Department of Energy
Richland Operations Office
P.O. Box 550
Richland, Washington 99352

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EDMC

Mr. E. K. Thomson, President
Fluor Hanford, Inc.
Richland, Washington 99352

Dear Mr. Thomson:

CONTRACT NO. DE-AC06-96RL13200 – U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA) APPROVAL OF THE K-EAST BASIN SLUDGE AND WATER SYSTEM RADIOACTIVE AIR MONITORING PLAN, REVISION 3

Enclosed for your information is a copy of the July 24, 2002, EPA approval for the Radioactive Air Monitoring Plan (RAMP), K-East Basin Sludge and Water System, DOE/RL-2001-46, Revision 3, dated July 2002. Please note that the document approved by EPA is not the same version that was transmitted to DOE on June 19, 2002. Changes were made to the document as a result of EPA comments, and the document was reissued as Revision 3. To ensure that the correct document is put into the final distribution, we have enclosed a copy of the revised RAMP along with the EPA approval letter.

RL should be notified immediately upon knowledge of additional changes in design, procedures, or operations that would require a modification to the RAMP or other regulatory interface. In addition, operating procedures should be reviewed and revised, if necessary, to be consistent with the RAMP.

If you have any questions, please contact Steve Veitenheimer, Director, Office of Spent Nuclear Fuels, on (509) 373-9725, or Mark French, of his staff, on (509) 373-9863.

Sincerely,

Sally A. Sjeracki
Contracting Officer

RCA:JKY

Enclosures

cc w/encls:
J. A. Bates, FHI
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P. T. Day, HND
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R. M. Suyama, FHI
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100 KR-2 Administrative File

57803

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10 HANFORD PROJECT OFFICE
712 Swift Boulevard, Suite 5
Richland, Washington 99352

July 24, 2002

Steven J. Veitenheimer, Director
Office of Spent Nuclear Fuel
U.S. Department of Energy
P.O. Box 550, A4-79
Richland, WA 99352

57802

Subject: EPA Approval of "Radioactive Air Monitoring Plan, K-East Basin Sludge and Water System", DOE/RL-2001-46, Revision 3.

Dear Mr. Veitenheimer:

The U.S. Environmental Protection Agency (EPA) approves the subject document. If you have any questions, you may call me at 509-376-9884.

Sincerely,

Laurence E Gadbois

Laurence E. Gadbois
K Basins Project Manager

Cc: Randy S. Acselrod, WA DOH
Mark S. French, DOE
Carole A. Rodriguez, IT
Dave J. Watson, Fluor
Administrative Record, 100-KR-2

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DOE/RL-2001-46
Revision 3

Radioactive Air Monitoring Plan, K-East Basin Sludge and Water System

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management
Project Hanford Management Contractor for the
U.S. Department of Energy under Contract DE-AC06-96RL13200

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

Approved for public release; further dissemination unlimited

DOE/RL-2001-46
Revision 3

Radioactive Air Monitoring Plan, K-East Basin Sludge and Water System

Date Published
July 2002

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Project Hanford Management Contractor for the
U.S. Department of Energy under Contract DE-AC06-96RL13200

United States Department of Energy
P.O. Box 550
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James Gardel 7-24-2002
Release Approval Date

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GLOSSARY

ALARA	as low as reasonably achievable
ARAR	applicable or relevant and appropriate requirements
BARCT	best available radionuclide control technology
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
CFR	Code of Federal Regulations
Ci	curie
DOE-RL	U.S. Department of Energy, Richland Operations Office
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
HEPA	high-efficiency particulate air
IST	interim staging tank
mrem	millirem
PCB	polychlorinated biphenyls
PTE	potential-to-emit
PUREX	plutonium-uranium extraction
RAMP	radioactive air monitoring plan
RH-TRU	remote-handled transuranic
ROD	record of decision
SNF	spent nuclear fuel
SWS	Sludge and Water System
TSCA	*Toxic Substances Control Act of 1976*
WAC	Washington Administrative Code
WSCF	Waste Sampling and Characterization Facility

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	0.03937	inches
inches	2.54	centimeters	centimeters	0.393701	inches
feet	0.3048	meters	meters	3.28084	feet
yards	0.9144	meters	meters	1.0936	yards
miles (statute)	1.60934	kilometers	kilometers	0.62137	miles (statute)
Area			**Area**		
square inches	6.4516	square centimeters	square centimeters	0.155	square inches
square feet	0.09290304	square meters	square meters	10.7639	square feet
square yards	0.8361274	square meters	square meters	1.19599	square yards
square miles	2.59	square kilometers	square kilometers	0.386102	square miles
acres	0.404687	hectares	hectares	2.47104	acres
Mass (weight)			**Mass (weight)**		
ounces (avoir)	28.34952	grams	grams	0.035274	ounces (avoir)
pounds	0.45359237	kilograms	kilograms	2.204623	pounds (avoir)
tons (short)	0.9071847	tons (metric)	tons (metric)	1.1023	tons (short)
Volume			**Volume**		
ounces (U.S., liquid)	29.57353	milliliters	milliliters	0.033814	ounces (U.S., liquid)
quarts (U.S., liquid)	0.9463529	liters	liters	1.0567	quarts (U.S., liquid)
gallons (U.S., liquid)	3.7854	liters	liters	0.26417	gallons (U.S., liquid)
cubic feet	0.02831685	cubic meters	cubic meters	35.3147	cubic feet
cubic yards	0.7645549	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
Energy			**Energy**		
kilowatt hour	3,412	British thermal unit	British thermal unit	0.000293	kilowatt hour
kilowatt	0.94782	British thermal unit per second	British thermal unit per second	1.055	kilowatt
Force/Pressure			**Force/Pressure**		
pounds (force) per square inch	6.894757	kilopascals	kilopascals	0.14504	pounds per square inch

06/2001

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

RADIOACTIVE AIR MONITORING PLAN, K-EAST BASIN SLUDGE AND WATER SYSTEM

1.0 INTRODUCTION

The purpose of the K-East (KE) Basin Sludge and Water System (SWS) is to provide a system that will transfer the KE Basin sludge from in-basin storage or source locations to containment and loadout for subsequent transport to the T Plant Complex for storage. The SWS will provide a system to retrieve and contain the identified as-settled sludge volume in the KE Basin, while maintaining basin water clarity and associated radioactive control limits per KE Basin water treatment requirements to support the KE Basin fuel transfer and debris removal systems.

Revision 3 to the RAMP was to add further definition and clarification to venting configurations of the sludge container and cask.

1.1 BACKGROUND

The KE and K-West (KW) Basins (K Basins) in the 100 K Area of the Hanford Site were built in the early 1950's and have been used to store spent nuclear fuel (SNF) underwater. In 1992, the decision to deactivate the Plutonium-Uranium Extraction (PUREX) Facility left approximately 2,100 metric tons of SNF in the K Basins with no means for near-term processing. A substantial fraction of the SNF in the K Basins has become degraded because of cladding breaches during reactor discharge, and corrosion has continued during underwater storage.

The fuel in the KE Basin is stored in open top canisters, some of which have screened bottoms while others have closed bottoms. The open canisters release soluble fission products into the basin water and allow fuel corrosion products to combine with canister rack dust, concrete dust, and environmental particulate material. These materials settle to the basin bottom as a fine sludge, along with debris and scrap fuel. Depths exceeding 3 feet have been measured in one of the pits in the KE Basin.

The construction and operations of the SWS is part of a *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA) *of 1980* Interim Response Action as described in the Record of Decision (ROD) that was issued by U.S. Department of Energy, Richland Operations Office (DOE-RL), U.S. Environmental Protection Agency (EPA), and the Washington State Department of Ecology (Ecology) in September 1999 (99-SFD-190). The KE Basin sludge removal activities have been identified as part of a CERCLA interim remedial action. In the ROD, applicable or relevant and appropriate requirements (ARAR) were identified. Those ARARs included Washington Administrative Code (WAC) 246-247 "Radiation Protection Air Emissions', 40 Code of Federal Regulations (CFR) Part 61 "National Emissions Standards for Hazardous Air Pollutants", and WAC 173-480 "Ambient Air Quality Standards and Emission Limits for Radionuclides".

The substantive requirements of those ARARs were identified in DOE/RL-99-89, *Remedial Design Report and Remedial Action Work Plan for the K Basins Interim Remedial Action*, which specifically identified the following:

- Airborne emissions from K Basins activities will not cause the cumulative site emissions to exceed the site public dose limit of 10 millirem (mrem) per year effective dose equivalent. (The limit applies to total emissions from the Hanford Site.)

- Apply best available radionuclide control technology (BARCT)

- Monitor as appropriate.

This document presents compliance with these requirements.

Once the sludge is separated from the fuel and removed from the K Basins, the sludge will be managed as remote-handled transuranic (RH-TRU) waste. Because of the presence of polychlorinated biphenyls (PCBs), the sludge will be regulated under the *Toxic Substances Control Act* (TSCA) *of 1976*. The physical and chemical characteristics of K Basins sludge are documented in HNF-SD-SNF-TI-009, Volume 2, *105-K Basins Material Design Basis Feed Description for Spent Nuclear Fuel Project Facilities* and HNF-SD-SNF-TI-015, Volume 2 , *Spent Nuclear Fuel Project Technical Databook, Volume 2, Sludge.*

The KE Basin sludge will be retrieved and managed as one waste stream. Approximately 2,200 cubic feet will be packaged in sludge containers. This sludge consists primarily of less reactive components (windblown sand and rocks, spalled concrete from basin walls, iron and aluminum corrosion products, ion exchange material, uranium oxides) along with uranium metal particles and fuel corrosion products.

1.2 PLANNED ACTIVITIES

Retrieval of sludge in the KE Basin will be performed using manually operated equipment. Sludge will be retrieved by vacuuming on top of and around the existing fuel canisters and the basin floor/pit. Figure 1 shows a general flow diagram of the process.

Scrap fuel and debris pieces 0.25 inch and larger will be separated from the sludge waste stream using strainers. Sludge particulate less than 0.25 inch will be pumped from the strainers directly into a sludge container where the heavy sludge particles will settle out or be filtered out of the waste stream. The sludge container will be located above water and stored inside a cask on the sludge transport trailer located within the 105 KE Basin Building. The filters in the sludge container will remove particulate down to 5 micrometers. The filtered effluent from the sludge container will be returned directly to the 105 KE Basin.

The weight of the sludge container will be monitored as an indication as to how much sludge has been added and when to replace the sludge container with an empty sludge container. Only one sludge container will be in use in the KE Basin at any particular time.

The venting configuration of the sludge container and cask at different phases in their life cycle are as follows. First, during filling of the sludge container and wet lay-up (sludge container is not yet full but is connected to the system and sludge pumping is not occurring), the sludge container is vented outside the basin air space through a HEPA filter and a sampled vent. Second, during the intervening time between when the piping connections are removed from the top of the sludge container and the cask lid is installed, a HEPA filter is connected to the top of the sludge container. The purpose of the HEPA filter is to: (1) allow for any hydrogen generated in the sludge container to vent, which in this case is vented to the basin air space, and (2) allow for the ingress of helium into any air spaces in the sludge container during later helium purging operations. Third, when the cask lid is placed on top of the sludge container, connections are made on the cask lid to: (1) vent any gases generated in the sludge container and (2) purge the cask and sludge container inside with helium. In both of these instances, air/gases are vented outside the basin air space using the same HEPA filter and sampled vent. Therefore, there is only one time when the sludge container is vented directly to the basin air space and that is during the

intervening time between when the piping connections are removed from the top of the sludge container and the cask lid is installed.

The sludge container will be operated in either of the two following configurations.

1. Closed loop - during this configuration, the sludge container will receive sludge, and process recirculation flow from the sludge container (consisting of fines less than 5 microns) will be directed back to the basin.

2. Vented - during this configuration, the sludge container will be vented:

   a. Inside the basin to:

      - Allow ingress of air during draining of water

      - Relieve any gases that might be generated in the sludge containers or to adapt to changes in atmospheric pressure during the intervening time when the piping connections are removed from the top of the sludge container and cask lid is installed.

   b. Outside the basin to:

      - Allow egress of air during filling with water either (e.g., initial fill, filling during filter backwash)

      - Allow ingress and egress of air/helium during the purging that takes place before transferring the sludge container.

The sludge container 5 micron filter will be backwashed with the backwashed filtered solids being retained within the sludge container. When this occurs, the water in the sludge container is lowered below the filters to allow for a water backwash. The air in the sludge container is vented to the atmosphere during filter backwashing operations through a HEPA-type filter and a sample filter paper as shown in Figure 2.

The sludge container will be in a cask above water on the sludge transport trailer during sludge loading operations. The cask lid will be placed on the cask using a crane. When the sludge container is filled and ready for preparations to be transferred to T Plant Complex, the cask/sludge container will undergo cycles of being purged with helium and vented to the atmosphere. After purging, the cask lid penetrations will be sealed mechanically before transfer to T Plant Complex. Figure 3 provides a description of the sludge container life cycle.

2.0 AIRBORNE SOURCE INFORMATION

The potential exists for particulate radioactive airborne emissions resulting from the previously described KE Basin sludge removal activities. Emission estimates were based on bounding assumptions, which included approximately 400 pounds of sludge that could be entrapped on the filters within the sludge container that could be exposed during the venting of air/helium from the sludge container. The maximum quantity of sludge for which the filter assembly is capable of holding was reported by a vendor as 400 pounds.

2.1 POTENTIAL-TO-EMIT AND ESTIMATED ABATED EMISSION

Potential-to-Emit

A potential-to-emit (PTE) has been estimated for two succinct operating configurations of the sludge and water system: (1) venting to basin air space and (2) vented to the outside. In both of these configurations, 400 pounds of sludge is assumed retained on the filters and exposed.

The PTE for when the sludge container is vented to the basin air space is described in Table 1. The calculated unabated dose is approximately 0.00164 millirem per year. The release fraction used in Table 1 was derived from actual K Basins data gathered in December 1995, during which time two filter cartridges from the water treatment system were removed from KE Basin. December 1995 radioactive air emissions, conservatively attributed entirely to the activity of changing the filter cartridges, were compared to the characterization inventory of the cartridges, which contained sludge. The December 1995 cesium-137 air emissions (9.5 E-06 Ci) divided by the total cesium-137 inventory of the cartridges [9.58 Ci (Solid Waste Disposal Records)] yielded a release fraction of 9.92 E-07. The cesium-137 release fraction was the highest calculated for isotopes reported in December 1995; therefore, for conservatism, the cesium-137 release fraction was used for calculations presented in Table 1.

The PTE for when the sludge container is vented to the outside is described in Table 2. The calculated unabated dose is approximately 1.65 mrem/yr using a release fraction of 1.00 E-03. This fraction is derived from 40 CFR 61 Appendix D, and is applied for those venting configurations in which air/helium is being driven out of the sludge container.

Abated Emissions

The abated emissions from the SWS for when the sludge container is vented to the basin airspace is described Table 1.

The abated emissions from the SWS for when the sludge container is vented to the outside is described in Table 2.

2.2 KE BASIN RADIOLOGICAL INVENTORY

The primary (>98 percent of the dose) radiological constituents are plutonium, americium, strontium, and cesium (Tables 1 and 2). The remainder of the isotopes also are included for dose calculations.

2.3 BEST AVAILABLE RADIONUCLIDE CONTROL TECHNOLOGY

The KE Basin sludge removal activities have the potential to release radioactive emissions to the atmosphere. Applying best available radionuclide control technology (BARCT) for these radioactive emissions has been identified as an ARAR.

In general, the KE Basin does not provide for inlet supply air and exhausted air is not filtered. Air is exhausted from the building via roof vents, two over the basin and two over the high bay transfer area.

When above-water contaminated equipment or structures are encountered during construction of the SWS, as low as reasonably achievable (ALARA) practices will be followed to minimize emissions.

Contaminated areas will be decontaminated before work, as practical, or engineered controls such as glovebags, fixatives, ventilation, or containment will be used as needed.

For nonaggressive decontamination on surfaces with smearable contamination, the use of wiping or applying foam polymers is an ALARA control that has been accepted as BARCT for fugitive particulate radionuclide air emissions, particularly when the potential offsite dose is low.

For the KE Basin sludge removal, activities will consist primarily of transferring sludge to sludge containers. During this transfer, the SWS will be a closed-loop system that will allow no pathway to the environment during transfer operations.

Specific controls will be applied to KE Basin sludge removal operational activities, as necessary, for above-water activities involving sludge container/shielded transfer cask loading. These controls will include the following.

- The contamination levels on the exterior of the cask will be maintained to less than U.S. Department of Transportation requirements (49 CFR 173.443, "Containment Control").

- The vented air stream will pass through a HEPA-type filter when the sludge container is vented outside the basin (e.g., during backwashing, helium purging).

- Alternatively, when the sludge container is only passively vented to the basin air space to relieve any gases that might be generated or to adapt to changes in atmospheric pressure, the sludge container will be equipped with NucFil® filters.

Maintenance activities performed on sludge removal equipment will follow current ALARA practices. These activities will be conducted in accordance with routine activity contamination control practices; e.g., glovebags, decontaminations, fixatives, etc. These controls will minimize the potential airborne contamination. Any equipment to be removed from the water will be rinsed on removal from the water; any equipment left out of the water will be contained appropriately (e.g., bagged in plastic, painted, wrapped) for storage.

2.4 MONITORING

Monitoring during the operation of the SWS, including sludge removal activities, will be conducted using: (1) the existing 105 KE Basin roof vent samplers, (2) existing ambent air monitors, and (3) a sample filter on the vent line from the sludge container that is exhausted outside.

KE BASIN ROOF VENT SAMPLERS

The sampling system inside the KE Basin consists of three fixed head samplers. The design of the fixed head samplers allows the filter head to be lowered or elevated for safe changeout and sample collection. The particulate filters from the three samplers are collected weekly. The particulate filters currently are delivered to the onsite Waste Sampling and Characterization Facility (WSCF). WSCF performs total alpha/beta and isotopic analyses on the particulate filters. The contractual detection limits and other requirements are specified in the statement of work for services provided by the WSCF Effluent and Environmental Monitoring Program (HNF-EP-0835). Weekly filters are composited for a monthly analysis for those particulate isotopes contributing greater than 10 percent or more of the PTE unabated

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emissions. The particulate radionuclides contributing 10 percent or more of the PTE from KE Basin (Table 1) are strontium-90, plutonium-239/ 240, plutonium-241, and americium-241.

The three samplers are located as follows: two are located over the KE Basin and one is located in the transfer high bay area. The samplers over the KE Basin are positioned directly in front of roof vent 11 and roof vent 10, the inlet to the exhaust fans. The sample head filter assembly is attached to an adjustable support extended to the inlet of the fan, approximately 11 feet above the floor. The third sampler is in the transfer high bay area near the exhaust fans for roof vent 6 and roof vent 7. The filter assembly for the high bay sampler is approximately 20 feet above the floor. Figure 4 identifies the relative position of these fixed head samplers.

The sampler system design eliminates any sample line loss concerns. The particulate filter employed is 1.9-inch-glass fiber filter with a 91 percent capture efficiency for particles with a median diameter of 0.3 micron. The sampler filter assembly is connected to a vacuum pump via plastic tubing. Because the particulate filter is upstream of the plastic tubing, the particulate filter is not influenced by the tubing. The sample pumps are equipped with a flow regulator. The nominal sample flow rate is 2 cubic feet per minute.

Operational checks of the exhaust fans and the sample pumps are performed daily. In the event a fan/sampler is found not operating or is de-energized for any reason, the associated sampler/fan is turned off until both pieces of equipment are returned to service simultaneously. The only exception to this operating philosophy is in the transfer area, where one sampler has been established for two exhaust fans. The sampler is turned on when one or both exhaust fans are running. If the sampler, or both fans are found not operating or are de-energized for any reason, both exhaust fans or the sampler are turned off. The operability information for the samplers and exhaust fans is logged and reported to monitoring program personnel. The sample pump flow rate is checked quarterly using a calibrated National Institute of Standards and Technology traceable flow meter.

EXISTING AMBIENT AIR MONITORS

Near-field ambient air monitoring currently is being performed at several locations around the KE Basin. Three monitors, designated as N-401, N-402, and -403, will continue to be operated during the construction and operations described in this RAMP are complete (Figure 5).

SAMPLER ON SLUDGE CONTAINER VENT LINE

During the time the sludge container is vented to the outside, the sludge container will be vented through a HEPA type filter and a sample filter paper during filter backwashing and purging operations. The sample filter paper will be collected monthly and analyzed for total alpha, total beta, gamma energy analysis, strontium 90, isotopic plutonium, and americium. Figure 2 identifies the vent and purge lines.

2.5 TECHNOLOGY STANDARDS

The following discussion describes the applicability and aspects of the technology standards described in WAC 246-247-120 to the design and operation of the vent line from the sludge container that exhausts to the outside.

- ASME AG-1-1994, *Code on Nuclear Air and Gas Treatment*. The HEPA type filter on the vent line to the sludge container will be field testable and achieve a 99.95 % efficiency in removing particulates in a test aerosol of 0.3 micrometer average particle size.

- ASME N509-1989, *Nuclear power Plant Air Cleaning Units and Components.* The HEPA type filter on the vent line to the sludge container will be field testable and achieve a 99.95 % efficiency in removing particulates in a test aerosol of 0.3 micrometer average particle size.

- ASME N510-1989, *Testing of Nuclear Air Treatment Systems.* The HEPA type filter on the vent line to the sludge container will be field testable and achieve a 99.95 % efficiency in removing particulates in a test aerosol of 0.3 micrometer average particle size.

- ANSI/ASME NQA-1, *Quality Assurance Program Requirements for Nuclear Facilities* and NQA-2, *Quality Assurance Program Requirements for Nuclear Facility Applications.* The design and operations of the sludge removal system will be in conformance with 10 CFR 830.120. The implementation plan to these codified quality assurance requirements describes in detail which portions of the same standard are applicable and carried forward into design and operation.

- ANSI N13.1-1969, *American National Standard Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities.* There is no continuous air emission stream from the operation of the sludge removal system. It is intermittent. Representative sampling of air emissions from the venting and purging of the sludge container will take place continuously during venting operations. The sample filter media will conform to the recommendations in Table D.1 of ANSI N13.1-1999.

3.0 REFERENCES

99-SFD-190, "Signed Record of Decision (ROD) for K Basins Interim Remedial Action", U.S. Department of Energy, Richland Operations Office, Richland, Washington, September 30, 1999.

DOE/RL-99-89, *Remedial Design Report and Remedial Action Work Plan for the K Basins Interim Remedial Action*, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

HNF-3602, *Volume 1: Calculating Potential to Emit Releases and Doses for FEMPs and NOCs*, Fluor Hanford, Richland, Washington, January 2002.

HNF-EP-0835, *Statement of Work for Services Provided by the Waste Sampling and Characterization Facility for the Environmental Compliance Program,* Fluor Hanford, Richland, Washington, June 2000, revised periodically.

HNF-SD-SNF-TI-009, Volume 2, *105-K Basins Material Design Basis Feed Description for Spent Nuclear Fuel Project Facilities*, Fluor Hanford, Richland, Washington.

HNF-SD-SNF-TI-015, Volume 2, *Spent Nuclear Fuel Project Technical Databook. Volume 2 Sludge*, Fluor Hanford, Richland, Washington.

Solid Waste Disposal Records, dated September 23, 1998; package identification numbers 9606685 and 9606686, Fluor Hanford, Richland, Washington.

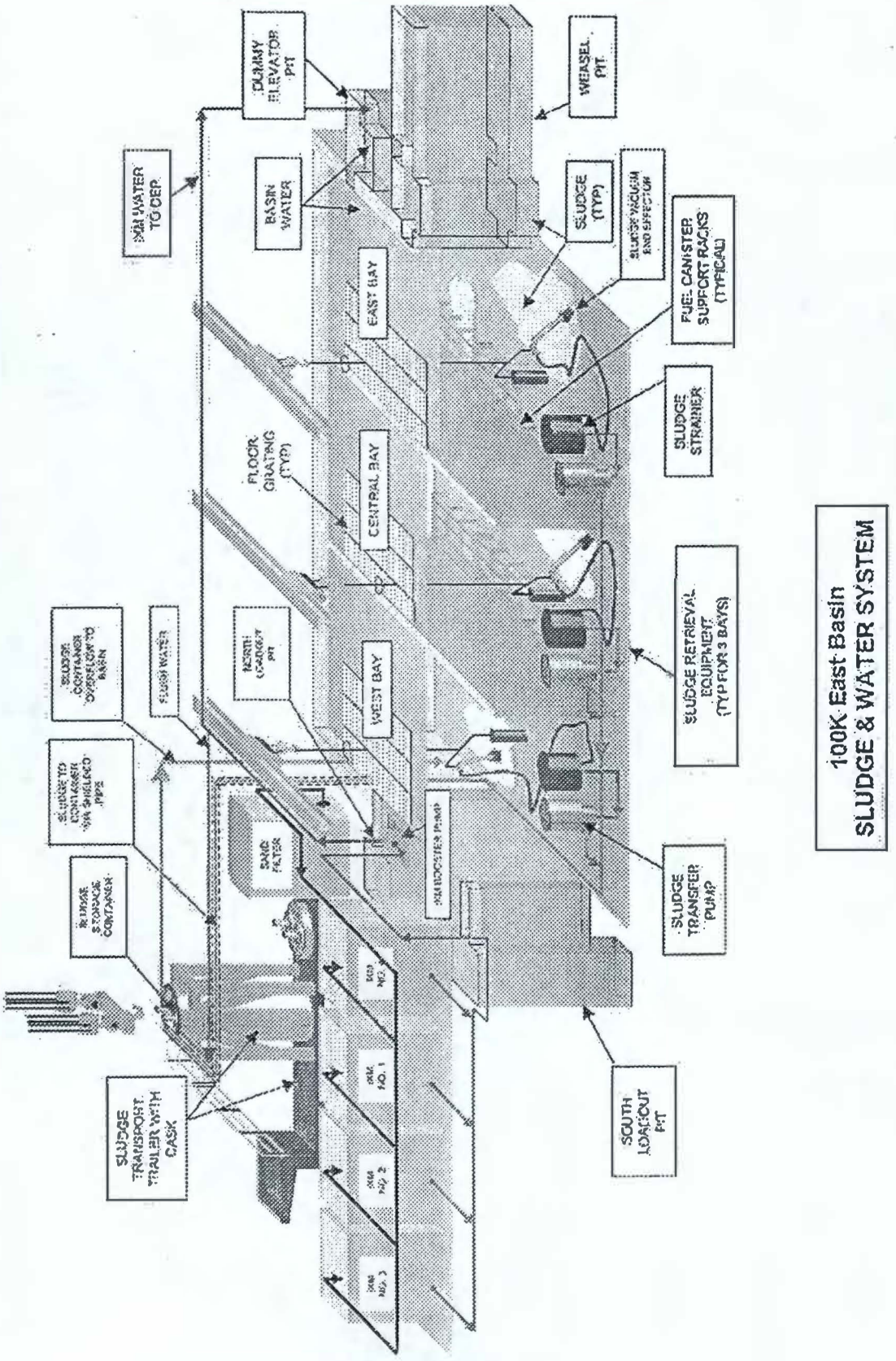
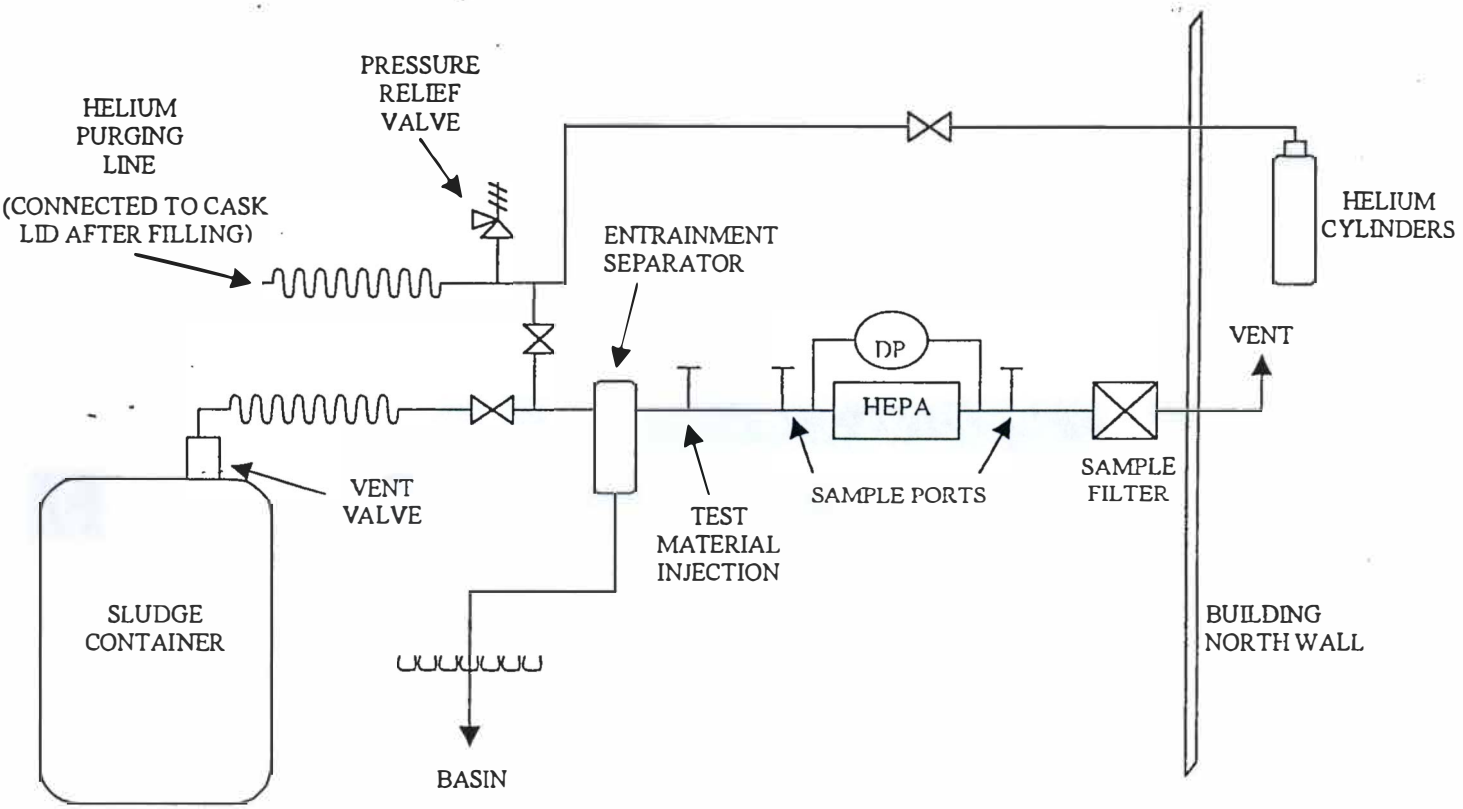


Figure 1. General Flow Diagram.



Note: The pressure relief valve in the helium purge line is to protect the system from over pressurization. Over pressurization could result in a release of helium that has the potential for radiological contamination (i.e., the section of piping could be radiologically contaminated). The likelihood of this pressure relief valve actuating is less than 1 percent.

Figure 2. KE Sludge Retrieval System Sludge Container Vent and Purge.

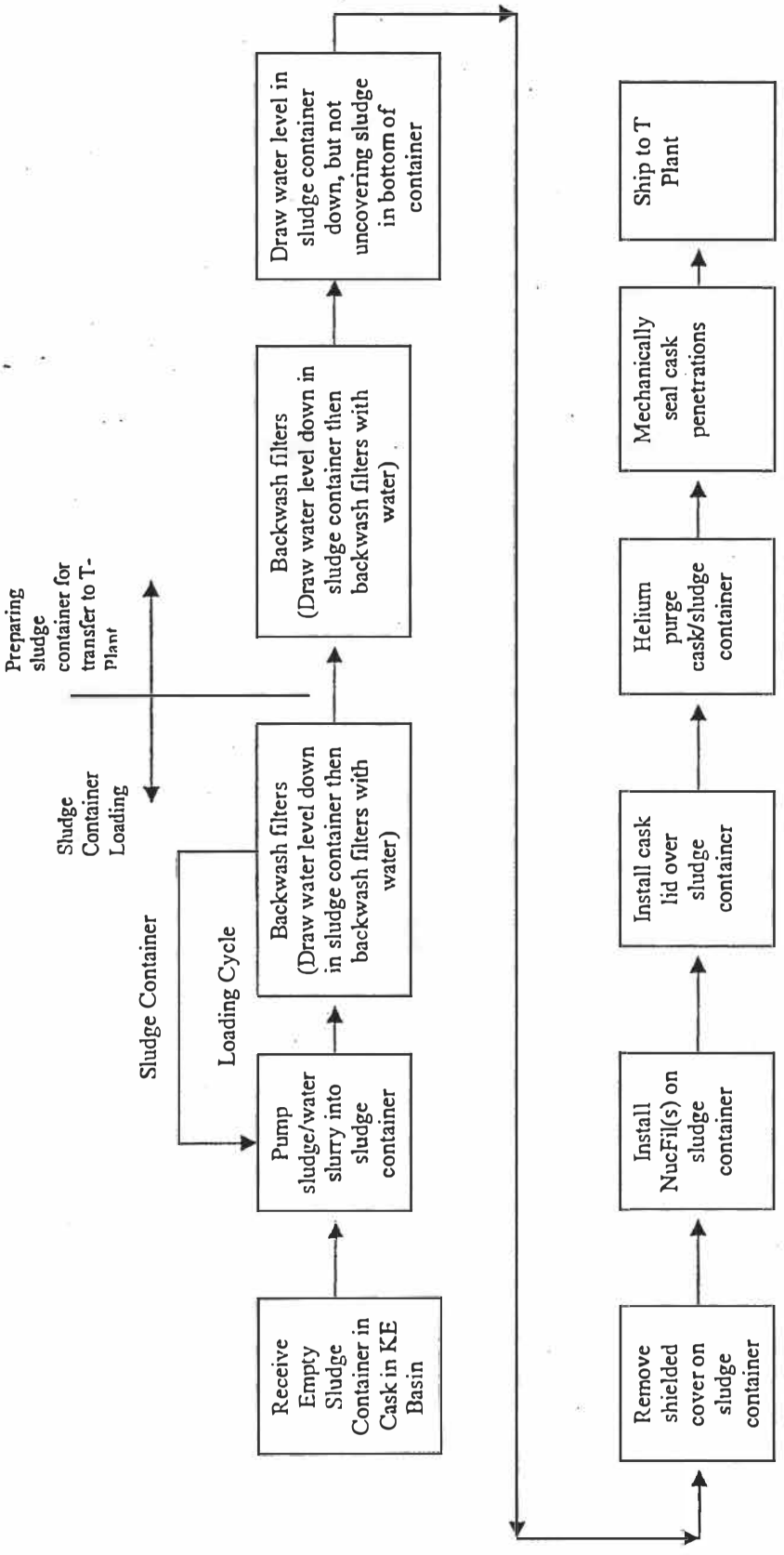


Figure 3. KE Basin Sludge Container Life Cycle.

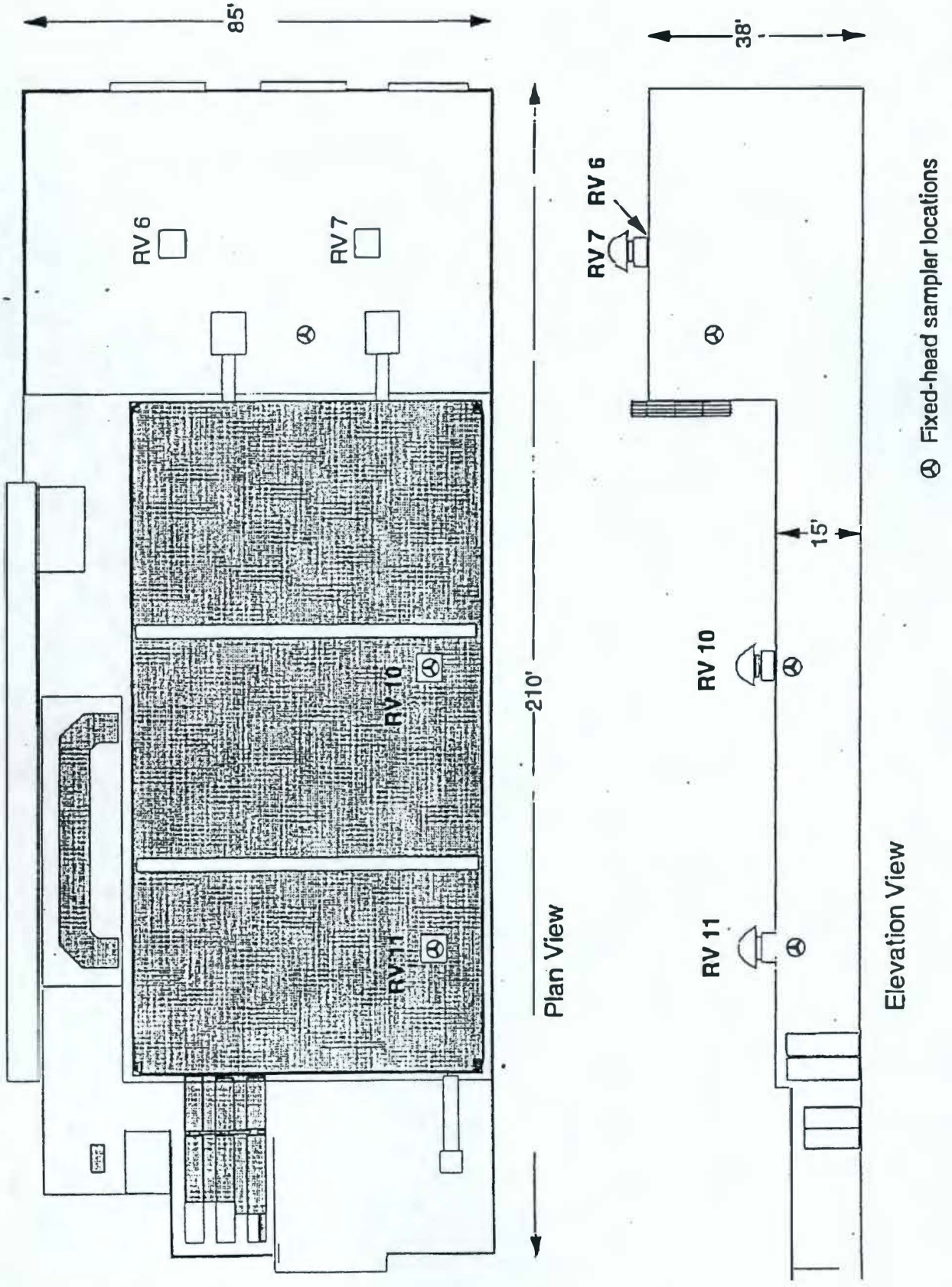


Figure 4. Fixed Head Sampler Positions.

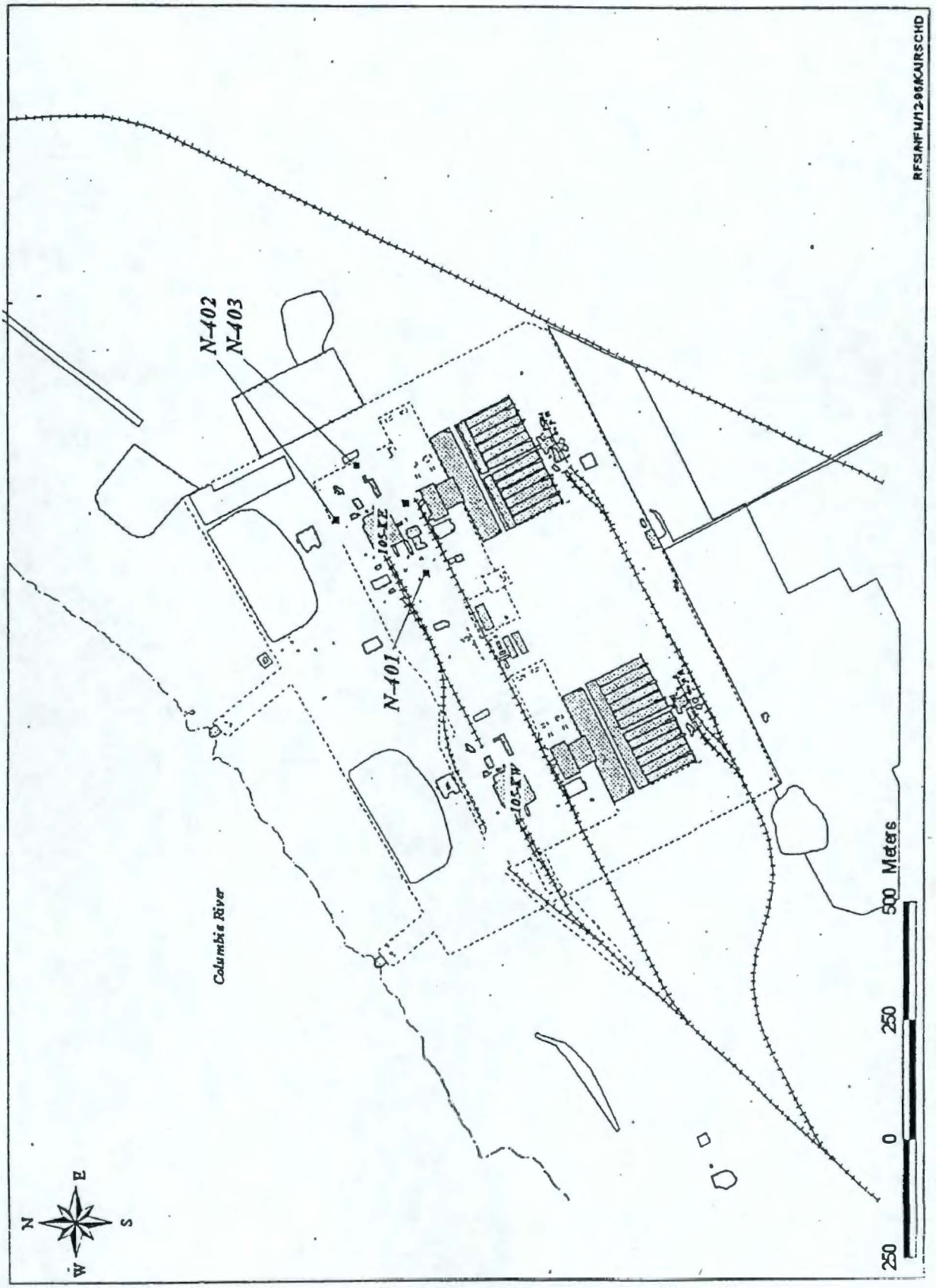


Figure 5. Locations of Near-Field Monitoring Locations.

Table 1.. Transfer of KE Basin Sludge to Sludge Container.

Radionuclide	Canister Ci/m^3 Table 4-15 TI-0015 [1]	Container Ci [2,3]	Above Water Release Fraction	CAP 88 Dose Conversion Factor (mrem/yr)Ci	Unabated Dose TEDE to MEI (mrem/yr)	Dose Percent Total Unabated	Abated Dose 2000 TEDE to MEI (mrem/yr)	Dose Percent Total Abated
Co-60	4.11E+00	2.98E-01	9.92E-07	4.90E-01	1.45E-07	0.01	7.25E-11	0.01
Sr-90	1.05E+04	7.62E+02	9.92E-07	2.20E-01	1.66E-04	10.14	8.32E-08	10.14
Tc-99	6.03E+01	4.38E+00	9.92E-07	4.50E-02	1.95E-07	0.01	9.77E-11	0.01
Cs-137	3.62E+03	2.63E+02	9.92E-07	5.30E-02	1.38E-05	0.84	6.91E-09	0.84
Eu-154	5.76E+01	4.18E+00	9.92E-07	3.90E-01	1.62E-06	0.10	8.09E-10	0.10
Eu-155	5.84E+01	4.24E+00	9.92E-07	1.60E-02	6.73E-08	0.00	3.36E-11	0.00
U-234	1.59E+00	1.15E-01	9.92E-07	6.20E+00	7.10E-07	0.04	3.55E-10	0.04
U-235	4.73E-02	3.43E-03	9.92E-07	5.90E+00	2.01E-08	0.00	1.00E-11	0.00
U-236	1.40E-01	1.02E-02	9.92E-07	5.80E+00	5.85E-08	0.00	2.92E-11	0.00
Np-237	8.51E-02	6.18E-03	9.92E-07	2.30E+01	1.41E-07	0.01	7.05E-11	0.01
U-238	1.12E+00	8.13E-02	9.92E-07	5.50E+00	4.43E-07	0.03	2.22E-10	0.03
Pu-238	8.45E+01	6.13E+00	9.92E-07	1.50E+01	9.13E-05	5.56	4.56E-08	5.56
Pu-239	3.27E+02	2.37E+01	9.92E-07	1.60E+01	3.77E-04	22.97	1.88E-07	22.97
Pu-240	1.79E+02	1.30E+01	9.92E-07	1.60E+01	2.06E-04	12.57	1.03E-07	12.57
Pu-241	9.63E+03	6.99E+02	9.92E-07	2.60E-01	1.80E-04	10.99	9.01E-08	10.99
Pu-242	8.64E-02	6.27E-03	9.92E-07	1.60E+01	9.95E-08	0.01	4.98E-11	0.01
Am-241	3.35E+02	2.43E+01	9.92E-07	2.50E+01	6.03E-04	36.77	3.01E-07	36.77
		1.80E+03			1.64E-03	100.06	8.20E-07	100.06

Note: 1. Curie source term is based on 105 K SNFP Technical Databook, Volume 2, Sludge HNF-SD-SNF-TI-015 Rev 8, Volume 2.

2. Canister sludge is used because this is the most conservative curie loading.

3. Canister source term is based on 400 lbs x 453.6 grams/lb/ 2.5 gram/cm^3 X 1.0E-6m^3/cm^3 = 7.26 E-02 m^3.

Table 2. Backwash/Helium/Passive Venting.

Radionuclide	Ci/m3 Table 4-15 TI-0015 [1]	Container Ci [2,3]	Release Fraction	Unabated Emission (Ci) Backwash	CAP 88 Dose Conversion Factor (mrem/yr)Ci	Unabated Dose TEDE to MEI (mrem/yr)	Dose Percent Total Unabated	Abated Dose 2000 TEDE to MEI (mrem/yr)	Dose Percent Total Abated
Co-60	4.11E+00	2.98E-01	1.00E-03	2.98E-04	4.90E-01	1.46E-04	0.01	7.31E-08	0.01
Sr-90	1.05E+04	7.62E+02	1.00E-03	7.62E-01	2.20E-01	1.68E-01	10.16	8.38E-05	10.14
Tc-99	6.03E+01	4.38E+00	1.00E-03	4.38E-03	4.50E-02	1.97E-04	0.01	9.85E-08	0.01
Cs-137	3.62E+03	2.63E+02	1.00E-03	2.63E-01	5.30E-02	1.39E-02	0.84	6.96E-06	0.84
Eu-154	5.76E+01	4.18E+00	1.00E-03	4.18E-03	3.90E-01	1.63E-03	0.10	8.15E-07	0.10
Eu-155	5.84E+01	4.24E+00	1.00E-03	4.24E-03	1.60E-02	6.78E-05	0.00	3.39E-08	0.00
U-234	1.59E+00	1.15E-01	1.00E-03	1.15E-04	6.20E+00	7.15E-04	0.04	3.58E-07	0.04
U-235	4.73E-02	3.43E-03	1.00E-03	3.43E-06	5.90E+00	2.03E-05	0.00	1.01E-08	0.00
U-236	1.40E-01	1.02E-02	1.00E-03	1.02E-05	5.80E+00	5.89E-05	0.00	2.95E-08	0.00
Np-237	8.51E-02	6.18E-03	1.00E-03	6.18E-06	2.30E+01	1.42E-04	0.01	7.10E-08	0.01
U-238	1.12E+00	8.13E-02	1.00E-03	8.13E-05	5.50E+00	4.47E-04	0.03	2.24E-07	0.03
Pu-238	8.45E+01	6.13E+00	1.00E-03	6.13E-03	1.50E+01	9.20E-02	5.58	4.60E-05	5.56
Pu-239	3.27E+02	2.37E+01	1.00E-03	2.37E-02	1.60E+01	3.80E-01	23.01	1.90E-04	22.96
Pu-240	1.79E+02	1.30E+01	1.00E-03	1.30E-02	1.60E+01	2.08E-01	12.60	1.04E-04	12.57
Pu-241	9.63E+03	6.99E+02	1.00E-03	6.99E-01	2.60E-01	1.82E-01	11.01	9.09E-05	10.99
Pu-242	8.64E-02	6.27E-03	1.00E-03	6.27E-06	1.60E+01	1.00E-04	0.01	5.02E-08	0.01
Am-241	3.35E+02	2.43E+01	1.00E-03	2.43E-02	2.50E+01	6.08E-01	36.84	3.04E-04	36.75
		1.80E+03		1.80E+00		1.65E+00	100.25	8.27E-04	100.01

Note: 1. Curie source term is based on 105 K SNFP Technical Databook, Volume 2, Sludge HNF-SD-SNF-TI-015 Rev 8, Volume 2.

2. Canister sludge is used because this is the most conservative curie loading.

3. Canister source term is based on 400 lbs x 453.6 grams/lb/ 2.5 gram/cm^3 X 1.0E-6m^3/cm^3 = 7.26 E-02 m^3.

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