AIR MONITORING PLAN FOR THE REMEDIATION OF THE 618-10 BURIAL GROUND
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Distribution

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1.0 INTRODUCTION

The remediation of the 618-10 Burial Ground has the potential-to-emit (PTE) radionuclides. This activity is being conducted under a *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA) Record of Decision (ROD) (EPA 2001), in accordance with the *Remedial Design Report/Remedial Action Work Plan for the 300 Area* (DOE/RL 2009). This air monitoring plan is an addendum to DOE/RL 2009. Quantification of radioactive emissions, implementing best available radionuclide control technology (BARCT), and air monitoring have been identified as substantive requirements (i.e., applicable or relevant and appropriate requirements) for this remedial action. A BARCT compliance demonstration is determined by the regulatory agency on a case-by-case basis. These substantive requirements are according to *Washington Administrative Code* (WAC) 246-247-040. This plan presents compliance with those requirements.

The 618-10 Burial Ground consists of 12 trenches and 94 vertical pipe units (VPUs). The trenches range in size from 320 ft (97 m) long by 70 ft (21 m) wide to 50 ft(15 m) long by 40 ft (12m) wide. Most VPUs are 22-in. (65-cm) diameter, 15-ft (4.6-m) long waste receptacles constructed by welding five 55-gallon bottomless drums together end-to-end and burying them vertically. Some of the VPUs consist of 15 ft lengths of 14 inch pipe and 20 ft lengths of 12 inch pipes. The 618-10 burial ground was covered in soil when it was closed. The work scope includes remediation of the 618-10 Burial Ground disposal trenches and vertical pipe units.

2.0 PLANNED ACITIVITIES – TRENCH REMEDIATION

General remedial action operations include excavating, sampling, sorting, size reducing, stockpiling, treating (if necessary) containerizing, loading, backfilling, and transport of materials from the trenches. Materials may include a wide range of chemically and/or radiologically contaminated soil, miscellaneous debris, buried equipment, and structural materials. In addition, this work scope includes performance of all operations and incidentals for the handling, processing, and staging of buried drums or other anomalous materials that may be encountered. Also included are test pitting, trenching, and other activities that may be performed during remediation to further characterize the buried waste and/or determine the limits of the waste sites. Specific treatment activities include stabilization of uranium oxide and crushing/stabilization of liquids in bottles.

Excavated material will be sent primarily to the Environmental Restoration Disposal Facility (ERDF) for disposal. On a case-by-case basis, other EPA approved disposal facilities may be used based on the specific waste stream designation.

2.1 Soil and Miscellaneous Debris Excavation

Scattered debris within some of the trenches will be picked up by hand; however, standard construction equipment will be used for excavation, loading, and hauling. The loading of contaminated material into waste containers may result in soil spilled on the waste containers and/or haul trucks. Haul trucks with loaded containers will enter a survey area where they will be screened to detect exterior contamination. A decontamination station will be established to decontaminate containers and haul trucks, as required. Waste containers and/or haul trucks will be decontaminated by conventional means such as brushing or wiping. Decontaminated trucks and containers will then proceed to the container transfer area where the transportation subcontractor will pick up the containers for transport to the ERDF.

Stockpiling and leaving open face excavations overnight will be minimized.

2.2 Anomaly Processing

Most anomalies (including drums and containers) will be overpacked at the excavation site and then characterized for disposal. Anomalies that contain significant quantities of Plutonium or other radionuclides that present an airborne risk will be opened in a HEPA filtered enclosure. .

2.3 Drum Handling

Drummed waste will be encountered in the 618-10 Burial Ground trenches. The exact quantity of drums and the types of waste material contained in the drums is not known at this time. Extensive records searches indicate that low-activity wastes were primarily disposed of in the trenches, but some of the moderate- to high-activity wastes were also disposed of in the trenches inside concrete/lead-shielded drums. Wastes included radiological contaminated laboratory instruments, bottles, boxes, filters, aluminum cuttings, metal cuttings, irradiated fuel element samples, metallurgical samples, electrical equipment, lighting fixtures, barrels, laboratory equipment and hoods/gloveboxes, and low and high activity liquid waste sealed in containers. To address the potential emission contributions from drummed waste handling a database was created based upon information gathered from a review of historical documentation related to the 618-10 Burial Ground. This database was queried to develop a worksheet that indentified the population of waste drums and associated inventory that was used for the emission calculation.

Drums will be placed in a salvage container (salvage drum, B-12 box, etc.) at the dig face and then moved through non-destructive assay stations. To support physical characterization and sampling of the contents, waste drum lids may be pierced under negative pressure and drum contents sampled in the HEPA ventilated drum punch facility (DPF). The HEPA ventilated drum punch unit is a fully enclosed, remotely operated structure designed to safely handle unvented drums. The drummed waste will subsequently be moved to a control area within the burial ground Area of Contamination (AOC) or other regulatory approved locations, loaded onto flatbed trailers, and transported to the ERDF or other regulatory approved locations for interim staging or disposal. Retrieved drums containing Zircaloy-2 chips and oil or black uranium oxide will be put into larger steel salvage containers (may be Nucfil™ vented or equivalent). Clean mineral oil or water will be added to these drums and salvage containers as needed to ensure chips are immersed.

During the overpacking, a Nucfil™ vent or equivalent may be inserted into the salvage container. The potential emissions from this activity are negligible compared with potential emissions from sampling and containerizing drums. This activity (venting drums) assumes a release fraction of 2E-09 (A. W. Conklin 1999) resulting in a calculated potential-to-emit several orders of magnitude below that associated with sampling and containerizing the drums. Therefore, potential to emit during the sampling and containerizing of drums accounts for the activity of venting of drums.

If any of the drums are corroded to the point that they cannot be overpacked, the potential emissions will be part of soil excavation and will result in lower emissions from the drum handling activities.

2.4 Uranium Oxide Treatment

Approximately 600 containers of uranium oxide powder are suspected of being disposed at the 618-10 burial ground. The waste is intended for disposal at the Environmental Restoration Disposal Facility (ERDF). The waste consists of uranium oxide potentially contaminated with barium, cadmium, or lead, and possibly other TCLP metals. The waste requires stabilization of the TCLP metals prior to disposal in the ERDF. Additionally, uranium that may have been incompletely oxidized may form uranium hydrides in the waste matrix, which could cause the powder to be pyrophoric. The stabilization technique will also deactivate the potential pyrophoricity of the material and render it safe to handle, transport, and dispose. Drums of uranium oxide will be placed in a mixing box, covered with a Portland cement-based flowable grout solution, the drums will be opened under the grout with a pulverizer or other type of processor,and mixed with the grout. After curing, if the stabilized waste meets the ERDF waste acceptance criteria, it will be loaded into ERDF containers and transported for disposal.

2.5 Bottle Processing and Treatment

Treatment of liquid waste in bottles, up to one gallon per bottle, will occur in a tray or box within the excavation. Bottles will be placed in a spaced pattern into a containment structure, such as a tray or box, within an excavated trench. Bottles will be covered with soil and fixative and then crushed. Crushing may occur individually or in a batch process. After all bottles in the tray are crushed, they will be stabilized by mixing with grout. Post treatment verification sampling will be performed to demonstrate compliance with land disposal restrictions and disposal facility acceptance criteria. Liquid waste treated in this manner will be subsequently handled as bulk waste or may be transported for disposal as a monolith within an acceptable container. Waste will be disposed in the ERDF.

3.0 PLANNED ACTIVITIES – VERTICAL PIPE UNIT REMEDIATION

3.1 Overcasing

For each VPU, a steel casing will be driven into the ground around the outside of the VPU with a vibratory hammer suspended from a crane.

3.2 *In Situ* Stabilization

In situ stabilization will be performed after installation of the auger tool enclosure (ATE). The Auger Tool Enclosure (ATE) consists of a stabilization auger within an enclosure. The ATE attaches to a VPU over-casing as shown in Figure 1. This auger provides the cutting and mixing functions to stabilize the contents of the over-casing. This auger can also be used for grouting if required.

The ATE's main function is to contain contamination during the stabilization operation. The ATE will be connected to an active HEPA-filtered negative pressure ventilation system. This system is described in the 5th paragraph of Section 3.4 below.

Access ports are provided around the ATE for sampling of the auger prior to removal of the enclosure. High pressure, low volume jets are located near the top and bottom of the ATE for controlling dust within the enclosure and to provide a high pressure wash of the auger and stem as it is retracted from the over-casing depths.

3.3 Sampling

Sampling will utilize a drill rig to remove a core from the VPU after the stabilization step and be collected within a plastic sleeve. On site radiological screening will occur to ensure transportation can occur. Offsite testing will be performed to determine if the contents of the VPU can be disposed of at the Environmental Restoration Disposal Facility (ERDF) or sent to the Central Waste Complex (CWC).

3.4 Material Removal if Determined to be Suspect Transuranic (TRU) Waste

If analysis results of the core sample show that waste within the VPU is suspect TRU waste, retrieval of the stabilized contents of a VPU over-casing requires the reconfiguration of the drill rig, the placement of a retrieval enclosure (RE) over the over-casing, and the connection to the active HEPA-filtered negative pressure ventilation system. The RE contains a retrieval grab tool and a transfer mechanism to move retrieved contents from an over-cased VPU to 55-gallon drums. A drum loading area is located under the RE.

The RE will house remotely operated cameras, material transfer equipment that includes drum load out/in hardware, and support radiation monitoring equipment. The RE will be moved from one VPU to another and connected to each VPU's over-casing. Water spray jets are located at the top of the RE and provide a means for water spray during the retrieval operation to minimize dust and airborne contamination within the RE.

Drums will be moved into place beneath the RE using a mobile scissor lift. A plate on the bottom of the RE will open and the contents will fill the drum. Sufficient negative pressure will be maintained to prevent escape of contaminants.

The retrieval grab tool will contain lighting and a camera to assist in removal of the contents within the VPU over-casing. A separate operations trailer will house the computers/work stations to support the cameras, and operation of the drill rig and RE.

The RE will incorporate an engineered active ventilation system and a demister at the top of the over-casing to reduce emissions to acceptable levels and minimize the risk of a radionuclide airborne discharge to the environment during the retrieval operation. The active ventilation system will include inlet filters, pressure control flaps, two HEPA exhaust filters (1st and 2nd stage), down stream ducting, a downstream flow control damper, and an exhaust fan. A drawing of the RE is depicted in Figure 2.

3.5 Material Removal if Determined to be Low-Level Waste

If analysis results of the core sample show that material within the VPU is low-level waste and acceptable at the ERDF (i.e., not TRU or greater than Class C), then the over-casing will be removed and the augered VPU will be stabilized using a hollow shaft auger. The auger allows stabilization material (e.g., grout) to flow down the shaft and out of ports added in the cutting plate. The stabilization subsystem includes a truck and pump, stabilization mix, and connecting hoses/accessories. After stabilization, the VPU material will be remediated using conventional excavation methods and the waste will be loaded into ERDF containers. Active ventilation will not be used during this activity.

4.0 AIRBORNE SOURCE INFORMATION

There is a potential for radioactive airborne emissions resulting from the 618-10 and remediation activities. The primary radiological constituents of concern at the waste sites include plutonium, americium, uranium, strontium, yttrium, cesium, and barium. Other isotopes will be encountered, however, it is expected that dose estimated provided below are conservative and represent the upper bound of what will actually be found.

5.0 INVENTORY

The radionuclide annual possession quantities and subsequent potential emission calculations for the 618-10 Burial Ground are summarized in Attachments 1 through 4. The record review described in section 2.3 resulted in creation of a database of radiological information for the burial ground. This database was queried to develop a worksheet that indentified the population of waste drums and associated inventory that was used for the emission calculation. Since trench remediation and VPU remediation will occur sequentially, rather than simultaneously, their respective inventory and dose estimates are described separately.

5.1 Trench Remediation

For trench remediation, the burial ground inventory is divided into two categories which are 1) emitted as a point source through the DPF, and 2) emitted as a fugitive emission during remediation of the burial ground trenches. The point source emission category was formed by assembling all unshielded drums in the 618-10 trenches. The fugitive emissions category encompasses all remaining waste items, including shielded drums and 10% of the unshielded drums that will be processed through the drum punch facility (to account for degraded drums). Waste items in the 618-10 VPUs are excluded. The item count associated with each category and container size is shown in the table below.

Table 1. 618-10 Burial Ground Item Type and Count

Category				Total
Point Source (Drum Punch Facility)	Unshielded Drums			1283
Fugitive Emissions	Remaining waste items (3451)	Shielded Drums (972)	Degraded unshielded Drums (128 estimated)	4551
Total				5834

An additional source of inventory must also be considered. Well water is planned to be used as a dust suppressant to control potentially airborne contaminants during the remediation activities. Two water supply wells (200-PO-1 Operable Unit Groundwater) have been constructed approximately 1000 feet northwest of the 618-10 Burial Ground boundary for this purpose. Groundwater samples have been collected from monitoring wells at the Hanford Site for nearly 40 years and analytical results compiled into the Hanford Environmental Information System (HEIS) database. A search of the HEIS database for all analytical data from existing wells in the vicinity of the 618-10 site provided over 14,000 entries for non-radiological and radiological hazardous materials. The information provided from the database search will serve as the basis for determining an inventory of isotopes for the dust suppression water. This inventory will be counted in the fugitive emission inventory.

Drum characterization may consist of placing drums into the drum punch facility and obtaining a sample of up to 2L from each drum sampled. Conservatively, the entire inventory of unshielded drums is assumed to be emitted through the point source for purposes of the dose calculation. Shielded drums will not be processed through the drum punch facility.
There are three general types of drums:

1. Drums containing miscellaneous waste including metal turnings (such as uranium and Zircaloy), oxides and powders (including uranium oxide, and thorium oxide), and miscellaneous trash (contaminated objects, paper, plastic, cloth).

2. Drums containing detectable levels of plutonium (using a combination of gamma spectroscopy and neutron counting)

3. Drums in which the contents have been concreted.

Type 1 drums will be punched in the DPF with about a 6 inch hole, sampled (by removing approximately 2 liters of material) and overpacked for shipment to off site treatment, or returned to the excavation to be broken up and mixed with the soil, and loaded out for disposal at ERDF.

Type 2 drums will be punched in the DPF with a minimal size hole (no larger than about 1/2 inch) to vent gasses potentially generated through alpha radiolysis. These drums will not be sampled, but will be overpacked with a lid fitted with a NucFil (or equivalent) filter.

Type 3 drums will not be punched, but instead will be non-destructively assayed and non-destructively examined and overpacked for shipment to off site treatment, or returned to the excavation if assayed non-TRU, to be broken up and mixed with the soil, and loaded out for disposal at ERDF.

Consistent with WAC 246-247, a release fraction 1E-03 was applied to the inventory assuming all of the material disposed of is in the form of particulate. An exception is H-3 and Kr-85 which are multiplied by 1. The use of these release fractions is considered conservative because it will be used on waste forms including bulk soil, neutron irradiated items, fixed contamination, and volumetrically contaminated items. It is assumed that all trench remediation activities will occur over one year.

The CAP88-PC model was used to determine the total effective dose equivalent, or annual unabated offsite dose for trench remediation. The potential-to-emit (curies per year) were the input for the computer model, and the model generated the annual unabated dose. The CAP88-PC model summary and synopsis are presented in calculation 0600X-CA-V0087 (WCH 2011). The total effective dose equivalent (TEDE) to the hypothetical maximally exposed offsite individual (MEI) for trench remediation is 1.96E-01 mrem/yr. The TEDE to the MEI for drum characterization is 2.64E-02 mrem/yr. The MEI for both activities was located at Energy Northwest, which is located 4,265m to the North.

5.1.1 Special Considerations for Uranium Oxide and Bottle Treatment

Potential emissions and TEDE for burial ground activities are detailed in calculation 0600X-CA-V0087. The TEDE calculation estimated that 1155 drums, which included uranium oxide drums, would be processed through the drum punch facility. The result of the TEDE calculation showed that the drum punch facility is classified as a "minor stack" (TEDE < 0.1 mrem/yr to the maximally exposed offsite individual) For the planned onsite treatment of uranium oxide, these emissions would actually be in the diffuse/fugitive category rather than the point source (drum punch). Moving the site of potential emission from uranium oxide drums from the drum punch facility to being part of the fugitive emissions from the trenches (which were already categorized as a major unit) does not change the total PTE for the project or the major/minor unit status of the two areas.

5.2 VPU Remediation

The radionuclide inventory for the 618-10 Burial Ground VPUs was obtained from Table 16 of WCH, 2012a and shown in Attachment 5. The 618-10 VPUs received a broad spectrum of wastes primarily from the 300 Area of the Hanford Site. WCH, 2012a presents an overview of the results of the review of records that were kept of the disposal practices. Waste items included activated graphite, activated metal, weapons grade fuel, high exposure fuel, Neptunium targets, weapons grade Plutonium, high exposure Plutonium, fission and activation products removed during the plutonium uranium reduction and extraction (PUREX) chemical separation method, strontium, thorium, depleted uranium, and natural uranium.

The 618-10 burial ground operated between 1954 and 1963. During this period, information associated with shipment of waste to the 618-10 burial grounds was primarily documented in

Hanford technical documents, as well as radiation survey records, onsite radioactive shipment documents, and routine and repetitive survey forms.

Consistent with WAC 246-247, a release fraction 1E-03 was applied to the inventory assuming all of the material disposed of is in the form of particulate. An exception is H-3 and Kr-85 which are multiplied by 1.

Point source emissions could include those from the dual stage HEPA filters of the active ventilation system. Fugitive emissions could occur during the grouting and conventional excavation of the grouted VPUs (for each VPU determined to have ERDF acceptable waste). For purposes of calculating the unabated emission from VPU remediation, the entire VPU inventory was considered. In addition, to conservatively calculate the abated emission from the active ventilation system, the entire VPU inventory was considered, even though some of the inventory may actually be emitted as fugitive emissions. Consequently, VPU remediation potential emissions and TEDE are assumed to be from a point source.

The CAP88-PC model was used to determine the total effective dose equivalent, or annual unabated offsite dose to the hypothetical maximally exposed individual (MEI) for VPU remediation. Onsite receptors (Columbia Generating Station) will not consume vegetables, livestock, and milk grown/raised onsite, but rather from the MEI's hypothetical residence located off of the Hanford site. Therefore, the agriculture setting in the model was set to "imported" because a hypothetical MEI would not consume vegetables, livestock, and milk grown/raised on the Energy Northwest or LIGO site. To calculate the "imported" contribution to the onsite MEI from the MEI's residence located off of the Hanford site, the ingestion contribution from an offsite MEI case calculated with CAP88-PC was used. The ingestion value from the offsite CAP88-PC run was added to the individual TEDE calculated for the onsite CAP88-PC run in order to determine the total TEDE for the onsite MEI case.

An unabated dose of 1.19E+00 mrem/yr at 5508m to the North Northeast was calculated in WCH 2012b, but excludes the ingestion pathway. The ingestion value of 4.58E-01 mrem/yr calculated from the offsite TEDE MEI at 6107m to the Southeast was added to the onsite value of 1.19E+00 mrem/yr to arrive at a **total onsite TEDE of 1.65 mrem/yr** at 5508m to the NNE. Use of a two-stage active HEPA filtration system will be used with an in-place testable efficiency of ≥99.95% for removal of test aerosol particulate with a median diameter of 0.7 micron. Therefore, an abatement factor of 5E-04 will be applied when calculating an abated dose rate to particulates, but not gaseous emitters (H-3, Kr-85, Rn-219, Rn-220, and Rn-222). Although some activities may have the potential to emit in an unabated manner (e.g. sampling activities, open air remediation of VPUs deemed to contain relative low radiological inventory/transuranic materials), most of the inventory disturbing activities will be performed within the active ventilated enclosures. The abated dose rate was calculated as 1.31E-03 mrem/yr.

6.0 BEST AVAILABLE RADIONUCLIDE CONTROL TECHNOLOGY (BARCT)

The following is the BARCT to be implemented during the 618-10 remedial action.

6.1 Drum Venting Filters

The venting filters inserted in drums, if used, will be Nucfil™ filters or equivalent that are considered BARCT for radioactive emissions at the Hanford Site.

6.2 Drum Sampling and Overpacking – HEPA Filtration

During trench remediation, drum sampling activities will be conducted utilizing as low as reasonably achievable (ALARA) practices during the sampling/containerization campaign. These practices include isolating each drum prior to sampling, ensuring each drum is stabilized as appropriate, and utilizing safety precautions such as grounding equipment and non-sparking tools. If physical characterization is needed, the lids of intact waste drums will be pierced and drum contents sampled. Depending on specific radiological conditions for the drum, sampling may occur in the HEPA ventilated drum punch, or it may occur in a separate unventilated area. The HEPA ventilated drum punch unit is a fully enclosed, remotely operated structure designed to safely handle unvented drums.

The use of HEPA filters has been generally accepted as BARCT and their use is encouraged whenever practical during remediation activities. HEPA filters shall have efficiency testing performed upon installation and on an annual basis thereafter and must be demonstrated to 99.95% removal efficiency.

6.3 VPU Remediation – HEPA Filtration

The auger tool enclosure (ATE) and retrieval enclosure (RE) will be vented through an active ventilation system of the same design approved as BARCT by WDOH in Approval AIR 11-1006-F. This abatement technology will consist of 2 banks of HEPA filters with an in-place testable efficiency of 99.95% for removal of test aerosol particulate with a median diameter of 0.7 micron. In addition, negative pressure ensures no outleakage during routine operations.

The annual average volumetric flow rate through the intermittently operated ventilation system exhauster is 0.47 m3/sec (1000 cfm) providing up to 27.8 air exchanges per hour within the structures. Ventilation for this system will include inlet filters, pressure control flaps, an inlet demister pad, a heater unit, two (2) exhaust HEPA filters (1st and 2ndstage), downstream ducting, a downstream flow control damper, and an exhaust fan. Each HEPA filter stage will provide an in-place testable efficiency of at least 99.95% for removal of test aerosol particulate with a median diameter of 0.7 micron. The exhaust duct is 8 inches in diameter and will exhaust at least 3 feet above grade. When the system is in use the active ventilation system will be in operation. During ventilation system operation, airflow into this containment system will be through 30% efficient inlet filters. The demister and heater unit will prevent water buildup on the HEPA filters and allow operation when the humidity is above 70% relative humidity and/or when misting is used during retrieval operations to control contamination spread.
Control technology standard applicability and compliance for the VPU active ventilation system is discussed in Section 18.3 of DOE/RL-2001-57, rev. 6, *Radioactive Air Emission Notice of Construction for the Transuranic Waste Retrieval Project.*

6.4 Application of Dust Suppressants

The following describes the controls to be implemented during the excavation, sorting, size reduction, stockpiling, and bulk material loading:

- Water will be applied during excavation, sorting, size reduction, container loading, stockpiling, and backfilling processes to minimize airborne releases. Only the amount necessary to control airborne releases will be used so as to minimize the potential for downward migration of mobile contaminants.

- Soil fixatives will be applied to any contaminated soils and debris that will be inactive for more than 24 hours.

- Fixatives will be applied to contaminated soils and debris (including stockpiles) that will be inactive less than 24 hours at the end of work operations, if the sustained windspeed is predicted overnight to be greater than 32.2 kph (20 mph) based on the Hanford Meteorological Station morning forecast. This will allow the project enough time, if necessary, to prepare for the application of dust control measures. If a soil fixative has already been applied and the soil will remain undisturbed, further use of fixatives will not be needed. The fixatives or other controls will not be applied when the contaminated soils are frozen, or if it is raining, snowing, or other freezing precipitation is falling at the end of work operations.

- An entry will be made in the project logbook or equivalent when the forecast predicts, sustained wind speeds of greater than 32.2 kph (20 mph) and dust control is to be applied at the end of the work shift.

- Additional measures for controlling small debris in waste piles may be prudent based on waste site conditions as determined by project personnel. Some additional measures that may be used are: 1) apply a thin layer of other contaminated soil from the same waste site that is free of debris on the surface and follow normal fixative application, 2) apply a thin layer of uncontaminated soil that is free of debris on the surface and follow normal fixative application, 3) apply a bonded fiber fixative, 4) cover the area containing small debris that is easily re-suspended with a tarp or other appropriate material.

- Other dust suppression methods, such as processing magnesium chloride into the soil matrix, may be utilized.

- For uranium oxide and bottled liquid treatment, the practice of opening container under a layer of grout will be employed.

7.0 MONITORING – GENERAL

During remediation of the 618-10 Burial Ground, monitoring activities will consist of four previously established air monitoring stations (Figure 3). These air monitors will be located upwind and downwind of the burial ground. In addition, four thermoluminescent dosimeters

(TLDs) will be used to supplement the air monitoring data. The TLDs will be co-located with the air monitors (Figure 3).

These air monitors/TLDs are the means/methods to measure emissions. The operation of these monitors/TLDs will follow the protocol established for these programs. The data from these monitors/TLDs will be included in the annual reports prepared for the Hanford Site. Air samples are collected every two weeks and analyzed for total alpha and total beta. These samples are composited semi-annually and analyzed for isotopic uranium, isotopic plutonium, Am-241, Sr-90, and gamma emitting radionuclides (gamma energy analysis). Soil deposition samples will also be collected before, during, and after remediation. The samples will be obtained near the air monitor locations and will be analyzed for isotopic uranium, isotopic plutonium, Am-241, Sr-90, and gamma emitting radionuclides (gamma energy analysis).

The TLDs are collected and read quarterly.

Air monitors are run continuously during remediation activities and air monitor downtime will be minimized. If any one of the near facility air monitor stations is out of operation for more than 48 hours during normal work operations (excluding weekends and holidays), the regulatory agency will be notified. At least 3 air monitors must be operating for normal work operations, excavation and sampling activities to continue at the site.

Exhaust points from HEPA filters (and any ductwork, seams, or other potential release locations from enclosures) will be monitored on a routine basis for potential radionuclide releases and results recorded (e.g., post survey results negative). Any positive survey results will require appropriate maintenance on the facility to ensure that continued releases do not occur. In the event of positive survey results, work will stop and the cause investigated. The results of this investigation will be discussed with EPA before operations continue. Records of routine monitoring and necessary maintenance will be provided to regulatory staff upon request.

As part of the site-wide evaluation of near-facility monitoring (NFM) data, the electronic release summary database compares NFM composite air sample results to 10% of the Table 2 values, Appendix E, 40 CFR 61. The database identifies results that exceed these values. Results from the air monitors identified in this plan that are above these values will be investigated and the adequacy of the controls evaluated as appropriate.

During uranium oxide treatment and bottle processing at 618-10, a minimum of one portable air sampler will be deployed, as close to the work area boundary as practicable, in the predominant downwind direction. The air samplers that will be used are those that are employed daily by radiological control to assess the airborne radiological conditions present during operations. The resulting air samples will be processed in accordance with WCH procedures including RC-200-4.1 "Field Air Sampling" and RC-100-4.1 "Monitoring and Evaluating Airborne Radioactive Material". The air sample(s) will be collected and analyzed according to these procedures.

The air samples will be counted as soon as possible but no later than the next working morning. If the sample result is greater than or equal to 0.1 Total DAC (TDAC), the sample will be retained for further counting. If the sample result is less than 0.1 TDAC no further counting is required. If 72 calendar hours have elapsed since the sample was collected and the sample result is greater than or equal to 0.3 TDAC the sample will be sent to the Radiological Counting

Facility (RCF) for further analysis. All results are documented on the Air Sample Evaluation Record (ASER).

8.0 ALTERNATIVE MONITORING FOR VPU REMEDIATION POINT SOURCES

In lieu of installation of a continuous flow measurement and sample extraction system (WAC 246-247-040(5), WAC 246-247-060(5), WAC 246-247-075(4)), destructive examination of the final stage HEPA filter for the active ventilation system described in Section 6.3 above will occur. This destructive examination will be performed once per calendar year any time the system is used within the calendar year (DOE/RL, 2001).

Note: ™ Nucfil is a registered trademark of Nuclear Filter Technology Incorporated, 5161 Ward Rd., Wheat Ridge, CO 80033.

9.0 REFERENCES

DOE/RL, 2001, *Radioactive Air Emission Notice of Construction for the Transuranic Waste Retrieval Project,* DOE/RL-2001-57, Revision. 6, April 2011, U.S. Dept. of Energy-Richland Operation Office, Richland, Washington

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Attachment 1

Trench Item Potential to Emit (Fugitive)

Nuclide	Trench PTE (Ci/year)	Well Water PTE (Ci/year)	Total Fugitive PTE (Ci/year)
Ac-225	1.32E-15		1.32E-15
Ac-227	3.60E-08		3.60E-08
Ac-228	7.18E-05		7.18E-05
Am-241	2.79E-03		2.79E-03
Am-242	4.00E-07		4.00E-07
Am-242m	4.02E-07		4.02E-07
Am-243	2.26E-07		2.26E-07
At-217	1.32E-15		1.32E-15
Ba-137m	6.79E-02	1.35E-06	6.79E-02
Be-10	2.22E-10		2.22E-10
Be-7		8.79E-06	8.79E-06
Bi-210	2.07E-09		2.07E-09
Bi-211	3.60E-08		3.60E-08
Bi-212	7.16E-05		7.16E-05
Bi-213	1.32E-15		1.32E-15
Bi-214	5.52E-09		5.52E-09
C-14	5.24E-04	3.92E-07	5.25E-04
Ca-41	1.98E-05		1.98E-05
Ce-144		2.47E-06	2.47E-06
Cl-36	4.37E-06		4.37E-06
Cm-242	3.31E-07		3.31E-07
Cm-243	3.77E-08		3.77E-08
Cm-244	5.65E-07		5.65E-07
Cm-245	7.64E-11		7.64E-11
Cm-246	2.11E-12		2.11E-12
Co-58		2.52E-07	2.52E-07
Co-60	4.50E-06	1.50E-06	6.00E-06
Cs-134	1.46E-09	4.79E-07	4.80E-07
Cs-135	8.77E-07		8.77E-07
Cs-137	7.18E-02	1.42E-06	7.18E-02
Eu-152	2.31E-06	5.53E-07	2.86E-06
Eu-154	4.43E-05	7.56E-07	4.50E-05
Eu-155		1.30E-06	1.30E-06
Fe-59		7.73E-07	7.73E-07
Fr-221	1.32E-15		1.32E-15
Fr-223	4.97E-10		4.97E-10
H-3	5.40E-01	5.30E+00	5.84E+00
I-129	6.71E-08	3.99E-08	1.07E-07
K-40		1.30E-05	1.30E-05
Kr-85	9.19E-01		9.19E-01
Mo-93	7.08E-09		7.08E-09
Nb-93m	4.99E-06		4.99E-06
Nb-94	7.27E-08		7.27E-08
Ni-59	3.68E-06		3.68E-06
Ni-63	3.21E-04		3.21E-04
Np-237	5.70E-07		5.70E-07
Np-238	2.01E-09		2.01E-09
Np-239	2.26E-07		2.26E-07
Np-240m	2.22E-19		2.22E-19
Pa-231	7.05E-08		7.05E-08
Pa-233	5.70E-07		5.70E-07
Pa-234	4.00E-06		4.00E-06
Pa-234m	3.07E-03		3.07E-03
Pb-209	1.32E-15		1.32E-15
Pb-210	2.07E-09		2.07E-09
Pb-211	3.60E-08		3.60E-08
Pb-212	7.16E-05		7.16E-05
Pb-214	5.52E-09		5.52E-09
Pd-107	1.32E-07		1.32E-07
Po-210	2.07E-09		2.07E-09
Po-211	1.01E-10		1.01E-10

Nuclide	Trench PTE (Ci/year)	Well Water PTE (Ci/year)	Total Fugitive PTE (Ci/year)
Po-212	4.59E-05		4.59E-05
Po-213	1.29E-15		1.29E-15
Po-214	5.52E-09		5.52E-09
Po-215	3.60E-08		3.60E-08
Po-216	7.16E-05		7.16E-05
Po-218	5.52E-09		5.52E-09
Pu-238	4.70E-04	7.04E-09	4.70E-04
Pu-239	3.41E-03	1.11E-09	3.41E-03
Pu-240	1.10E-03		1.10E-03
Pu-241	7.95E-03		7.95E-03
Pu-242	1.79E-07		1.79E-07
Ra-223	3.60E-08		3.60E-08
Ra-224	7.16E-05		7.16E-05
Ra-225	1.32E-15		1.32E-15
Ra-226	5.52E-09		5.52E-09
Ra-228	7.18E-05		7.18E-05
Re-187	4.45E-13		4.45E-13
Rn-219	3.60E-08		3.60E-08
Rn-220	7.16E-05		7.16E-05
Rn-222	5.52E-09		5.52E-09
Ru-106		1.20E-05	1.20E-05
Sb-125		2.13E-06	2.13E-06
Sb-126	2.27E-07		2.27E-07
Sb-126m	1.62E-06		1.62E-06
Se-79	9.85E-07		9.85E-07
Sm-151	2.38E-03		2.38E-03
Sn-121m	2.97E-06		2.97E-06
Sn-126	1.62E-06		1.62E-06
Sr-90	6.97E-02	4.13E-08	6.97E-02
Tc-99	3.28E-05	9.25E-06	4.20E-05
Th-227	3.55E-08		3.55E-08
Th-228	7.16E-05		7.16E-05
Th-229	1.32E-15		1.32E-15
Th-230	4.96E-07		4.96E-07
Th-231	6.43E-05		6.43E-05
Th-232	7.20E-05		7.20E-05
Th-234	3.07E-03		3.07E-03
Tl-207	3.59E-08		3.59E-08
Tl-208	2.58E-05		2.58E-05
U-232	5.64E-09		5.64E-09
U-233	1.55E-10	7.05E-07	7.06E-07
U-234	1.06E-03	3.51E-06	1.07E-03
U-235	6.43E-05	1.88E-07	6.45E-05
U-236	2.00E-06		2.00E-06
U-237	1.95E-07		1.95E-07
U-238	3.07E-03	5.40E-06	3.08E-03
U-240	2.22E-19		2.22E-19
Y-90	6.97E-02	4.13E-08	6.97E-02
Zn-65		6.18E-07	6.18E-07
Zr-93	5.65E-06		5.65E-06
Zr-95		1.85E-05	1.85E-05

Notes:
Radionuclide potential to emit values are presented in Calculation 0600X-CA-V0087, *Total Effective Dose Emission Calculation for Remediation of the 618-10 Burial Ground,* rev. 0.

Attachment 2

Well Water Inventory and Potential to Emit (Fugitive)

A	B	C	D	E	F
Well Name	Nuclide	Concentration (pCi/L)	Concentration (Ci/L)	Activity (Ci)	PTE (Ci/year)
699-S6-E4D	Be-7	6.98E+01	6.98E-11	8.79E-03	8.79E-06
699-S6-E4A	C-14	3.11E+00	3.11E-12	3.92E-04	3.92E-07
699-S6-E4D	Ce/Pr-144 (1)	1.96E+01	1.96E-11	2.47E-03	2.47E-06
699-S6-E4A	Co-58	2.00E+00	2.00E-12	2.52E-04	2.52E-07
699-S6-E4B	Co-60	1.19E+01	1.19E-11	1.50E-03	1.50E-06
699-S6-E4A	Cs-134	3.80E+00	3.80E-12	4.79E-04	4.79E-07
699-S6-E4D	Cs-137	1.13E+01	1.13E-11	1.42E-03	1.42E-06
	Ba-137m (6)			1.35E-03	1.35E-06
699-S6-E4K	Eu-152	4.39E+00	4.39E-12	5.53E-04	5.53E-07
699-S6-E4D	Eu-154	6.00E+00	6.00E-12	7.56E-04	7.56E-07
699-S6-E4A	Eu-155	1.03E+01	1.03E-11	1.30E-03	1.30E-06
699-S6-E4A	Fe-59	6.14E+00	6.14E-12	7.73E-04	7.73E-07
699-S6-E4D	H-3 (5)	4.21E+04	4.21E-08	5.30E+00	5.30E+00
699-S6-E4D	I-129	3.17E-01	3.17E-13	3.99E-05	3.99E-08
699-S6-E4D	K-40	1.03E+02	1.03E-10	1.30E-02	1.30E-05
699-S6-E4A	Pu-238	5.59E-02	5.59E-14	7.04E-06	7.04E-09
699-S6-E4B	Pu-239/240 (2)	8.83E-03	8.83E-15	1.11E-06	1.11E-09
699-S6-E4D	Ru-106	9.54E+01	9.54E-11	1.20E-02	1.20E-05
699-S6-E4D	Sb-125	1.69E+01	1.69E-11	2.13E-03	2.13E-06
699-S6-E4A	Sr-90	3.28E-01	3.28E-13	4.13E-05	4.13E-08
	Y-90 (7)			4.13E-05	4.13E-08
699-S6-E4D	Tc-99	7.34E+01	7.34E-11	9.25E-03	9.25E-06
699-S6-E4L	U-233/234 (3)	5.60E+00	5.60E-12	7.05E-04	7.05E-07
699-S6-E4A	U-234	2.79E+01	2.79E-11	3.51E-03	3.51E-06
699-S6-E4A	U-235	1.49E+00	1.49E-12	1.88E-04	1.88E-07
699-S6-E4A	U-238	4.29E+01	4.29E-11	5.40E-03	5.40E-06
699-S6-E4D	Zn-65	4.91E+00	4.91E-12	6.18E-04	6.18E-07
699-S6-E4D	Zr/Nb-95 (4)	1.47E+02	1.47E-10	1.85E-02	1.85E-05

Notes:

(1) Assumed to be all Ce-144
(2) Assumed to be all Pu-239
(3) Assumed to be all U-233
(4) Assumed to be all Zr-95
(5) Release Fraction of 1 consistent with gaseous material form.
(6) Ba-137m, a daughter product of Cs-137, is assumed to be 0.946 of Cs-137 activity.
(7) Y-90, a daughter product of Sr-90, is assumed to be in equal proportion to Sr-90.
(8) Radionuclide potential to emit values are presented in Calculation 0600X-CA-V0087, *Total Effective Dose Emission Calculation for Remediation of the 618-10 Burial Ground,* rev. 0.

Attachment 3

Fugitive and Well Water Combined Potential to Emit And Total Effective Dose Equivalent

Nuclide	Trench PTE (Ci/year)	Well Water PTE (Ci/year)	Total Fugitive PTE (Ci/year)
Ac-225	1.32E-15		1.32E-15
Ac-227	3.60E-08		3.60E-08
Ac-228	7.18E-05		7.18E-05
Am-241	2.79E-03		2.79E-03
Am-242	4.00E-07		4.00E-07
Am-242m	4.02E-07		4.02E-07
Am-243	2.26E-07		2.26E-07
At-217	1.32E-15		1.32E-15
Ba-137m	6.79E-02	1.35E-06	6.79E-02
Be-10	2.22E-10		2.22E-10
Be-7		8.79E-06	8.79E-06
Bi-210	2.07E-09		2.07E-09
Bi-211	3.60E-08		3.60E-08
Bi-212	7.16E-05		7.16E-05
Bi-213	1.32E-15		1.32E-15
Bi-214	5.52E-09		5.52E-09
C-14	5.24E-04	3.92E-07	5.25E-04
Ca-41	1.98E-05		1.98E-05
Ce-144		2.47E-06	2.47E-06
Cl-36	4.37E-06		4.37E-06
Cm-242	3.31E-07		3.31E-07
Cm-243	3.77E-08		3.77E-08
Cm-244	5.65E-07		5.65E-07
Cm-245	7.64E-11		7.64E-11
Cm-246	2.11E-12		2.11E-12
Co-58		2.52E-07	2.52E-07
Co-60	4.50E-06	1.50E-06	6.00E-06
Cs-134	1.46E-09	4.79E-07	4.80E-07
Cs-135	8.77E-07		8.77E-07
Cs-137	7.18E-02	1.42E-06	7.18E-02
Eu-152	2.31E-06	5.53E-07	2.86E-06
Eu-154	4.43E-05	7.56E-07	4.50E-05
Eu-155		1.30E-06	1.30E-06
Fe-59		7.73E-07	7.73E-07
Fr-221	1.32E-15		1.32E-15
Fr-223	4.97E-10		4.97E-10
H-3	5.40E-01	5.30E+00	5.84E+00
I-129	6.71E-08	3.99E-08	1.07E-07
K-40		1.30E-05	1.30E-05
Kr-85	9.19E-01		9.19E-01
Mo-93	7.08E-09		7.08E-09
Nb-93m	4.99E-06		4.99E-06
Nb-94	7.27E-08		7.27E-08
Ni-59	3.68E-06		3.68E-06
Ni-63	3.21E-04		3.21E-04
Np-237	5.70E-07		5.70E-07
Np-238	2.01E-09		2.01E-09
Np-239	2.26E-07		2.26E-07
Np-240m	2.22E-19		2.22E-19
Pa-231	7.05E-08		7.05E-08
Pa-233	5.70E-07		5.70E-07
Pa-234	4.00E-06		4.00E-06
Pa-234m	3.07E-03		3.07E-03
Pb-209	1.32E-15		1.32E-15
Pb-210	2.07E-09		2.07E-09
Pb-211	3.60E-08		3.60E-08
Pb-212	7.16E-05		7.16E-05
Pb-214	5.52E-09		5.52E-09
Pd-107	1.32E-07		1.32E-07
Po-210	2.07E-09		2.07E-09
Po-211	1.01E-10		1.01E-10

Nuclide	Trench PTE (Ci/year)	Well Water PTE (Ci/year)	Total Fugitive PTE (Ci/year)
Po-212	4.59E-05		4.59E-05
Po-213	1.29E-15		1.29E-15
Po-214	5.52E-09		5.52E-09
Po-215	3.60E-08		3.60E-08
Po-216	7.16E-05		7.16E-05
Po-218	5.52E-09		5.52E-09
Pu-238	4.70E-04	7.04E-09	4.70E-04
Pu-239	3.41E-03	1.11E-09	3.41E-03
Pu-240	1.10E-03		1.10E-03
Pu-241	7.95E-03		7.95E-03
Pu-242	1.79E-07		1.79E-07
Ra-223	3.60E-08		3.60E-08
Ra-224	7.16E-05		7.16E-05
Ra-225	1.32E-15		1.32E-15
Ra-226	5.52E-09		5.52E-09
Ra-228	7.18E-05		7.18E-05
Re-187	4.45E-13		4.45E-13
Rn-219	3.60E-08		3.60E-08
Rn-220	7.16E-05		7.16E-05
Rn-222	5.52E-09		5.52E-09
Ru-106		1.20E-05	1.20E-05
Sb-125		2.13E-06	2.13E-06
Sb-126	2.27E-07		2.27E-07
Sb-126m	1.62E-06		1.62E-06
Se-79	9.85E-07		9.85E-07
Sm-151	2.38E-03		2.38E-03
Sn-121m	2.97E-06		2.97E-06
Sn-126	1.62E-06		1.62E-06
Sr-90	6.97E-02	4.13E-08	6.97E-02
Tc-99	3.28E-05	9.25E-06	4.20E-05
Th-227	3.55E-08		3.55E-08
Th-228	7.16E-05		7.16E-05
Th-229	1.32E-15		1.32E-15
Th-230	4.96E-07		4.96E-07
Th-231	6.43E-05		6.43E-05
Th-232	7.20E-05		7.20E-05
Th-234	3.07E-03		3.07E-03
Tl-207	3.59E-08		3.59E-08
Tl-208	2.58E-05		2.58E-05
U-232	5.64E-09		5.64E-09
U-233	1.55E-10	7.05E-07	7.06E-07
U-234	1.06E-03	3.51E-06	1.07E-03
U-235	6.43E-05	1.88E-07	6.45E-05
U-236	2.00E-06		2.00E-06
U-237	1.95E-07		1.95E-07
U-238	3.07E-03	5.40E-06	3.08E-03
U-240	2.22E-19		2.22E-19
Y-90	6.97E-02	4.13E-08	6.97E-02
Zn-65		6.18E-07	6.18E-07
Zr-93	5.65E-06		5.65E-06
Zr-95		1.85E-05	1.85E-05

Trench Fugitive Category Total Effective Dose Equivalent

Nuclide	TEDE (mrem/y)
Am-242m	4.77E-06
Am-242	2.29E-09
Cm-242	5.47E-07
Pu-238	6.97E-03
U-234	1.25E-03
Th-230	2.31E-06
Ra-226	6.02E-09
Rn-222	1.52E-16
Po-218	2.87E-18
Pb-214	2.37E-11
Bi-214	2.58E-11
Po-214	2.60E-17
Pb-210	7.20E-10
Bi-210	6.07E-11
Po-210	2.13E-09
At-218	0.00E+00
Pu-242	2.73E-06
U-238	2.96E-03
Th-234	1.38E-05
Pa-234m	5.61E-06
Pa-234	1.88E-07
Np-238	1.42E-12
Be-10	0.00E+00
Be-7	2.97E-09
C-14	1.66E-06
Ca-41	9.05E-08
Ce-144	4.02E-08
Pr-144m	2.89E-12
Pr-144	3.93E-11
Cl-36	8.24E-06
Cm-243	3.76E-07
Am-243	2.99E-06
Np-239	8.79E-11
Pu-239	5.49E-02
U-235	6.70E-05
Th-231	2.38E-08
Pa-231	2.13E-06
Ac-227	8.27E-07
Th-227	1.16E-07
Ra-223	8.44E-08
Rn-219	1.37E-13
Po-215	3.47E-16
Pb-211	1.26E-10
Bi-211	9.08E-14
Tl-207	2.01E-14
Po-211	0.00E+00
Fr-223	0.00E+00
Cm-244	4.82E-06
Pu-240	1.77E-02
U-236	2.15E-06
Th-232	5.82E-04
Ra-228	2.01E-04
Ac-228	1.41E-06

Th-228	9.01E-04
Ra-224	6.76E-05
Rn-220	1.91E-12
Po-216	1.78E-11
Pb-212	4.02E-06
Bi-212	9.45E-07
Po-212	0.00E+00
Tl-208	1.18E-06
Cm-245	0.00E+00
Pu-241	2.30E-03
Am-241	3.74E-02
Np-237	4.19E-06
Pa-233	2.80E-09
U-233	8.40E-07
Th-229	0.00E+00
Ra-225	0.00E+00
Ac-225	0.00E+00
Fr-221	0.00E+00
At-217	0.00E+00
Bi-213	0.00E+00
Po-213	0.00E+00
Pb-209	0.00E+00
Tl-209	0.00E+00
U-237	5.25E-10
Co-58	2.76E-09
Co-60	6.42E-07
Cs-134	2.25E-07
Cs-135	4.76E-08
Cs-137	2.61E-02
Ba-137m	6.61E-04
Eu-152	9.46E-08
Gd-152	0.00E+00
Eu-154	1.76E-06
Eu-155	4.57E-09
Fe-59	6.58E-09
I-129	1.48E-07
K-40	2.65E-06
Kr-85	3.41E-07
Mo-93	1.32E-12
Nb-93m	1.75E-09
Nb-94	2.27E-09
Ni-59	3.04E-09
Ni-63	6.54E-07
Pd-107	2.46E-11
Ru-106	2.61E-07
Rh-106	5.83E-08
Sb-125	2.05E-08
Te-125m	1.17E-09
Se-79	7.90E-08
Sm-151	3.32E-06
Sn-121m	2.01E-08
Sn-121	1.24E-11
Sn-126	1.24E-07
Sb-126m	4.23E-08
Sb-126	1.09E-08
Sr-90	4.35E-02
Y-90	1.61E-04
Tc-99	4.58E-06
U-232	1.39E-08

Zn-65	7.88E-08
Zr-93	2.56E-08
Zr-95	1.31E-07
Nb-95m	4.63E-11
Nb-95	4.14E-10
H-3	4.27E-04
Cm-246	0.00E+00
TOTAL	1.96E-01

Notes:
The annual unabated dose was determined using the CAP88-PC, Version 2 Model. The PTE was the input for the model, and the model generated the annual unabated dose. The CAP88-PC model summary and synopsis is presented in 0600X-CA-V0087, *Total Effective Dose Emission Calculation for Remediation of the 618-10 Burial Ground,* rev. 0.

Attachment 4

Drum Punch Facility Inventory, Potential to Emit and Total Effective Dose Equivalent

Nuclide	Activity (Ci)	PTE (Ci/year)
Ac-225	1.499E-15	1.50E-18
Ac-227	1.350E-04	1.35E-07
Ac-228	1.196E-01	1.20E-04
Am-241	4.108E-02	4.11E-05
Am-242	8.350E-06	8.35E-09
Am-242m	8.391E-06	8.39E-09
Am-243	4.848E-06	4.85E-09
At-217	1.499E-15	1.50E-18
Ba-137m	6.652E-01	6.65E-04
Be-10	3.246E-10	3.25E-13
Bi-210	4.738E-06	4.74E-09
Bi-211	1.351E-04	1.35E-07
Bi-212	1.194E-01	1.19E-04
Bi-213	1.499E-15	1.50E-18
Bi-214	1.262E-05	1.26E-08
C-14	8.407E-05	8.41E-08
Cm-242	6.906E-06	6.91E-09
Cm-243	8.330E-07	8.33E-10
Cm-244	1.253E-05	1.25E-08
Cm-245	1.715E-09	1.71E-12
Cm-246	4.773E-11	4.77E-14
Co-60	5.918E-06	5.92E-09
Cs-134	2.061E-08	2.06E-11
Cs-135	8.572E-06	8.57E-09
Cs-137	7.033E-01	7.03E-04
Eu-152	1.644E-05	1.64E-08
Eu-154	6.262E-04	6.26E-07
Fr-221	1.499E-15	1.50E-18
Fr-223	1.862E-06	1.86E-09
H-3	6.688E-04	6.69E-04
I-129	6.785E-07	6.78E-10
Kr-85	8.702E-03	8.70E-03
Mo-93	1.035E-08	1.03E-11
Nb-93m	4.006E-05	4.01E-08
Nb-94	2.111E-09	2.11E-12
Ni-59	5.026E-06	5.03E-09
Ni-63	4.319E-04	4.32E-07
Np-237	6.686E-06	6.69E-09
Np-238	4.197E-08	4.20E-11
Np-239	4.848E-06	4.85E-09
Np-240m	4.264E-18	4.26E-21
Pa-231	2.644E-04	2.64E-07
Pa-233	6.686E-06	6.69E-09
Pa-234	2.465E-02	2.47E-05
Pa-234m	1.896E+01	1.90E-02
Pb-209	1.499E-15	1.50E-18
Pb-210	4.737E-06	4.74E-09
Pb-211	1.351E-04	1.35E-07
Pb-212	1.194E-01	1.19E-04
Pb-214	1.262E-05	1.26E-08
Pd-107	1.518E-06	1.52E-09
Po-210	4.738E-06	4.74E-09
Po-211	3.782E-07	3.78E-10
Po-212	7.652E-02	7.65E-05
Po-213	1.467E-15	1.47E-18
Po-214	1.262E-05	1.26E-08
Po-215	1.351E-04	1.35E-07
Po-216	1.194E-01	1.19E-04
Po-218	1.262E-05	1.26E-08
Pu-238	6.591E-03	6.59E-06
Pu-239	3.142E-02	3.14E-05
Pu-240	1.322E-02	1.32E-05

Nuclide	Activity (Ci)	PTE (Ci/year)
Pu-241	1.164E-01	1.16E-04
Pu-242	3.134E-06	3.13E-09
Ra-223	1.351E-04	1.35E-07
Ra-224	1.194E-01	1.19E-04
Ra-225	1.499E-15	1.50E-18
Ra-226	1.262E-05	1.26E-08
Ra-228	1.196E-01	1.20E-04
Re-187	6.381E-13	6.38E-16
Rn-219	1.351E-04	1.35E-07
Rn-220	1.194E-01	1.19E-04
Rn-222	1.262E-05	1.26E-08
Sb-126	2.306E-06	2.31E-09
Sb-126m	1.647E-05	1.65E-08
Se-79	9.586E-06	9.59E-09
Sm-151	1.941E-02	1.94E-05
Sn-121m	5.826E-06	5.83E-09
Sn-126	1.647E-05	1.65E-08
Sr-90	5.510E-01	5.51E-04
Tc-99	3.198E-04	3.20E-07
Th-227	1.333E-04	1.33E-07
Th-228	1.194E-01	1.19E-04
Th-229	1.499E-15	1.50E-18
Th-230	1.133E-03	1.13E-06
Th-231	2.413E-01	2.41E-04
Th-232	1.200E-01	1.20E-04
Th-234	1.896E+01	1.90E-02
Tl-207	1.347E-04	1.35E-07
Tl-208	4.292E-02	4.29E-05
U-232	7.835E-08	7.83E-11
U-233	1.778E-09	1.78E-12
U-234	2.432E+00	2.43E-03
U-235	2.413E-01	2.41E-04
U-236	1.812E-05	1.81E-08
U-237	2.857E-06	2.86E-09
U-238	1.896E+01	1.90E-02
U-240	4.264E-18	4.26E-21
Y-90	5.512E-01	5.51E-04
Zr-93	4.535E-05	4.54E-08

Notes:
Radionuclide potential to emit and total effective dose equivalent values are presented in Calculation 0600X-CA-V0087, *Total Effective Dose Emission Calculation for Remediation of the 618-10 Burial Ground*, rev. 0.

Drum Punch Point Source Category Total Effective Dose Equivalent

Nuclide	TEDE mrem/y)
Am-242m	9.76E-08
Am-242	4.55E-11
Cm-242	1.01E-08
Pu-238	9.76E-05
U-234	2.82E-03
Th-230	5.26E-06
Ra-226	1.37E-08
Rn-222	3.47E-16
Po-218	6.55E-18
Pb-214	5.40E-11
Bi-214	5.89E-11
Po-214	5.93E-17
Pb-210	1.65E-09
Bi-210	1.39E-10
Po-210	4.88E-09
At-218	0.00E+00
Pu-242	4.69E-08
U-238	1.82E-02
Th-234	8.51E-05
Pa-234m	3.46E-05
Pa-234	1.16E-06
Np-238	0.00E+00
C-14	2.66E-10
Cm-243	0.00E+00
Am-243	6.29E-08
Np-239	1.46E-12
Pu-239	5.05E-04
U-235	2.50E-04
Th-231	8.89E-08
Pa-231	7.95E-06
Ac-227	3.15E-06
Th-227	4.35E-07
Ra-223	3.28E-07
Rn-219	5.13E-13
Po-215	3.81E-13
Pb-211	6.86E-10
Bi-211	9.98E-11
Tl-207	1.25E-10
Po-211	0.00E+00
Fr-223	6.11E-12
Cm-244	1.05E-07
Pu-240	2.12E-04
U-236	1.83E-08
Th-232	9.69E-04
Ra-228	3.35E-04
Ac-228	2.36E-06
Th-228	1.50E-03
Ra-224	1.12E-04
Rn-220	3.16E-12
Po-216	2.95E-11
Pb-212	6.68E-06
Bi-212	1.57E-06
Po-212	0.00E+00

Tl-208	1.96E-06
Cm-245	0.00E+00
Pu-241	3.35E-05
Am-241	5.50E-04
Np-237	4.78E-08
Pa-233	7.09E-12
U-233	0.00E+00
Th-229	0.00E+00
Ra-225	0.00E+00
Ac-225	0.00E+00
Fr-221	0.00E+00
At-217	0.00E+00
Bi-213	0.00E+00
Po-213	0.00E+00
Pb-209	0.00E+00
Tl-209	0.00E+00
U-237	1.51E-12
Co-60	1.99E-11
Cs-134	0.00E+00
Cs-135	1.86E-12
Cs-137	2.56E-04
Ba-137m	6.47E-06
Eu-152	2.18E-10
Gd-152	0.00E+00
Eu-154	2.44E-08
H-3	4.89E-08
I-129	0.00E+00
Kr-85	3.23E-09
Mo-93	0.00E+00
Nb-93m	1.27E-11
Nb-94	0.00E+00
Ni-59	2.09E-13
Ni-63	8.80E-10
Pd-107	4.07E-14
Se-79	3.43E-12
Sm-151	2.70E-08
Sn-121m	8.17E-12
Sn-121	0.00E+00
Sn-126	1.47E-10
Sb-126m	1.53E-12
Sb-126	2.45E-12
Sr-90	3.43E-04
Y-90	1.27E-06
Tc-99	3.48E-08
U-232	0.00E+00
Zr-93	2.05E-10
TOTAL	2.64E-02

Attachment 5

Vertical Pipe Unit, Point Source Emission Potential to Emit and Total Effective Dose Equivalent

Nuclide	Inventory (Ci)	PTE (Ci/yr)
H-3	1.066E+01	1.066E+01
Be-10	5.625E-04	5.625E-07
C-14	1.456E+02	1.456E-01
Cl-36	5.218E-04	5.218E-07
Ca-41	2.360E-03	2.360E-06
Co-60	1.050E+01	1.050E-02
Ni-59	8.799E+00	8.799E-03
Ni-63	7.511E+02	7.511E-01
Se-79	1.193E-02	1.193E-05
Kr-85	1.068E+01	1.068E+01
Sr-90	6.758E+02	6.758E-01
Y-90	6.761E+02	6.761E-01
Zr-93	2.806E+00	2.806E-03
Nb-93m	2.477E+00	2.477E-03
Nb-94	4.071E-05	4.071E-08
Mo-93	1.790E-02	1.790E-05
Tc-99	3.994E-01	3.994E-04
Pd-107	2.039E-03	2.039E-06
Sn-121m	7.124E+00	7.124E-03
Sn-126	2.096E-02	2.096E-05
Sb-126	2.934E-03	2.934E-06
Sb-126m	2.096E-02	2.096E-05
I-129	8.604E-04	8.604E-07
Cs-134	2.970E-05	2.970E-08
Cs-135	1.069E-02	1.069E-05
Cs-137	8.782E+02	8.782E-01
Ba-137m	8.307E+02	8.307E-01
Sm-151	2.181E+01	2.181E-02
Eu-152	2.374E-02	2.374E-05
Eu-154	9.043E-01	9.043E-04
Re-187	1.128E-06	1.128E-09
Tl-207	3.331E-06	3.331E-09
Tl-208	4.143E-05	4.143E-08
Pb-209	8.423E-17	8.423E-20
Pb-210	2.948E-07	2.948E-10
Pb-211	3.340E-06	3.340E-09
Pb-212	1.153E-04	1.153E-07
Pb-214	7.784E-07	7.784E-10
Bi-210	2.949E-07	2.949E-10
Bi-211	3.340E-06	3.340E-09
Bi-212	1.153E-04	1.153E-07
Bi-213	8.423E-17	8.423E-20
Bi-214	7.784E-07	7.784E-10
Po-210	2.949E-07	2.949E-10
Po-211	1.583E-09	1.583E-12
Po-212	7.390E-05	7.390E-08
Po-213	8.240E-17	8.240E-20
Po-214	7.784E-07	7.784E-10
Po-215	3.340E-06	3.340E-09

Nuclide	Inventory (Ci)	PTE (Ci/yr)
Po-216	1.153E-04	1.153E-07
Po-218	7.787E-07	7.787E-10
At-217	8.423E-17	8.423E-20
Rn-219	3.340E-06	3.340E-06
Rn-220	1.153E-04	1.153E-04
Rn-222	7.787E-07	7.787E-07
Fr-221	8.423E-17	8.423E-20
Fr-223	4.604E-08	4.604E-11
Ra-223	3.340E-06	3.340E-09
Ra-224	1.153E-04	1.153E-07
Ra-225	8.423E-17	8.423E-20
Ra-226	7.787E-07	7.787E-10
Ac-225	8.423E-17	8.423E-20
Ac-227	3.336E-06	3.336E-09
Th-227	3.294E-06	3.294E-09
Th-228	1.153E-04	1.153E-07
Th-229	8.423E-17	8.423E-20
Th-230	6.911E-05	6.911E-08
Th-231	5.705E-03	5.705E-06
Th-234	1.156E-01	1.156E-04
Pa-231	6.431E-06	6.431E-09
Pa-233	8.640E-03	8.640E-06
Pa-234	1.503E-04	1.503E-07
Pa-234m	1.156E-01	1.156E-04
U-232	1.123E-04	1.123E-07
U-233	2.270E-06	2.270E-09
U-234	1.470E-01	1.470E-04
U-235	5.705E-03	5.705E-06
U-236	1.983E-02	1.983E-05
U-237	4.222E-03	4.222E-06
U-238	1.156E-01	1.156E-04
U-240	6.760E-15	6.760E-18
Np-237	8.640E-03	8.640E-06
Np-238	6.611E-05	6.611E-08
Np-239	7.683E-03	7.683E-06
Np-240m	6.760E-15	6.760E-18
Pu-238	9.603E+00	9.603E-03
Pu-239	3.799E+01	3.799E-02
Pu-240	1.824E+01	1.824E-02
Pu-241	1.720E+02	1.720E-01
Pu-242	4.863E-03	4.863E-06
Am-241	6.073E+01	6.073E-02
Am-242	1.315E-02	1.315E-05
Am-242m	1.322E-02	1.322E-05
Am-243	7.683E-03	7.683E-06
Cm-242	1.088E-02	1.088E-05
Cm-243	1.330E-03	1.330E-06
Cm-244	2.002E-02	2.002E-05
Cm-245	2.746E-06	2.746E-09
Cm-246	7.656E-08	7.656E-11

Notes:

Radionuclide potential to emit and total effective dose equivalent values are presented in Calculation 0600X-CA-V0131, *Total Effective Dose Emission Calculation for Remediation of the 618-10 Burial Ground Vertical Pipe Units*, rev. 0.

Nuclide	TEDE ONSITE (mrem/y)
H-3	7.72E-05
Be-10	1.09E-09
C-14	5.87E-05
Cl-36	8.20E-10
Ca-41	4.44E-11
Co-60	2.70E-04
Ni-59	2.30E-07
Ni-63	7.05E-05
Se-79	2.69E-09
Kr-85	2.52E-06
Sr-90	4.78E-03
Y-90	9.74E-04
Zr-93	5.69E-06
Nb-93m	2.66E-07
Nb-94	6.47E-10
Mo-93	2.84E-09
Tc-99	3.19E-07
Pd-107	3.44E-11
Sn-121m	6.56E-06
Sn-121	6.00E-09
Sn-126	1.29E-07
Sb-126m	3.45E-07
Sb-126	8.67E-08
I-129	5.98E-10
Cs-134	4.10E-11
Cs-135	1.47E-09
Cs-137	8.42E-04
Ba-137m	5.10E-03
Sm-151	1.72E-05
Eu-152	4.65E-07
Gd-152	0.00E+00
Eu-154	2.06E-05
Re-187	1.41E-15
U-232	1.74E-07
Th-228	9.08E-07
Ra-224	6.80E-08
Rn-220	5.77E-15
Po-216	1.82E-14
Pb-212	9.72E-09
Bi-212	1.04E-09
Po-212	0.00E+00
Tl-208	6.42E-10
Am-242m	9.69E-05
Am-242	4.74E-08
Cm-242	1.12E-05
Pu-238	8.80E-02
U-234	1.01E-04
Th-230	1.92E-07
Ra-226	0.00E+00
Rn-222	1.36E-14
Po-218	3.68E-15
Pb-214	3.27E-10
Bi-214	6.08E-10
Po-214	3.20E-14

At-218	0.00E+00
Pu-242	4.59E-05
U-238	6.55E-05
Th-234	1.86E-07
Pa-234m	1.33E-07
Pa-234	6.37E-09
Np-238	3.86E-10
Cm-243	8.31E-06
Am-243	6.28E-05
Np-239	1.90E-09
Pu-239	3.78E-01
U-235	3.50E-06
Th-231	1.33E-09
Pa-231	1.19E-07
Ac-227	4.82E-08
Th-227	6.78E-09
Ra-223	4.93E-09
Rn-219	8.06E-15
Po-215	2.03E-17
Pb-211	1.88E-11
Bi-211	1.34E-14
Tl-207	2.19E-15
Po-211	0.00E+00
Fr-223	0.00E+00
Cm-244	1.06E-04
Pu-240	1.81E-01
U-236	1.26E-05
Th-232	0.00E+00
Ra-228	0.00E+00
Ac-228	0.00E+00
Cm-245	2.31E-08
Pu-241	3.07E-02
Am-241	5.02E-01
Np-237	3.89E-05
Pa-233	2.29E-08
U-233	1.60E-09
Th-229	0.00E+00
Ra-225	0.00E+00
Ac-225	0.00E+00
Fr-221	0.00E+00
At-217	0.00E+00
Bi-213	0.00E+00
Po-213	0.00E+00
Pb-209	0.00E+00
Tl-209	0.00E+00
U-237	6.90E-09
TOTAL	1.19E+00

Figure 1 VPU *In Situ* Stabilization and Size Reduction

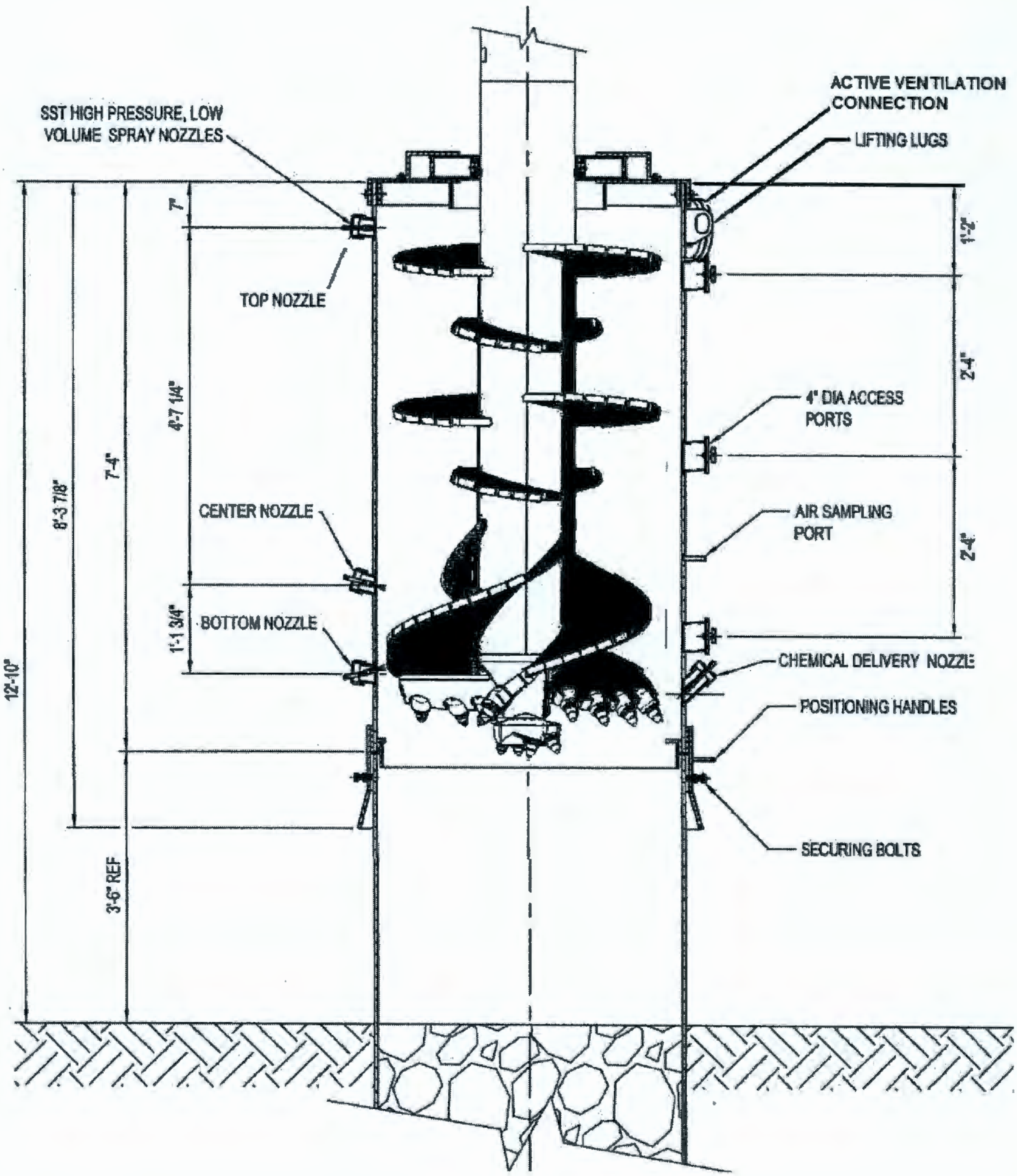


Figure 2 Retrieval Enclosure for Vertical Pipe Unit Remediation

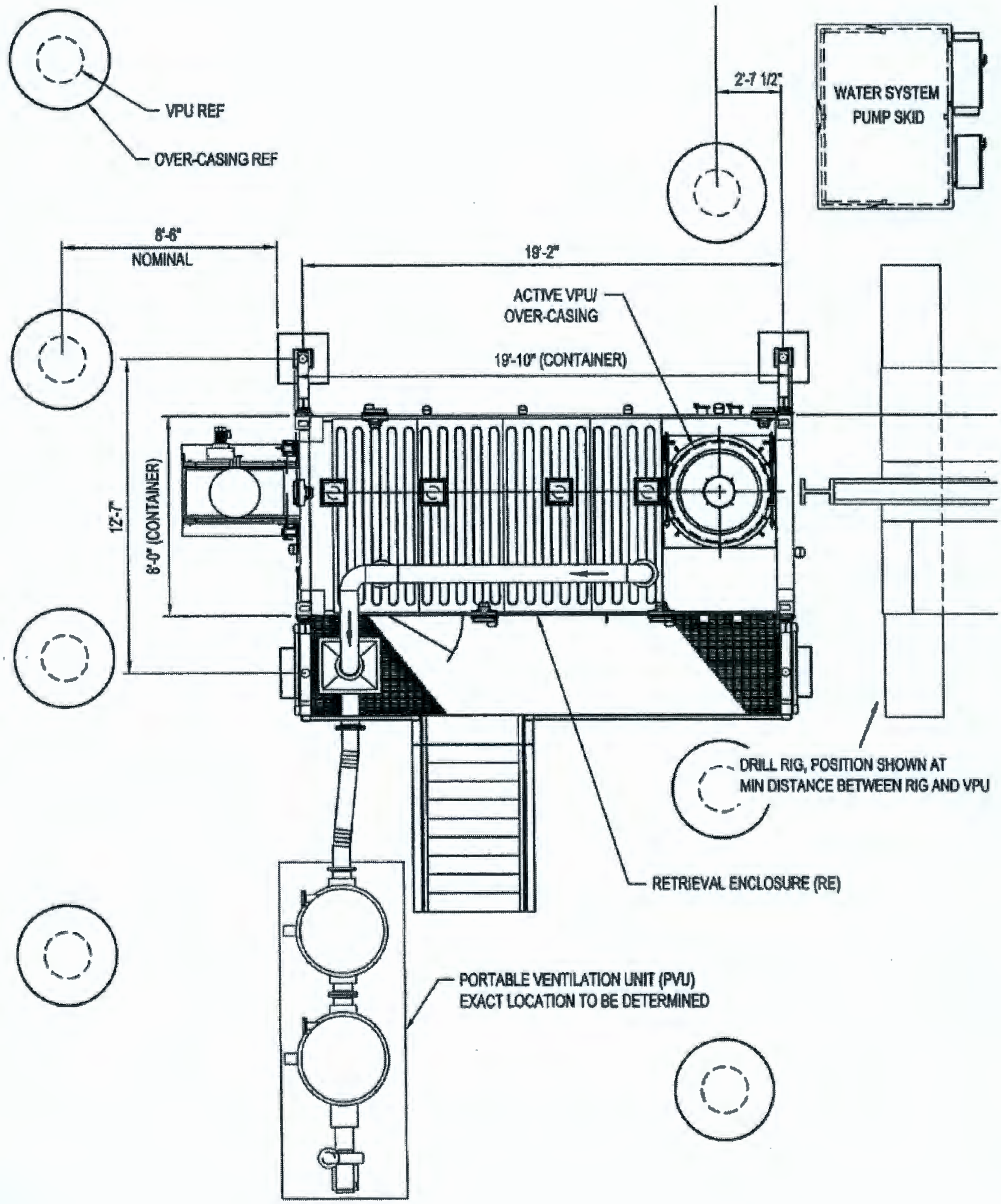
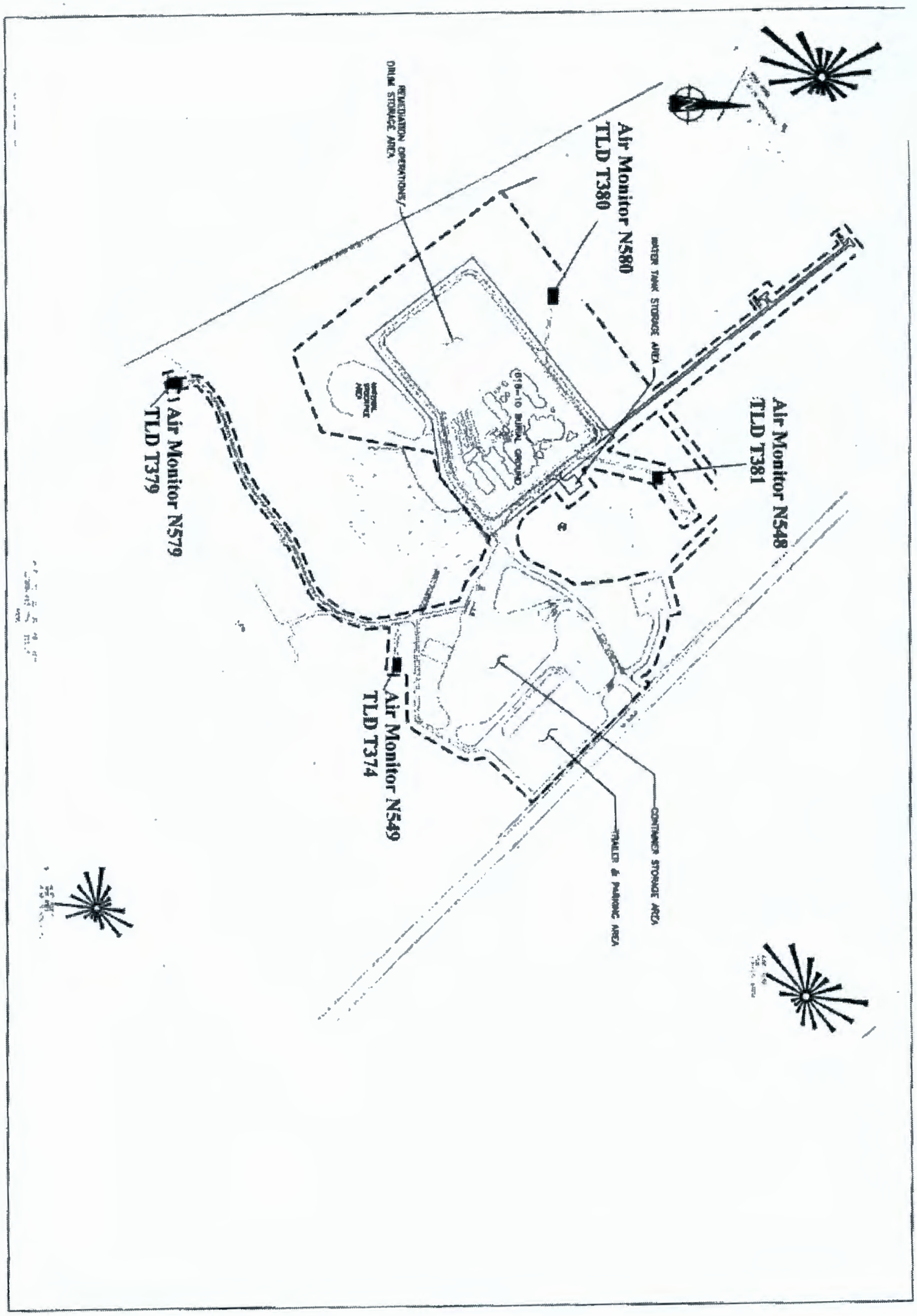


Figure 3 618-10 Near Facility Air Monitor and TLD Locations



APPROVAL PAGE

Title: Air Monitoring Plan for the Remediation of the 618-10 Burial Ground, September 2012

Approval: J Zeisloft
U.S. Department of Energy
Richland Operations Office

Signature: [signature] Date: 10/10/12

LE Gadbois
U.S. Environmental Protection Agency

Signature: Larry Gadbois Date: Oct 18, 2012