated alpha emission =

$$\left(0.058\,\frac{\text{pCi}}{\text{L}}\right)\text{x}\left(10^{-12}\,\frac{\text{Ci}}{\text{pCi}}\right)\text{x}\left(\frac{1{,}200\,\frac{\text{ft}^3}{\text{min}}}{35.3\,\frac{\text{ft}^3}{\text{M}^3}}\right)\text{x}\left(10^3\,\frac{\text{L}}{\text{M}^3}\right)\text{x}\left(60\,\frac{\text{min}}{\text{hr}}\right)\text{x}$$

$$\left(24\,\frac{\text{hr}}{\text{day}}\right)\text{x}\left(365\,\frac{\text{days}}{\text{year}}\right)=1.04\,\text{E-}3\,\frac{\text{Ci}}{\text{year}}.$$

10.4 POTENTIAL ANNUAL ABATED EMISSIONS DURING SALT WELL PUMPING

Potential annual abated emissions for each tank during salt well pumping at an active ventilation rate of 34 cubic meters per minute and under passive breathing conditions are calculated from the unabated emissions and the decontamination factor (DF) for the HEPA filters.

In the case of active ventilation, the DF for each HEPA filter is equal to:

$$\frac{1}{1-\text{efficiency}} = \frac{1}{1-.9995} = 2\,\text{E}+03.$$

The overall DF is determined by multiplying the DFs for each HEPA filter together, i.e., (2 E+03) times (2 E+03) equals 4 E+06 for the ventilation system. The abated emissions equal the unabated emissions divided by the overall DF. The potential annual abated emissions for each tank during active ventilation are presented in Appendix C.

In the passive breathing case, a breather HEPA filter emission adjustment factor of .01, per Appendix D of 40 CFR 61, is multiplied by the calculated unabated emissions. The potential annual abated emissions for each tank during passive breathing are presented in Appendix B.

10.5 POTENTIAL ANNUAL UNABATED EMISSIONS DURING WATER LANCING

Potential annual unabated emissions during water lancing operations to insert the salt well screen or the jet pump assembly in each tank also were estimated using the measured total alpha, total beta, and cesium-137 concentrations collected on filter papers used during vapor sampling of vapor space in each tank (PNNL 1997). However, as noted previously, use of a portable exhauster is not required during lancing operations. Therefore, to determine potential emissions during this operation, a tank breathing rate of 0.28 cubic meter per minute (Section 10.3.1) was used to calculate total potential emissions. As discussed in Section 10.3.1, this methodology was developed and used to estimate emissions from SSTs reported in the draft air operating permit (DOE/RL-95-07).

The results are shown in Appendix D. (Note that the resultant dose has been increased by a conservative factor of 10 to account for uncertainty regarding a potential increase in vapor space radionuclide particulates because of the use of the water lance on the waste and intrusion of the water lance into the waste (Section 10.1.)

10.6 POTENTIAL ANNUAL ABATED EMISSIONS DURING WATER LANCING

Potential abated emissions from water lancing under passive ventilation rates were estimated by multiplying the unabated emissions by a breather HEPA filter emission adjustment factor. The adjustment factor, 0.01, was taken from Appendix D of 40 CFR 61. Results are presented in Appendix D.

10.7 POTENTIAL ANNUAL UNABATED EMISSIONS DURING WATER ADDITION TO THE WASTE

Occasionally water will be added to the tank to prevent plugging of the salt well screen and the waste line. The water will be piped from a storage tank through a metering system at an average rate of 280 liters per minute or less. Entry into the tank is made through the pump pit via an existing port on the pit cover and into the salt well screen. No mechanism for increasing the concentration of radionuclides in the vapor space is foreseen as a result of this activity and therefore, no increase in the potential to emit is estimated.

10.8 POTENTIAL ANNUAL UNABATED EMISSIONS DURING TRANSFER LINE FLUSHING AND PLUG REMOVAL

Flushing of transfer lines and cleaning plugs from transfer lines are accomplished as described in Section 6.4. No mechanism for increasing the concentration of radionuclides in the vapor space is foreseen as a result of these activities and therefore, no increase in the potential to emit is estimated.

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11.0 OFFSITE IMPACT (REQUIREMENTS 14 AND 15)

This section presents information regarding the total effective dose equivalent (TEDE) to the hypothetical maximally exposed individual (MEI) resulting from unabated and abated emission estimates from salt well pumping with active ventilation and, the unabated emissions from water lancing and salt well pumping under passive tank ventilation rates.

For SSTs AX-101, BY-105, and BY-106, the MEI is located at the Hanford Site boundary, 16 kilometers east of the 200 East Area. All other tanks covered by this NOC are located in the 200 West Area where the MEI is at the Hanford Site boundary, 24 kilometers east of the 200 West Area. The unit dose factors used to calculate offsite dose were submitted previously to the Washington State Department of Health (WDOH). The information required to develop the unit dose factors from the Clean Air Assessment Package 1988 computer code is included in *Unit Dose Calculation Methods Summary of Facility Effluent Monitoring Plan Determinations* (WHC-EP-0498).

Potential unabated doses are calculated as the product of the unabated emissions and the applicable unit dose factor. These calculations assume the total alpha to be from americium-241, instead of radon 226 as indicated in Section 10.3, because americium provides the highest dose consequence of all alpha emitters, 7.79 millirem per curie versus 3.23 E-01 millirem per curie. The total beta activity is assumed to be strontium-90.

Appendix B provides the potential annual unabated dose and abated dose for each tank during salt well pumping at passive tank breathing rates. The highest unabated dose expected is 1.38 E-02 millirem per year from tank S-112.

Appendix C provides the potential annual unabated dose and abated dose for each tank during salt well pumping assuming the most conservative case that the exhauster is run 24 hours per day, 365 days per year, at the maximum flow rate. Under these conditions, the following tanks exceed the regulatory dose criterion of 0.1 millirem per year TEDE to the MEI emission points:

- 241-S-103 (1.30 E-01 millirem per year)
- 241-S-107 (4.15 E-01 millirem per year)
- 241-S-112 (1.68 E+00 millirem per year).

The remaining tanks fall below the regulatory criterion of 0.1 millirem per year. However, as discussed in Section 9.0, the monitoring system used with all portable exhausters will be compliant with 40 CFR 61, Subpart H and the reference requirements.

Appendix D provides the potential annual unabated dose and abated dose for each tank during water lancing operations. The analysis assumes water lancing operations will be performed under passive tank breathing rates for a period not to exceed 72 hours of actual water lancing. The 72-hour period will be controlled administratively. Also note that the resultant dose has been increased by a conservative factor of 10 to account for uncertainty regarding a potential increase in vapor space radionuclide particulates because of using the water lance on the waste and from intrusion of the water lance into the waste (Section 10.1). The highest potential unabated dose expected during water lancing operations from tank S-112 is 1.13 E-03 millirem per year.

As discussed in Section 1.0, a portable exhauster also could be used to simultaneously exhaust more than one SST during salt well pumping. Although the exact combination of tanks to be pumped or exhausted

simultaneously is not known at this time, preliminary planning includes simultaneous pumping of tanks BY-105 and BY-106. Also, it is likely that some tanks within S Farm will be pumped simultaneously using a single portable exhauster, and some tanks within U Farm will be pumped simultaneously using a single portable exhauster. If requested, specific details regarding simultaneous pumping of tanks will be forwarded to WDOH when available.

As provided in Appendix C, the maximum abated dose for pumping all tanks at the same time is conservatively estimated at 6.51 E-07 millirem per year. However, in actual practice, application of an exhauster to the tanks covered by this NOC is scheduled to occur from 1998 into the year 2002. Although the exact schedule is not certain, it is extremely unlikely that all tanks will be ventilated at the same time.

The TEDE resulting from all Hanford Site operations in 1997 was determined to be 0.026 millirem per year (DOE/RL-98-33). The emissions resulting from water lancing and salt well pumping, in conjunction with other current operations on the Hanford Site, will not violate the National Emission Standard of 10 millirem per year.

12.0 COST FACTORS AND FACILITY LIFETIME (REQUIREMENTS 16 AND 17)

It is proposed that the HEPA filtration systems portable exhausters, for the portable exhausters as described in Section 8.0, be approved as best available radionuclide control technology (BARCT) for salt well pumping activities when active ventilation is required. The WDOH has provided guidance in the past that HEPA filtration is considered BARCT for particulate emissions. It also is proposed that the passive breather filters, also described in Section 8.0, be approved as low as reasonably achievable control technology (ALARACT) for salt well pumping activities performed in the passive ventilation mode. As such, cost factors for construction, operation, and maintenance of the control technology components and system have not been provided.

The minimum design life of the portable exhauster equipment is 10 years. Each exhauster could be operated continuously or intermittently for the duration of the pumping campaign. Pumping operations could be in a continuous mode for up to 3 or more years. Operations will be conducted up to 24 hours a day, 7 days a week.

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13.0 TECHNOLOGY STANDARDS (REQUIREMENT 18)

During active ventilation, the emissions control equipment employed on the portable exhausters to be used on tanks included in this NOC adhere to the compliance standards as noted in Table 13-1. This table summarizes the compliance of emissions control equipment with the listed technology standards for tanks with a potential to emit greater than 0.1 millirem per year TEDE to the MEI as discussed in Sections 9.0 and 11.0.

In the passive breathing mode, none of the salt well activities have the potential to emit greater than 0.1 millirem per year TEDE to the MEI. Therefore, the design of the HEPA breather filters must meet, as applicable and to the extent justified by a cost/benefit evaluation, the technology standards listed under WAC 246-247-110(18). Table 13-2 summarizes the compliance of emissions control equipment listed with technology standards

Table 13-1. Emissions Control Equipment Standards Compliance For Portable Exhausters.

Standard	Does design comply	Notes
ASME/ANSI AG-1	Yes	
ASME/ANSI N509	Yes	Glycol heater will substitute for electric heater because of flammable gas concerns.
ASME/ANSI N510	Yes	
ANSI/ASME NQA-1	Yes	
40 CFR 61.93 (b)(3)	Yes	Shrouded probe via alternate method allowed per EPA (1994).
ANSI N13.1	No	
40 CFR 52, Appendix E	Yes	Design to be confirmed by running a 168 hour test.
40 CFR 60, Appendix A Test Methods: 1, 1A		
2, 2A, 2C, 2D		
4		
5, 17	No	Design will be provided to regulator.

Table 13-2. Emissions Control Equipment Standards Compliance for Breather Filters.

Standard	Does design comply	Notes
ASME/ANSI AG-1	No	Filters installed meet AG-1. Housings were fabricated prior to AG-1.
ASME/ANSI N509	No/Yes	Open face design does not meet N509. G-1 housing design meets N509.
ASME/ANSI N510	Yes	
ANSI/ASME NQA-1	No/Yes	Open face design does not meet N509. G-1 housing design meets N509.
ANSI N13.1	No	Not required for periodic confirmatory measurement.
40 CFR 52, Appendix E	No	Not required for periodic confirmatory measurement.
40 CFR 60, Appendix A Test Methods: 1, 1A		
2, 2A, 2C, 2D		
4		
5, 17		Not required for periodic confirmatory measurement.

14.0 REFERENCES

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APPENDIX A

TANK RADIONUCLIDE INVENTORY

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Best-Basis Inventory Estimates for Radioactive Components in Tank 241-AX-101 Decayed to January 1, 1994 (Effective May 31, 1997).

Analyte	Total Inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{3}H	0.943	E	
^{14}C	7.91	E	
^{59}Ni	6.93	E	
^{60}Co	700	E	
^{63}Ni	681	E	
^{79}Se	3.86	E	
^{90}Sr	1.25 E+06	E	
^{90}Y	1.25 E+06	E	Calculated from Parent
^{93m}Nb	14.3	E	
^{93}Zr	16.7	E	
^{99}Tc	458	E	
^{106}Ru	0.030	E	
^{113m}Cd	35.5	E	
^{125}Sb	0.919	E	
^{126}Sn	6.20	E	
^{129}I	0.103	E	
^{134}Cs	0.111	E	
^{137}Cs	604,000	E	
^{137m}Ba	571,000	E	Calculated from Parent
^{151}Sm	14,400	E	
^{152}Eu	3.61	E	
^{154}Eu	84.9	E	
^{155}Eu	221	E	
^{226}Ra	4.66 E-04	E	
^{227}Ac	0.0024	E	
^{228}Ra	2.11 E-09	E	
^{229}Th	3.51 E-07	E	
^{231}Pa	0.0036	E	
^{232}Th	2.85 E-11	E	
^{232}U	9.31 E-08	E	
^{233}U	1.31 E-09	E	

Best-Basis Inventory Estimates for Radioactive Components in Tank 241-AX-101 Decayed to January 1, 1994 (Effective May 31, 1997).

Analyte	Total Inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{234}U	3.90 E-04	E	
^{235}U	1.52 E-05	E	
^{236}U	2.57 E-05	E	
^{237}Np	0.0016	E	
^{238}Pu	5.42	E	
^{238}U	3.12 E-04	E	
$^{239/240}Pu$	5,020	E	
^{241}Am	2,940	E	
^{241}Pu	384	E	
^{242}Cm	0.137	E	
^{242}Pu	0.0023	E	
^{243}Am	0.0086	E	
^{243}Cm	0.0124	E	
^{244}Cm	0.502	E	

[1]S = Sample-based
M = Hanford Defined Waste model-based, Agnew et al. (1997a)
E = Engineering assessment-based.

Best-Basis Inventory Estimates for Radioactive Components in Tank 241-BY-105 Decayed to January 1, 1994 (Effective January 31, 1997).

Analyte	Total inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{3}H	168	M	
^{14}C	43.7	M	
^{59}Ni	6.78	M	
^{60}Co	40.6	M	
^{63}Ni	653	M	
^{79}Se	3.68	M	
^{90}Sr	620,000	E	
^{90}Y	620,000	E	Referenced to ^{90}Sr
^{93}Zr	17.8	M	
^{93m}Nb	12.9	M	
^{99}Tc	243	M	
^{106}Ru	0.00810	M	
^{113m}Cd	93.5	M	
^{125}Sb	182	M	
^{126}Sn	5.51	M	
^{129}I	0.470	M	
^{134}Cs	1.99	M	
^{137}Cs	522,000	E	
^{137m}Ba	494,000	E	Referenced to ^{137}Cs
^{151}Sm	12,700	M	
^{152}Eu	6.05	M	
^{154}Eu	686	M	
^{155}Eu	372	M	
^{226}Ra	1.94 E-04	M	
^{227}Ac	0.00255	M	
^{228}Ra	2.17	M	
^{229}Th	0.0501	M	

Best-Basis Inventory Estimates for Radioactive Components in Tank 241-BY-105 Decayed to January 1, 1994 (Effective January 31, 1997).

Analyte	Total inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{231}Pa	0.0129	M	
^{232}Th	0.0801	M	
^{232}U	12.1	M	
^{233}U	46.3	M	
^{234}U	11.6	M	
^{235}U	0.497	M	
^{236}U	0.163	M	
^{237}Np	0.819	M	
^{238}Pu	3.24	M	
^{238}U	15.3	M	
$^{239/240}Pu$	122	E	
^{241}Am	57.1	M	
^{241}Pu	233	M	
^{242}Cm	0.00702	M	
^{242}Pu	0.00112	M	
^{243}Am	0.00197	M	
^{243}Cm	1.44 E-04	M	
^{244}Cm	3.23 E-04	M	

[1]S = Sample-based
M = Hanford Defined Waste model-based, Agnew et al. (199)
E = Engineering assessment-based

Best-Basis Inventory Estimates for Radioactive Components in Tank 241-BY-106 Decayed to January 1, 1994 (Effective January 31, 1997).

Analyte	Total inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{3}H	270	M	
^{14}C	70.1	M	
^{59}Ni	8.84	M	
^{60}Co	65.5	M	
^{63}Ni	865	M	
^{79}Se	5.90	M	
^{90}Sr	496,000	S	
^{90}Y	496,000	S	Referenced to ^{90}Sr
^{93}Zr	28.5	M	
^{93m}Nb	20.6	M	
^{99}Tc	391	M	
^{106}Ru	0.0131	M	
^{113m}Cd	150	M	
^{125}Sb	294	M	
^{126}Sn	8.82	M	
^{129}I	0.756	M	
^{134}Cs	3.20	M	
^{137}Cs	704,000	S	
^{137m}Ba	666,000	S	Referenced to ^{137}Cs
^{151}Sm	20,400	M	
^{152}Eu	9.43	M	
^{154}Eu	1,110	M	
^{155}Eu	574	M	
^{226}Ra	2.90 E-04	M	
^{227}Ac	0.00404	M	
^{228}Ra	3.50	M	
^{229}Th	0.0808	M	

Best-Basis Inventory Estimates for Radioactive Components in Tank 241-BY-106 Decayed to January 1, 1994 (Effective January 31, 1997).

Analyte	Total inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{231}Pa	0.0207	M	
^{232}Th	0.129	M	
^{232}U	19.5	M	
^{233}U	74.8	M	
^{234}U	5.32	M	
^{235}U	0.197	M	
^{236}U	0.176	M	
^{237}Np	1.31	M	
^{238}Pu	5.23	M	
^{238}U	11.1	M	
^{239}Pu	61.4	S	
^{240}Pu	32.1	M	
^{241}Am	91.9	M	
^{241}Pu	376	M	
^{242}Cm	0.00520	M	
^{242}Pu	0.00181	M	
^{243}Am	0.00317	M	
^{243}Cm	1.06 E-04	M	
^{244}Cm	4.65 E-04	M	

[1]S = Sample-based
M = Hanford Defined Waste model-based, Agnew et al. (1997)
E = Engineering assessment-based

Best-Basis Inventory Estimates for Radioactive Components in Tank 241-S-101 Decayed to January 1, 1994 (Effective January 31, 1997).

Analyte	Total inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{3}H	273	M	
^{14}C	31.8	M	
^{59}Ni	9.22	M	
^{60}Co	<493	S	
^{63}Ni	877	M	
^{79}Se	5.18	M	
^{90}Sr	525,000	S	
^{90}Y	525,000	S	From ^{90}Sr
^{93}Zr	25.0	M	
^{93m}Nb	19.2	M	
^{99}Tc	229	M	
^{106}Ru	0.00608	M	
^{113m}Cd	86.6	M	
^{125}Sb	142	M	
^{126}Sn	7.89	M	
^{129}I	0.440	M	
^{134}Cs	2.69	M	
^{137}Cs	291,000	S	
^{137m}Ba	275,000	S	From ^{137}Cs
^{151}Sm	18,400	M	
^{152}Eu	8.50	M	
^{154}Eu	575	M	
^{155}Eu	448	M	
^{226}Ra	6.48E-04	M	
^{227}Ac	0.00330	M	
^{228}Ra	0.108	M	
^{229}Th	0.00255	M	

Best-Basis Inventory Estimates for Radioactive Components in Tank 241-S-101 Decayed to January 1, 1994 (Effective January 31, 1997).

Analyte	Total inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{231}Pa	0.00703	M	
^{232}Th	0.00697	M	
^{232}U	0.559	M	
^{233}U	2.14	M	
^{234}U	2.72	M	
^{235}U	0.114	M	
^{236}U	0.0738	M	
^{237}Np	0.873	M	
^{238}Pu	6.94	M	
^{238}U	2.73	M	
^{239}Pu	404	M	
^{240}Pu	59.0	M	
^{241}Am	87.1	M	
^{241}Pu	405	M	
^{242}Cm	0.172	M	
^{242}Pu	0.00190	M	
^{243}Am	0.00285	M	
^{243}Cm	0.0120	M	
^{244}Cm	0.107	M	

[1]S = Sample-based
M = Hanford Defined Waste model-based (Agnew et al. 1997)
E = Engineering assessment-based.

Best-Basis Inventory Estimates for Radioactive Components in Tank 241-S-102 Decayed to January 1, 1994 (Effective January 31, 1997).

Analyte	Total inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{3}H	241	M	
^{14}C	34.2	M	
^{59}Ni	2.43	M	
^{60}Co	37.6	M	
^{63}Ni	237	M	
^{79}Se	3.41	M	
^{90}Sr	310,000	E	
^{90}Y	310,000	E	From ^{90}Sr
^{93}Zr	16.7	M	
^{93m}Nb	12.1	M	
^{99}Tc	244	M	
^{106}Ru	0.00664	M	
^{113m}Cd	87.4	M	
^{125}Sb	161	M	
^{126}Sn	5.15	M	
^{129}I	0.470	M	
^{134}Cs	2.48	M	
^{137}Cs	443,000	E	
^{137m}Ba	418,000	E	From ^{137}Cs
^{151}Sm	12,000	M	
^{152}Eu	3.95	M	
^{154}Eu	611	M	
^{155}Eu	232	M	
^{226}Ra	1.61 E-04	M	
^{227}Ac	9.85 E-04	M	
^{228}Ra	0.131	M	
^{229}Th	0.00307	M	
^{231}Pa	0.00420	M	

Best-Basis Inventory Estimates for Radioactive Components in Tank 241-S-102 Decayed to January 1, 1994 (Effective January 31, 1997).

Analyte	Total inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{232}Th	0.00869	M	
^{232}U	0.680	M	
^{233}U	2.61	M	
^{234}U	0.809	M	
^{235}U	0.0329	M	
^{236}U	0.0252	M	
^{237}Np	0.897	M	
^{238}Pu	1.47	M	
^{238}U	0.925	M	
^{239}Pu	54.2	M	
^{240}Pu	8.98	M	
^{241}Am	57.4	M	
^{241}Pu	98.4	M	
^{242}Cm	0.147	M	
^{242}Pu	5.34 E-04	M	
^{243}Am	0.00197	M	
^{243}Cm	0.0134	M	
^{244}Cm	0.133	M	

[1]S = Sample-based
M = Hanford Defined Waste model-based (Agnew et al. 1997)
E = Engineering assessment-based.

Best-Basis Inventory Estimates for Radioactive Components in Tank 241-S-103 Decayed to January 1, 1994 (Effective May 31, 1997).

Analyte	Total inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{3}H	254	M	
^{14}C	36.5	M	
^{59}Ni	2.86	M	
^{60}Co	40.4	M	
^{63}Ni	278	M	
^{79}Se	3.64	M	
^{90}Sr	143,000	E	
^{90}Y	143,000	E	Referenced to ^{90}Sr
^{93}Zr	17.8	M	
^{93m}Nb	13.0	M	
^{99}Tc	260	M	
^{106}Ru	0.00717	M	
^{113m}Cd	93.4	M	
^{125}Sb	173	M	
^{126}Sn	5.49	M	
^{129}I	0.501	M	
^{134}Cs	2.74	M	
^{137}Cs	195,000	E	
^{137m}Ba	184,000	E	Referenced to ^{137}Cs
^{151}Sm	12,800	M	
^{152}Eu	4.41	M	
^{154}Eu	655	M	
^{155}Eu	258	M	
^{226}Ra	1.92 E-04	M	
^{227}Ac	0.00114	M	
^{228}Ra	0.151	M	
^{229}Th	0.00354	M	
^{231}Pa	0.00452	M	

Best-Basis Inventory Estimates for Radioactive Components in Tank 241-S-103 Decayed to January 1, 1994 (Effective May 31, 1997).

Analyte	Total inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{232}Th	0.010	M	
^{232}U	0.776	M	
^{233}U	2.97	M	
^{234}U	0.876	M	
^{235}U	0.0356	M	
^{236}U	0.0274	M	
^{237}Np	0.952	M	
^{238}Pu	1.70	M	
^{238}U	1.01	M	
^{239}Pu	66.8	M	
^{240}Pu	10.9	M	
^{241}Am	61.8	M	
^{241}Pu	113	M	
^{242}Cm	0.164	M	
^{242}Pu	6.10 E-04	M	
^{243}Am	0.00214	M	
^{243}Cm	0.0148	M	
^{244}Cm	0.145	M	

[1]S = Sample-based
M = Hanford Defined Waste model-based (Agnew et al. 1996)
E = Engineering assessment-based.

Best-Basis Inventory Estimates for Radioactive Components in Tank 241-S-106 Decayed to January 1, 1994 (Effective May 31, 1997).

Analyte	Total inventory (Ci)	Basis (S, M, or E)[a]	Comment
^{3}H	478	M	
^{14}C	58.4	M	
^{59}Ni	3.82	M	
^{60}Co	59.9	M	
^{63}Ni	372	M	
^{79}Se	6.05	M	
^{90}Sr	322,000	E	
^{90}Y	322,000	E	Based on ^{90}Sr activity
^{93}Zr	29.6	M	
^{93m}Nb	21.8	M	
^{99}Tc	418	M	
^{106}Ru	0.00981	M	
^{113}Cd	149	M	
^{125}Sb	246	M	
^{126}Sn	9.15	M	
^{129}I	0.805	M	
^{134}Cs	2.92	M	
^{137}Cs	458,000	E	
^{137}Ba	433,000	E	Based on 0.946 of ^{137}Cs activity
^{151}Sm	21,300	M	
^{152}Eu	5.34	M	
^{154}Eu	978	M	
^{155}Eu	306	M	
^{226}Ra	2.67 E-04	M	
^{227}Ac	0.00161	M	
^{228}Ra	0.0874	M	
^{229}Th	0.00209	M	
^{231}Pa	0.00724	M	

Best-Basis Inventory Estimates for Radioactive Components in Tank 241-S-106 Decayed to January 1, 1994 (Effective May 31, 1997).

Analyte	Total inventory (Ci)	Basis (S, M, or E)[a]	Comment
^{232}Th	0.00603	M	
^{232}U	0.547	M	
^{233}U	2.10	M	
^{234}U	3.16	M	
^{235}U	0.132	M	
^{236}U	0.0799	M	
^{237}Np	1.64	M	
^{238}Pu	5.04	M	
^{238}U	3.15	M	
^{239}Pu	267	M	
^{240}Pu	39.4	M	
^{241}Am	980	M	
^{241}Pu	300	M	
^{242}Cm	0.185	M	
^{242}Pu	0.00143	M	
^{243}Am	0.00296	M	
^{243}Cm	0.0166	M	
^{244}Cm	0.186	M	

[a]S = Sample-based
M = Hanford Defined Waste model-based, Agnew et al. (1997)
E = Engineering assessment-based.

Best-Basis Inventory Estimates for Radioactive Components in Tank 241-S-107 Decayed to January 1, 1994 (Effective May 31, 1997).

Analyte	Total inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{3}H	99.9	M	
^{14}C	13.1	M	
^{59}Ni	6.28	M	
^{60}Co	317	S	
^{63}Ni	591	M	
^{79}Se	1.74	M	
^{90}Sr	404,000	S	
^{90}Y	404,000	S	Referenced to ^{90}Sr
^{93}Zr	8.47	M	
^{93m}Nb	6.35	M	
^{99}Tc	93.0	M	
^{106}Ru	0.0036	M	
^{113m}Cd	36.9	M	
^{125}Sb	60.6	M	
^{126}Sn	2.65	M	
^{129}I	0.179	M	
^{134}Cs	1.46	M	
^{137}Cs	214,000	S	
^{137m}Ba	203,000	S	Referenced to ^{137}Cs
^{151}Sm	6,160	M	
^{152}Eu	4.91	M	
^{154}Eu	247	M	
^{155}Eu	252	M	
^{226}Ra	4.51 E-04	M	
^{227}Ac	0.00212	M	
^{228}Ra	0.0453	M	
^{229}Th	0.00106	M	
^{231}Pa	0.00224	M	
^{232}Th	0.00301	M	
^{232}U	0.235	M	

Best-Basis Inventory Estimates for Radioactive Components in Tank 241-S-107 Decayed to January 1, 1994 (Effective May 31, 1997).

Analyte	Total inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{233}U	0.895	M	
^{234}U	14.9	M	
^{235}U	0.587	M	
^{236}U	0.767	M	
^{237}Np	0.358	M	
^{238}Pu	71.6	M	
^{238}U	11.9	M	
$^{239/240}Pu$	2,200	S	
^{241}Am	30.9	M	
^{241}Pu	3,910	M	
^{242}Cm	0.151	M	
^{242}Pu	0.0223	M	
^{243}Am	0.00119	M	
^{243}Cm	0.0110	M	
^{244}Cm	0.152	M	

[1]S = Sample-based
M = Hanford Defined Waste model-based (Agnew et al. 1997)
E = Engineering assessment-based.

Best-Basis Inventory Estimates for Radioactive Components in Tank 241-S-109 (11/9/96).

Analyte	Total Inventory (Ci)	Basis (S, M, or E)[1,2]	Comments
^{3}H	490	M	
^{14}C	63.8	M	
^{59}Ni	4.28	M	
^{60}Co	65.2	M	
^{63}Ni	416	M	
^{79}Se	6.54	M	
^{90}Sr	2.75 E+05	E	Based on calculations from dome space temperatures
^{90}Y	2.75E+05	E	
^{93}Zr	31.9	M	
^{93m}Nb	23.6	M	
^{99}Tc	454	M	
^{106}Ru	1.02E-02	M	
^{113m}Cd	157	M	
^{125}Sb	269	M	
^{126}Sn	9.90	M	
^{129}I	0.875	M	
^{134}Cs	2.86	M	
^{137}Cs	1.06 E+05	E	Based on calculations from dome space temperatures
^{137m}Ba	1.00E+05	E	
^{151}Sm	2.31E+04	M	
^{152}Eu	5.84	M	
^{154}Eu	1.04E+03	M	
^{155}Eu	336	M	
^{226}Ra	3.01E-04	M	
^{227}Ac	1.82E-03	M	
^{228}Ra	0.111	M	
^{229}Th	2.65E-03	M	
^{231}Pa	8.07E-03	M	

Best-Basis Inventory Estimates for Radioactive Components in Tank 241-S-109 (11/9/96).

Analyte	Total Inventory (Ci)	Basis (S, M, or E)[1,2]	Comments
^{232}Th	7.51E-03	M	
^{232}U	0.676	M	
^{233}U	2.59	M	
^{234}U	2.30	M	
^{235}U	9.60E-02	M	
^{236}U	6.11E-02	M	
^{237}Np	1.78	M	
^{238}Pu	3.46	M	
^{238}U	2.35	M	
^{239}Pu	161	M	
^{240}Pu	24.7	M	
^{241}Am	106	M	
^{241}Pu	2.16	M	
^{242}Cm	0.210	M	
^{242}Pu	1.09E-03	M	
^{243}Am	3.05E-03	M	
^{243}Cm	1.89E-02	M	
^{244}Cm	0.208	M	

Notes:

[1]S = Sample-based
M = Hanford Defined Waste model-based
E = Engineering assessment-based
NR = Not reported

[2]Sample data were not used because sample recovery was poor and samples were obtained from only the upper portion of the tank (see Appendix B). Model estimates taken from Agnew (1997).

Best-Basis Inventory Estimates for Radioactive Components in Tank 241-S-111.[1]

Analyte	Total Inventory (Ci)	Basis (S, M, or E)[2]	Analyte	Total Inventory (Ci)	Basis (S, M, or E)[2]
^{3}H	556	M	^{226}Ra	5.80E-04	M
^{14}C	71.5	M	^{228}Ra	0.154	M
^{59}Ni	8.27	M	^{227}Ac	3.08E-03	M
^{60}Co	74.9	M	^{231}Pa	8.81E-03	M
^{63}Ni	791	M	^{229}Th	3.66E-03	M
^{79}Se	7.29	M	^{232}Th	0.0108	M
^{90}Sr	51,200	S	^{232}U	0.869	M
^{90}Y	51,200	S	^{233}U	3.33	M
^{93}Zr	35.7	M	^{234}U	2.32	M
^{93m}Nb	26.2	M	^{235}U	0.0964	M
^{99}Tc	511	M	^{236}U	0.0640	M
^{106}Ru	0.0125	M	^{238}U	2.42	M
^{113m}Cd	182	M	^{237}Np	1.96	M
^{125}Sb	313	M	^{238}Pu	5.34	M
^{126}Sn	11.0	M	^{239}Pu	281	M
^{129}I	0.984	M	^{240}Pu	42.2	M
^{134}Cs	3.91	M	^{241}Pu	332	M
^{137}Cs	4.18E+05	S	^{242}Pu	1.65E-03	M
^{137m}Ba	3.96E+05	S	^{241}Am	2,530	E
^{151}Sm	7.29	M	^{243}Am	3.75E-03	M
^{152}Eu	8.64	M	^{242}Cm	0.287	M
^{154}Eu	1220	M	^{243}Cm	0.0234	M
^{155}Eu	482	M	^{244}Cm	0.243	M

Notes:

[1]Radionuclides decayed to January 1, 1994.

[2]S = sample-based, M = HDW model-based, E = engineering assessment-based

Best-Basis Inventory Estimates for Radioactive Components in Tank 241-S-112, decayed to January 1, 1994 (effective January 31, 1997)

Analyte	Total inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{3}H	523	M	
^{14}C	66.8	M	
^{59}Ni	4.73	M	
^{60}Co	67.5	M	
^{63}Ni	458	M	
^{79}Se	6.97	M	
^{90}Sr	340,000	E	
^{90}Y	340,000	E	Referenced to ^{90}Sr
^{93}Zr	34	M	
^{93m}Nb	25.2	M	
^{99}Tc	476	M	
^{106}Ru	0.0104	M	
^{113m}Cd	166	M	
^{125}Sb	277	M	
^{126}Sn	10.6	M	
^{129}I	0.917	M	
^{134}Cs	3.11	M	
^{137}Cs	582,000	E	
^{137m}Ba	551,000	E	Referenced to ^{137}Cs
^{151}Sm	24,600	M	
^{152}Eu	6.18	M	
^{154}Eu	1,080	M	
^{155}Eu	354	M	
^{226}Ra	3.38 E-04	M	
^{227}Ac	0.00202	M	
^{228}Ra	0.118	M	
^{229}Th	0.0028	M	
^{231}Pa	0.00867	M	

Best-Basis Inventory Estimates for Radioactive Components in Tank 241-S-112, decayed to January 1, 1994 (effective January 31, 1997)

Analyte	Total inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{232}Th	0.00793	M	
^{232}U	0.71	M	
^{233}U	2.72	M	
^{234}U	1.87	M	
^{235}U	0.0776	M	
^{236}U	0.052	M	
^{237}Np	1.89	M	
^{238}Pu	2.68	M	
^{238}U	1.94	M	
^{239}Pu	111	M	
^{240}Pu	17.6	M	
^{241}Am	113	M	
^{241}Pu	173	M	
^{242}Cm	0.219	M	
^{242}Pu	9.14 E-04	M	
^{243}Am	0.00315	M	
^{243}Cm	0.0194	M	
^{244}Cm	0.213	M	

[1]S = Sample-based
M = Hanford Defined Waste model-based, Agnew et al. (1997)
E = Engineering assessment-based.

Best-Basis Inventory Estimates for Radioactive Components in Tank 241-U-103, Decayed to January 1, 1994 (Effective May 31, 1997).

Analyte	Total inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{3}H	427	M	
^{14}C	92.7	M	
^{59}Ni	4.09	M	
^{60}Co	69.6	M	
^{63}Ni	401	M	
^{79}Se	6.23	M	
^{90}Sr	311,000	E	
^{90}Y	311,000	E	Referenced to ^{90}Sr
^{93}Zr	30.6	M	
^{93m}Nb	22.2	M	
^{99}Tc	444	M	
^{106}Ru	0.0126	M	
^{113m}Cd	161	M	
^{125}Sb	301	M	
^{126}Sn	9.42	M	
^{129}I	0.856	M	
^{134}Cs	5.09	M	
^{137}Cs	411,000	E	
^{137m}Ba	389,000	E	Referenced to ^{137}Cs
^{151}Sm	21,900	M	
^{152}Eu	7.46	M	
^{154}Eu	1,130	M	
^{155}Eu	443	M	
^{226}Ra	2.84 E-04	M	
^{227}Ac	0.00175	M	
^{228}Ra	0.292	M	
^{229}Th	0.00683	M	
^{231}Pa	0.00784	M	
^{232}Th	0.0192	M	
^{232}U	1.49	M	

Best-Basis Inventory Estimates for Radioactive Components in Tank 241-U-103, Decayed to January 1, 1994 (Effective May 31, 1997).

Analyte	Total inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{233}U	5.71	M	
^{234}U	18.2	M	
^{235}U	0.811	M	
^{236}U	0.155	M	
^{237}Np	1.61	M	
^{238}Pu	2.60	M	
^{238}U	18.7	M	
^{239}Pu	61	M	
^{240}Pu	15.1	M	
^{241}Am	1,910	E	
^{241}Pu	176	M	
^{242}Cm	0.285	M	
^{242}Pu	9.67 E-04	M	
^{243}Am	0.00379	M	
^{243}Cm	0.0264	M	
^{244}Cm	0.257	M	

[1]S = Sample-based
M = Hanford Defined Waste model-based (Agnew et al. 1997a)
E = Engineering assessment-based.

Best-Basis Inventory Estimate for Nonradioactive Components in Tank 241-U-105 (Effective January 31, 1997).

Analyte	Total inventory (kg)	Basis (S, M, or C)[1]	Comment
Zr	84.9	S	%Mean RSD=31.7

[1]S = Sample-based
M = Hanford Defined Waste model-based (Agnew 1996)
C = Calculated by charge balance; includes oxides as hydroxides, not including CO_3, NO_2, NO_3, PO_4, SO_4, and SiO_3.

Best-Basis Inventory Estimate for Radioactive Components in Tank 241-U-105 Decayed to January 1, 1994 (Effective January 31, 1997).

Analyte	Total inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{3}H	427	M	
^{14}C	62.9	M	
^{59}Ni	4.08	M	
^{60}Co	70.1	M	
^{63}Ni	400	M	
^{79}Se	6.25	M	
^{90}Sr	154,000	S	%Mean RSD=9.24
^{90}Y	154,000	S	Equilibrium value with ^{90}Sr
^{93m}Nb	22.2	M	
^{93}Zr	30.7	M	
^{99}Tc	446	M	
^{106}Ru	0.0127	M	
^{113m}Cd	161	M	
^{125}Sb	303	M	
^{126}Sn	9.44	M	
^{129}I	0.86	M	
^{134}Cs	5.09	M	
^{137m}Ba	383,000	S	Equilibrium value with ^{137}Cs
^{137}Cs	404,500	S	%Mean RSD=7.37
^{151}Sm	22,000	M	

Best-Basis Inventory Estimate for Radioactive Components in Tank 241-U-105 Decayed to January 1, 1994 (Effective January 31, 1997).

Analyte	Total inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{152}Eu	7.5	M	
^{154}Eu	1,140	M	
^{155}Eu	445	M	
^{226}Ra	2.84 E-04	M	
^{227}Ac	0.00174	M	
^{228}Ra	0.29	M	
^{229}Th	0.00679	M	
^{231}Pa	0.00783	M	
^{232}Th	0.0192	M	
^{232}U	1.47	M	
^{233}U	5.65	M	
^{234}U	18.2	M	
^{235}U	0.81	M	
^{236}U	0.154	M	
^{237}Np	1.61	M	
^{238}Pu	2.61	M	
^{238}U	18.7	M	
^{239}Pu	89.5	M	
^{240}Pu	15.2	M	
^{241}Am	107	M	
^{241}Pu	177	M	
^{242}Cm	0.287	M	
^{242}Pu	9.74 E-04	M	
^{243}Am	0.00382	M	
^{243}Cm	0.0266	M	
^{244}Cm	0.259	M	

[1]S = Sample-based
M = Hanford Defined Waste model-based
E = Engineering assessment-based
NR = Not reported.

Table D4-2. Best-Basis Inventory Estimates for Radioactive Components in Tank 241-U-106 (January 31, 1997). (Decayed to January 1, 1994)

Analyte	Total Inventory (Ci)	Basis (S, M, or E)[1,2]	Comment
^{229}Th	3.91E-03	M	
^{231}Pa	4.97E-03	M	
^{232}Th	1.18E-02	M	
^{232}U	0.830	M	
^{233}U	3.18	M	
^{234}U	14.4	M	
^{235}U	0.645	M	
^{236}U	0.115	M	
^{237}Np	1.07	M	
^{238}Pu	1.71	M	
^{238}U	14.8	M	
^{239}Pu	57.0	M	
^{240}Pu	9.74	M	
^{241}Am	<2,280	S	
^{241}Pu	1.17	M	
^{242}Cm	0.186	M	
^{242}Pu	6.44E-04	M	
^{243}Am	2.56E-03	M	
^{243}Cm	1.74E-02	M	
^{244}Cm	0.172	M	

[1]S = Sample-based
M = Hanford Defined Waste model-based
E = Engineering assessment-based

[2]For more information about the origin and quality of the sample-based numbers in this table, refer to Appendix B, Section B6.0. For more information about the model-based numbers in this table refer to Agnew et al. (1997)

Best-Basis Inventory Estimates for Radioactive Components in Tank 241-U-106 (January 31, 1997). (Decayed to January 1, 1994)

Analyte	Total Inventory (Ci)	Basis (S, M, or E)[1,2]	Comment
^{3}H	279	M	
^{14}C	42.0	M	
^{59}Ni	2.57	M	
^{60}Co	182	S	
^{63}Ni	252	M	
^{79}Se	4.07	M	
^{90}Sr	1.06E+05	S	
^{90}Y	1.06E+05	S	Based on ^{90}Sr
^{93}Zr	19.9	M	
^{93m}Nb	14.5	M	
^{99}Tc	297	M	
^{106}Ru	8.63	M	
^{113m}Cd	105	M	
^{125}Sb	205	M	
^{126}Sn	6.15	M	
^{129}I	0.574	M	
^{134}Cs	3.00	M	
^{137}Cs	2.15E+05	S	
^{137m}Ba	2.00E+05	S	Based on ^{137}Cs
^{151}Sm	14,300	M	
^{152}Eu	4.86	M	
^{154}Eu	759	S	
^{155}Eu	288	S	
^{226}Ra	1.82E-04	M	
^{227}Ac	1.10E-03	M	
^{228}Ra	0.166	M	

Best-Basis Inventory Estimate for Radioactive Components in Tank 241-U-107 Decayed to January 1, 1994 (Effective January 31, 1997).

Analyte	Total inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{3}H	335	M	
^{14}C	48.3	M	
^{59}Ni	3.13	M	
^{60}Co	<41.6	S	
^{63}Ni	307	M	
^{79}Se	4.8	M	
^{90}Sr	57.2	S	
^{90}Y	57.2	S	In equilibrium with ^{90}Sr
^{93m}Nb	17.1	M	
^{93}Zr	23.6	M	
^{99}Tc	344	M	
^{106}Ru	0.00952	M	
^{113m}Cd	124	M	
^{125}Sb	230	M	
^{126}Sn	7.25	M	
^{129}I	0.664	M	
^{134}Cs	3.65	M	
^{137m}Ba	206,000	S	In equilibrium with ^{137}Cs
^{137}Cs	218,000	S	
^{151}Sm	16,900	M	
^{152}Eu	5.6	M	
^{154}Eu	<190	S	
^{155}Eu	<815	S	
^{226}Ra	2.06 E-04	M	
^{227}Ac	0.0013	M	
^{228}Ra	0.201	M	
^{229}Th	0.00472	M	
^{231}Pa	0.00596	M	

Best-Basis Inventory Estimate for Radioactive Components in Tank 241-U-107 Decayed to January 1, 1994 (Effective January 31, 1997).

Analyte	Total inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{232}Th	0.0134	M	
^{232}U	1.03	M	
^{233}U	3.96	M	
^{234}U	5.41	M	
^{235}U	0.228	M	
^{236}U	0.13	M	
^{237}Np	1.26	M	
^{238}Pu	9.18	M	
^{238}U	5.49	M	
$^{239/240}Pu$	0.0059	S	
^{241}Am	<1,360	S	
^{241}Pu	531	M	
^{242}Cm	0.211	M	
^{242}Pu	0.00242	M	
^{243}Am	0.00283	M	
^{243}Cm	0.0195	M	
^{244}Cm	0.192	M	

[1]S = Sample-based
M = Hanford Defined Waste model-based, Agnew et al. (1997)
E = Engineering assessment-based.

Best-Basis Inventory Estimate for Radioactive Components in Tank 241-U-108 Decayed to January 1, 1994 (Effective May 31, 1997).

Analyte	Total Inventory (Ci)	Basis (S,M or E)[1]	Comment
^{14}C	76.3	M	
^{59}Ni	4.7	M	
^{60}Co	< 61.5	S	Average solid segment data
^{63}Ni	462	M	
^{79}Se	7.31	M	
^{90}Sr	29,400	S	Average solid segment data
^{90}Y	29,400	S	Based on ^{90}Sr
^{93m}Nb	26	M	
^{93}Zr	35.9	M	
^{99}Tc	542	M	
^{106}Ru	0.0151	M	
^{113m}Cd	190	M	
^{125}Sb	368	M	
^{126}Sn	11.1	M	
^{129}I	1.05	M	
^{134}Cs	5.17	M	
^{137m}Ba	390,000	S	Based on ^{137}Cs
^{137}Cs	411,000	S	Average core segment data
^{151}Sm	25,700	M	
^{152}Eu	8.68	M	
^{154}Eu	< 241	S	Average core segment data
^{155}Eu	< 884	S	Average core segment data
^{226}Ra	3.04 E-04	M	
^{227}Ac	0.00192	M	
^{228}Ra	0.269	M	
^{229}Th	0.00634	M	
^{231}Pa	0.0089	M	
^{232}Th	0.0183	M	
^{232}U	1.4	M	
^{233}U	5.39	M	
^{234}U	8.72	M	
^{235}U	0.346	M	
^{236}U	0.423	M	

Best-Basis Inventory Estimate for Radioactive Components in Tank 241-U-108 Decayed to January 1, 1994 (Effective May 31, 1997).

Analyte	Total Inventory (Ci)	Basis (S,M or E)[1]	Comment
^{237}Np	1.96	M	
^{238}Pu	21.5	M	
^{238}U	7.33	M	
^{239}Pu	615	M	
^{240}Pu	102	M	
^{241}Am	< 1,930	S	Average core segment data
^{241}Pu	962	M	
^{242}Cm	0.328	M	
^{242}Pu	0.00314	M	
^{243}Am	0.00438	M	
^{243}Cm	0.0305	M	
^{244}Cm	0.303	M	

[1]S=Sample-based
M=Hanford Defined Waste model-based
E=Engineering assessment-based

Best-Basis Inventory Estimates for Radioactive Components in Tank 241-U-109, Decayed to January 1, 1994 (Effective May 31, 1997).

Analyte	Total inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{3}H	559	M	
^{14}C	82.6	M	
^{59}Ni	5.14	M	
^{60}Co	504	M	
^{63}Ni	92.2	M	
^{79}Se	8.06	M	
^{90}Sr	82,400	E	
^{90}Y	82,400	E	Determined from ^{90}Sr value.
^{93}Zr	39.5	M	
^{93m}Nb	28.7	M	
^{99}Tc	586	M	
^{106}Ru	0.0167	M	
^{113m}Cd	209	M	
^{125}Sb	399	M	
^{126}Sn	12.2	M	
^{129}I	1.13	M	
^{134}Cs	6.04	M	
^{137}Cs	339,000	E	
^{137m}Ba	321,000	E	Determined from ^{137}Cs value.
^{151}Sm	28,400	M	
^{152}Eu	9.6	M	
^{154}Eu	1,490	M	
^{155}Eu	569	M	
^{226}Ra	3.46 E-04	M	
^{227}Ac	2.14 E-03	M	
^{228}Ra	0.280	M	
^{229}Th	6.62 E-03	M	
^{231}Pa	9.79 E-03	M	

Best-Basis Inventory Estimates for Radioactive Components in Tank 241-U-109, Decayed to January 1, 1994 (Effective May 31, 1997).

Analyte	Total inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{3}H	559	M	
^{14}C	82.6	M	
^{59}Ni	5.14	M	
^{60}Co	504	M	
^{63}Ni	92.2	M	
^{79}Se	8.06	M	
^{90}Sr	82,400	E	
^{90}Y	82,400	E	Determined from ^{90}Sr value.
^{93}Zr	39.5	M	
^{93m}Nb	28.7	M	
^{99}Tc	586	M	
^{106}Ru	0.0167	M	
^{113m}Cd	209	M	
^{125}Sb	399	M	
^{126}Sn	12.2	M	
^{129}I	1.13	M	
^{134}Cs	6.04	M	
^{137}Cs	339,000	E	
^{137m}Ba	321,000	E	Determined from ^{137}Cs value.
^{151}Sm	28,400	M	
^{152}Eu	9.6	M	
^{154}Eu	1,490	M	
^{155}Eu	569	M	
^{226}Ra	3.46 E-04	M	
^{227}Ac	2.14 E-03	M	
^{228}Ra	0.280	M	
^{229}Th	6.62 E-03	M	
^{231}Pa	9.79 E-03	M	

Best-Basis Inventory Estimates for Radioactive Components in Tank 241-U-111 Decayed to January 1, 1994 (Effective May 31, 1997).

Analyte	Total inventory (Ci)	Basis (S, M, or E)[a]	Comment
^{3}H	227	M	
^{14}C	32.3	M	
^{59}Ni	2.82	M	
^{60}Co	35.6	M	
^{63}Ni	273	M	
^{79}Se	3.24	M	
^{90}Sr	221,100	E	
^{90}Y	221,000	E	Based on ^{90}Sr activity.
^{93}Zr	15.9	M	
^{93m}Nb	11.6	M	
^{99}Tc	230	M	
^{106}Ru	0.00633	M	
^{113m}Cd	83	M	
^{125}Sb	153	M	
^{126}Sn	4.9	M	
^{129}I	0.444	M	
^{134}Cs	2.46	M	
^{137}Cs	248,000	E	
^{137m}Ba	234,000	E	Based on 0.946 times ^{137}Cs activity.
^{151}Sm	11,400	M	
^{152}Eu	4.05	M	
^{154}Eu	580	M	
^{155}Eu	235	M	
^{226}Ra	1.91 E-04	M	
^{227}Ac	0.0011	M	
^{228}Ra	0.128	M	
^{229}Th	0.00301	M	

Best-Basis Inventory Estimates for Radioactive Components in Tank 241-U-111 Decayed to January 1, 1994 (Effective May 31, 1997).

Analyte	Total inventory (Ci)	Basis (S, M, or E)[a]	Comment
^{231}Pa	0.00402	M	
^{232}Th	0.00852	M	
^{232}U	0.664	M	
^{233}U	2.55	M	
^{234}U	1.56	M	
^{235}U	0.0668	M	
^{236}U	0.0291	M	
^{237}Np	0.845	M	
^{238}Pu	1.64	M	
^{238}U	1.69	M	
^{239}Pu	69.0	M	
^{240}Pu	11	M	
^{241}Am	54.9	M	
^{241}Pu	108	M	
^{242}Cm	0.148	M	
^{242}Pu	5.75 E-4	M	
^{243}Am	0.00189	M	
^{243}Cm	0.0131	M	
^{244}Cm	0.128	M	

[a]S = Sample-based
M = Hanford Defined Waste model-based, Agnew et al. (1997)
E = Engineering assessment-based.

Best-Basis Inventory Estimates for Radioactive Components inTank 241-T-104
Decayed to January 1, 1994 Effective 5/12/99

Analyte	Total Inventory Ci	Basis	Comments
3H	2.73E+00	M	
14C	9.71E-02	S/E	Upper bounding estimate
59Ni	7.22E-02	M	
60Co	3.42E-01	M	
63Ni	6.64E+00	M	
79Se	6.80E-02	M	
90Sr	5.51E+03	S	Method/sample prep: (RA/ Fusion)
90Y	5.51E+03	C	Based on 90Sr
93Zr	3.27E-01	M	
93mNb	2.60E-01	M	
99Tc	1.25E+00	S	Method/sample prep: (RA/ Water)
106Ru	5.67E-05	M	
113mCd	1.17E+00	M	
125Sb	1.34E+00	M	
126Sn	1.03E-01	M	
129I	6.17E-03	M	
134Cs	2.40E-02	M	
137Cs	4.17E+02	S	Method/sample prep: (RA/ Fusion)
137mBa	3.95E+02	C	Based on 137Cs
151Sm	2.48E+02	M	
152Eu	9.11E-02	M	
154Eu	8.00E+00	S	Method/sample prep: (RA/ Fusion)
155Eu	6.20E+00	S	
226Ra	1.24E-05	M	
227Ac	6.45E-05	M	
228Ra	9.12E-04	M	
229Th	2.16E-05	M	
231Pa	1.57E-04	M	
232Th	6.00E-05	M	
232U	1.34E-04	C	Based on UTOTAL and HDW model isotopic ditribution
233U	4.68E-04	C	Based on UTOTAL and HDW model isotopic ditribution
234U	6.37E-01	C	Based on UTOTAL and HDW model isotopic ditribution
235U	2.84E-02	C	Based on UTOTAL and HDW model isotopic ditribution
236U	5.44E-03	C	Based on UTOTAL and HDW model isotopic ditribution
237Np	1.52E-02	M	Sample considered high
238Pu	2.02E+00	C	Based on 239Pu and HDW model isotopic distribution
238U	6.46E-01	C	Based on UTOTAL and HDW model isotopic ditribution
239Pu	2.77E+02	C	Based on 239/240Pu and HDW model isotopic ditribution
240Pu	2.52E+01	C	Based on 239/240Pu and HDW model isotopic ditribution
241Am	3.73E+01	S	Method/sample prep: (RA/ Fusion)
241Pu	8.49E+01	C	Based on 239Pu and HDW model isotopic distribution
242Cm	1.05E-01	C	Based on 241Am and HDW model radionuclide distribution.
242Pu	3.89E-04	C	Based on 239Pu and HDW model isotopic distribution
243Am	8.86E-04	C	Based on 241Am and HDW model radionuclide distribution.
243Cm	6.30E-03	C	Based on 241Am and HDW model radionuclide distribution.
244Cm	5.42E-02	C	Based on 241Am and HDW model radionuclide distribution.
Notes:	S = Sample-based		
	M = Hanford Defined Waste model-based (HDW model)		
	E = Engineering assessment- based		
	C = Calculated from other analyte data		

Best Basis Inventory Estimates for Radioactive Components in Tank 241-T-110
Decayed to January 1, 1994 Effective 5/31/98

Analyte	Total Inventory Ci	Basis	Comment
3H	4.94E-02	M/E	HDW TLM inventory only
14C	1.69E-02	M/E	HDW TLM inventory only
59Ni	4.80E-03	M/E	HDW TLM inventory only
60Co	3.24E-03	M/E	HDW TLM inventory only
63Ni	4.28E-01	M/E	HDW TLM inventory only
79Se	3.55E-03	M/E	HDW TLM inventory only
90Sr	9.18E+03	E	
90Y	9.18E+03	E	Based on 90Sr
93Zr	1.69E-02	M/E	HDW TLM inventory only
93mNb	1.44E-02	M/E	HDW TLM inventory only
99Tc	1.40E+01	E	
106Ru	9.78E-10	M/E	HDW TLM inventory only
113mCd	3.85E-02	M/E	HDW TLM inventory only
125Sb	2.64E-03	M/E	HDW TLM inventory only
126Sn	5.32E-03	M/E	HDW TLM inventory only
129I	2.19E-04	M/E	HDW TLM inventory only
134Cs	9.87E-05	M/E	HDW TLM inventory only
137Cs	2.81E+02	E	
137mBa	2.66E+02	E	Based on 137Cs
151Sm	1.33E+01	M/E	HDW TLM inventory only
152Eu	1.02E-02	M/E	HDW TLM inventory only
154Eu	5.40E-02	M/E	HDW TLM inventory only
155Eu	8.36E-01	M/E	HDW TLM inventory only
226Ra	1.19E-06	M/E	HDW TLM inventory only
227Ac	6.05E-06	M/E	HDW TLM inventory only
228Ra	4.76E-11	M/E	HDW TLM inventory only
229Th	9.22E-09	M/E	HDW TLM inventory only
231Pa	1.29E-05	M/E	HDW TLM inventory only
232Th	4.98E-12	M/E	HDW TLM inventory only
232U	2.33E-05	M/E	Based on total U
233U	1.28E-06	M/E	Based on total U
234U	1.63E+00	M/E	Based on total U
235U	7.32E-02	M/E	Based on total U
236U	1.17E-02	M/E	Based on total U
237Np	7.13E-04	M/E	HDW TLM inventory only
238Pu	1.20E+00	M/E	Based on 239/240Pu and HDW model isotopic distribution.
238U	1.66E+00	M/E	Based on total U
239Pu	2.30E+02	M/E	Calculated from 239/240Pu hybrid inventory of 247 Ci
240Pu	1.73E+01	M/E	Calculated from 239/240Pu hybrid inventory of 247 Ci
241Am	7.58E+01	E	
241Pu	3.92E+01	M/E	Based on 239/240Pu and HDW model isotopic distribution.
242Cm	6.05E-01	M/E	Based on 241Am and HDW model radionuclide distribution.
242Pu	1.72E-04	M/E	Based on 239/240Pu and HDW model isotopic distribution.
243Am	4.95E-04	M/E	Based on 241Am and HDW model radionuclide distribution.
243Cm	1.23E-02	M/E	Based on 241Am and HDW model radionuclide distribution.
244Cm	1.15E-02	M/E	Based on 241Am and HDW model radionuclide distribution.
Notes:	M = Hanford Defined Waste model-based (HDW model)		
	E = Engineering assessment- based		

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APPENDIX B

EMISSION AND DOSE CALCULATIONS--SALT WELL PUMPING UNDER PASSIVE VENTILATION

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EMISSION AND DOSE CALCULATIONS FOR SALT WELL PUMPING
PASSIVE VENTILATION

SALT WELL PUMPING-PASSIVE VENTILATION								
VENTILATION FLOW RATE	0.28	METER^3/MIN						
BREATHER HEPA EMISSION ADJUSTMENT FACTOR	1.00%	Per 40 CFR 61 APP D						
DOSE CONVERSION MREM/CURIE								
	200-EAST	200-WEST						
TOTAL ALPHA (Am-241)	13.1	7.79						
TOTAL BETA (Sr-90)	4.38E-02	2.60E-02						
Cs-137	2.39E-02	1.42E-02						
						UNABATED EMISSION		
TANK	LOCATION	TOTAL ALPHA pCi/LITER	TOTAL BETA pCi/LITER	Cs-137 pCi/LITER	ALPHA PER YEAR, Ci	BETA PER YEAR, Ci	Cs-137 PER YEAR, Ci	ALPHA PER YEAR, Ci
241-AX-101	200-EAST	0.24	1.09	0.1	3.53E-05	1.60E-04	1.47E-05	3.53E-07
241-BY-105	200-EAST	0.003	0.01	0.1	4.42E-07	1.47E-06	1.47E-05	4.42E-09
241-BY-106	200-EAST	0.01	0.03	0.1	1.47E-06	4.42E-06	1.47E-05	1.47E-08
241-S-101	200-WEST	0.258	1.99	26.9	3.80E-05	2.93E-04	3.96E-03	3.80E-07
241-S-102	200-WEST	0.37	1.07	0.5	5.45E-05	1.57E-04	7.36E-05	5.45E-07
241-S-103	200-WEST	0.86	8.12	23.9	1.27E-04	1.20E-03	3.52E-03	1.27E-06
241-S-106	200-WEST	0.609	2.06	28	8.96E-05	3.03E-04	4.12E-03	8.96E-07
241-S-107	200-WEST	2.91	2.63	32.4	4.28E-04	3.87E-04	4.77E-03	4.28E-06
241-S-109	200-WEST	0.058	0.32	0.25	8.54E-06	4.71E-05	3.68E-05	8.54E-08
241-S-111	200-WEST	0.5	0.8	0.1	7.36E-05	1.18E-04	1.47E-05	7.36E-07
241-S-112	200-WEST	12	13	0.1	1.77E-03	1.91E-03	1.47E-05	1.77E-05
241-T-104	200-WEST	0.07	0.32	0.1	1.03E-05	4.71E-05	1.47E-05	1.03E-07
241-T-110	200-WEST	0.06	0.09	0.1	8.83E-06	1.32E-05	1.47E-05	8.83E-08
241-U-103	200-WEST	0.21	0.01	0.1	3.09E-05	1.47E-06	1.47E-05	3.09E-07
241-U-105	200-WEST	0.02	0.08	0.1	2.94E-06	1.18E-05	1.47E-05	2.94E-08
241-U-106	200-WEST	0.15	0.17	0.5	2.21E-05	2.50E-05	7.36E-05	2.21E-07
241-U-107	200-WEST	0.005	0.05	0.1	7.36E-07	7.36E-06	1.47E-05	7.36E-09
241-U-108	200-WEST	0.03	0.16	0.1	4.42E-06	2.35E-05	1.47E-05	4.42E-08
241-U-109	200-WEST	0.22	0.31	0.1	3.24E-05	4.56E-05	1.47E-05	3.24E-07
241-U-111	200-WEST	0.05	0.2	0.1	7.36E-06	2.94E-05	1.47E-05	7.36E-08
TOTALS								

EMISSION AND DOSE CALCULATIONS FOR SALT WELL PUMPING
PASSIVE VENTILATION

	ABATED EMISSION			UNABATED DOSE				ABATED DOSE		
TANK	BETA PER YEAR, Ci	Cs PER YEAR, Ci	ALPHA PER YEAR, mrem	BETA PER YEAR, mrem	Cs-137 PER YEAR, mrem	TOTAL UNABATED PER YEAR, mrem	ALPHA PER YEAR, mrem	BETA PER YEAR, mrem	Cs-137 PER YEAR, mrem	TOTAL ABATED DOSE PER YEAR, mrem
241-AX-101	1.60E-06	1.47E-07	4.63E-04	7.03E-06	3.52E-07	**4.70E-04**	4.63E-06	7.03E-08	3.52E-09	**4.70E-06**
241-BY-105	1.47E-08	1.47E-07	5.78E-06	6.45E-08	3.52E-07	**6.20E-06**	5.78E-08	6.45E-10	3.52E-09	**6.20E-08**
241-BY-106	4.42E-08	1.47E-07	1.93E-05	1.93E-07	3.52E-07	**1.98E-05**	1.93E-07	1.93E-09	3.52E-09	**1.98E-07**
241-S-101	2.93E-06	3.96E-05	2.96E-04	7.61E-06	5.62E-05	**3.60E-04**	2.96E-06	7.61E-08	5.62E-07	**3.60E-06**
241-S-102	1.57E-06	7.36E-07	4.24E-04	4.09E-06	1.04E-06	**4.29E-04**	4.24E-06	4.09E-08	1.04E-08	**4.29E-06**
241-S-103	1.20E-05	3.52E-05	9.86E-04	3.11E-05	4.99E-05	**1.07E-03**	9.86E-06	3.11E-07	4.99E-07	**1.07E-05**
241-S-106	3.03E-06	4.12E-05	6.98E-04	7.88E-06	5.85E-05	**7.65E-04**	6.98E-06	7.88E-08	5.85E-07	**7.65E-06**
241-S-107	3.87E-06	4.77E-05	3.34E-03	1.01E-05	6.77E-05	**3.41E-03**	3.34E-05	1.01E-07	6.77E-07	**3.41E-05**
241-S-109	4.71E-07	3.68E-07	6.65E-05	1.22E-06	5.22E-07	**6.82E-05**	6.65E-07	1.22E-08	5.22E-09	**6.82E-07**
241-S-111	1.18E-06	1.47E-07	5.73E-04	3.06E-06	2.09E-07	**5.76E-04**	5.73E-06	3.06E-08	2.09E-09	**5.76E-06**
241-S-112	1.91E-05	1.47E-07	1.38E-02	4.97E-05	2.09E-07	**1.38E-02**	1.38E-04	4.97E-07	2.09E-09	**1.38E-04**
241-T-104	4.71E-07	1.47E-07	8.03E-05	1.22E-06	2.09E-07	**8.17E-05**	8.03E-07	1.22E-08	2.09E-09	**8.17E-07**
241-T-110	1.32E-07	1.47E-07	6.88E-05	3.44E-07	2.09E-07	**6.93E-05**	6.88E-07	3.44E-09	2.09E-09	**6.93E-07**
241-U-103	1.47E-08	1.47E-07	2.41E-04	3.83E-08	2.09E-07	**2.41E-04**	2.41E-06	3.83E-10	2.09E-09	**2.41E-06**
241-U-105	1.18E-07	1.47E-07	2.29E-05	3.06E-07	2.09E-07	**2.34E-05**	2.29E-07	3.06E-09	2.09E-09	**2.34E-07**
241-U-106	2.50E-07	7.36E-07	1.72E-04	6.50E-07	1.04E-06	**1.74E-04**	1.72E-06	6.50E-09	1.04E-08	**1.74E-06**
241-U-107	7.36E-08	1.47E-07	5.73E-06	1.91E-07	2.09E-07	**6.13E-06**	5.73E-08	1.91E-09	2.09E-09	**6.13E-08**
241-U-108	2.35E-07	1.47E-07	3.44E-05	6.12E-07	2.09E-07	**3.52E-05**	3.44E-07	6.12E-09	2.09E-09	**3.52E-07**
241-U-109	4.56E-07	1.47E-07	2.52E-04	1.19E-06	2.09E-07	**2.54E-04**	2.52E-06	1.19E-08	2.09E-09	**2.54E-06**
241-U-111	2.94E-07	1.47E-07	5.73E-05	7.65E-07	2.09E-07	**5.83E-05**	5.73E-07	7.65E-09	2.09E-09	**5.83E-07**
										2.19E-04

APPENDIX C

EMISSION AND DOSE CALCULATIONS--SALT WELL PUMPING UNDER ACTIVE VENTILATION

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EMISSION AND DOSE CALCULATIONS FOR SALT WELL PUMPING-ACTIVE VENTILATION

SALT WELL PUMPING-ACTIVE VENTILATION								
VENTILATION FLOW RAT	34	METER^3/MIN						
# HEPA FILTERS IN SE	2							
HEPA FILTER EFFICIEN	99.95%							
DOSE CONVERSION MREM/CURIE								
	200-EAST	200-WEST						
TOTAL ALPHA (Am-241)	13.1	7.79						
TOTAL BETA (Sr-90)	4.38E-02	2.60E-02						
Cs-137	2.39E-02	1.42E-02						
						UNABATED		
TANK	LOCATION	TOTAL ALPHA pCi/LITER	TOTAL BETA pCi/LITER	Cs-137 pCi/LITER	ALPHA PER YEAR, Ci	BETA PER YEAR, Ci	Cs-137 PER YEAR, Ci	ALPHA PER YEAR, Ci
241-AX-101	200-EAST	0.24	1.09	0.1	4.29E-03	1.95E-02	1.79E-03	1.07E-09
241-BY-105	200-EAST	0.003	0.01	0.1	5.36E-05	1.79E-04	1.79E-03	1.34E-11
241-BY-106	200-EAST	0.01	0.03	0.1	1.79E-04	5.36E-04	1.79E-03	4.47E-11
241-S-101	200-WEST	0.258	1.99	26.9	4.61E-03	3.56E-02	4.81E-01	1.15E-09
241-S-102	200-WEST	0.37	1.07	0.5	6.61E-03	1.91E-02	8.94E-03	1.65E-09
241-S-103	200-WEST	0.86	8.12	23.9	1.54E-02	1.45E-01	4.27E-01	3.84E-09
241-S-106	200-WEST	0.609	2.06	28	1.09E-02	3.68E-02	5.00E-01	2.72E-09
241-S-107	200-WEST	2.91	2.63	32.4	5.20E-02	4.70E-02	5.79E-01	1.30E-08
241-S-109	200-WEST	0.058	0.32	0.25	1.04E-03	5.72E-03	4.47E-03	2.59E-10
241-S-111	200-WEST	0.5	0.8	0.1	8.94E-03	1.43E-02	1.79E-03	2.23E-09
241-S-112	200-WEST	12	13	0.1	2.14E-01	2.32E-01	1.79E-03	5.36E-08
241-T-104	200-WEST	0.07	0.32	0.1	1.25E-03	5.72E-03	1.79E-03	3.13E-10
241-T-110	200-WEST	0.06	0.09	0.1	1.07E-03	1.61E-03	1.79E-03	2.68E-10
241-U-103	200-WEST	0.21	0.01	0.1	3.75E-03	1.79E-04	1.79E-03	9.38E-10
241-U-105	200-WEST	0.02	0.08	0.1	3.57E-04	1.43E-03	1.79E-03	8.94E-11
241-U-106	200-WEST	0.15	0.17	0.5	2.68E-03	3.04E-03	8.94E-03	6.70E-10
241-U-107	200-WEST	0.005	0.05	0.1	8.94E-05	8.94E-04	1.79E-03	2.23E-11
241-U-108	200-WEST	0.03	0.16	0.1	5.36E-04	2.86E-03	1.79E-03	1.34E-10
241-U-109	200-WEST	0.22	0.31	0.1	3.93E-03	5.54E-03	1.79E-03	9.83E-10
241-U-111	200-WEST	0.05	0.2	0.1	8.94E-04	3.57E-03	1.79E-03	2.23E-10
TOTALS								

EMISSION AND DOSE CALCULATIONS FOR SALT WELL PUMPING-ACTIVE VENTILATION

	ABATED			UNABATED DOSE				ABATED DOSE		
Tank	BETA PER YEAR, Ci	Cs-137 PER YEAR, Ci	ALPHA PER YEAR, mrem	BETA PER YEAR, mrem	Cs-137 PER YEAR, mrem	TOTAL UNABATED PER YEAR, mrem	ALPHA PER YEAR, mrem	BETA PER YEAR, mrem	Cs-137 PER YEAR, mrem	TOTAL ABATED PER YEAR, mrem
241-AX-101	4.87E-09	4.47E-10	5.62E-02	8.53E-04	4.27E-05	5.71E-02	1.40E-08	2.13E-10	1.07E-11	1.43E-08
241-BY-105	4.47E-11	4.47E-10	7.02E-04	7.83E-06	4.27E-05	7.53E-04	1.76E-10	1.96E-12	1.07E-11	1.88E-10
241-BY-106	1.34E-10	4.47E-10	2.34E-03	2.35E-05	4.27E-05	2.41E-03	5.85E-10	5.87E-12	1.07E-11	6.02E-10
241-S-101	8.89E-09	1.20E-07	3.59E-02	9.25E-04	6.83E-03	4.37E-02	8.98E-09	2.31E-10	1.71E-09	1.09E-08
241-S-102	4.78E-09	2.23E-09	5.15E-02	4.97E-04	1.27E-04	5.21E-02	1.29E-08	1.24E-10	3.17E-11	1.30E-08
241-S-103	3.63E-08	1.07E-07	1.20E-01	3.77E-03	6.06E-03	1.30E-01	2.99E-08	9.43E-10	1.52E-09	3.24E-08
241-S-106	9.20E-09	1.25E-07	8.48E-02	9.57E-04	7.11E-03	9.28E-02	2.12E-08	2.39E-10	1.78E-09	2.32E-08
241-S-107	1.17E-08	1.45E-07	4.05E-01	1.22E-03	8.22E-03	4.15E-01	1.01E-07	3.05E-10	2.06E-09	1.04E-07
241-S-109	1.43E-09	1.12E-09	8.07E-03	1.49E-04	6.34E-05	8.29E-03	2.02E-09	3.72E-11	1.59E-11	2.07E-09
241-S-111	3.57E-09	4.47E-10	6.96E-02	3.72E-04	2.54E-05	7.00E-02	1.74E-08	9.29E-11	6.34E-12	1.75E-08
241-S-112	5.81E-08	4.47E-10	1.67E+00	6.04E-03	2.54E-05	1.68E+00	4.18E-07	1.51E-09	6.34E-12	4.19E-07
241-T-104	1.43E-09	4.47E-10	9.74E-03	1.49E-04	2.54E-05	9.92E-03	2.44E-09	3.72E-11	6.34E-12	2.48E-09
241-T-110	4.02E-10	4.47E-10	8.35E-03	4.18E-05	2.54E-05	8.42E-03	2.09E-09	1.05E-11	6.34E-12	2.10E-09
241-U-103	4.47E-11	4.47E-10	2.92E-02	4.65E-06	2.54E-05	2.93E-02	7.31E-09	1.16E-12	6.34E-12	7.32E-09
241-U-105	3.57E-10	4.47E-10	2.78E-03	3.72E-05	2.54E-05	2.85E-03	6.96E-10	9.29E-12	6.34E-12	7.12E-10
241-U-106	7.59E-10	2.23E-09	2.09E-02	7.90E-05	1.27E-04	2.11E-02	5.22E-09	1.97E-11	3.17E-11	5.27E-09
241-U-107	2.23E-10	4.47E-10	6.96E-04	2.32E-05	2.54E-05	7.45E-04	1.74E-10	5.81E-12	6.34E-12	1.86E-10
241-U-108	7.15E-10	4.47E-10	4.18E-03	7.43E-05	2.54E-05	4.28E-03	1.04E-09	1.86E-11	6.34E-12	1.07E-09
241-U-109	1.38E-09	4.47E-10	3.06E-02	1.44E-04	2.54E-05	3.08E-02	7.66E-09	3.60E-11	6.34E-12	7.70E-09
241-U-111	8.94E-10	4.47E-10	6.96E-03	9.29E-05	2.54E-05	7.08E-03	1.74E-09	2.32E-11	6.34E-12	1.77E-09
										6.51E-07

APPENDIX D

EMISSION AND DOSE CALCULATIONS--WATER LANCING

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EMISSION AND DOSE CALCULATIONS FOR WATER LANSING-PASSIVE VENTILATION

WATER LANSING-PASSIVE VENTILATION-ADMINISTRATIVELY CONTROLLED TO 72 HOURS MAXIMUM OPERATION IN EACH TANK

VENTILATION FLOW RATE	0.28	METER^3/MI						
BREATHER HEPA EMISSION ADJUSTMENT FACTOR	1.00%	Per 40 CFR 61 APP D						
DOSE CONVERSION MREM/CURIE								
	200-EAST	200-WEST						
TOTAL ALPHA (Am-241)	13.1	7.79						
TOTAL BETA (Sr-90)	4.38E-02	2.60E-02						
Cs-137	2.39E-02	1.42E-02						
						UNABATED EMISSIONS		
TANK	LOCATION	TOTAL ALPHA pCi/LITER	TOTAL BETA pCi/LITER	Cs-137 pCi/LITER	ALPHA PER YEAR, Ci	BETA PER YEAR, Ci	Cs-137 PER YEAR, Ci	ALPHA PER YEAR, Ci
241-AX-101	200-EAST	0.24	1.09	0.1	2.90E-07	1.32E-06	1.21E-07	2.90E-09
241-BY-105	200-EAST	0.003	0.01	0.1	3.63E-09	1.21E-08	1.21E-07	3.63E-11
241-BY-106	200-EAST	0.01	0.03	0.1	1.21E-08	3.63E-08	1.21E-07	1.21E-10
241-S-101	200-WEST	0.258	1.99	26.9	3.12E-07	2.41E-06	3.25E-05	3.12E-09
241-S-102	200-WEST	0.37	1.07	0.5	4.48E-07	1.29E-06	6.05E-07	4.48E-09
241-S-103	200-WEST	0.86	8.12	23.9	1.04E-06	9.82E-06	2.89E-05	1.04E-08
241-S-106	200-WEST	0.609	2.06	28	7.37E-07	2.49E-06	3.39E-05	7.37E-09
241-S-107	200-WEST	2.91	2.63	32.4	3.52E-06	3.18E-06	3.92E-05	3.52E-08
241-S-109	200-WEST	0.058	0.32	0.25	7.02E-08	3.87E-07	3.02E-07	7.02E-10
241-S-111	200-WEST	0.5	0.8	0.1	6.05E-07	9.68E-07	1.21E-07	6.05E-09
241-S-112	200-WEST	12	13	0.1	1.45E-05	1.57E-05	1.21E-07	1.45E-07
241-T-104	200-WEST	0.07	0.32	0.1	8.47E-08	3.87E-07	1.21E-07	8.47E-10
241-T-110	200-WEST	0.06	0.09	0.1	7.26E-08	1.09E-07	1.21E-07	7.26E-10
241-U-103	200-WEST	0.21	0.01	0.1	2.54E-07	1.21E-08	1.21E-07	2.54E-09
241-U-105	200-WEST	0.02	0.08	0.1	2.42E-08	9.68E-08	1.21E-07	2.42E-10
241-U-106	200-WEST	0.15	0.17	0.5	1.81E-07	2.06E-07	6.05E-07	1.81E-09
241-U-107	200-WEST	0.005	0.05	0.1	6.05E-09	6.05E-08	1.21E-07	6.05E-11
241-U-108	200-WEST	0.03	0.16	0.1	3.63E-08	1.94E-07	1.21E-07	3.63E-10
241-U-109	200-WEST	0.22	0.31	0.1	2.66E-07	3.75E-07	1.21E-07	2.66E-09
241-U-111	200-WEST	0.05	0.2	0.1	6.05E-08	2.42E-07	1.21E-07	6.05E-10

EMISSION AND DOSE CALCULATIONS FOR WATER LANSING-PASSIVE VENTILATION

	ABATED EMISSIONS			UNABATED DOSE					ABATED DOSE
TANK	BETA PER YEAR, Ci	Cs-137 PER YEAR, Ci	ALPHA PER YEAR, mrem	BETA PER YEAR, mrem	Cs-137 PER YEAR, mrem	TOTAL UNABATED PER YEAR, mrem	10X UNABATED PER YEAR, mrem*		10X TOTAL ABATED PER YEAR.mrem
241-AX-101	1.32E-08	1.21E-09	3.80E-06	5.77E-08	2.89E-09	3.86E-06	3.86E-05		3.86E-07
241-BY-105	1.21E-10	1.21E-09	4.75E-08	5.30E-10	2.89E-09	5.10E-08	5.10E-07		5.10E-09
241-BY-106	3.63E-10	1.21E-09	1.58E-07	1.59E-09	2.89E-09	1.63E-07	1.63E-06		1.63E-08
241-S-101	2.41E-08	3.25E-07	2.43E-06	6.26E-08	4.62E-07	2.96E-06	2.96E-05		2.96E-07
241-S-102	1.29E-08	6.05E-09	3.49E-06	3.37E-08	8.59E-09	3.53E-06	3.53E-05		3.53E-07
241-S-103	9.82E-08	2.89E-07	8.10E-06	2.55E-07	4.11E-07	8.77E-06	8.77E-05		8.77E-07
241-S-106	2.49E-08	3.39E-07	5.74E-06	6.48E-08	4.81E-07	6.28E-06	6.28E-05		6.28E-07
241-S-107	3.18E-08	3.92E-07	2.74E-05	8.27E-08	5.57E-07	2.81E-05	2.81E-04		2.81E-06
241-S-109	3.87E-09	3.02E-09	5.47E-07	1.01E-08	4.29E-09	5.61E-07	5.61E-06		5.61E-08
241-S-111	9.68E-09	1.21E-09	4.71E-06	2.52E-08	1.72E-09	4.74E-06	4.74E-05		4.74E-07
241-S-112	1.57E-07	1.21E-09	1.13E-04	4.09E-07	1.72E-09	1.13E-04	1.13E-03		1.13E-05
241-T-104	3.87E-09	1.21E-09	6.60E-07	1.01E-08	1.72E-09	6.71E-07	6.71E-06		6.71E-08
241-T-110	1.09E-09	1.21E-09	5.65E-07	2.83E-09	1.72E-09	5.70E-07	5.70E-06		5.70E-08
241-U-103	1.21E-10	1.21E-09	1.98E-06	3.14E-10	1.72E-09	1.98E-06	1.98E-05		1.98E-07
241-U-105	9.68E-10	1.21E-09	1.88E-07	2.52E-09	1.72E-09	1.93E-07	1.93E-06		1.93E-08
241-U-106	2.06E-09	6.05E-09	1.41E-06	5.35E-09	8.59E-09	1.43E-06	1.43E-05		1.43E-07
241-U-107	6.05E-10	1.21E-09	4.71E-08	1.57E-09	1.72E-09	5.04E-08	5.04E-07		5.04E-09
241-U-108	1.94E-09	1.21E-09	2.83E-07	5.03E-09	1.72E-09	2.89E-07	2.89E-06		2.89E-08
241-U-109	3.75E-09	1.21E-09	2.07E-06	9.75E-09	1.72E-09	2.08E-06	2.08E-05		2.08E-07
241-U-111	2.42E-09	1.21E-09	4.71E-07	6.29E-09	1.72E-09	4.79E-07	4.79E-06		4.79E-08

*The total dose is multiplied by a factor of 10 to account for uncertainity regarding a potential increase in vapor space rad concentration due to use of water lance in the waste (see Section 10.1).

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