INFORMATION CLEARANCE FORM

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B. Document Number DOE/RL-99-34

C. Title

Notice of Construction for Tank Waste Remediation System
Vadose Zone Characterization

D. Internet Address

E. Required Information

1. Is document potentially Classified? ☒ No ☐ Yes (MANDATORY)

E. M. Greager
Manager's Signature Required

If Yes _____ ☒ No ☐ Yes Classified
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Counsel _____
Program _____

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K. If Additional Comments, Please Attach Separate Sheet

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

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99-EAP-328

JUN 03 1999

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Seattle, Washington 98101

Dear Addresses:

**NOTICE OF CONSTRUCTION (NOC) FOR TANK WASTE REMEDIATION SYSTEM
VADOSE ZONE CHARACTERIZATION**

The enclosed document serves as a NOC, pursuant to the requirements of Washington Administrative Code 246-247-060, and as a request for approval of construct, pursuant to 40 Code of Federal Regulations 61.07 for Vadose Zone characterization activities to be performed on the Hanford site over the next several years. These activities are a key component of the U.S. Department of Energy's understanding of the Vadose Zone near single-shell tanks. Should you have any questions, please contact Art Ingle, of my staff, on (509) 372-1822.

Sincerely,

James E. Rasmussen, Director
Environmental Assurance, Permits,
and Policy Division

MSO:DWB

Enclosure

cc: See page 2

Addresses
99-EAP-328

-2-

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Lockheed Martin Hanford Corporation
P.O. Box 1500
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May 4, 1999

Mr. J. C. Peschong, Program Manager
Office of River Protection
U.S. Department of Energy S7-51
Richland Operations Office
Post Office Box 550
Richland, Washington 99352

Dear Mr. Peschong:

CONTRACT NUMBER DE-AC06-96RL13200 - SUBCONTRACT NUMBER 8023764-9-
K001 - NOTICE OF CONSTRUCTION FOR TANK WASTE REMEDIATION SYSTEM
VADOSE ZONE CHARACTERIZATION

Attached are copies of Notices of Construction (NOC) for each subject stack. The NOCs are being submitted for transmittal to the U.S. Environmental Protection Agency (EPA), Region 10, and the State of Washington, Department of Health (WDOH) in accordance with Title 40, Code of Federal Regulations, Part 61.07 and Washington Administrative Code 246-247, respectively. Please forward the NOCs to the EPA and WDOH.

Should you have any questions regarding this matter, please contact Mr. B. G. (Brad) Erlandson of my staff at 372-2678.

Sincerely,

E. E. Mayer, Director
Environment, Safety, Health
and Quality Assurance

bc

Attachments

CONCURRENCE:

This correspondence has been reviewed by FDH,
which concurs with its content and conclusions.

A. M. Umek, Project Director Date
TWRS
Fluor Daniel Hanford, Inc.

S

Notice of Construction for Tank Waste Remediation System Vadose Zone Characterization

**United States
Department of Energy**
Richland, Washington

Approved for Public Release

RELEASE AUTHORIZATION

Document Number: DOE/RL-99-34, Rev. 0

Document Title: Notice of Construction for Tank Waste Remediation System Vadose Zone Characterization

This document, reviewed in accordance with DOE Order 241.1, "Scientific and Technical Information Management," and DOE G 241.1-1, "Guide to the Management of Scientific and Technical Information," does not contain classified or sensitive unclassified information and is:

APPROVED FOR PUBLIC RELEASE

C. Willingham

5/4/99

Date

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NOTICE OF CONSTRUCTION FOR TANK WASTE REMEDIATION SYSTEM VADOSE ZONE CHARACTERIZATION

1.0 INTRODUCTION

The following description and any attachments and references are provided to the Washington State Department of Health (WDOH), Division of Radiation Protection, Air Emissions & Defense Waste Section as a notice of construction (NOC) in accordance with Washington Administrative Code (WAC) 246-247, Radiation Protection – Air Emissions. The WAC 246-247-060, "Applications, registration, and licensing", states "This section describes the information requirements for approval to construct, modify, and operate an emission unit. Any NOC requires the submittal of information listed in Appendix A." Appendix A (WAC 246-247-110) lists the requirements that must be addressed.

Additionally, the following description, attachments and references are provided to the U.S. Environmental Protection Agency (EPA) as an NOC, in accordance with Title 40 Code of Federal Regulations (CFR), Part 61, "National Emission Standards for Hazardous Air Pollutants." The information required for submittal to the EPA is specified in 40 CFR 61.07. The potential emissions from this activity are estimated to provide less than 0.1 millirem/year total effective dose equivalent (TEDE) to the hypothetical offsite maximally exposed individual (MEI), and commencement is needed within a short time frame. Therefore, this application is also intended to provide notification of the anticipated date of initial startup in accordance with the requirement listed in 40 CFR 61.09(a)(1), and it is requested that approval of this application will also constitute EPA acceptance of this initial start-up notification. Written notification of the actual date of initial startup, in accordance with the requirement listed in 40 CFR 61.09(a)(2) will be provided at a later date.

This NOC covers the activities associated with vadose zone characterization within the Single-Shell Tank Farms located in the 200-East and 200-West Areas of the Hanford Site. Vadose zone characterization activities include the drilling and sampling of soil from the surface to the depth of groundwater.

Management of locations impacted by past accidental releases from single-shell tanks to the soil, planning for control of accidental leaks from tank waste retrieval operations, and closure of tanks and tank farms requires understanding the science of subsurface conditions and processes. The vadose zone characterization program provides justification and an implementation plan for the following activities (DOE-RL 1998):

- Develop a sufficient understanding of subsurface conditions and transport processes to support decisions on management, cleanup, and containment of past single-shell tank releases
- Develop a sufficient understanding of transport processes to support decisions on controlling potential leaks from tank waste retrieval operations
- Develop a sufficient understanding of transport processes to support decisions on tank farm closure
- Provide new information on geotechnical properties in the 200 Area to supplement data used for design and performance assessment for disposal facilities handling immobilized low-activity waste.

For the various characterization options covered under this NOC which do not involve active ventilation, the maximum unabated TEDE to the hypothetical MEI is 7.16E-02 millirem per year. For these options, the abated TEDE is conservatively estimated to be equivalent to the unabated TEDE.

Characterization options which involve active ventilation (e.g. air rotary drilling), results in a conservatively estimated overall maximum unabated and abated TEDE to the hypothetical MEI of 7.08E-02 and 7.66E-07 millirem per year, respectively.

2.0 FACILITY LOCATION (REQUIREMENT 1)

U. S. Department of Energy, Office of River Protection
825 Jadwin Avenue
P.O. Box 550
Richland, Washington 99352-3562

Vadose zone characterization work may be performed in all the single-shell tank farms. The following is a listing of coordinates for the individual single-shell tank farms based on the location of a tank within the farm (center location if data was readily available) or an average of two tank coordinates that would result in a location near the center of the farm.

Table 1. Facility Locations.

Tank Farm	Latitude	Longitude	Reference Tank(s)
241-A	46° 33' 11.6" N	119° 31' 2.3" W	Average 241-A-103 & -104
241-AX	46° 33' 15.7" N	119° 31' 29.6" W	Average 241-AX-101 & -104
241-B	46° 33' 52.3" N	119° 32' 13.9" W	241-B-108
241-BX	46° 33' 54.0" N	119° 32' 23.2" W	Average 241-BX-101 & -112
241-BY	46° 33' 58.5" N	119° 32' 36.1" W	Average 241-BY-101 & -112
241-C	46° 33' 28.2" N	119° 31' 12.0" W	241-C-108
241-S	46° 32' 22.9" N	119° 37' 88.8" W	Average 241-S-101 & -112
241-SX	46° 32' 13.7" N	119° 37' 43.0" W	241-SX-113
241-T	46° 33' 35.7" N	119° 37' 43.1" W	241-T-108
241-TX	46° 33' 20.0" N	119° 37' 44.9" W	241-TX-110
241-TY	46° 33' 26.4" N	119° 37' 45.6" W	Average 241-TY-101 & -106
241-U	46° 32' 41.9" N	119° 37' 43.7" W	241-U-108

3.0 RESPONSIBLE MANAGER (REQUIREMENT 2)

The responsible manager for the activities described under this NOC is as follows:

Mr. R. T. French, Manager
U.S. Department of Energy, Office of River Protection
P.O. Box 550
Richland, Washington 99352
(509) 376-7591

4.0 TYPE OF PROPOSED ACTION (REQUIREMENT 3)

The proposed action results in the construction of new minor emission units. This will not represent a significant modification.

5.0 STATE ENVIRONMENTAL POLICY ACT (REQUIREMENT 4)

The proposed action is categorically exempt from the requirements of the State Environmental Policy Act under WAC 197-11-845.

6.0 PROCESS DESCRIPTION (REQUIREMENT 5)

To accomplish the goals of the vadose zone characterization program, there will be a need to perform subsurface sampling within selected single-shell tank farms identified in Table 1. Subsurface sampling and drilling techniques will be performed using the guidance document contained in Attachment A.

A maximum of 10 equivalent boreholes may be drilled per year for a maximum of twenty years. An equivalent borehole for the purposes of this NOC is assumed to have a nominal top diameter of 10 inches for the first 50 feet and a nominal bottom diameter of 8 inches for the remaining 200 feet of pipe (average depth is 250 feet).

The most aggressive (greatest potential for particulate generation) option for drilling boreholes will involve use of an air rotary type drill. The air rotary type drill is expected to suspend all particulate matter into the cyclone and the torit®¹ (process equipment for material recovery) shown in Figure 1. According to the manufacturer, the torit has an efficiency of 99.96% for particulates with a median diameter of 0.4 microns. Based on previous air drilling experience, approximately 0.53 cubic feet (4 gallons) [DSI-99a] of soil per borehole is collected at the bottom of the torit when air drilling is used for the entire borehole. Based on the previous discussion, the maximum amount of excavated material to challenge the HEPA filter has been estimated at 2.0E-04 cubic feet.

Samples from air rotary type drilling will be obtained from the "sampling sock" located on the side of the cyclone and from the drums underneath the cyclone and torit (see, Figure 1). The "sampling sock" is a polyethylene (or similar material) bag that will catch material for chemical and radiochemical analyses. Geological description samples will be obtained from the drums. The drums will be labeled to allow correlating the material level in the drum to the depth in the borehole where the material resided. The material in the drums will be sampled by pulling a mini-core from the drum.

Other possible borehole drilling techniques that may be used are briefly described below.

- Sonic drilling - a non-air assisted drill and drive system that mechanically removes the cuttings in a vibrated core barrel set up. The core barrel is vibrated down. This captures the soils in the barrel, the barrel is removed and emptied, the casing is advanced by vibration and the whole process is repeated.
- Closed end probe - a casing with closed end is driven into the ground by a number of methods- pile driver (percussion), vibrated (sonic), air hammer (driven from inside of the pipe by an air driven

¹ Torit is a registered trademark of Donaldson Company, Inc. - Minneapolis, MN

hammer, the circulation air is not in contact with formation and therefore is not contaminated). At the maximum depth, the end of the probe is removed (either unscrewed or milled-drilled out) and the probe is extracted. Sampling is accomplished by rotating and driving a small sampler into the sidewall of the borehole as the probe is extracted. No air or circulating fluid is utilized for this sampling process. Several telescoped lengths of probe may be utilized to achieve total depth for this method.

- Traditional cable tool drilling from top to bottom. A core barrel is driven into the soil by mechanical impact, the barrel is removed, emptied and the casing is driven down by impact at surface.
- Cone Penetrometer – consists of a probe containing either instrumentation to measure activity in the ground, or a soil sampler pushed into the ground by sheer weight. There is minimal potential for sudden or other air emissions from this technology. The equipment design and operation keeps personnel and environmental exposures to contamination very low (i.e., no drill tailings, no compressed air, pipe is pushed slowly, sensors provide real-time information, soil exposure to the air pathway is extremely minimal).

Soil sampling techniques will include one or a combination of the following techniques;

- Air Rotary Cuttings (cyclone and torit material recovery)
- Air Rotary Split Spoon
- Cable Tool
- Cable Tool and Auger with a Split Spoon Core Barrel
- Sonic Core Barrel and Split Spoon
- Rotary Coring
- Sidewall Sampling

Sampling and change-out of the drums will performed inside the containment structure with continuous HPT coverage. The radioactive material in the drums is expected to be at a very low level as assured by the administrative limits for using the air rotary type drilling method. With the exception of sidewall sampling, a detailed description of the drilling and sampling techniques are discussed in chapter two of EPA 1993. Sidewall sampling of the borehole involves the use of a “whipstock” located at the end of the casing to deflect a sample tube from the vertical direction and direct it into the surrounding formation (maximum of 8 inches). Once the sample is captured, the drill rod with the sampler attached will be removed from the borehole using the drilling machine. At the surface, the sampler will be sealed to prevent loss of material and packaged in a container suitable for shipment to the laboratory for analysis.

Additionally, a maximum of 10 equivalent boreholes will be closed per year (boreholes with casing removal) for a maximum of twenty years. For casing removal, in the event contamination is detected, the casing will be pulled into sleeved plastic and cut into segments (nominal length of 10 feet) using a wheel cutter. The wheel cutter, similar to a tubing cutter, does not use a high-speed blade. The cut pieces of casing will be capped and placed in a burial box. Using a tremie, the hole will be backfilled with clean (non-radioactive) materials (e.g., granular bentonite and/or grout). A tremie is an apparatus that consists of a hopper or funnel at the top (ground level) end and a long metal tube for placing fill materials directly on the bottom of the borehole. Using a tremie reduces void spaces while filling the backhole and reduce the potential to resuspend contaminated soil. Casing removal activities will be performed outside of the containment structure. The closure of the boreholes may also be performed by backfilling the borehole without pulling the casing.

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

The annual possession quantity was estimated based on the soil containing an administrative maximum average limit of 7.0 nanocuries of cesium-137 (Cs-137) per gram of soil (total of $3.88\text{E-}02$ curies of Cs-137 per year) for air rotary drilling. For cable tool and sonic drilling an administrative maximum average limit of 7.0 microcuries of Cs-137 per gram of soil (total of 38.8 curies of Cs-137 per year) will be adhered to. For the other drilling methods, closed end probe and cone penetrometer, the annual possession quantity was conservatively estimated based on the soil containing 330 microcuries of Cs-137 per gram of soil (total of 71.8 curies of Cs-137 per year). The 330 microcuries of Cs-137 per gram of soil is based on a 100 percent saturation of the soil pore space (30 percent total porosity) by a waste solution (BNWL 1966).

Based on previous soil characterization rate, the highest measured Cs-137 concentration in the soil was 100 microcuries (100,000 nanocuries) per gram of soil (BNWL 1966). Other isotopes may have higher off-site dose consequences and they have been accounted for; however, Cs-137 was selected as the base isotope since it is readily detected in the soil. Provided in Attachment B is the listing of known or assumed leaking tanks (HNF 1998) and the corresponding tank inventory from the database in the Tank Waste Information Network System 2 which is available on the internet (<http://twins.pnl.gov:8001>). A ratio of each isotope to Cs-137, based on curies, was calculated for each tank as shown in Attachment C. A comparison of the curie ratio for each isotope in each tank was performed with the average value being considered representative of the extent of soil contamination for other isotopes.

As shown in Attachment D, a maximum of 10 equivalent boreholes may be drilled per year. Each equivalent borehole will have a nominal top diameter of 10 inches for the first 50 feet and a nominal bottom diameter of 8 inches for the remaining 200 feet of boring (maximum average depth is 250 feet). Under normal air drilling, the soil has been observed to expand approximately 15% over what would be calculated since the soil is no longer compacted. Based on previous drilling experience, the average vertical range of soil contamination is assumed to span an average of 20 feet per borehole (HNF 1999a). For conservatism, the contamination is assumed to occur in the 10-inch diameter section of the borehole.

Based on the previous assumptions, approximately 112 cubic feet of soil is removed per borehole. An estimated 13 cubic feet of the soil per borehole is assumed contaminated. Using the average isotope ratios multiplied by the administrative limit of 7.0 nanocuries of Cs-137 (maximum average) per gram of soil and the total weight of soil (based on an average density of 97.5 pounds per cubic foot for loose dry sand and gravel, Avallone and Baumeister), the total possession quantity of each isotope has been provided in Attachment D.

The total possession quantity for the cable tool and sonic drilling were calculated similar to that for air drilling since all the material will be removed from the borehole and brought to the surface. Approximately 112 cubic feet of soil is removed per borehole. An estimated 13 cubic feet of the soil per borehole is assumed contaminated. Using the average isotope ratios multiplied by the administrative limit of 7.0 microcuries of Cs-137 (maximum average) per gram of soil and the total weight of soil (based on an average density of 97.5 pounds per cubic foot for loose dry sand and gravel, Avallone and Baumeister), the total possession quantity of each isotope has been provided in the Attachment D.

The total possession quantity for the closed end probe and the cone penetrometer is based on the soil volume brought to the surface that occurs during sampling. These estimations are contained within Attachment D and assume the equivalent of 10, 4-inch diameter by 2 feet long (approximately 1.75 cubic feet) samples, with 25% of the sample being contaminated with the worst case composition of 330 microcuries of Cs-137 per gram of soil.

Attachment E contains the annual possession quantity contributed by the closure of 10 equivalent boreholes. Under field conditions, the soil column abrasively scrubs the casing free of a soil layer leaving a few patches (up to 15% of the exposed surface area) of soil on the casing material (DSI 99b). The thin soil patches were assumed to consist of a thickness of 1/64-inch with the worst case composition of 330 microcuries of Cs-137 per gram of soil. For conservatism an additional 10% was added to the exterior contamination on the casing to account for any potential contamination on the interior of the casing. For boreholes that do not require casing removal, the annual possession quantity is assumed to be zero since the annual possession quantity was included in constructing the borehole.

Attachment F contains a summary of the annual possession quantity associated with the installation and closure of 10 boreholes per year using the air rotary method, the cable tool /sonic drilling, and the closed end probe/cone penetrometer). All isotopes are assumed to be in the form of particulate solids or liquids (bound to soil). An example calculation has been provided in Attachment G.

8.0 ABATEMENT TECHNOLOGY AND CONCEPTUAL DRAWING(S)

(REQUIREMENTS 6 AND 7)

Emissions from air rotary drilling activities will be contained using an active ventilation system attached to the process equipment and a passive vent system attached to the process equipment containment structure. Radioactive air emissions will be abated by the cyclone and filtered through the torit and one stage of high efficiency particulate air (HEPA) filter. The cyclone has a calculated average efficiency of 99.5%, the torit is rated at 99.96% for particles of a median diameter of 0.4 microns and the HEPA filter will be tested and provide a minimum collection efficiency of 99.95 percent for particulates with a median diameter of 0.3 microns. The example calculation provided in Attachment G contains the methodology for calculating the average efficiency of the cyclone.

The average volumetric flowrate from the compressor to the borehole is estimated to be 1.2 cubic meters per second (2,400 cubic feet per minute) with approximately 0.6 cubic meters per second (1,200 cubic feet per minute) returning out the borehole into the cyclone. The difference in the flowrate is attributed to the soil column absorbing a fraction of the air volume which is gradually released into the process and abatement control equipment after the compressor is turned off.

The exhaust fan will have a maximum average velocity of 0.85 cubic meters per second (1,800 cubic feet per minute) with a range of 0.6 to 1.2 cubic meters per second (1,200 to 2,400 cubic feet per minute) to maintain the ducting between the cyclone and the HEPA filter at atmospheric or less than atmospheric pressure. The drill rig will be sealed to the casing so that particulates will be contained and routed to the process equipment (e.g., cyclone and torit) located inside the plastic containment structure. The flange on the well discharge head and on the inlet of the cyclone will be double flanged to reduce the potential for an unabated release to the atmosphere. Additionally, the flexible line connecting the well discharge head and the cyclone will be encased by another flexible line. The flexible encasement line and flanges will also be vented to the cyclone. The plastic containment structure surrounding the process control equipment will be passively ventilated through one stage of HEPA filtration. Figure 1 is a conceptual drawing of the proposed system.

When the borehole has been completed and the process equipment is ready to be removed, equipment will be broken down at the disconnect points and contaminated equipment openings will be sealed or plugged to minimize the spread of contamination. Any exterior contamination greater than 1000 disintegrations per minute per 100 square centimeters, beta/gamma, or 20 disintegrations per minute per 100 square centimeters, alpha, will be removed by manual methods or fixatives will be applied to prevent the spread

of contamination. All work related to disconnecting and moving the equipment will be performed in accordance with TWRS as low as reasonably achievable control technology (ALARACT) demonstration number 12 (HNF-1999b), "TWRS ALARACT Demonstration for Packaging and Transportation of Equipment & Vehicles."

Emission controls to be used during sonic drilling, cable tool drilling, cone penetrometer, use of the closed end probe, and casing removal will be decontaminated by manual methods, bagged or have fixatives applied to prevent the spread of contamination. In addition, samples containers will be capped after retrieval and the casing will be sleeved into plastic during the removal process to prevent the spread of contamination.

A wind speed restriction of 20 miles per hour will be applied to drilling, sampling and casing removal work. This criterion applies to sustained wind speeds as determined by the Hanford Meteorological Station. The radiological conditions associated with the work activities will be controlled by following a radiation work package (RWP). Continuous Health Physics Technician coverage will be provided while drilling, sampling and removing casing.

9.0 MONITORING SYSTEM (REQUIREMENT 9)

Periodic confirmatory monitoring of emissions from borehole drilling using the air rotary drilling technique will be accomplished by a non-destructive analysis of the record filters combined with radiological field surveys during the work. The record filters will have a minimum efficiency of 90 percent for particulates with a median diameter of 0.3 microns. The upstream duct/HEPA filter surface will initially be smeared after completing each borehole and counted to determine the isotopic distribution of Strontium-90 (Sr-90), Cs-137, Plutonium-239 (Pu-239) and Americium (Am-241). Sr-90, Pu-239 and Am-241 are the only isotopes that potentially contribute greater than 10% of the unabated offsite dose; whereas, Pu-239 and Sr-90 are the only isotopes that contribute greater than 25% of the offsite dose due to abated emissions. Each record filter will be counted using a gamma spectrometer with a minimum detection level of one microcurie for Cs-137. The ratio of the record filter Cs-137 inventory to the initial upstream smear sample Cs-137 inventory will be applied to the remaining isotopes obtained from the analysis of the HEPA filter upstream duct/HEPA filter surface. Counting will be done using either a destructive or non-destructive technique.

The smear and record filter ratios discussed above will be used to determine actual emissions instead of the ratios used in Attachment C because they are expected to be less than the overly conservative ratios contained within Attachment C since Sr-90, Pu-239 and Am-241 are not as soluble and will not transport through the entire leak plume as readily as Cs-137. Using a detection level of one microcurie for Cs-137, the proposed periodic confirmatory method is capable of providing the required detection levels to verify low emissions.

Emissions from cable tool and sonic drilling, closed end probe, and the cone penetrometer identified are also provided in Attachment D. These emission sources will be fugitive. To confirm low emissions, Health Physics Technicians will perform surveys of the equipment and samples as they are removed from the ground and after packaging the equipment and samples for shipment.

Fugitive emissions may result from removing casing from the ground. To confirm low emissions, Health Physics Technicians will perform surveys of the casing as the casing is pulled from the ground.

10.0 RELEASE RATES (REQUIREMENTS 12 AND 13)

A detailed summary of the unabated and abated release rate for each radionuclide for the various drilling techniques, casing removal activities and overall total summary has been provided in Attachments D, E, and F, respectively. With the exception of tritium (H-3) and carbon-14 (C-14) which are expected to be released as a gas, all remaining isotopes are assumed to be released as a particulate solid.

11.0 OFFSITE IMPACT (REQUIREMENTS 14 AND 15)

A detailed summary of the estimated potential-to-emit TEDE to the hypothetical MEI for each radionuclide for the various drilling techniques, casing removal activities and overall total summary has been provided in Attachments D, E, and F, respectively. The MEI is 16,000 meters east of the 200-East Area of the Hanford Site.

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

Requirement 16 is not applicable because a best available radionuclide control technology (BARCT) demonstration is provided (Attachment H).

The maximum design life of the project is twenty years.

13.0 TECHNOLOGY STANDARDS (REQUIREMENT 18)

The HEPA filter performance standards of ASME/ANSI N510, Section 10.5 will be met. The HEPA filters will have a minimum efficiency of 99.95% for particles with a median diameter of 0.3 microns. The HEPA filters will not be ASME/ANSI AG-1 and ASME/ANSI N-509 compliant. Achieving the HEPA filter performance standards of ASME/ANSI N510 will result in having a HEPA filter that is as efficient as a more expensive filter which meets the ASME/ANSI AG-1, ASME/ANSI N509, and ASME/ANSI N510 standards. Therefore, the cost/benefit does not justify the expense of an ASME/ANSI AG-1, ASME/ANSI N509, and ASME/ANSI N510 compliant system for an emission source of this magnitude. Additionally, line pressure tests will be performed on the line between the well head and the cyclone and line between the torit and the fan. The line pressure test will be performed in accordance with ASME/ANSI N510.

In accordance with WAC 246-247-075(3), for emission units with a potential-to-emit of less than 0.1 millirem per year TEDE to the MEI, the option exists to estimate radionuclide emissions in accordance with 40 CFR 61 Appendix D, or other approved methods. Additionally, WDOH may require periodic confirmatory measurements during routine operations to verify low emissions. A destructive or nondestructive analysis of the record filters are proposed to be used for providing periodic confirmatory measurement to verify low emissions; therefore, 40 CFR 60 Appendix A, Methods 1, 1A, 2, 2A, 2C, 2D, 4, 5, and 17 do not address the record filter system design. In addition, ANSI N13.1 does not address the record filter system design since a sampling probe will not be used to measure emissions.

The system is compatible with NQA-1 as imposed by NESHAP Quality Assurance Project Plan for Radioactive Airborne Emissions, all of Sections 2.0, 3.0 and 5.0. ANSI/ASME NQA-2 is no longer an active National Standard and has been incorporated into NQA-1.

14.0 REFERENCES

- BNWL, 1996, Characterization of Subsurface Contamination in the SX Tank Farm, BNWL-CC-701, by J. R. Raymond and E. G. Shdo, Battelle-Northwest, Richland, Washington.
- DSI-99a, Volume of fines Collected During Air Drilling, DSI, Kent Reynolds, Waste Management Northwest, Inc., to Stan Hill, Waste Management Federal Services of Hanford, Inc., Richland, Washington, January 15, 1999.
- DSI-99b, Well Decommissioning, DSI, Kent Reynolds, Waste Management Northwest, Inc., to Stan Hill, Waste Management Federal Services of Hanford, Inc., Richland, Washington, February 22, 1999.
- DOE-RL, 1998, Tank Waste Remediation System Vadose Zone Program Plan, DOE/RL-98-49, U.S. Department of Energy, Richland Operations Office, Richland, Washington.
- EPA, 1993, Subsurface Characterization and Monitoring Techniques, Volume 1, EPA/625/R-93-003a, U.S. Environmental Protection Agency, Center for Environmental Research Information, Cincinnati, Ohio.
- HNF, 1998, Waste Tank Summary Report for Month Ending July 31, 1998, HNF-EP-0182-124, Fluor Daniel Hanford, Inc., Richland, Washington.
- HNF, 1999a, Radionuclide Inventories of Liquid Waste Sites at Hanford, HNF-1744, Fluor Daniel Hanford, Inc., Richland, Washington, expected release June 1999.
- HNF 1999b, Control of Airborne Radioactive Emissions for Frequently Performed TWRS Work Activities (ALARACT Demonstrations), HNF-4327, Fluor Daniel Hanford, Inc., Richland, Washington, April 1999.
- E. A. Avallone and T. Baumeister III, "Marks' Standard Handbook for Mechanical Engineers", 9th Edition, McGraw Hill, 1987.
- WDOH, 1992, Letter, Air 92-107, A. W. Conklin, Washington State Department of Health, to J. D. Bauer, U.S. Department of Energy, Richland Operations Office, no subject, October 5, 1992.

Figure 1. Process Flow Diagram

ATTACHMENT A

**INSTRUCTIONS FOR BOREHOLE SAMPLING
(WHC-SD-EN-AP-181, REV. 0)**

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INTRODUCTION

Geologic systems generally are complex with physical properties and trends that can be difficult to predict. Subsurface geology (including stratigraphy, mineralogy, geochemistry) exerts a fundamental control on groundwater flow and contaminant transport. Federal and state regulations (Title 40, Code of Federal Regulations (CFR) Part 265.90(a), 40 CFR 265.90(c)(1)(ii), 40 CFR 265.90(2)(i), 40 CFR 265.91(a), Washington Administrative Code (WAC) 173-303-282, WAC 173-303806, WAC 173-200-080, WAC 173-160-050) require characterization of subsurface hydrogeologic conditions to allow for defensible calculations of flow and transport conditions, and to assess the impacts of the geology on groundwater and vadose zone conditions.

The primary source for direct observation of subsurface geologic information is a borehole. However, direct observations from a borehole essentially are limited to the diameter and spacing of boreholes and the quality of the information derived from the drilling. Because it is impractical to drill a borehole every few feet to obtain data, it is necessary to maximize the data gathered during limited drilling operations. A technically defensible balance between the customer's data quality objectives and control of drilling costs through limited drilling can be achieved with proper conduct of operations.

This report presents the minimum criteria for geologic and hydrologic characterization and sampling that must be met during drilling. It outlines the sampling goals that need to be addressed when drilling boreholes, and the types of drilling techniques that work best to achieve these goals under the geologic conditions found at Hanford. This report provides general guidelines for: (1) how sampling methods are controlled by data needs, (2) how minimum sampling requirements change as knowledge and needs change, and (3) when drilling and sampling parameters need to be closely controlled with respect to the specific data needs. Consequently, the report is divided into two sections that center on: (1) a discussion of basic categories of subsurface characterization, sampling, and sampling techniques, and (2) guidelines for determining which drilling and sampling techniques meet required characterization and sampling objectives.

Data quality objectives for subsurface characterization in any given project are established in characterization plans, work plans, data sheets, and similar documentation. The guidelines outlined in this report are used to determine the appropriate drilling and sampling techniques necessary to achieve the stated objectives. This document is not intended to be used to establish the data quality objectives for a specific project, only to aid in achieving them.

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SUBSURFACE SAMPLING

Subsurface sampling is the main driving force of any characterization/drilling program. Sampling during drilling can be grouped under general categories which relate to the data needs for a given project. These categories range from no sampling, to basic or gross scale sampling, to intermediate sampling, to detailed analysis. Depending on data needs and project objectives, different scales of sampling effort are necessary. Successful implementation of sampling, regardless of the type, is highly dependant on input from an experienced drilling engineer and the project geologist.

Sampling Categories

The basic rational, typical techniques, and situations for the different categories of sampling are outlined below:

1. No Sampling - In some situations a projects data quality objectives may not involve geologic/physical sampling. Under these circumstances it would be appropriate to not do any geologic sampling.
2. Basic Sampling - Basic sampling (also referred to as gross or grab sampling) is used to provide enough information to identify basic geologic features such as formation, member, and unit and to differentiate between major sediment types or facies. Under some circumstances, these samples also may be adequate for chemical and radiological screening. Basic samples typically consist of cuttings bailed from the borehole and/or removed from an air/fluid circulation stream. The geologist's ability to accurately interpret the geologic features represented by particular cuttings is directly dependant upon drilling factors such as lagtime, hole cleaning, over drilling, and excessive milling. Generally, basic sampling is done in areas where sufficient data already exists to meet project data needs, in areas where only confirmation of the most basic geologic information is needed, and as a scoping tool in areas where reconnaissance or exploratory drilling is being conducted.
3. Intermediate Scale - Intermediate sampling is done in areas where a moderate amount of data already exists and where project goals call for specific, limited technically defendable sampling. Such objectives include, but are not limited to, verification of stratigraphic picks and facies types previously interpreted from cuttings and the collection of certain types of samples for specific analysis. Commonly, this type of characterization may require that samples be called for anytime there is a need to establish a level of control or defensibility not attainable with drill cuttings alone. Appropriate techniques for this sampling would include split spoons, sonic core barrel methods, and rotary coring.
4. Detailed - Detailed sampling, generally in the form of coring (e.g., rotary or sonic), usually is undertaken in areas where there is little

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or no accurate data to meet project data quality objectives. These needs range from physical data about formation geologic properties that is only obtainable from intact samples to specific sample requirements for analytical evaluation. Specific sample techniques are controlled by the types of samples needed and the geologic conditions (e.g., cemented vs. uncemented, or gravelly vs. silty).

Establishing Sampling Categories

Determining which sampling category is used during any given project is dependant on a clear definition of the data quality objectives. In order to determine the objectives, one must first evaluate the nature and quality of existing data applicable to a given project. Based on this evaluation specific project data needs (e.g., the data quality objectives) are identified and the requirements for borehole sampling established.

The existing data and data needs are usually identified in characterization and work plans written prior to the beginning of a drilling project. Data sheets for individual wells take the information from the work and characterization plans to identify drilling and sampling goals (e.g. sample categories) for a well, establish the type of sample required, and indicate the approximate sample intervals. The project geologist, in consultation with the client, is responsible for determining overall sampling needs, and the effectiveness and reliability of the samples retrieved during the project.

The following discussion lists two examples of how sampling categories are used in combination to achieve specific data quality objectives:

1. For many projects adequate well coverage and data to address most, if not all, data quality objectives already exists. In these situations new drilling and sampling will center on correlating the geology encountered in the new wells to preexisting wells, and sampling will consist dominantly of category 2 methods. Some category 3 sampling to verify stratigraphic/facies picks will be undertaken if it is determined to be necessary. Occasionally, category 4 sampling will be undertaken if site specific data quality objectives must be met. In some cases if no additional information is required no sampling would be needed (i.e., sampling category 1).
2. For some projects little or no data applicable to the project objectives may exist. Consequently, drilling for this project relies heavily on sampling categories 3 and 4 in order to establish site specific data and tie the new site to other, previously characterized locations.

During any given project, the scale of the sampling effort is likely to change. For example, as data from drilling is assimilated, the level of the sampling effort may decrease (e.g., from categories 4 to 3) as data quality objectives are met. Another example of conditions under which a

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scale-down in sampling may occur is in situations where drilling conditions are such that intact cores (category 4) simply can not be obtained. Under many circumstances a scale up in sampling effort is necessary. This typically happens when previously unforeseen geologic conditions are encountered during drilling and it is determined that more detailed sampling is necessary to meet the project data quality objectives.

SAMPLING TECHNIQUES

Sampling techniques and sampling categories are closely related and, in practice, essentially inseparable. Inappropriate sampling techniques for the geologic conditions encountered limits the ability to recover a representative sample, and consequently leads to decreased accuracy and reliability in the analysis performed. During subsurface geologic sampling, data needs and formation conditions must be considered when determining the appropriate drilling/sampling techniques to collect the required data.

Tables 1 and 2 compare various field and analytical samples to different drilling techniques to show which techniques are more appropriate for the kind of analysis planned. These comparisons take the form of a yes (Y) or no (N) to show whether a particular drilling method has a reasonable chance of acquiring a sample adequate for a given analysis or data need. In many cases the yes/no response is marked by a number that corresponds to a footnote following the tables. These footnotes list basic considerations that need to be taken into account for the specific drilling techniques and sampling requirements. These considerations center on two fundamental areas of critical importance to the acquisition of representative subsurface samples: (1) geologic or formation conditions, and (2) drilling technique and rig operation.

Table 1 lists the descriptive parameters that well site geologists commonly consider when providing general subsurface geologic descriptions. In addition, the parameters listed in Table 1 generally represent the minimum data requirements necessary for the field geologist to identify subsurface samples that meet sampling criteria established in the characterization plans and data sheets.

Table 2 lists analyses typically done on borehole samples and compares them to the various drilling techniques. This table shows that a number of drilling techniques are not appropriate for the types of analysis requested for many of the samples collected on the Hanford Site. The table can be used to establish the drilling technique needed to acquire samples for the analyses required to meet the project data quality objectives. If the drilling criteria for the specific analyses outlined in Table 2 cannot be met, the data quality objectives for the project will not be met. In such cases the selected drilling/sampling techniques need to be reassessed.

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Table 1. Field Criteria

	Auger, solid stem	Cable Tool, HT	Cable Tool and Auger, spl. spoon, core barrel	Sonic core barrel and split spoon	Air Rotary, cuttings	Air Rotary, split spoon	Mud Rotary	Rotary Coring
Relative Moisture (see EII 9.1)	N ²	N	Y ¹	N ⁹	N	Y ⁶	N	Y ¹
Cements (Ca, Si, Fe)	Y ¹⁰ /N ²	Y ¹¹	Y ⁴	Y	Y ^{3,10}	Y ⁴	Y ¹⁰	Y
Colors (<1 ft)	N ²	N	Y	Y/N ⁵	Y ^{3,12}	Y	Y ¹²	Y
Lith., textures (1 phi)	N	N	Y ⁴	Y/N ⁵	Y ^{3,12}	Y ⁴	Y ¹²	Y
Lith., bedding (2 ft) ¹⁴	N ¹³	N ¹³	Y	Y/N ⁵	Y ³	Y	N-uncon. Y-consol/ ¹²	Y
Mineralogy (±5%)	N ²	N ^{6,12}	Y ⁴	Y	Y ³	Y ⁴	N	Y

Explanations of parameters used in Table 1.

Cements - The basic nature and characteristics of cementing agents need to be identified because of their fundamental control on hydrologic properties such as high and low flow zones. Cementing agents typically present include calcium carbonate, silica, ferro-magnesium oxides, and muds.

Colors - Color changes are often an important indicator of unit and facies changes. As such they need to be readily identified. Changes in color need to be identified within 1 foot of actual occurrence.

Lith., textures - Lithologic texture essentially refers to grain size. Grain size variations down to 1 phi have to be identifiable in the sand to small pebble range.

Lith., bedding - Resolution of stratigraphic features within 2 ft of their actual occurrence is necessary to identify facies changes important to hydrologic flow systems and to pick major formational and stratigraphic unit contacts.

Mineralogy - In fine-grained sand and larger sizes the field geologist should be able to identify major mineral types (e.g. basalt, quartz, feldspar, micas, etc.) and estimate abundance by volume to ±10%. Below the fine-grained sand size geologist cannot identify mineralogy by hand lens.

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Table 2. Analytical Criteria

	Auger, solid stem	Cable Tool, HT	Cable Tool and Auger, spl. spoon, core barrel	Sonic core barrel and split spoon	Air Rotary, Cuttings	Air Rotary, split spoon	Mud Rotary cuttings	Rotary Coring
Moisture	N	N	Y ¹	N ⁹	N	Y	N	Y ^{1,7}
CaCO ₃ , Cements	N ²	N	Y	Y	Y ³	Y	Y	Y
Sieve	N ²	N	Y ⁴	Y	N	Y ⁴	N	Y
Specific Gravity	N	N	Y ⁴	Y/N ⁵	N	Y ⁴	N	Y
Density, Porosity (>3.5")	N	N	Y ⁴	Y/N ⁵	N	Y ⁴	N	Y
Unsat & Sat K (>3.5")	N	N	Y ⁴	Y/N ⁵	N	Y ⁴	N	Y
Moisture Retention	N	N	Y ⁴	Y/N ⁵	N	Y ⁴	N	Y
XRD Min.	N ²	N	Y ^{4,8}	Y	Y ³	Y ^{4,8}	Y ³	Y
XRF Geochem.	N ²	N	Y ^{4,8}	Y	Y ³	Y ^{4,8}	Y ³	Y
Thin Sec.	N ²	N	Y ^{4,8}	Y	Y ³	Y ^{4,8}	Y ³	Y
Chemical	N ²	N	Y	Y - nonvol. N - volatile	N	Y	N	Y ⁷

Density, Porosity and Unsat. and Sat. K - A minimum 3.5 inch diameter sample needs to be acquired on sample runs less than 10 feet long. If sampling runs longer than 10 ft are being done sample minimum diameter will be 2.5 inch.

Footnotes to Tables 1 and 2.

1. If fluid not added.
2. Mixing of cuttings with borehole wall during transport of cuttings up auger flights limits use.

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3. Assumes a reasonable lag time of no more than 20% over calculated lag time based on an uphole velocity of 6000 ft/min, less than 1 ft of slough in the borehole, absence of significant overmilled material, and position of drill bit is as per manufacturers spec for the system in use.
4. Best applied in unconsolidated to consolidated muds and sands. Will not work well in gravelly or cemented deposits because driving the sampler into these sediment types will break and fracture formation materials. Anything recovered from the sampler under these circumstances will not be intact.
5. Sonic core barrel samples in many cases show evidence of having expanded at some point during drilling (e.g. rig will drill 5 ft but sample will fill a 10 ft of core barrel). Expansion commonly results in the destruction of bedding features. As yet, the cause and extent of expansion is not clearly understood, making it difficult to determine if many samples are representative of true formation conditions. Whether or not expansion has occurred needs to be determined in order to decide if a yes or no applies.
6. Fines are generated while driving the sampler because of abrasion and breaking of formation materials. Also have to have clean boreholes to insure recovery of representative sample.
7. Mud rotary core may alter.
8. In crystalline and homogeneous sedimentary rocks should work well. In heterogeneous deposits have to assume an ability to separate grains broken during drilling from those that are unbroken. As a consequence, this may only be usable in gravel-poor formations and uncemented strata.
9. Temperatures measured during drilling are too high for reliable estimates of moisture content and sampling of volatile materials.
10. Can use observed differences in drilling responses, e.g. chattering, torque, changing advance rate, bucking, etc; to determine at least the presence or absence of cement.
11. Gross scale observations (changes over several feet), based on advance rate. Small scale features such as individual beds and changes over just a few feet are difficult to identify.
12. Gross scale resolution of such things as beds over several feet thick and formational and member contacts is based on first arrivals of a particular parameter. Small scale features such as individual beds and changes over just a few feet are difficult to identify.
13. The exception is formational and high contrast member/unit contacts that are based on major, large scale parameters such as very different colors, textures, etc.

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14. Resolution of bedding is incumbent upon whether or not features are actually present. Knowing this is dependant upon good regional and facies knowledge typically acquired from outcrop analogues and intact cores.

CONCLUSIONS

Accurate subsurface characterization is dependant on the acquisition of representative geologic samples. To acquire such samples, the appropriate drilling technology must be matched to a projects stated data needs. These data needs, presented as part of the data quality objectives, should be found in planning documents (such as the characterization plan, drilling plan, and data sheets) for any given project. The guidelines outlined in this report can then be used by the project staff, in consultation with the client, to determine the specific drilling techniques necessary to obtain the stated data quality objectives for subsurface characterization.

ATTACHMENT B

TANK INVENTORY DATA

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Constituent Name	Units	A-103	A-104	A-105	AX-102	AX-104	B-101	B-103	B-105	B-107	B-110	B-111
3H	Cl	300	0.006	9.18	32.4	3.38	3.27	0.767	1.79	3.58	1.48	13.2
14C	Cl	4.92	1.18	1.71	5.1	0.63	0.546	0.141	0.262	0.803	0.281	1.7
59Ni	Cl	3.86	11.8	8.48	1.57	3.12	15.8	0.134	0.312	0.115	1.34	11.6
63Ni	Cl	360	1160	852	161	313	1570	12.1	28	10.4	135	1170
60Co	Cl	23.5	485	2.36	6.61	347	0.863	0.0248	0.058	8.17	0.374	4.12
90Sr	Cl	148000	2.93E+06	4.71E+06	172000	2.95E+06	2230	1290	6730	38100	135000	284000
90Y	Cl	148000	2.93E+06	4.71E+06	172000	2.95E+06	2230	1290	6730	38100	135000	284000
93Zr	Cl	25.3	22.4	36.8	23.3	13.6	21.5	0.114	0.263	0.289	5.82	50.5
99Tc	Cl	236	8.29	12.1	37.7	95.3	3.51	0.79	1.82	17.5	20.7	121
106Ru	Cl	0.0108	0.00133	0.01	0.585	0.0101	0.706	9.51E-09	2.29E-08	8.43E-05	0.00433	0.0376
125Sb	Cl	273	483	242	30.8	281	5.16	0.0222	0.0525	3.03	1.67	15.2
126Sn	Cl	7.94	8.71	12.5	8.35	4.61	7.79	0.0361	0.0632	0.0889	1.98	17.1
129I	Cl	0.00267	0.016	0.0235	0.0728	0.00864	0.00675	0.00149	0.00343	7.83	0.045	0.0341
134Cs	Cl	5.33	0.2	0.562	0.504	0.207	0.0315	0.000584	0.00143	3.26	0.0867	0.774
137Cs	Cl	293000	77700	173000	55700	61600	15900	9300	24500	21700	18600	168000
151Sm	Cl	18500	20500	29900	15500	11000	14200	89.5	206	214	4730	41000
152Eu	Cl	7.17	7.85	9.13	21.1	3.36	31.9	0.017	0.0404	0.0566	1.45	12.5
154Eu	Cl	944	2860	7370	1660	1860	1570	0.437	1.03	29.9	83	181
159Eu	Cl	435	513	680	1030	1780	1650	1.36	3.08	46.2	108	932
226Ra	Cl	0.000257	0.000765	0.000532	0.000234	0.000196	0.000704	8.22E-06	1.58E-05	7.76E-06	8.47E-05	0.000729
228Ra	Cl	0.493	8.48E-05	4.81E-09	0.0379	1.77E-09	1.47E-08	7.49E-11	1.59E-10	0.0086	7.91E-10	0.00252
228Ac	Cl	0.00151	0.00399	0.00287	0.00114	0.00106	0.00316	3.79E-05	8.07E-05	0.00092	0.000456	0.00393
229Th	Cl	0.0114	3.93E-05	7.51E-07	0.000882	2.77E-07	1.73E-06	1.45E-08	3.09E-08	0.000378	1.25E-07	5.91E-07
232Th	Cl	0.0534	9.15E-06	4.34E-10	0.00386	1.60E-10	1.95E-10	3.28E-11	7.54E-11	0.00128	7.19E-11	0.000311
232Pa	Cl	0.00588	0.00548	0.00646	0.000591	0.00238	0.000198	7.71E-05	0.000174	0.00151	0.0103	0.00885
232U	Cl	1.64	0.00537	9.89E-08	0.111	4.67E-06	1.92E-05	8.84E-06	6.99E-05	1.16E-05	1.25E-06	0.00268
233U	Cl	6.27	0.0208	2.33E-09	0.426	1.10E-07	9.89E-07	4.69E-07	3.30E-06	1.17E-05	6.80E-06	0.0103
235U	Cl	0.999	0.0167	0.00122	0.0875	0.0576	1.14	0.563	3.22	0.735	0.0857	0.0693
235U	Cl	0.0395	0.00682	5.08E-05	0.0035	0.0024	0.051	0.0252	0.143	0.0331	0.00384	0.00304
236U	Cl	0.0322	0.00455	3.32E-05	0.00286	0.00157	0.00908	0.00428	0.0306	0.00469	0.000621	0.000813
238U	Cl	0.888	0.0161	0.00119	0.0784	0.0561	1.16	0.571	3.27	0.745	0.0868	0.0701
238Np	Cl	1.25	0.0262	0.0259	0.133	0.00954	0.0147	0.00468	0.0112	0.0184	0.14	0.0761
238Pu	Cl	7.23	13.6	6.78	60.7	11	54.1	0.391	0.168	0.167	4.02	3.26
239Pu	Cl	240	723	176	415	286	515	70.6	31	52.1	89.6	92.7
240Pu	Cl	41.5	114	33.5	148	54.5	150	5.48	2.38	3.08	9.76	15.9
241Pu	Cl	503	995	483	4200	785	3750	13.5	5.68	2.03	82	209
242Pu	Cl	0.00274	0.00433	0.00279	0.0303	0.00454	0.0265	5.95E-05	2.50E-05	6.20E-06	0.000459	0.0012
243Am	Cl	232	175	276	1330	965	1110	1.35	0.476	0.105	90.8	74.1
243Am	Cl	0.00819	0.0038	0.00848	0.148	0.0296	0.116	9.27E-06	3.29E-06	3.95E-07	0.00278	0.00227
243Cm	Cl	0.565	0.187	0.252	1.79	0.881	1.61	0.00204	0.000743	0.000119	0.0831	0.0677
243Cm	Cl	0.0509	0.0103	0.0194	0.218	0.0677	0.19	4.17E-05	1.52E-05	2.15E-06	0.064	0.02
244Cm	Cl	0.411	0.0806	0.596	8.96	2.08	7.25	0.000218	7.76E-05	1.49E-05	1.54	0.48

Constituent Name	B-112	B-201	B-203	B-204	BX-101	BX-102	BX-108	BX-110	BX-111	BY-103	BY-105	BY-106
3H	9.36	0.000563	0.00101	0.000986	1.4	0.0931	0.0521	21.1	68	193	168	270
14C	0.254	0.0435	0.000312	0.000305	0.135	0.23	0.0111	5.47	17.7	50.3	43.7	70.1
59Ni	0.224	4.96E-05	8.86E-05	8.68E-05	9.31	0.00879	0.00315	0.586	2.46	5.37	6.78	8.84
63Ni	22.2	0.00457	0.00817	0.00801	922	0.777	0.284	59	244	533	653	865
60Co	2.28	5.60E-05	0.0001	9.81E-05	7.18	10.2	0.00243	5.07	21.6	47.1	40.6	65.5
90Sr	26200	287	32.5	31.9	61200	20400	14300	20100	22900	79600	62000	496000
90Y	26200	287	32.6	31.9	61200	20400	14300	20100	22900	79600	62000	496000
93Zr	0.92	0.000175	0.000312	0.000306	0.233	0.031	0.0111	2.26	9.34	20.4	17.8	28.5
99Tc	10.4	0.267	0.00216	0.00212	9.05	5.99	4.96	30.6	98.3	280	243	391
106Ru	0.000428	4.20E-11	7.35E-11	7.35E-11	0.0785	3.54E-06	9.60E-10	0.00101	0.0043	0.0094	0.0081	0.0131
125Sb	10.2	6.48E-05	0.000115	0.000113	1.28	0.0159	0.00219	22.7	96.6	211	182	294
126Sn	0.284	5.59E-05	9.91E-05	9.72E-05	0.0787	0.00968	0.00351	0.57	2.89	6.31	5.51	8.82
129I	0.00572	2.29E-06	4.08E-06	4.00E-06	0.012	0.00537	0.000145	0.0592	0.19	0.542	0.47	0.756
134Cs	0.105	2.78E-06	4.97E-06	4.87E-06	0.00359	0.000775	8.88E-05	0.247	1.05	2.29	1.99	3.2
137Cs	12700	110	36.9	36.2	17500	8100	2050	67100	76400	22600	52200	704000
151Sm	658	0.139	0.249	0.244	184	24.6	8.72	1620	6860	14600	12700	20400
152Eu	0.287	0.000182	0.000325	0.000319	7.42	0.0179	0.00306	0.733	3.04	6.64	6.05	9.43
154Eu	21.1	0.602	0.00161	0.00157	5.22	0.0974	0.0431	85.7	364	795	686	1110
155Eu	17.4	0.0164	0.0294	0.0288	426	1.71	0.24	44.7	184	403	372	574
226Ra	8.86E-06	8.22E-09	1.47E-08	1.44E-08	0.000325	1.20E-05	6.75E-07	2.57E-05	4.03E-05	0.000203	0.000194	0.00029
228Ra	0.109	5.29E-13	9.44E-13	9.25E-13	0.00187	0.00102	1.30E-11	0.27	1.15	2.52	2.17	3.5
227Ac	0.000121	4.34E-08	7.75E-08	7.59E-08	0.00139	0.00315	3.44E-06	0.000328	0.00132	0.00848	0.00255	0.00404
229Th	0.00251	1.02E-10	1.83E-10	1.79E-10	4.37E-05	0.00461	2.51E-09	0.00624	0.0115	0.0589	0.0501	0.0808
232Th	0.00451	1.62E-14	8.25E-14	8.08E-14	0.000231	4.75E-05	3.19E-12	0.00998	0.0184	0.093	0.0801	0.129
233Pa	0.000623	1.00E-07	1.79E-07	1.75E-07	7.38E-05	0.00465	7.43E-06	0.00163	0.00293	0.0231	0.0129	0.0207
232U	0.0448	1.42E-07	9.57E-08	9.38E-08	0.00985	0.00112	1.01E-05	0.0499	0.76	1.69	7.72	0.853
233U	0.172	6.47E-09	4.37E-09	4.28E-09	0.00354	0.00434	5.11E-07	0.191	2.91	6.47	28.6	3.27
234U	0.0128	0.00707	0.00477	0.00468	3.48	0.261	0.569	2.6	0.42	0.514	7.43	0.232
235U	0.000479	0.000315	0.000212	0.000208	0.157	0.0117	0.0254	0.0908	0.017	0.0193	0.317	0.00861
238U	0.000411	6.17E-05	4.16E-05	4.08E-05	0.0222	0.0018	0.00468	0.0205	0.009	0.0169	0.104	0.00771
238Pu	0.0108	0.00718	0.00484	0.00475	3.53	0.263	0.578	2.78	0.384	0.434	7.14	0.193
237Np	0.0144	7.51E-06	1.34E-05	1.31E-05	0.00504	0.0013	0.000474	0.104	0.194	0.94	0.819	1.31
238Pu	0.00689	0.949	0.302	0.364	4.68	1.01	0.0332	1.58	0.798	1.78	2.88	1.46
239Pu	0.356	142	43.7	52.7	82.2	42.5	4.79	158	30.7	67.6	104	52.4
240Pu	0.0497	12.5	3.83	4.62	17.8	7.52	0.425	14.5	5.04	11.8	17.7	8.97
241Pu	0.462	41.3	12.7	15.3	328	81.2	1.34	48.3	56.8	134	207	105
242Pu	2.21E-06	0.000191	5.89E-05	7.07E-05	0.00214	0.000228	6.08E-06	0.00022	0.000273	0.000541	0.000996	0.000505
243Am	0.107	4.26	0.357	0.431	173	176	5.05	0.482	13.6	65.9	143	123
243Am	3.71E-06	3.46E-05	2.90E-06	3.50E-06	0.0131	0.00114	3.48E-05	7.81E-06	0.000469	0.00228	0.00492	0.00423
242Cm	1.91E-06	0.0416	0.00349	0.0042	0.339	1.83	0.014	0.000665	0.000233	0.00117	0.0175	0.00693
243Cm	3.92E-08	0.00904	7.51E-05	9.05E-05	0.0361	0.0478	0.000286	5.31E-05	4.79E-06	2.62E-05	0.000369	0.000142
244Cm	5.42E-07	0.217	7.38E-05	8.90E-05	0.968	0.0374	0.000821	5.38E-05	6.58E-05	0.000308	0.000806	0.000621

Constituent Name	BY-107	BY-108	C-101	C-110	C-111	C-201	C-202	C-203	C-204	S-104	SX-104	SX-107
3H	74.6	32.9	0.427	1.07	0.166	0.00441	0.000819	0.0152	0.008	6.15	568	34.7
14C	19.3	8.35	0.0891	0.316	0.0315	0.0114	0.00113	0.0424	0.0218	1.64	76.7	1.85
59Ni	3.07	3.09	0.0176	0.0175	0.224	0.423	0.423	0.424	0.423	10.2	12	11.3
63Ni	296	287	1.63	1.53	20.2	41.5	41.5	41.5	41.5	971	1150	1100
60Co	18	7.64	0.0284	0.00855	0.00909	0.00136	0.00119	0.0019	0.00154	6.67	84	1.52
90Sr	33600	195000	1070	4690	1.14E+06	16980	14630	9320	376	549000	528000	198000
90Y	33600	195000	1070	4690	1.14E+06	16980	14630	9320	376	549000	528000	198000
93Zr	7.9	3.53	0.0624	0.0615	0.0315	0.0231	0.0218	0.0269	0.0243	21	44.5	15.9
99Tc	108	46.9	0.434	34.1	0.219	0.0168	0.00795	0.0433	0.0256	44.2	548	14.2
106Ru	0.00358	0.00151	1.78E-05	2.01E-10	6.59E-08	9.41E-06	9.42E-06	9.40E-06	9.41E-06	0.00146	0.015	0.000328
125Sb	80.4	34	0.0851	0.00461	0.0135	0.00466	0.00457	0.00495	0.00476	23.1	359	5.16
126Sn	2.45	1.1	0.02	0.0192	0.01	0.00828	0.00788	0.00947	0.00868	6.81	13.9	4.85
129I	0.209	0.0907	0.000825	0.00079	0.000413	3.18E-05	1.54E-05	8.12E-05	4.83E-05	0.116	1.06	0.027
134Cs	0.882	0.387	0.00446	7.32E-05	0.00164	4.52E-06	4.42E-06	4.82E-06	4.62E-06	1.42	5.84	0.375
137Cs	241000	351000	1730	18600	12000	176	91.8	318	134	110000	522000	53300
151Sm	5680	2550	48.5	48.8	24.6	19.5	18.5	22.6	20.5	15800	32300	13400
152Eu	2.74	1.42	0.168	0.00599	0.0409	0.325	0.325	0.326	0.325	8.29	13.2	12.4
154Eu	303	69.6	0.572	0.115	0.18	0.191	0.189	0.198	0.193	160	1380	36.6
155Eu	170	91.4	12	0.905	2.89	21.2	21.2	21.3	21.3	410	732	628
226Ra	8.54E-05	4.71E-05	4.01E-06	5.50E-06	1.88E-06	3.72E-05	3.68E-05	3.88E-05	3.78E-05	0.000728	0.000829	0.000961
228Ra	0.959	0.405	0.00509	8.15E-11	1.31E-10	2.09E-10	2.06E-10	2.19E-10	2.12E-10	0.0096	0.289	0.00101
227Ac	0.00114	0.000536	0.0156	2.77E-05	9.57E-06	0.000181	0.00018	0.000185	0.000182	0.00362	0.00441	0.00432
229Th	0.0221	0.00936	0.00231	1.57E-08	2.54E-08	3.79E-08	3.73E-08	3.97E-08	3.85E-08	0.000231	0.00679	2.58E-05
232Th	0.0354	0.015	0.000237	1.91E-11	8.83E-12	6.65E-13	2.69E-13	1.86E-12	1.06E-12	0.000129	0.0193	1.36E-05
231Pa	0.00573	0.00254	0.0231	5.78E-05	2.08E-05	6.06E-06	4.86E-06	9.67E-06	7.27E-06	0.0066	0.0118	0.00415
232U	5.91	16.8	0.0889	8.25E-06	2.96E-05	8.44E-09	2.65E-08	1.53E-08	6.41E-09	0.0864	2.6	0.0738
233U	22.7	64.2	0.345	4.94E-07	1.33E-06	5.05E-10	6.97E-10	9.15E-10	3.84E-10	0.33	9.95	0.282
234U	3.1	4.86	1.41	0.696	1.39	0.000712	0.00038	0.00129	0.000541	4.36	3.58	2.01
235U	0.125	0.183	0.0607	0.0313	0.0618	3.20E-05	1.60E-05	5.80E-05	2.43E-05	0.182	0.145	0.0817
236U	0.0686	0.154	0.0246	0.00444	0.0124	4.55E-06	8.84E-06	8.23E-06	3.45E-06	0.126	0.117	0.0767
238U	2.85	4.1	1.4	0.704	1.41	0.000721	0.000377	0.00131	0.000548	4.07	3.24	1.77
237Np	0.364	0.162	0.00278	0.00255	0.00135	7.71E-05	2.41E-05	0.000236	0.00013	0.28	2.03	0.0662
238Pu	0.924	8.57	8.55	0.238	3.31	2.93	0.763	0.698	0.00916	7.49	6.03	8.56
239Pu	35.8	51.3	416	74.6	216	124	32.2	29.6	0.387	450	296	250
240Pu	5.85	8.4	69.7	4.4	32.5	20.4	5.3	4.85	0.0636	65.2	45.6	42.5
241Pu	65.7	95.1	665	2.81	240	212	55.1	50.4	0.661	422	380	431
242Pu	0.000316	0.000458	0.00207	8.60E-06	0.000915	0.00104	0.000271	0.000248	3.25E-06	0.00195	0.00195	0.00236
241Am	15.9	24.7	549	0.0213	0.0529	41.8	10.9	9.96	0.131	74.5	154	209
243Am	0.000544	0.000371	0.00481	5.96E-08	4.25E-07	0.001	0.000261	0.000239	3.13E-06	0.0023	0.00527	0.00927
242Cm	0.00275	0.00666	9.56	2.40E-05	0.000761	0.0673	0.0175	0.016	0.00021	0.0671	0.376	0.52
243Cm	5.64E-05	0.000136	0.224	3.56E-07	1.67E-05	0.00369	0.000961	0.000879	1.15E-05	0.00154	0.0307	0.0497
244Cm	0.000102	0.000128	0.18	9.12E-07	1.69E-05	0.00179	0.000467	0.000427	5.60E-06	0.00123	0.291	1.48

ATTACHMENT B

Constituent Name	SX-108	SX-109	SX-110	SX-111	SX-112	SX-113	SX-114	SX-115	T-101	T-103	T-106	T-107
3H	17.7	17.4	43.1	62.9	38.2	0.221	134	5.73	6.18	1.7	0.0635	0.219
14C	8.99	2.06	3.16	3.16	1.97	0.0171	6.74	0.311	1.18	0.304	0.00925	0.0561
59Ni	9.4	12.3	10.6	16	10.7	0.112	15.4	0.492	0.0633	0.0164	0.00263	0.016
63Ni	908	1190	1050	1570	1050	10.5	1510	46.5	6.26	1.62	0.244	1.4
60Co	0.715	7.98	2.03	2.88	1.71	0.06575	6.21	0.254	1.34	0.34	0.00394	0.00782
90Sr	1.09E+06	1.10E+06	116900	237000	175000	3870	267000	22700	118000	27100	3050	107000
90Y	1.09E+06	1.10E+06	116900	237000	175000	3870	267000	22700	118000	27100	3050	107000
93Zr	10.5	32.9	21.4	28.2	17	0.0171	37.1	0.798	0.452	0.117	0.00984	0.0562
99Tc	7.65	69.7	16.3	24.7	15.3	0.12	52.6	2.38	6.24	2.03	0.067	0.388
106Ru	0.001132	0.00183	0.000503	0.00677	0.00389	1.93E-08	0.00147	5.41E-05	0.00226	6.78E-05	3.66E-07	1.84E-10
125Sb	2.21	28.3	7.49	10.3	6.01	0.00992	22.4	0.865	5.85	1.49	0.00897	0.00422
126Sn	3.19	10.5	6.53	8.63	5.21	0.00558	11.6	0.259	0.138	0.0359	0.00305	0.0175
129I	0.0146	0.132	0.031	0.0468	0.029	0.00023	0.0998	0.00452	0.0159	0.00404	0.000127	0.000722
134Cs	0.173	1.81	0.556	0.747	0.435	0.000205	1.5	0.0529	0.0201	0.00826	0.000385	6.69E-05
137Cs	69200	258000	31500	63700	47100	1040	202000	6110	93000	28400	1980	12200
151Sm	8960	25700	18000	23600	14300	13	30000	602	324	83.8	7.39	44.6
152Eu	9.46	14.3	14.6	19.9	12.5	0.0529	20.4	0.36	0.275	0.0681	0.0166	0.00547
154Eu	17.4	191	48.8	69.3	41.3	0.163	149	6.08	19.8	5.08	0.0866	0.105
155Eu	476	725	745	1010	636	0.00922	1040	17.7	16.4	4.55	0.946	0.828
226Ra	0.000787	0.000967	0.000951	0.0014	0.000922	8.17E-06	0.00132	3.52E-05	4.48E-06	1.36E-06	3.22E-07	5.03E-06
228Ra	1.58E-08	0.0113	0.00179	0.0025	0.00137	7.00E-11	0.00793	0.000358	6.48E-05	0.00348	3.28E-11	7.45E-11
228Ac	0.0035	0.00477	0.00432	0.00633	0.00416	3.60E-05	0.00621	0.000171	2.25E-05	0.0106	1.66E-06	2.54E-05
229Th	1.29E-06	0.000273	4.43E-05	6.22E-05	3.43E-05	1.34E-08	0.000192	8.62E-06	3.05E-06	0.00157	3.32E-09	1.44E-08
232Th	5.77E-10	0.000152	2.40E-05	3.36E-05	1.84E-05	4.47E-12	0.000106	4.79E-06	2.15E-05	0.000168	3.70E-12	1.74E-11
231Pa	0.00267	0.00977	0.00559	0.00742	0.00447	5.43E-06	0.0103	0.000251	9.55E-05	0.0157	3.83E-06	5.28E-05
232U	0.000131	0.351	0.0612	0.113	0.0765	1.48E-06	0.201	0.0117	0.00298	0.179	1.39E-05	8.24E-05
233U	4.19E-06	1.34	0.234	0.433	0.283	5.64E-08	0.769	0.0448	0.0096	0.697	4.82E-07	5.75E-06
234U	2.3	6.54	1.23	2.46	1.8	0.0337	3.77	0.231	8.47	1.46	0.318	7.38
235U	0.0961	0.264	0.0496	0.0992	0.0728	0.00145	0.152	0.00639	0.328	0.0618	0.01133	0.332
238U	0.0646	0.269	0.0546	0.102	0.0725	0.000534	0.158	0.00908	0.493	0.0315	0.00977	0.0472
238U	2.17	5.64	1.04	2.11	1.56	0.0344	3.23	0.202	6.21	1.41	0.287	7.48
237Np	0.0394	0.307	0.0663	0.107	0.0693	0.000777	0.225	0.0111	0.0294	0.00738	0.000475	0.00233
238Pu	6.85	7.35	9.38	13.1	8.42	0.05	12	0.204	24.9	4.01	0.166	0.446
239Pu	222	222	185	313	223	3.57	262	12.4	692	167	6.66	140
240Pu	36.8	37.4	35.6	56.5	39	0.511	583	1.82	114	29.7	1.01	8.24
241Pu	350	372	451	643	418	3	593	11.8	1020	321	7.56	5.27
241Pu	0.00189	0.00202	0.00258	0.00361	0.00232	1.38E-05	0.0033	5.69E-05	0.0027	0.009905	2.47E-05	1.61E-05
242Am	152	219	280	361	220	0.0612	367	2.83	1.53	0.4	8.85	13.8
243Am	0.00578	0.0087	0.0124	0.016	0.00972	5.72E-07	0.0158	8.63E-05	5.90E-05	1.51E-05	7.13E-05	3.88E-05
243Cm	0.403	0.349	0.542	0.849	0.529	0.00122	0.75	0.00369	0.00598	0.00167	0.0688	0.0156
242Cm	0.0376	0.0332	0.0851	0.0839	0.0514	2.79E-05	0.0754	8.45E-05	0.00045	0.00012	0.00155	0.000231
244Cm	1.11	0.985	1.97	2.52	1.54	2.04E-05	2.28	6.57E-05	0.00466	0.00116	0.00212	0.000591

ATTACHMENT B

Constituent Name	T-108	T-109	T-111	TX-105	TX-107	TX-110	TX-113	TX-114	TX-115	TX-116	TX-117	TX-101
3H	0.287	0.856	0.0545	354	3.13	220	242	274	330	119	168	0.667
14C	0.0457	0.0978	0.0198	50.5	0.516	30.7	34.2	38.6	47	17.5	24.4	0.638
59Ni	0.0807	0.189	0.11	3.85	0.0354	2.3	2.6	3.1	3.58	2.43	2.66	0.4
63Ni	7.26	17.9	12	378	3.44	225	254	302	351	229	255	36.3
60Co	0.00971	0.0221	0.8	55.3	0.491	34.8	38	43	51.5	18.7	26.2	2.47
90Sr	1580	2450	10900	188000	1710	120000	133000	142000	157000	68000	86000	7470
90Y	1580	2450	10900	188000	1710	120000	133000	142000	157000	68000	86100	7470
93Zr	0.0465	0.0959	0.0198	25.5	0.244	16.7	18	20.4	23.8	8.8	12.4	0.126
99Tc	0.322	0.692	17	360	3.16	219	243	275	335	125	174	5.39
108Ru	3.49E-09	8.74E-09	1.90E-09	0.00388	9.51E-05	0.00681	0.00717	0.00812	0.00924	0.00303	0.00425	1.33E-08
125Sb	0.00845	0.02	0.0042	235	2.13	152	164	185	219	78.5	110	0
126Sn	0.0147	0.0316	0.00627	7.84	0.0753	5.14	5.55	6.28	7.32	2.7	3.81	0.0388
129I	0.00605	0.0013	0.000259	0.694	0.00609	0.422	0.469	0.53	0.646	0.241	0.336	0.0344
134Cs	0.000376	0.000928	0.000379	4.05	0.0532	2.6	2.63	6.4	3.84	1.31	12.7	0.00792
137Cs	988	1130	334	437000	24200	305000	309000	408000	407000	247000	315000	172
151Sm	36.5	78.3	15.5	18300	176	12000	12900	14600	17100	6320	8890	98.2
152Eu	0.0105	0.0247	0.0176	5.67	0.0637	4.49	4.5	5.1	5.34	1.93	2.68	0.0606
154Eu	0.169	0.392	0.0813	891	8.36	596	635	719	831	294	413	0.549
155Eu	0.854	1.9	1.28	336	3.96	268	269	304	317	117	162	4.26
228Ra	2.96E-06	5.91E-06	1.14E-06	0.000251	6.37E-06	0.000158	0.000175	0.0002	0.000231	0.000111	0.000141	6.67E-06
228Ac	4.83E-11	9.87E-11	6.08E-11	0.409	0.00335	0.236	0.268	0.302	0.38	0.167	0.316	1.91E-10
227Ac	1.52E-05	3.04E-05	5.83E-06	0.00163	2.48E-05	0.00102	0.00114	0.00129	0.00151	0.000706	0.000948	3.44E-05
229Th	9.35E-09	1.91E-08	1.18E-08	0.00948	7.76E-05	0.00547	0.00621	0.00701	0.00881	0.00388	0.00729	3.72E-08
232Th	1.35E-11	2.86E-11	5.64E-12	0.0251	0.00206	0.0145	0.0165	0.0186	0.0233	0.0103	0.0192	3.54E-11
231Pa	3.27E-05	6.81E-05	1.27E-05	0.00717	7.34E-05	0.00454	0.00499	0.00565	0.00688	0.00281	0.00402	7.56E-05
232U	7.00E-06	1.34E-06	3.79E-05	0.182	0.00084	0.482	0.0768	0.334	1.9	0.0914	0.172	1.34E-05
233U	3.84E-07	6.38E-08	1.95E-06	0.698	0.00245	1.85	0.294	1.28	7.28	0.35	0.658	6.15E-07
234U	0.484	0.9528	2.22	0.519	0.159	1.25	0.642	0.593	1.56	0.817	0.57	0.562
235U	0.0217	0.00278	0.099	0.0226	0.00715	0.0537	0.0281	0.0251	0.0625	0.0359	0.0248	0.0248
238U	0.00349	0.00588	0.0178	0.00719	0.00103	0.0208	0.00798	0.0119	0.0504	0.00982	0.00572	0.00572
238Pu	0.491	0.0638	2.25	0.507	0.161	1.22	0.644	0.568	1.38	0.821	0.564	0.571
237Np	0.00197	0.00426	0.000847	1.3	0.0115	0.786	0.878	0.992	1.21	0.458	0.636	0.00539
238Pu	0.135	0.0811	1.81	2.09	0.0205	1.5	1.83	1.81	1.95	1.12	1.25	0.976
239Pu	24.7	13.5	276	75.4	0.801	5.1	92.5	75.4	70.4	98.9	81.7	128
240Pu	1.9	1.1	23.7	12.5	0.125	9.14	12.8	11.4	11.7	9.96	9.43	12.1
241Pu	4.66	2.98	71	137	1.35	98.8	114	118	129	60.6	74	41.7
242Pu	2.01E-05	1.33E-05	0.000319	0.000749	7.43E-06	0.000543	0.000816	0.000642	0.0007	0.000308	0.000381	0.00019
243Am	0.271	0.179	92	94.4	0.983	62.5	67.7	76.5	88.2	27.7	39.7	0.264
243Am	1.84E-06	1.24E-06	0.000643	0.00318	3.10E-05	0.00222	0.00233	0.00264	0.00298	0.000941	0.00135	1.86E-06
242Cm	0.000608	0.000408	0.808	0.219	0.00239	0.173	0.173	0.196	0.206	0.0704	0.0997	0.00114
243Cm	1.24E-05	8.35E-06	0.0166	0.0203	0.00022	0.016	0.016	0.0181	0.0191	0.00635	0.00909	2.34E-05
244Cm	4.04E-05	2.73E-05	0.0152	0.21	0.00201	0.144	0.152	0.172	0.197	0.0643	0.0898	4.27E-05

ATTACHMENT B

Constituent Name	TY-103	TY-104	TY-105	TY-106	U-101	U-104	U-110	AVERAGE VALUE, CURIES
3H	24.5	0.174	3.24	0.00863	0.0791	38	0.294	61.8303927
14C	1.04	0.936	1.05	0.103	0.227	4.88	0.352	8.96859409
59Ni	0.441	0.105	0.127	0.000339	0.00801	0.565	0.0239	3.497771879
63Ni	42	9.61	11.5	0.0306	0.703	55	2.1	342.4319598
60Co	1.53	2.22	6.65	0.000273	0.0392	4.3	0.0117	22.80273829
90Sr	94300	31800	256000	9760	42500	77200	342000	309490.2636
90Y	94300	31800	256000	9760	42500	77200	342000	309491.7803
93Zr	1.78	0.0349	0.449	0.0012	0.282	2.99	0.0341	9.886620187
99Tc	16.4	9.06	44	10.7	0.194	32.7	7.35	68.2110747
106Ru	0.000629	4.13E-09	4.27E-08	1.14E-10	9.24E-11	0.000702	2.75E-10	0.023595376
125Sb	15.6	0.00859	0.0949	0.00253	0.00212	15.9	0.0063	59.34433569
126Sn	0.548	0.0111	0.142	0.000379	0.00879	0.91	0.0262	3.715166982
129I	0.0482	0.000458	0.046	1.56E-05	0.000362	0.0629	0.00108	0.2364868495
134Cs	0.257	0.00304	0.00089	3.17E-06	2.28E-06	0.824	6.59E-05	1.041460503
137Cs	14900	11000	10500	1590	11400	51500	26500	110027.8318
151Sm	1280	27.3	352	0.937	22.4	2130	86.6	7555.863318
152Eu	0.552	0.0528	0.442	0.00273	0.00523	0.607	0.0109	4.413022818
154Eu	59.1	0.164	1.85	0.0492	0.0527	78.1	0.157	403.8494727
155Eu	35.6	3.84	33.3	0.206	0.791	38.2	1.65	271.3284939
226Ra	2.18E-06	1.72E-06	2.58E-05	6.86E-08	1.14E-05	5.01E-05	1.72E-05	0.000231292
228Ra	0.0305	1.84E-10	1.69E-09	1.04E-11	7.13E-11	0.00261	1.48E-10	0.213302237
227Ac	0.000135	8.86E-06	0.000132	3.51E-07	2.86E-05	0.000263	5.52E-05	0.001819635
229Th	0.000704	3.57E-08	3.27E-07	2.02E-09	1.37E-08	0.000152	2.86E-08	0.004778877
232Th	0.00195	9.72E-12	1.28E-10	3.40E-13	8.74E-12	0.000697	2.80E-11	0.009014993
231Pa	0.000541	1.96E-05	0.000286	7.62E-07	2.65E-05	0.00101	7.89E-05	0.003752768
232U	0.116	4.54E-05	0.000202	4.51E-06	4.42E-06	0.00352	4.42E-05	0.648355343
233U	0.445	2.08E-06	9.99E-06	2.23E-07	2.64E-07	0.0135	2.64E-06	2.482520866
234U	5.92	1.89	10.7	0.239	0.373	0.717	3.73	1.71090655
235U	0.261	0.0833	0.476	0.0106	0.0168	0.0322	0.168	0.072115965
236U	0.0627	0.0193	0.0919	0.00206	0.00238	0.00469	0.0238	0.038197839
238U	6.01	1.92	10.9	0.243	0.377	0.724	3.77	1.61177903
238Np	0.00923	0.00151	0.0192	5.11E-05	0.00117	0.123	0.00348	0.233282353
239Pu	1.86	0.388	0.502	0.0217	0.231	0.201	0.775	5.011493182
239Pu	168	48.3	76.4	3.3	72.5	7.99	243	144.0964091
240Pu	18	4.71	6.56	0.283	4.27	1.19	14.3	23.66768636
241Pu	96.9	17	19.8	0.882	2.73	12	9.16	301.1592576
242Pu	0.000482	7.78E-05	8.90E-05	3.04E-06	8.35E-06	5.95E-05	2.80E-05	0.001733999
243Am	33.5	9.71	0.882	0.00229	2.57	9.6	88.9	126.8469044
243Am	0.00112	6.93E-05	6.01E-06	1.60E-08	7.17E-06	0.000292	0.000249	0.0063267
243Cm	0.0968	0.119	0.0809	5.00E-05	0.00552	0.018	0.134	0.367910044
243Cm	0.00753	0.00245	0.000166	1.02E-06	8.19E-05	0.00137	0.00198	0.02318917
244Cm	0.0751	0.00165	0.000142	3.75E-07	0.00011	0.0169	0.0038	0.547576011

ATTACHMENT C

TANK ISOTOPE TO CESIUM-137 RATIOS

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ISOTOPE TO CS-137 RATIO FOR EACH TANK												
Constituent Name	A-103	A-104	A-105	AX-102	AX-104	B-101	B-103	B-105	B-107	B-110	B-111	B-112
3H	1.02E-03	7.80E-06	5.31E-05	5.82E-04	5.49E-05	2.06E-04	8.22E-05	7.31E-05	1.65E-04	7.96E-05	7.88E-05	7.37E-04
14C	1.68E-05	1.52E-05	9.88E-06	9.18E-05	1.02E-05	3.43E-05	1.52E-05	1.07E-05	2.78E-05	1.51E-05	1.01E-05	2.00E-05
59Ni	1.25E-05	1.52E-04	4.90E-05	2.82E-05	5.08E-05	9.94E-04	1.44E-05	1.37E-05	5.30E-06	7.20E-05	6.90E-05	1.76E-05
60Co	1.23E-03	1.49E-02	4.92E-03	2.89E-03	5.08E-03	9.97E-02	1.30E-03	1.14E-03	4.79E-04	7.26E-03	6.98E-03	1.75E-03
63Ni	8.02E-05	6.24E-03	1.36E-05	1.19E-04	5.63E-03	5.43E-05	2.67E-06	2.37E-06	3.76E-04	2.01E-05	2.45E-05	1.80E-04
90Sr	5.05E-01	3.77E-01	2.72E-01	3.08E-00	4.79E-01	1.40E-01	1.39E-01	2.75E-01	1.76E-00	7.26E-00	1.57E-00	2.06E-00
90Y	5.05E-01	3.77E-01	2.72E-01	3.08E-00	4.79E-01	1.40E-01	1.39E-01	2.75E-01	1.76E-00	7.26E-00	1.57E-00	2.06E-00
93Zr	8.05E-04	2.88E-04	2.13E-04	4.18E-04	2.21E-04	1.35E-04	1.23E-05	1.07E-05	1.33E-05	3.13E-04	3.01E-04	7.24E-05
99Tc	8.05E-04	2.88E-04	2.13E-04	4.18E-04	2.21E-04	1.35E-04	1.23E-05	1.07E-05	1.33E-05	3.13E-04	3.01E-04	7.24E-05
106Ru	3.69E-08	1.71E-08	5.78E-08	1.05E-05	1.64E-07	4.44E-05	1.02E-12	9.35E-13	3.88E-09	2.33E-07	2.24E-07	3.37E-08
108Ru	9.32E-04	6.22E-03	1.40E-03	5.53E-04	4.56E-03	3.25E-04	2.38E-06	2.14E-05	1.40E-04	8.98E-05	9.05E-05	8.03E-04
128Sn	2.71E-05	1.12E-04	7.23E-05	1.50E-04	7.48E-05	4.90E-04	3.88E-06	3.40E-06	4.10E-06	1.05E-04	1.02E-04	2.24E-05
129I	9.01E-09	2.06E-07	1.36E-07	1.31E-06	1.40E-07	4.25E-07	3.88E-07	3.40E-06	4.10E-06	1.05E-04	1.02E-04	2.24E-05
134Cs	1.82E-05	2.57E-06	3.25E-06	9.05E-06	3.36E-06	1.88E-06	6.29E-08	5.84E-08	1.50E-04	4.77E-06	4.61E-06	8.27E-06
137Cs	1.00E-00	1.00E-00	1.00E-00	1.00E-00	1.00E-00	1.00E-00	1.00E-00	1.00E-00	1.00E-00	1.00E-00	1.00E-00	1.00E-00
151Sm	6.31E-02	2.64E-01	1.73E-01	2.78E-01	1.79E-01	8.93E-01	9.62E-03	8.41E-03	9.88E-03	2.54E-01	2.44E-01	5.18E-02
152Eu	2.45E-05	1.01E-04	5.28E-05	2.98E-02	5.45E-05	2.01E-05	1.83E-06	1.85E-06	2.61E-06	7.80E-05	7.44E-05	2.26E-05
154Eu	3.22E-03	3.68E-02	4.26E-02	2.98E-02	3.02E-02	9.97E-02	4.70E-05	4.20E-05	1.39E-03	4.46E-03	1.08E-03	1.66E-03
156Eu	1.48E-03	6.60E-03	3.93E-03	1.85E-02	2.89E-02	1.04E-01	1.46E-04	1.26E-04	2.13E-03	5.81E-03	5.55E-03	1.37E-03
158Eu	8.77E-01	9.85E-09	3.08E-09	4.20E-09	3.18E-09	4.43E-08	8.84E-10	6.45E-10	3.58E-10	4.55E-09	4.34E-09	6.98E-10
228Ra	1.68E-06	1.09E-09	2.78E-14	6.80E-07	2.87E-14	9.25E-13	8.02E-15	6.49E-15	4.89E-07	4.25E-14	1.50E-08	8.58E-06
228Ac	5.15E-09	5.14E-08	1.66E-08	2.05E-08	1.72E-08	1.99E-07	4.08E-09	3.29E-09	4.53E-08	2.45E-08	2.34E-08	9.53E-09
228Th	3.89E-08	5.08E-10	4.34E-12	1.58E-08	4.50E-12	1.09E-10	1.56E-12	1.26E-12	1.74E-08	6.72E-12	3.52E-10	1.98E-07
232Th	1.82E-07	1.18E-10	2.51E-15	6.93E-08	2.60E-15	1.23E-14	3.53E-15	3.08E-15	5.90E-08	3.86E-15	1.85E-09	3.55E-07
232Pa	2.01E-08	7.05E-08	3.73E-08	1.08E-08	3.86E-08	1.25E-08	8.29E-09	7.10E-09	6.96E-08	5.54E-08	5.27E-08	4.91E-08
232U	5.80E-06	8.91E-08	5.71E-13	1.99E-06	7.58E-11	1.21E-09	9.51E-10	2.85E-09	5.33E-10	3.66E-12	6.13E-08	3.53E-06
233U	3.41E-06	2.15E-07	7.05E-09	1.57E-06	1.77E-06	6.22E-11	5.04E-11	1.35E-10	5.39E-10	3.66E-12	6.13E-08	3.53E-06
233U	3.41E-06	2.15E-07	7.05E-09	1.57E-06	1.77E-06	6.22E-11	5.04E-11	1.35E-10	5.39E-10	3.66E-12	6.13E-08	3.53E-06
235U	1.35E-07	8.91E-09	2.94E-10	6.28E-08	3.90E-08	3.21E-08	6.05E-05	5.34E-05	1.53E-06	2.06E-07	4.81E-06	1.01E-06
235U	1.35E-07	8.91E-09	2.94E-10	6.28E-08	3.90E-08	3.21E-08	6.05E-05	5.34E-05	1.53E-06	2.06E-07	4.81E-06	1.01E-06
238U	1.01E-07	8.89E-09	1.92E-10	5.13E-08	2.55E-08	5.71E-07	4.60E-07	1.25E-06	2.16E-07	3.34E-08	4.84E-09	3.24E-08
238U	1.01E-07	8.89E-09	1.92E-10	5.13E-08	2.55E-08	5.71E-07	4.60E-07	1.25E-06	2.16E-07	3.34E-08	4.84E-09	3.24E-08
238U	3.03E-05	2.07E-07	6.88E-09	1.41E-06	9.11E-07	7.30E-05	6.14E-05	1.33E-04	3.34E-05	4.67E-06	4.17E-07	8.50E-07
238Pu	4.27E-06	3.37E-04	1.50E-07	2.39E-06	1.55E-07	9.25E-07	5.23E-07	4.57E-07	8.48E-07	7.53E-08	4.55E-07	1.13E-08
238Pu	4.27E-06	3.37E-04	1.50E-07	2.39E-06	1.55E-07	9.25E-07	5.23E-07	4.57E-07	8.48E-07	7.53E-08	4.55E-07	1.13E-08
239Pu	2.47E-05	1.75E-04	3.92E-05	1.09E-03	1.79E-04	3.40E-03	4.20E-05	6.89E-05	7.70E-03	2.16E-04	1.94E-05	5.43E-07
239Pu	8.19E-04	9.31E-03	1.94E-04	7.45E-03	4.64E-03	3.24E-02	7.59E-03	1.27E-03	2.40E-03	4.82E-03	5.52E-04	2.80E-05
240Pu	1.42E-04	1.47E-03	1.02E-04	2.66E-03	8.65E-04	9.43E-03	5.89E-04	9.71E-05	1.42E-04	5.25E-04	9.45E-05	3.91E-06
241Pu	1.72E-03	1.28E-02	2.79E-03	5.54E-02	1.27E-02	2.38E-01	1.45E-03	2.32E-04	9.35E-05	4.41E-03	1.24E-03	3.72E-01
242Pu	9.35E-09	5.57E-08	1.61E-08	5.44E-07	7.37E-06	1.67E-06	6.40E-09	1.02E-09	2.88E-10	2.47E-08	7.14E-09	1.74E-10
243Am	7.92E-04	2.29E-03	1.60E-03	2.39E-02	1.57E-02	6.98E-02	1.45E-04	1.94E-05	4.84E-05	4.88E-03	4.41E-04	8.43E-06
243Am	7.92E-04	2.29E-03	1.60E-03	2.39E-02	1.57E-02	6.98E-02	1.45E-04	1.94E-05	4.84E-05	4.88E-03	4.41E-04	8.43E-06
244Cm	2.80E-08	4.89E-08	4.90E-08	2.66E-06	4.81E-07	7.30E-06	9.97E-10	1.34E-10	1.82E-11	1.49E-07	1.35E-08	2.92E-10
244Cm	1.93E-08	2.41E-06	1.46E-05	3.21E-05	1.43E-05	1.01E-04	2.19E-07	3.03E-08	5.48E-09	4.47E-06	4.05E-07	3.15E-07
244Cm	1.74E-07	1.33E-07	1.12E-07	3.91E-06	1.10E-06	1.19E-05	4.48E-09	6.20E-10	9.91E-11	3.44E-06	1.19E-07	3.09E-12
244Cm	1.40E-06	1.04E-06	3.45E-06	1.61E-04	3.38E-05	4.58E-04	2.34E-08	3.17E-09	6.87E-10	8.28E-05	2.89E-06	4.27E-11

ISOTOPE TO CS-137	Constituent Name	B-203	B-204	BX-101	BX-102	BX-108	BX-110	BX-111	BY-103	BY-105	BY-106	BY-107	BY-108	C-101	C-110
3H	2.74E-05	2.72E-05	3.00E-05	1.15E-05	2.54E-05	3.14E-04	8.90E-04	8.54E-04	3.22E-04	3.84E-04	3.10E-04	9.37E-05	2.47E-04	5.75E-05	
4H	8.48E-06	8.43E-06	7.71E-06	2.84E-05	5.41E-06	8.15E-05	2.32E-05	2.38E-05	8.37E-05	9.99E-05	8.01E-05	2.89E-05	5.12E-05	1.70E-05	
59Ni	2.40E-06	2.40E-06	3.32E-04	1.09E-05	1.54E-06	6.88E-06	3.22E-05	2.39E-05	2.29E-05	1.30E-05	1.27E-05	8.90E-06	1.02E-05	9.41E-07	
63Ni	2.21E-04	2.21E-04	5.27E-02	6.95E-05	1.39E-04	8.79E-04	3.19E-03	2.39E-03	7.25E-03	1.23E-03	1.23E-03	8.18E-04	9.42E-04	8.26E-05	
63Co	2.77E-06	2.77E-06	4.10E-04	1.26E-03	1.19E-06	7.56E-05	2.83E-04	2.09E-04	1.75E-05	9.30E-05	7.47E-05	2.18E-05	1.64E-06	4.60E-07	
90Sr	8.81E-01	8.81E-01	3.50E+00	2.52E+00	6.98E+00	3.00E-01	3.00E-01	3.00E-01	1.19E+00	7.05E-01	1.39E-01	5.66E-01	6.18E-01	2.52E-01	
90Y	8.83E-01	8.81E-01	3.50E+00	2.52E+00	6.98E+00	3.00E-01	3.00E-01	3.52E-01	1.19E+00	7.05E-01	1.39E-01	5.66E-01	6.18E-01	2.52E-01	
92Zr	8.46E-06	8.45E-06	1.33E-05	3.83E-06	5.41E-06	3.37E-05	1.22E-04	9.03E-05	4.05E-05	3.48E-05	3.28E-05	1.01E-05	3.61E-05	3.31E-06	
99Tc	3.89E-05	5.88E-05	5.17E-04	7.40E-04	2.42E-03	4.56E-04	1.29E-03	1.24E-03	4.66E-04	5.55E-04	4.48E-04	1.34E-04	2.81E-04	1.83E-04	
106Ru	2.03E-12	2.03E-12	4.49E-06	4.37E-10	4.63E-13	1.51E-08	5.63E-08	4.19E-08	1.89E-08	1.89E-08	1.49E-08	4.30E-09	1.03E-08	1.08E-14	
125Sb	3.12E-06	3.12E-06	7.31E-06	1.72E-06	1.07E-06	3.34E-04	1.26E-03	9.34E-04	3.45E-04	4.18E-04	3.34E-04	9.68E-05	4.92E-05	2.48E-07	
126Sn	2.69E-06	2.69E-06	4.50E-06	1.20E-06	1.71E-06	1.04E-05	3.78E-05	2.79E-05	1.06E-05	1.25E-05	1.02E-05	3.13E-06	1.16E-05	1.03E-06	
128Sn	1.11E-07	1.10E-07	6.88E-07	6.63E-07	7.07E-08	8.82E-07	2.49E-06	2.40E-06	9.00E-07	1.07E-06	8.87E-07	2.68E-07	4.77E-07	4.35E-08	
134Cs	1.35E-07	1.35E-07	2.05E-07	5.57E-08	4.33E-08	3.68E-05	1.37E-05	1.01E-05	3.81E-06	4.55E-06	3.68E-06	1.10E-06	2.59E-06	3.94E-09	
137Cs	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	
151Sm	6.75E-03	6.74E-03	1.05E-02	3.04E-03	4.25E-03	2.41E-02	8.76E-02	6.46E-02	2.43E-02	2.90E-02	2.36E-02	7.98E-03	2.89E-02	3.27E-03	
152Eu	8.81E-06	8.81E-06	4.24E-04	2.21E-06	1.49E-06	1.09E-05	3.98E-05	2.94E-05	1.16E-05	1.34E-05	1.14E-05	4.05E-06	9.71E-05	3.22E-07	
154Eu	4.38E-05	4.34E-05	2.98E-04	1.20E-05	2.10E-05	1.28E-03	4.76E-03	3.52E-03	1.31E-03	1.89E-03	1.26E-03	3.89E-04	6.94E-03	4.37E-05	
158Eu	7.97E-04	7.96E-04	2.43E-02	2.11E-04	1.17E-04	6.66E-04	2.41E-03	1.78E-03	7.13E-04	8.15E-04	7.05E-04	2.60E-04	6.94E-03	4.37E-05	
226Ra	3.98E-10	3.98E-10	1.86E-08	1.48E-09	3.29E-10	3.83E-10	5.27E-10	8.98E-10	3.72E-10	4.12E-10	3.54E-10	1.34E-10	2.32E-09	4.97E-10	
228Ra	2.58E-14	2.58E-14	1.07E-07	1.26E-07	6.34E-15	4.02E-06	1.51E-05	1.12E-05	4.16E-06	4.97E-06	3.88E-06	1.35E-06	2.94E-06	4.39E-10	
228Ac	2.10E-09	2.10E-09	7.34E-08	3.89E-07	1.68E-09	4.89E-09	1.73E-08	3.75E-08	4.89E-09	5.74E-09	4.79E-09	1.53E-09	9.02E-08	1.95E-08	
229Th	4.95E-12	4.94E-12	2.50E-09	5.69E-08	1.22E-12	9.30E-08	1.51E-07	2.61E-07	9.00E-08	1.15E-07	9.17E-08	2.75E-08	3.40E-08	8.44E-13	
232Th	2.24E-15	2.23E-15	1.32E-08	5.80E-09	1.59E-15	1.49E-07	2.41E-07	4.12E-07	1.53E-07	1.83E-07	1.47E-07	4.27E-08	1.37E-07	1.03E-13	
232Pa	4.85E-09	4.83E-09	5.51E-08	1.38E-07	3.62E-09	2.43E-08	3.84E-08	1.02E-07	2.47E-08	2.94E-08	2.38E-08	7.49E-09	1.34E-05	3.71E-07	
232U	2.59E-09	2.59E-09	5.51E-08	1.38E-07	3.62E-09	2.43E-08	3.84E-08	1.02E-07	2.47E-08	2.94E-08	2.38E-08	7.49E-09	1.34E-05	3.71E-07	
233U	1.18E-10	1.18E-10	2.02E-07	5.36E-07	2.49E-10	2.85E-06	9.65E-06	7.48E-06	1.48E-05	1.21E-06	9.42E-05	1.79E-05	5.14E-05	4.14E-10	
234U	1.29E-04	1.29E-04	1.99E-04	3.22E-05	2.78E-04	3.87E-05	5.50E-06	2.86E-05	5.67E-05	3.30E-07	1.29E-05	1.39E-05	8.15E-04	1.95E-05	
235U	5.75E-06	5.75E-06	8.97E-06	1.44E-06	1.24E-05	1.35E-06	2.33E-06	8.54E-06	1.42E-05	6.07E-07	1.22E-06	5.19E-07	5.21E-07	3.51E-05	
238U	1.13E-06	1.13E-06	1.27E-06	2.22E-07	2.29E-06	3.06E-07	1.18E-07	7.48E-08	1.99E-07	1.10E-08	2.55E-07	1.17E-08	8.09E-06	2.93E-07	
238Pu	3.63E-07	3.62E-07	2.89E-07	1.60E-07	3.25E-05	2.82E-04	5.03E-06	1.92E-06	1.37E-05	2.74E-07	1.10E-08	2.88E-07	1.17E-05	8.09E-06	
238Pu	8.18E-03	1.01E-02	2.67E-04	1.25E-04	1.62E-05	2.35E-05	1.04E-05	7.88E-06	5.92E-06	2.07E-06	3.93E-06	1.51E-06	4.39E-05	1.28E-05	
239Pu	1.18E-00	1.46E+00	4.70E-03	5.25E-03	2.34E-03	2.35E-03	4.02E-04	2.99E-04	1.98E-04	7.44E-05	1.49E-04	1.49E-04	2.44E-05	4.94E-03	
240Pu	1.04E-01	1.28E-01	1.02E-03	9.28E-04	2.07E-04	2.16E-04	6.60E-05	5.22E-05	3.98E-05	1.27E-05	2.75E-05	2.30E-05	2.03E-05	3.31E-04	
241Pu	3.44E-01	4.23E-01	1.87E-02	1.70E-02	6.54E-04	7.20E-04	4.39E-04	3.97E-04	1.49E-04	7.17E-05	1.31E-05	1.30E-06	1.20E-06	4.92E-10	
242Am	1.59E-06	1.95E-06	1.22E-07	2.81E-06	2.97E-09	3.28E-09	3.57E-09	2.39E-09	1.91E-09	1.71E-09	6.90E-05	7.04E-05	3.17E-01	1.15E-06	
243Am	9.67E-03	1.19E-02	9.89E-03	2.17E-02	2.46E-03	7.18E-04	1.78E-04	2.92E-04	9.01E-04	1.55E-04	6.01E-09	2.95E-09	1.06E-05	3.20E-12	
243Cm	7.86E-08	9.67E-08	7.49E-07	1.41E-07	1.70E-08	1.16E-10	6.14E-09	1.02E-08	9.35E-09	6.01E-09	5.85E-09	1.45E-08	1.80E-08	1.29E-08	
243Cm	9.46E-05	1.16E-04	1.94E-05	2.26E-04	6.83E-06	9.70E-08	5.18E-09	5.85E-09	3.95E-09	9.84E-09	2.34E-10	3.87E-10	1.23E-04	1.39E-11	
243Cm	2.04E-06	2.50E-06	2.09E-06	5.90E-06	1.40E-07	1.16E-10	6.89E-11	1.16E-10	6.89E-11	2.02E-10	2.02E-10	2.45E-10	3.87E-10	1.39E-11	
244Cm	2.00E-06	2.46E-06	5.53E-05	4.52E-05	4.00E-07	8.02E-10	1.36E-09	1.36E-09	1.54E-09	8.82E-10	4.25E-10	3.89E-10	1.04E-04	4.90E-11	

ISOTOPE TO CS-137													
Constituent Name	C-111	C-201	C-202	C-203	C-204	S-104	SX-104	SX-107	SX-108	SX-109	SX-110	SX-111	SX-112
3H	1.38E-05	2.51E-05	8.92E-06	4.78E-05	5.97E-05	5.59E-05	1.09E-03	6.51E-04	2.56E-04	6.74E-04	1.37E-03	9.87E-04	8.11E-04
14C	2.63E-06	6.48E-05	1.23E-05	1.33E-04	1.63E-04	1.49E-05	1.47E-04	3.47E-05	1.47E-05	3.48E-05	6.54E-05	4.96E-05	4.18E-05
59Ni	1.87E-05	2.40E-03	4.61E-03	1.33E-03	3.16E-03	9.27E-05	2.30E-05	2.12E-04	1.36E-04	4.77E-05	3.37E-04	2.51E-04	2.27E-04
63Ni	1.68E-03	2.36E-01	4.52E-01	1.31E-01	3.10E-01	8.83E-03	2.20E-03	2.06E-02	1.31E-02	4.61E-03	3.33E-02	2.46E-02	2.23E-02
60Co	7.58E-07	7.73E-06	1.30E-05	5.97E-06	1.15E-05	6.06E-05	1.61E-04	2.85E-05	1.03E-05	3.09E-05	6.44E-05	4.52E-05	6.36E-05
90Sr	9.50E+01	9.65E+01	1.59E+02	2.93E+01	2.81E+00	4.99E+00	1.01E+00	3.71E+00	1.58E+01	4.26E+00	3.71E+00	3.72E+00	3.72E+00
90Y	9.50E+01	9.65E+01	1.59E+02	2.93E+01	2.81E+00	4.99E+00	1.01E+00	3.71E+00	1.58E+01	4.26E+00	3.71E+00	3.72E+00	3.72E+00
93Zr	2.63E-06	1.31E-04	2.37E-04	8.46E-05	1.81E-04	1.91E-04	8.52E-05	2.98E-04	1.52E-04	1.28E-04	6.79E-04	4.43E-04	3.61E-04
98Tc	1.83E-05	9.55E-05	8.66E-05	1.36E-04	1.91E-04	4.02E-04	1.05E-03	2.66E-04	1.11E-04	2.70E-04	5.17E-04	3.88E-04	3.25E-04
106Ru	5.49E-12	5.35E-08	1.03E-07	2.96E-08	7.02E-08	1.33E-08	2.87E-08	6.15E-09	1.91E-09	7.09E-09	1.60E-08	1.05E-08	8.26E-09
125Sb	1.13E-08	2.65E-05	4.98E-05	1.56E-05	3.55E-05	2.10E-04	6.88E-04	9.68E-05	3.19E-05	1.10E-04	2.38E-04	1.62E-04	1.28E-04
126Sn	8.33E-07	4.70E-05	8.58E-05	2.98E-05	6.48E-05	6.19E-05	2.66E-05	9.10E-05	4.61E-05	4.07E-05	2.07E-04	1.35E-04	1.11E-04
129I	3.44E-08	1.81E-07	1.68E-07	2.55E-07	3.60E-07	1.05E-06	2.03E-06	5.07E-07	2.11E-07	5.12E-07	9.84E-07	7.35E-07	6.16E-07
134Cs	1.37E-07	2.57E-08	4.81E-08	1.52E-08	3.45E-08	1.29E-05	1.12E-05	7.04E-06	2.50E-06	7.02E-06	1.77E-05	1.17E-05	9.24E-06
137Cs	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
151Sm	2.05E-03	1.11E-01	2.02E-01	7.11E-02	1.53E-01	1.44E-01	6.19E-02	2.51E-01	1.29E-01	9.96E-02	5.71E-01	3.70E-01	3.04E-01
152Eu	3.41E-06	1.85E-03	3.54E-03	1.03E-03	2.43E-03	7.54E-05	2.53E-05	2.33E-04	1.37E-04	5.54E-05	4.63E-04	3.12E-04	2.65E-04
154Eu	1.50E-05	1.09E-03	2.06E-03	6.23E-04	1.44E-03	1.45E-03	2.64E-03	6.87E-04	2.51E-04	7.40E-04	1.55E-03	1.09E-03	8.77E-04
155Eu	2.41E-04	1.20E-01	2.31E-01	6.70E-02	1.59E-01	3.73E-03	1.40E-03	1.18E-02	6.88E-03	2.81E-03	2.37E-02	1.59E-02	1.35E-02
226Ra	1.57E-10	2.11E-07	4.01E-07	1.22E-07	2.82E-07	6.62E-09	1.59E-09	1.80E-08	1.14E-08	3.75E-09	3.02E-08	2.20E-08	1.96E-08
228Ra	1.09E-14	1.19E-12	2.24E-12	6.89E-13	1.58E-12	8.73E-08	5.54E-07	1.89E-08	2.28E-13	4.38E-08	5.68E-08	3.92E-08	2.91E-08
227Ac	7.98E-10	1.03E-06	1.96E-06	5.82E-07	1.36E-06	3.29E-08	8.45E-09	6.11E-08	5.06E-08	1.85E-08	1.37E-07	9.94E-08	8.83E-08
229Th	2.12E-12	2.15E-10	4.06E-10	1.25E-10	2.87E-10	2.10E-09	1.30E-08	4.84E-10	1.66E-11	1.06E-09	1.41E-09	9.76E-10	7.28E-10
232Th	7.38E-16	3.78E-15	2.93E-15	5.85E-15	7.91E-15	1.17E-09	3.70E-08	2.55E-10	8.34E-15	5.89E-10	7.62E-10	5.27E-10	3.91E-10
231Pa	1.72E-09	3.44E-08	5.29E-08	3.04E-08	5.43E-08	6.00E-08	2.26E-08	7.79E-08	3.86E-08	3.79E-08	1.77E-07	1.16E-07	9.49E-08
232U	2.47E-09	4.80E-11	2.89E-10	4.81E-11	4.78E-11	7.85E-07	4.98E-06	1.38E-06	1.89E-09	1.36E-06	1.94E-06	1.77E-06	1.62E-06
233U	1.11E-10	2.87E-12	7.59E-12	2.88E-12	2.87E-12	3.00E-06	1.91E-05	5.29E-06	6.05E-11	5.19E-06	7.43E-06	6.80E-06	6.22E-06
234U	1.16E-04	4.05E-06	4.14E-06	4.06E-06	4.04E-06	3.96E-05	6.66E-06	3.77E-05	3.32E-05	2.53E-05	3.90E-05	3.86E-05	3.82E-05
235U	5.15E-06	1.82E-07	1.74E-07	1.82E-07	1.81E-07	1.65E-06	2.78E-07	1.53E-06	1.39E-06	1.02E-06	1.57E-06	1.58E-06	1.55E-06
236U	1.03E-06	2.59E-08	9.63E-08	2.59E-08	2.57E-08	1.15E-06	2.24E-07	1.44E-06	9.34E-07	1.04E-06	1.73E-06	1.60E-06	1.54E-06
238U	1.18E-04	4.10E-06	4.11E-06	4.12E-06	4.09E-06	3.70E-05	6.21E-06	3.32E-05	3.14E-05	2.19E-05	3.30E-05	3.31E-05	3.31E-05
237Np	1.13E-07	4.38E-07	2.63E-07	7.42E-07	9.70E-07	2.55E-06	3.89E-06	1.24E-06	5.69E-07	1.19E-06	2.10E-06	1.68E-06	1.45E-06
238Pu	2.76E-04	1.66E-02	8.31E-03	2.19E-03	6.84E-05	6.81E-05	1.16E-05	1.61E-04	9.90E-05	2.85E-05	2.98E-04	2.06E-04	1.79E-04
239Pu	1.80E-02	7.05E-01	3.51E-01	9.31E-02	2.89E-03	4.09E-03	5.67E-04	4.69E-03	3.21E-03	8.60E-04	5.87E-03	4.91E-03	4.73E-03
240Pu	2.71E-03	1.16E-01	5.77E-02	1.53E-02	4.75E-04	5.93E-04	8.74E-05	7.97E-04	5.32E-04	1.45E-04	1.13E-03	8.87E-04	8.26E-04
241Pu	2.00E-02	1.20E+00	6.00E-01	1.58E-01	4.93E-03	3.84E-03	7.28E-04	8.09E-03	5.06E-03	1.44E-03	1.43E-02	1.01E-02	8.97E-03
242Pu	7.63E-08	5.91E-06	2.95E-06	7.80E-07	2.43E-08	1.77E-08	3.74E-09	4.43E-08	2.73E-08	7.83E-09	1.89E-08	6.57E-08	4.93E-08
241Am	4.41E-06	2.38E-01	1.19E-01	3.13E-02	9.78E-04	6.77E-04	2.95E-04	3.92E-03	2.20E-03	8.49E-04	8.89E-03	5.67E-03	4.67E-03
243Am	3.54E-11	5.68E-06	2.84E-06	7.52E-07	2.34E-08	2.09E-08	1.01E-08	1.74E-07	9.80E-08	3.37E-08	3.94E-07	2.51E-07	2.06E-07
242Cm	6.34E-08	3.82E-04	1.91E-04	5.03E-05	1.57E-06	6.10E-07	7.20E-07	9.76E-06	5.82E-06	1.35E-06	2.04E-05	1.33E-05	1.12E-05
243Cm	1.39E-09	2.10E-05	1.05E-05	2.76E-06	8.58E-08	1.40E-08	5.88E-08	9.32E-07	5.43E-07	1.29E-07	2.07E-06	1.32E-06	1.09E-06
244Cm	1.41E-09	1.02E-05	5.09E-06	1.34E-06	4.18E-08	1.12E-08	5.57E-07	2.78E-05	1.60E-05	3.82E-06	6.25E-05	3.96E-05	3.27E-05

ISOTOPE TO CS-137	Constituent Name	TX-114	TX-110	TX-113	TX-107	TX-105	T-109	T-108	T-106	T-107	T-108	T-109	T-111	TX-105	TX-107	TX-110	TX-113
63Si-04	3H	6.63E-04	9.98E-04	8.69E-05	3.21E-05	1.80E-05	2.89E-04	5.81E-04	1.63E-04	8.10E-04	1.29E-04	7.21E-04	7.83E-04	6.72E-04			
64Si-04	14C	3.34E-05	3.03E-05	1.27E-05	4.67E-06	4.60E-06	4.59E-05	8.69E-05	5.39E-05	1.16E-04	2.31E-05	1.01E-04	1.11E-04	9.68E-05			
72Si-05	69Ni	7.82E-05	6.81E-07	5.07E-07	1.33E-06	1.31E-06	4.08E-05	3.98E-05	3.29E-04	8.81E-06	1.46E-06	7.54E-06	8.41E-06	7.60E-06			
73Si-05	63Ni	7.46E-05	6.73E-05	5.70E-05	1.23E-04	1.15E-04	1.27E-03	1.47E-03	1.89E-02	3.59E-02	2.62E-04	7.39E-04	8.22E-04	7.40E-04			
76Si-06	60Co	3.07E-05	4.16E-05	1.20E-05	1.99E-06	6.41E-07	9.73E-08	1.98E-05	2.50E-02	1.27E-04	2.03E-05	1.14E-04	1.23E-04	1.05E-04			
80Si-07	90Sr	1.32E+00	3.72E+00	1.27E+00	1.54E+00	8.77E+00	1.58E+00	1.77E+00	3.28E+01	3.84E+01	7.07E-02	3.93E+01	4.30E+01	3.48E+01			
90Si-07	90Y	1.27E+00	9.54E-01	1.54E+00	1.45E+00	8.77E+00	1.58E+00	1.77E+00	3.28E+01	3.84E+01	7.07E-02	3.93E+01	4.30E+01	3.48E+01			
91Si-08	91Zr	1.84E-04	4.89E-06	4.12E-06	3.87E-05	3.81E-05	4.68E-05	6.84E-05	8.84E-05	5.94E-05	1.01E-05	5.48E-05	5.83E-05	5.00E-05			
92Si-08	92Nb	2.60E-04	3.90E-04	8.69E-05	4.37E-05	3.18E-05	2.32E-04	6.12E-04	5.93E-02	8.24E-04	1.31E-04	7.18E-04	7.86E-04	6.74E-04			
106Si-09	106Ru	7.28E-09	8.85E-09	2.39E-09	1.85E-10	1.61E-14	3.50E-12	7.77E-12	5.69E-12	2.26E-08	3.93E-09	2.23E-08	2.32E-08	1.99E-08			
126Si-10	126Sb	1.11E-04	1.42E-04	6.29E-05	4.52E-05	1.54E-06	4.38E-07	1.47E-05	1.89E-05	5.39E-04	8.90E-05	4.93E-04	5.31E-04	4.53E-04			
128Si-10	128In	5.74E-05	4.24E-05	1.48E-06	1.42E-07	6.41E-08	6.09E-07	1.15E-06	7.75E-07	1.59E-06	2.12E-07	1.63E-06	1.80E-05	1.59E-05			
129Si-10	129I	4.94E-07	7.40E-07	1.71E-07	1.26E-07	5.48E-08	3.77E-07	8.21E-07	5.39E-07	9.27E-06	2.70E-06	8.52E-08	8.51E-08	1.57E-06			
134Si-10	134Cs	7.43E-06	8.66E-06	2.19E-07	1.94E-07	5.48E-08	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00			
137Si-10	137Cs	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00			
141Si-11	141La	1.94E-01	9.85E-02	2.35E-03	3.73E-03	3.66E-03	3.69E-02	6.93E-02	4.84E-02	4.19E-02	7.27E-03	3.93E-02	4.17E-02	3.58E-02			
145Si-11	145Sm	2.96E-05	2.96E-05	2.40E-06	8.39E-06	4.48E-07	1.05E-05	1.05E-05	5.27E-05	1.30E-05	2.95E-06	1.47E-05	1.46E-05	1.25E-05			
146Si-11	146Eu	7.38E-04	9.95E-04	1.73E-04	4.79E-04	3.81E-06	1.69E-04	3.47E-04	2.94E-03	2.04E-03	3.45E-04	1.95E-03	2.06E-03	1.78E-03			
222Si-12	222Rn	5.15E-03	2.90E-03	1.65E-04	4.37E-04	6.79E-05	5.65E-04	1.68E-03	2.83E-03	7.69E-04	1.64E-04	8.79E-04	8.71E-04	7.48E-04			
226Si-12	226Ra	6.53E-09	5.78E-09	4.82E-11	1.63E-11	6.11E-15	2.97E-09	5.23E-09	3.43E-11	5.74E-10	2.63E-10	5.19E-10	5.66E-10	4.90E-10			
228Si-12	228Ac	3.93E-08	2.80E-08	2.42E-10	1.65E-10	4.12E-12	2.97E-09	5.23E-09	3.43E-11	5.74E-10	2.63E-10	5.19E-10	5.66E-10	4.90E-10			
9.00E-10	1.41E-09	3.28E-11	5.83E-08	1.68E-12	1.18E-12	9.37E-12	6.69E-11	3.59E-11	7.37E-08	3.71E-08	3.21E-08	3.34E-09	3.68E-09	3.18E-09			
5.25E-10	7.98E-10	2.31E-10	5.92E-09	1.57E-08	1.05E-08	1.52E-08	2.69E-08	1.73E-08	1.93E-09	1.73E-08	1.93E-09	1.73E-08	1.93E-09	1.73E-08			
5.10E-08	4.11E-08	1.03E-09	5.83E-07	1.93E-09	4.33E-09	1.35E-14	2.53E-14	6.95E-14	3.80E-08	1.84E-08	3.00E-08	1.49E-08	1.61E-08	1.38E-08			
9.95E-07	1.91E-06	3.20E-08	6.96E-07	8.87E-09	7.17E-09	7.01E-09	1.93E-09	1.13E-07	4.16E-07	2.94E-08	1.58E-08	1.58E-08	2.49E-07	8.19E-07			
3.81E-06	7.38E-06	1.03E-07	2.45E-05	2.43E-10	4.30E-10	3.89E-10	5.65E-05	8.74E-03	1.69E-14	5.74E-08	6.37E-06	6.07E-06	9.51E-07	3.14E-06			
7.52E-07	1.54E-06	3.53E-06	2.19E-06	6.72E-06	2.72E-05	2.17E-05	2.40E-06	2.99E-04	5.98E-05	5.17E-08	4.98E-08	4.98E-08	6.15E-08	6.15E-08			
7.82E-07	1.90E-06	5.30E-06	1.11E-06	4.93E-06	3.07E-05	3.80E-06	5.30E-06	5.20E-05	5.39E-05	1.65E-08	2.38E-08	2.38E-08	2.92E-08	2.92E-08			
1.60E-05	3.31E-05	6.89E-05	2.85E-07	1.49E-04	4.92E-04	1.97E-06	6.55E-05	8.74E-03	1.68E-06	6.55E-06	4.00E-06	2.08E-06	2.08E-06	1.39E-06			
1.11E-09	1.93E-06	3.10E-07	3.10E-07	2.40E-04	4.01E-04	9.12E-04	1.92E-04	2.54E-06	4.78E-06	8.47E-07	4.92E-06	5.92E-06	4.44E-06	4.44E-06			
5.04E-06	3.34E-05	2.00E-04	1.41E-04	3.83E-05	3.06E-05	1.35E-04	7.18E-05	5.42E-03	4.78E-05	4.78E-05	1.87E-04	2.89E-04	1.89E-04	1.89E-04			
1.30E-05	2.00E-03	7.44E-03	5.88E-03	3.36E-03	1.15E-02	2.42E-02	1.19E-02	8.28E-01	1.95E-02	2.86E-05	5.17E-06	3.00E-05	4.14E-05	2.79E-05			
2.89E-03	1.93E-03	1.10E-02	1.98E-03	5.10E-04	6.75E-04	1.90E-03	9.73E-04	7.10E-02	2.86E-05	3.24E-04	3.69E-04	3.24E-04	3.69E-04	2.89E-04			
1.63E-08	9.15E-09	2.90E-09	3.19E-08	3.82E-03	4.32E-04	4.57E-03	6.84E-03	2.13E-01	3.14E-04	5.58E-05	3.07E-05	1.76E-09	1.99E-04	1.57E-09			
1.82E-03	4.60E-04	1.69E-05	1.41E-05	1.47E-03	1.32E-03	2.72E-04	1.85E-04	2.75E-01	2.16E-04	3.65E-05	2.05E-04	2.05E-04	2.16E-04	1.89E-04			
7.82E-08	1.41E-08	6.34E-10	5.32E-10	3.60E-03	3.18E-06	1.84E-09	1.00E-09	1.93E-06	7.28E-09	1.28E-09	7.28E-09	7.28E-09	7.54E-09	6.47E-09			
3.74E-06	6.04E-07	6.43E-08	5.98E-08	3.47E-05	3.28E-06	6.09E-07	3.61E-07	2.42E-03	5.01E-07	5.01E-07	5.01E-07	5.01E-07	5.01E-07	4.80E-07			
3.73E-07	1.38E-08	4.64E-09	4.23E-09	7.83E-07	1.89E-08	1.24E-08	7.99E-09	4.97E-05	4.65E-08	4.65E-08	9.09E-09	5.25E-08	5.18E-08	4.44E-08			
1.13E-05	1.08E-08	5.01E-08	4.08E-08	1.07E-06	4.94E-08	4.05E-08	4.24E-08	4.55E-05	4.81E-07	4.81E-07	4.81E-07	4.81E-07	4.81E-07	4.81E-07			

ISOTOPE TO CS-137												AVERAGE ISOTOPE/CS-137 RATIO
Constituent Name	TX-115	TX-116	TX-117	TY-101	TY-103	TY-104	TY-105	TY-106	U-101	U-104	U-110	
3H	8.11E-04	4.82E-04	5.33E-04	3.88E-03	1.64E-03	1.58E-05	3.09E-04	5.43E-06	6.94E-06	7.39E-04	1.11E-05	4.15E-04
14C	1.15E-04	7.09E-05	7.75E-05	3.71E-03	6.98E-05	8.51E-05	1.00E-04	6.48E-05	1.99E-05	9.48E-05	1.33E-05	1.15E-04
59Ni	8.80E-06	9.84E-06	8.44E-06	2.33E-03	2.96E-05	9.55E-06	1.21E-05	2.13E-07	7.03E-07	1.10E-05	9.02E-07	2.77E-04
63Ni	8.62E-04	9.27E-04	8.10E-04	2.11E-01	2.82E-03	8.74E-04	1.10E-03	1.92E-05	6.17E-05	1.07E-03	7.92E-05	2.70E-02
60Co	1.27E-04	7.57E-05	8.32E-05	1.44E-02	1.03E-04	2.02E-04	6.33E-04	1.72E-07	3.44E-07	8.35E-05	4.42E-07	5.22E-04
90Sr	3.86E-01	2.87E-01	2.73E-01	4.34E+01	6.33E+00	2.89E+00	2.44E+01	6.14E+00	3.73E+00	1.50E+00	1.29E+01	1.12E+01
90Y	3.86E-01	2.87E-01	2.73E-01	4.34E+01	6.33E+00	2.89E+00	2.44E+01	6.14E+00	3.73E+00	1.50E+00	1.29E+01	1.12E+01
93Zr	5.85E-05	3.56E-05	3.94E-05	7.33E-04	1.19E-04	3.17E-06	4.28E-05	7.55E-07	2.47E-06	5.81E-05	3.17E-06	1.30E-04
99Tc	8.23E-04	5.08E-04	5.52E-04	1.33E-02	1.10E-03	8.24E-04	4.19E-03	6.73E-03	1.70E-05	6.35E-04	2.77E-04	1.92E-03
106Ru	2.27E-08	1.23E-08	1.35E-08	7.73E-11	4.22E-08	3.75E-13	4.07E-12	7.17E-14	8.11E-15	1.36E-08	1.04E-14	9.23E-07
125Sb	5.38E-04	3.18E-04	3.49E-04	0.00E+00	1.05E-03	7.81E-07	9.04E-06	1.59E-07	1.86E-07	3.09E-04	2.38E-07	3.92E-04
126Sn	1.80E-05	1.09E-05	1.21E-05	2.31E-04	3.68E-05	1.01E-06	1.35E-05	2.38E-07	7.71E-07	1.77E-05	9.89E-07	4.31E-05
128I	1.59E-06	9.78E-07	1.07E-06	2.00E-04	3.23E-06	4.16E-08	4.38E-06	9.81E-09	3.16E-08	1.22E-06	4.08E-08	9.28E-06
134Cs	9.43E-06	5.30E-06	4.03E-05	4.60E-05	1.72E-05	2.76E-07	8.49E-08	1.99E-09	1.98E-10	1.60E-05	2.49E-09	7.99E-08
137Cs	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
151Sm	4.20E-02	2.58E-02	2.82E-02	5.71E-01	8.59E-02	2.48E-03	3.35E-02	5.89E-04	1.96E-03	4.14E-02	2.51E-03	1.01E-01
152Eu	1.31E-05	7.81E-06	8.51E-06	3.52E-04	3.70E-05	4.80E-06	4.21E-05	1.72E-06	4.59E-07	1.18E-05	4.11E-07	2.23E-04
154Eu	2.04E-03	1.19E-03	1.31E-03	3.19E-03	3.97E-03	1.49E-05	1.76E-04	3.09E-06	4.62E-06	1.52E-03	5.92E-06	4.69E-03
155Eu	7.79E-04	4.74E-04	5.14E-04	2.48E-02	2.39E-03	3.49E-04	3.17E-03	1.30E-04	6.94E-05	7.42E-04	6.23E-05	1.41E-02
226Ra	5.68E-10	4.49E-10	4.48E-10	3.88E-08	1.46E-09	1.56E-10	2.46E-09	4.31E-11	1.00E-09	9.73E-10	6.49E-10	1.99E-08
228Ra	9.34E-07	6.76E-07	1.00E-06	1.11E-12	2.05E-06	1.67E-14	1.81E-13	6.54E-15	6.25E-15	5.07E-08	5.58E-15	1.04E-06
227Ac	3.71E-09	2.86E-09	3.01E-09	2.00E-07	9.13E-09	8.05E-10	1.26E-08	2.21E-10	2.51E-09	2.15E-09	2.08E-09	2.46E-07
228Th	2.16E-08	1.57E-08	2.31E-08	2.16E-10	4.72E-08	3.25E-12	3.11E-11	1.27E-12	1.20E-12	2.95E-09	1.08E-12	4.19E-08
232Th	5.72E-08	4.17E-08	6.10E-08	2.06E-13	1.24E-07	8.84E-16	1.22E-14	2.14E-16	7.67E-16	1.35E-08	9.81E-16	4.10E-08
231Pa	1.64E-08	1.14E-08	1.28E-08	4.40E-07	3.63E-08	1.78E-09	2.72E-08	4.79E-10	2.32E-09	1.96E-08	2.98E-09	2.55E-07
232U	4.67E-06	3.70E-07	5.46E-07	7.79E-08	7.79E-06	4.13E-09	1.92E-08	2.84E-09	3.88E-10	6.83E-08	1.67E-09	3.17E-06
233U	1.79E-05	1.42E-06	2.09E-06	3.58E-09	2.99E-05	1.89E-10	9.51E-10	1.40E-10	2.32E-11	2.62E-07	9.96E-11	1.22E-05
234U	3.83E-06	3.31E-06	1.81E-06	3.27E-03	3.97E-04	1.72E-04	1.02E-03	1.50E-04	3.27E-05	1.39E-05	1.41E-04	2.41E-04
235U	1.54E-07	1.45E-07	7.87E-08	1.44E-04	1.75E-05	7.57E-06	4.53E-05	6.67E-06	1.47E-06	6.25E-07	6.34E-06	1.06E-05
236U	1.24E-07	3.72E-08	2.49E-08	3.33E-05	4.21E-06	1.75E-06	8.75E-06	1.30E-07	2.09E-07	9.50E-08	8.98E-07	2.46E-06
238U	3.39E-06	3.32E-06	1.79E-06	3.32E-03	4.03E-04	1.75E-04	1.04E-03	1.53E-04	3.31E-05	1.41E-05	1.42E-04	2.42E-04
237Np	2.97E-06	1.85E-06	2.02E-06	3.13E-05	6.19E-06	1.37E-07	1.83E-06	3.21E-08	1.03E-07	2.39E-06	1.31E-07	1.92E-06
238Pu	4.79E-06	4.53E-06	3.97E-06	5.67E-03	1.25E-04	3.53E-05	4.78E-05	1.36E-05	2.03E-05	3.90E-06	2.92E-05	1.19E-03
239Pu	1.73E-04	4.00E-04	2.59E-04	7.44E-01	1.13E-02	4.39E-03	7.28E-03	2.08E-03	6.36E-03	1.55E-04	9.17E-03	1.08E-01
240Pu	2.87E-05	4.03E-05	2.99E-05	7.03E-02	1.21E-03	4.28E-04	6.25E-04	1.78E-04	3.75E-04	2.31E-05	5.40E-04	1.14E-02
241Pu	3.17E-04	2.45E-04	2.35E-04	2.42E-01	6.50E-03	1.55E-03	1.89E-03	5.36E-04	2.39E-04	2.33E-04	3.46E-04	6.76E-02
242Pu	1.72E-09	1.25E-09	1.21E-09	1.10E-06	3.23E-08	7.07E-09	8.48E-09	2.42E-09	7.32E-10	1.16E-09	1.06E-09	3.23E-07
241Am	2.17E-04	1.12E-04	1.26E-04	1.53E-03	2.25E-03	8.83E-04	8.21E-05	1.44E-06	2.25E-06	1.86E-04	3.35E-03	1.88E-02
243Am	7.32E-09	3.81E-09	4.29E-09	1.08E-08	7.52E-08	6.30E-09	5.72E-10	1.01E-11	6.29E-10	5.67E-09	9.40E-09	4.19E-07
242Cm	5.06E-07	2.85E-07	3.17E-07	6.63E-06	6.50E-06	1.08E-05	7.70E-07	3.14E-08	4.84E-07	3.50E-07	5.08E-06	1.47E-04
243Cm	4.69E-08	2.57E-08	2.89E-08	1.36E-07	5.05E-07	2.23E-07	1.59E-08	6.42E-10	7.18E-09	2.66E-08	7.47E-08	5.12E-06
244Cm	4.84E-07	2.60E-07	2.85E-07	2.48E-07	5.04E-06	1.50E-07	1.35E-08	2.38E-10	9.65E-09	3.28E-07	1.43E-07	4.77E-05

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ATTACHMENT D

**POTENTIAL-TO-EMIT ASSUMPTIONS AND CALCULATIONS
DRILLING BOREHOLES**

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SOURCE TERM FOR AIR ROTARY CORE DRILLING BASED ON SCALING TO TANK ISOPEICs-137 RATIOS										
ISOTOPE	AVERAGE TANK Cs-137 RATIO	AVERAGE CURIES PER GRAM OF SOIL	TOTAL POSSESSION QUANTITY CURIES PER GRAM OF SOIL	TOTAL UNABATED RELEASE CURIES PER YEAR	TOTAL ABATED RELEASE CURIES PER YEAR	200-EAST AREA CAP88 OFFSITE DOSE CONVERSION FACTOR MREM/CURIE	UNABATED OFFSITE DOSE MREM PER YEAR	ABATED OFFSITE DOSE MREM PER YEAR	PERCENT OF UNABATED DOSE	PERCENT OF ABATED DOSE
NUMBER OF BOREHOLES PER YEAR	10									
RELEASE FRACTION	1.00									
LENGTH OF EACH BOREHOLE	50	FEET								
CASING PER BOREHOLE	200									
CASING PER BOREHOLE	111.65	FEET*3								
VOLUME OF SOIL REMOVED PER BOREHOLE PLUS 15% EXPANSION	20	FEET								
AVERAGE DEPTH OF CONTAMINATED SOIL PER BOREHOLE (10-INCH BOREHOLE DIAMETER)	10.91	FEET*3								
VOLUME OF CONTAMINATED SOIL (20 FEET LAYER IN 10-INCH BOREHOLE)	12.54	FEET*3								
MAXIMUM VOLUME OF CONTAMINATED SOIL PER BOREHOLE * 15% EXPANSION	125.45	FEET*3								
PERCENT DENSITY OF SOIL	97.5									
EFFICIENCY OF TORT	99.96%									
AVERAGE VOLUME OF SOIL COLLECTED BY TORT PER BOREHOLE	0.53	FEET*3								
AVERAGE CALCULATED CYCLONE	99.52%									
TOTAL WEIGHT OF CONTAMINATED SOIL AVAILABLE TO CHALLENGE HEPA FILTER PER YEAR	5,55E+06	GRAMS/YEAR								
MAXIMUM AVERAGE Cs-137 CONCENTRATION SOIL IN CONTAMINATED LAYER	7.00E-09	CURIES PER GRAM OF SOIL								
NUMBER OF HEPA FILTERS	1									
HEPA FILTER EFFICIENCY	99.95%									

ISOTOPE	AVERAGE TANK Cs-137 RATIO	AVERAGE CURIES PER GRAM OF SOIL	TOTAL POSSESSION QUANTITY CURIES PER YEAR	TOTAL UNABATED RELEASE CURIES PER YEAR	TOTAL ABATED RELEASE CURIES PER YEAR	200-EAST AREA CAP88 OFFSITE DOSE CONVERSION FACTOR MREM/CURIE	UNABATED OFFSITE DOSE MREM PER YEAR	ABATED OFFSITE DOSE MREM PER YEAR	PERCENT OF UNABATED DOSE	PERCENT OF ABATED DOSE
231Pa	2.55E-07	1.79E-15	9.92E-09	9.92E-09	9.50E-18	8.67E+00	8.60E-08	8.24E-17	0.000%	0.000%
232U	3.17E-06	2.22E-14	1.23E-07	1.23E-07	1.18E-16	1.16E+01	1.43E-06	1.37E-15	0.002%	0.000%
233U	1.22E-05	8.52E-14	4.73E-07	4.73E-07	4.53E-16	3.23E+00	1.53E-06	1.46E-15	0.002%	0.000%
234U	2.41E-04	1.68E-12	9.34E-06	9.34E-06	8.95E-15	3.19E+00	2.98E-05	2.86E-14	0.042%	0.000%
235U	1.08E-05	7.45E-14	4.13E-07	4.13E-07	3.96E-16	2.96E+00	1.22E-06	1.17E-15	0.002%	0.000%
238U	2.46E-06	1.72E-14	9.55E-08	9.55E-08	9.15E-17	3.02E+00	2.89E-07	2.76E-16	0.000%	0.000%
238U	2.42E-04	1.70E-12	9.41E-06	9.41E-06	9.02E-15	2.84E+00	2.67E-05	2.56E-14	0.038%	0.000%
237Np	1.92E-06	1.34E-14	7.44E-08	7.44E-08	7.13E-17	1.19E+01	8.84E-07	8.47E-16	0.001%	0.000%
238Pu	1.19E-03	8.31E-12	4.61E-05	4.61E-05	4.42E-14	8.02E+00	3.70E-04	3.54E-13	0.522%	0.003%
239Pu	1.08E-01	7.58E-10	4.21E-03	4.21E-03	4.03E-12	8.67E+00	3.65E-02	3.49E-11	51.463%	0.288%
240Pu	1.14E-02	7.99E-11	4.44E-04	4.44E-04	4.25E-13	8.66E+00	3.84E-03	3.68E-12	5.422%	0.030%
241Pu	6.76E-02	4.70E-10	2.65E-03	2.65E-03	2.51E-12	1.39E+01	3.62E-04	3.47E-13	0.511%	0.003%
242Pu	3.23E-07	2.26E-15	1.26E-08	1.26E-08	1.20E-17	8.23E+00	1.03E-07	9.91E-17	0.000%	0.000%
241Am	1.68E-02	1.32E-10	7.31E-04	7.31E-04	7.00E-13	1.31E+01	9.57E-03	9.17E-12	13.510%	0.076%
243Am	4.19E-07	2.93E-15	1.63E-08	1.63E-08	1.56E-17	1.31E+01	2.13E-07	2.04E-16	0.000%	0.000%
242Cm	1.47E-04	1.03E-12	5.71E-06	5.71E-06	5.47E-15	1.32E+01	7.54E-05	7.23E-14	0.106%	0.001%
243Cm	5.12E-06	3.58E-14	1.99E-07	1.99E-07	1.91E-16	8.93E+00	1.78E-06	1.70E-15	0.003%	0.000%
244Cm	4.77E-05	3.34E-13	1.85E-08	1.85E-08	1.78E-15	6.94E+00	1.29E-05	1.23E-14	0.018%	0.000%
TOTAL			8.20E-01	8.20E-01	2.08E-05		7.08E-02	1.21E-08	100%	100%

SOURCE TERM FOR CABLE TOOL AND SONIC DRILLING BASED ON SCALING TO TANK ISOTOPE/Cs-137 RATIOS TO FIELD DATA BNWL-CC-701												
NUMBER OF BOREHOLES PER YEAR	10											
LENGTH OF 10-INCH NOMINAL DIAMETER CASING PER BOREHOLE	50	FEET										
LENGTH OF 8-INCH NOMINAL DIAMETER CASING PER BOREHOLE	200	FEET										
RELEASE FRACTION	1.00E-03											
VOLUME OF SOIL REMOVED PER BOREHOLE PLUS 15% EXPANSION	111.65	FEET*3										
AVERAGE DEPTH OF CONTAMINATED SOIL PER BOREHOLE (OCCURS AT 10-INCH BOREHOLE DIAMETER)	20	FEET										
VOLUME OF CONTAMINATED SOIL (20 FEET LAYER IN 10-INCH BOREHOLE)	10.91	FEET*3										
MAXIMUM VOLUME OF CONTAMINATED SOIL PER BOREHOLE + 15% EXPANSION	12.54	FEET*3										
MAXIMUM VOLUME OF CONTAMINATED SOIL PER YEAR + 15% EXPANSION	125.45	FEET*3										
DENSITY OF SOIL	97.5	POUNDS/FEET*3	(AVERAGE FOR LOOSE, DRY SAND & GRAVEL - MARKS STANDARD HANDBOOK FOR MECHANICAL ENGINEERS)									
TOTAL WEIGHT OF CONTAMINATED SOIL AVAILABLE TO CHALLENGE HEPA FILTER PER YEAR	5.55E+06	GRAMS/YEAR										
MAXIMUM AVERAGE Cs-137 CONCENTRATION SOIL IN CONTAMINATED LAYER	7.00E-06	CURIES PER GRAM OF SOIL										
NUMBER OF HEPA FILTERS	0											
HEPA FILTER EFFICIENCY	99.95%											
ISOTOPE	AVERAGE TANK Cs-137 RATIO	AVERAGE CURIES PER GRAM OF SOIL	TOTAL POSSESSION QUANTITY CURIES PER YEAR	TOTAL UNABATED RELEASE CURIES PER YEAR	TOTAL ABATED RELEASE CURIES PER YEAR	200-EAST AREA CAP88 OFFSITE DOSE CONVERSION FACTOR MREM/CURIE	UNABATED OFFSITE DOSE MREM PER YEAR	ABATED OFFSITE DOSE MREM PER YEAR	PERCENT OF UNABATED DOSE	PERCENT OF ABATED DOSE		
3H	4.15E-04	2.91E-09	1.61E-02	1.61E-05	1.61E-05	2.19E-05	3.53E-10	3.53E-10	0.000%	0.000%		
14C	1.15E-04	8.05E-10	4.47E-03	4.47E-06	4.47E-06	2.62E-03	1.17E-08	1.17E-08	0.000%	0.000%		
59Ni	2.77E-04	1.94E-09	1.08E-02	1.08E-05	1.08E-05	2.85E-04	3.07E-09	3.07E-09	0.000%	0.000%		
63Ni	2.70E-02	1.89E-07	1.05E+00	1.05E-03	1.05E-03	2.03E-04	2.13E-07	2.13E-07	0.000%	0.000%		
60Co	5.22E-04	3.65E-09	2.03E-02	2.03E-05	2.03E-05	2.90E-02	5.88E-07	5.88E-07	0.001%	0.001%		
90Sr	1.12E+01	7.81E-05	4.34E+02	4.34E-01	4.34E-01	4.38E-02	1.90E-02	1.90E-02	26.803%	26.803%		
90Y	1.12E+01	7.81E-05	4.34E+02	4.34E-01	4.34E-01	3.77E-04	1.63E-04	1.63E-04	0.231%	0.231%		
93Zr	1.30E-04	9.11E-10	5.05E-03	5.05E-06	5.05E-06	4.51E-03	2.28E-08	2.28E-08	0.000%	0.000%		
99Tc	1.92E-03	1.34E-08	7.46E-02	7.46E-05	7.46E-05	1.09E-03	8.13E-08	8.13E-08	0.000%	0.000%		
106Ru	9.23E-07	6.49E-12	3.58E-05	3.58E-08	3.58E-08	2.09E-02	7.49E-10	7.49E-10	0.000%	0.000%		
125Sb	3.92E-04	2.74E-09	1.52E-02	1.52E-05	1.52E-05	4.15E-03	6.32E-08	6.32E-08	0.000%	0.000%		
126Sn	4.31E-05	3.01E-10	1.67E-03	1.67E-06	1.67E-06	8.63E-03	1.44E-08	1.44E-08	0.000%	0.000%		
129I	9.28E-06	6.50E-11	3.61E-04	3.61E-07	3.61E-07	2.91E-01	1.05E-07	1.05E-07	0.000%	0.000%		
134Cs	7.99E-06	5.59E-11	3.10E-04	3.10E-07	3.10E-07	3.13E-02	9.71E-09	9.71E-09	0.000%	0.000%		
137Cs	1.00E+00	7.00E-06	3.89E+01	3.88E-02	3.88E-02	2.39E-02	9.28E-04	9.28E-04	1.310%	1.310%		
151Sm	1.01E-01	7.05E-07	3.91E+00	3.91E-03	3.91E-03	8.06E-04	3.15E-06	3.15E-06	0.004%	0.004%		
152Eu	2.23E-04	1.59E-09	8.66E-03	8.66E-06	8.66E-06	1.54E-02	1.33E-07	1.33E-07	0.000%	0.000%		
154Eu	4.69E-03	3.28E-08	1.82E-01	1.82E-04	1.82E-04	1.83E-02	3.33E-06	3.33E-06	0.005%	0.005%		
155Eu	1.41E-02	9.87E-08	5.48E-01	5.48E-04	5.48E-04	1.85E-03	1.01E-06	1.01E-06	0.001%	0.001%		
226Ra	1.99E-08	1.40E-13	7.74E-07	7.74E-10	7.74E-10	5.45E-01	4.22E-10	4.22E-10	0.000%	0.000%		
228Ra	1.04E-06	7.25E-12	4.02E-05	4.02E-08	4.02E-08	5.44E-01	2.19E-08	2.19E-08	0.000%	0.000%		
227Ac	2.48E-07	1.72E-12	9.55E-06	9.55E-09	9.55E-09	4.90E+01	4.68E-07	4.68E-07	0.001%	0.001%		
229Th	4.19E-08	2.94E-13	1.63E-06	1.63E-09	1.63E-09	1.66E+01	2.70E-08	2.70E-08	0.000%	0.000%		
232Th	4.10E-08	2.87E-13	1.59E-06	1.59E-09	1.59E-09	6.68E+00	1.06E-08	1.06E-08	0.000%	0.000%		
231Pa	2.55E-07	1.79E-12	9.92E-06	9.92E-09	9.92E-09	8.67E+00	8.60E-08	8.60E-08	0.000%	0.000%		
232U	3.17E-06	2.22E-11	1.23E-04	1.23E-07	1.23E-07	1.16E+01	1.43E-06	1.43E-06	0.002%	0.002%		
233U	1.22E-05	8.52E-11	4.73E-04	4.73E-07	4.73E-07	3.23E+00	1.53E-06	1.53E-06	0.002%	0.002%		
234U	2.41E-04	1.68E-09	9.34E-03	9.34E-06	9.34E-06	3.19E+00	2.98E-05	2.98E-05	0.042%	0.042%		
235U	1.06E-05	7.45E-11	4.13E-04	4.13E-07	4.13E-07	2.96E+00	1.22E-06	1.22E-06	0.002%	0.002%		

DOE/RL-99-34, Rev 0
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ATTACHMENT D - CABLE TOOL

23SU	1.72E-11	9.55E-05	9.55E-08	9.55E-08	3.02E+00	2.88E-07	2.88E-07	0.000%	0.000%
23RU	2.48E-04	1.70E-09	9.41E-03	9.41E-06	2.84E+00	2.67E-05	2.67E-05	0.038%	0.038%
23RP	1.92E-06	1.30E-11	7.44E-08	7.44E-08	1.19E+01	8.84E-07	8.84E-07	0.001%	0.001%
23SP	1.92E-06	1.30E-11	7.44E-08	7.44E-08	1.19E+01	8.84E-07	8.84E-07	0.001%	0.001%
238P	1.08E-01	7.59E-07	4.91E-02	4.91E-05	8.02E+00	3.70E-04	3.70E-04	0.522%	0.522%
240P	1.14E-02	7.59E-08	4.44E-01	4.44E-04	8.67E+00	3.85E-02	3.85E-02	51.463%	51.463%
241P	6.17E-02	4.73E-07	2.62E+00	2.62E-03	1.38E+01	3.62E-04	3.62E-04	5.422%	5.422%
242P	3.28E-07	2.65E-12	1.26E-05	1.26E-08	8.23E+00	1.03E-07	1.03E-07	0.000%	0.000%
244Am	1.88E-02	1.30E-07	7.31E-01	7.31E-04	1.31E+01	9.57E-03	9.57E-03	13.510%	13.510%
244Cm	1.88E-02	1.30E-07	7.31E-01	7.31E-04	1.31E+01	9.57E-03	9.57E-03	13.510%	13.510%
246Cm	1.92E-06	1.30E-11	7.44E-08	7.44E-08	1.19E+01	8.84E-07	8.84E-07	0.001%	0.001%
246Gm	5.19E-06	3.58E-11	1.85E-03	1.85E-06	8.94E+00	7.08E-02	7.08E-02	10.0%	10.0%
246Pu	4.77E-05	3.34E-10	1.85E-03	1.85E-06	8.94E+00	7.08E-02	7.08E-02	10.0%	10.0%
TOTAL									

SOURCE TERM FOR CLOSED END PROBE AND CONE PENETROMETER BASED ON SCALING TO TANK ISOTOPE/Cs-137 RATIOS											
NUMBER OF BOREHOLES PER YEAR		10									
VOLUME OF 75, 2-INCH DIAMETER X 10 INCH LONG SAMPLE PER BOREHOLE		1.3635	FEET^3								
VOLUME OF 10, 4-INCH DIAMETER X 2 FEET LONG SAMPLES		1.7453	FEET^3								
TOTAL SAMPLE VOLUME PER BOREHOLE		1.75	FEET^3	(MAXIMUM SOIL SAMPLE VOLUME PER BOREHOLE)							
VOLUME FRACTION OF SOIL SAMPLES FROM HIGHLY CONTAMINATED ZONE		0.25									
TOTAL VOLUME OF CONTAMINATED SOIL EXTRACTED PER BOREHOLE BASED ON MAXIMUM SAMPLE VOLUME PER BOREHOLE		0.44	FEET^3								
TOTAL VOLUME OF CONTAMINATED SOIL EXTRACTED PER YEAR		4.36	FEET^3								
DENSITY OF SOIL		110	POUNDS/FEET^3	(AVERAGE FOR COMPACTED, DRY SAND & GRAVEL - MARKS STANDARD HANDBOOK FOR MECHANICAL ENGINEERS)							
TOTAL WEIGHT OF CONTAMINATED SOIL		2.18E+05	GRAMS								
Cs-137 CONCENTRATION SOIL (ASSUMES 100% SATURATION OF VOID SPACE)		3.30E-04	CURIES PER GRAM OF SOIL								
FRACTION OF SAMPLE AVAILABLE FOR RELEASE TO ATMOSPHERE		0.10									
RELEASE FRACTION		1.00E-03									
NUMBER OF HEPA FILTERS		0									
HEPA FILTER EFFICIENCY		99.95%									
ISOTOPE	AVERAGE TANK Cs-137 RATIO	AVERAGE CURIES PER GRAM OF SOIL	TOTAL POSSESSION QUANTITY CURIES PER YEAR	TOTAL UNABATED RELEASE CURIES PER YEAR	TOTAL ABATED RELEASE CURIES PER YEAR	200-EAST AREA CAP88 OFFSITE DOSE CONVERSION FACTOR MREM/CURIE	UNABATED OFFSITE DOSE MREM PER YEAR	ABATED OFFSITE DOSE MREM PER YEAR	PERCENT OF UNABATED DOSE	PERCENT OF ABATED DOSE	
3H	4.15E-04	1.37E-07	2.98E-02	2.98E-06	2.98E-06	2.19E-05	6.53E-11	6.53E-11	0.000%	0.000%	
14C	1.15E-04	3.75E-08	8.26E-03	8.26E-07	8.26E-07	2.62E-03	2.16E-09	2.16E-09	0.000%	0.000%	
59NI	2.77E-04	9.15E-08	1.99E-02	1.99E-06	1.99E-06	2.85E-04	5.67E-10	5.67E-10	0.000%	0.000%	
63NI	2.70E-02	8.90E-06	1.94E+00	1.94E-04	1.94E-04	2.03E-04	3.93E-08	3.93E-08	0.000%	0.000%	
60Co	5.22E-04	1.72E-07	3.75E-02	3.75E-06	3.75E-06	2.90E-02	1.09E-07	1.09E-07	0.001%	0.001%	
90Sr	1.12E+01	3.69E-03	8.02E+02	8.02E-02	8.02E-02	4.38E-02	3.51E-03	3.51E-03	26.803%	26.803%	
90Y	1.12E+01	3.69E-03	8.02E+02	8.02E-02	8.02E-02	3.77E-04	3.02E-05	3.02E-05	0.231%	0.231%	
93Zr	1.30E-04	4.23E-08	9.35E-07	9.35E-07	9.35E-07	4.51E-03	4.22E-09	4.22E-09	0.000%	0.000%	
99Tc	1.92E-03	6.34E-07	1.38E-01	1.38E-05	1.38E-05	1.09E-03	1.50E-08	1.50E-08	0.000%	0.000%	
106Ru	9.23E-07	3.05E-10	6.63E-05	6.63E-09	6.63E-09	2.09E-02	1.39E-10	1.39E-10	0.000%	0.000%	
125Sb	3.92E-04	1.29E-07	2.82E-02	2.82E-06	2.82E-06	4.15E-03	1.17E-08	1.17E-08	0.000%	0.000%	
126Sn	4.31E-05	1.42E-08	3.09E-03	3.09E-07	3.09E-07	8.63E-03	2.67E-09	2.67E-09	0.000%	0.000%	
129I	9.28E-06	3.05E-09	6.67E-04	6.67E-08	6.67E-08	2.91E-01	1.94E-08	1.94E-08	0.000%	0.000%	
134Cs	7.99E-06	2.64E-09	5.74E-04	5.74E-08	5.74E-08	3.13E-02	1.80E-09	1.80E-09	0.000%	0.000%	
137Cs	1.00E+00	3.30E-04	7.18E+01	7.18E-03	7.18E-03	1.72E-04	1.72E-04	1.72E-04	1.310%	1.310%	
151Sm	1.01E-01	3.32E-05	7.24E+00	7.24E-04	7.24E-04	8.06E-04	1.54E-02	1.54E-02	0.004%	0.004%	
152Eu	2.23E-04	7.36E-08	1.60E-02	1.60E-06	1.60E-06	1.54E-02	2.47E-08	2.47E-08	0.000%	0.000%	
154Eu	4.69E-03	1.55E-06	3.37E-01	3.37E-05	3.37E-05	1.83E-02	6.16E-07	6.16E-07	0.005%	0.005%	
155Eu	1.41E-02	4.65E-06	1.01E-04	1.01E-04	1.01E-04	1.85E-03	1.87E-07	1.87E-07	0.001%	0.001%	
226Ra	1.99E-08	6.59E-12	1.43E-09	1.43E-10	1.43E-10	5.45E-01	7.80E-11	7.80E-11	0.000%	0.000%	
228Ra	1.04E-06	3.42E-10	7.44E-05	7.44E-09	7.44E-09	4.05E-09	4.05E-09	4.05E-09	0.000%	0.000%	
227Ac	2.46E-07	8.11E-11	1.77E-05	1.77E-09	1.77E-09	4.95E+01	5.00E-09	5.00E-09	0.001%	0.001%	
229Th	4.19E-08	1.38E-11	3.01E-06	3.01E-10	3.01E-10	1.66E+01	1.97E-09	1.97E-09	0.000%	0.000%	
232Th	4.10E-08	1.35E-11	2.95E-06	2.95E-10	2.95E-10	6.88E+00	1.59E-08	1.59E-08	0.000%	0.000%	
231Pa	2.56E-07	8.43E-11	1.83E-05	1.83E-09	1.83E-09	8.67E+00	2.64E-07	2.64E-07	0.002%	0.002%	
232U	3.17E-06	1.05E-09	8.74E-04	8.74E-08	8.74E-08	3.23E+00	2.82E-07	2.82E-07	0.002%	0.002%	
233U	1.22E-05	4.02E-09	8.74E-04	8.74E-08	8.74E-08	3.19E+00	5.51E-06	5.51E-06	0.042%	0.042%	
234U	2.41E-04	7.94E-08	1.73E-02	1.73E-06	1.73E-06	2.96E+00	2.28E-07	2.28E-07	0.002%	0.002%	
235U	1.06E-05	3.51E-09	7.64E-04	7.64E-08	7.64E-08	3.02E+00	5.33E-08	5.33E-08	0.000%	0.000%	
236U	2.46E-06	8.11E-10	1.77E-04	1.77E-08	1.77E-08	2.84E+00	4.95E-06	4.95E-06	0.038%	0.038%	
238U	2.42E-04	8.00E-08	1.74E-02	1.74E-06	1.74E-06	2.84E+00	4.95E-06	4.95E-06	0.038%	0.038%	

ISOTOPE	AVERAGE TANK C2-137 RATIO	AVERAGE CURIES PER GRAM OF SOIL	TOTAL POSSESSION QUANTITY CURIES PER YEAR	TOTAL UNABATED RELEASE CURIES PER YEAR	TOTAL ABATED RELEASE CURIES PER YEAR	200-EAST AREA CAPRI OFFSITE DOSE CONVERSION FACTOR MREM/CURIE	UNABATED OFFSITE DOSE MREM PER YEAR	ABATED OFFSITE DOSE MREM PER YEAR	PERCENT OF UNABATED DOSE	PERCENT OF ABATED DOSE
237Np	1.92E-06	6.37E-10	1.38E-04	1.38E-08	1.38E-08	1.19E-01	1.64E-07	1.64E-07	0.001%	0.001%
238Pu	1.19E-03	3.92E-07	8.53E-02	8.53E-06	8.53E-06	8.02E+00	6.84E-05	6.84E-05	0.522%	0.522%
239Pu	1.08E-01	3.57E-05	7.78E+00	7.78E-04	7.78E-04	8.67E+00	6.74E-03	6.74E-03	51.463%	51.463%
240Pu	1.14E-02	3.77E-05	8.20E-01	8.20E-05	8.20E-05	6.69E+00	7.11E-04	7.11E-04	5.422%	5.422%
241Pu	6.78E-02	2.23E-05	4.69E+00	4.69E-04	4.69E-04	1.36E+01	3.91E-03	3.91E-03	0.000%	0.000%
242Pu	1.69E-02	6.21E-06	1.35E-04	1.35E-08	1.35E-08	1.32E+01	1.77E-03	1.77E-03	13.510%	13.510%
243Am	4.19E-07	1.38E-10	3.01E-05	3.01E-09	3.01E-09	1.31E+01	3.94E-08	3.94E-08	0.000%	0.000%
243Cm	1.47E-04	4.85E-08	1.06E-02	1.06E-06	1.06E-06	1.32E+01	1.40E-05	1.40E-05	0.105%	0.105%
244Cm	5.12E-06	1.69E-09	3.68E-04	3.68E-08	3.68E-08	8.93E+00	3.28E-07	3.28E-07	0.003%	0.003%
244Cm	4.77E-05	1.58E-08	3.43E-03	3.43E-07	3.43E-07	6.54E+00	2.38E-06	2.38E-06	0.018%	0.018%
TOTAL			1.70E+03	1.70E-01	1.70E-01		1.31E-02	1.31E-02	100%	100%

ATTACHMENT E

**POTENTIAL-TO-EMIT ASSUMPTIONS AND CALCULATIONS
CLOSING BOREHOLES AND REMOVING CASING**

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SOURCE TERM FOR CLOSING BOREHOLES - AIR DRILLING METHOD											
NUMBER OF BOREHOLES DECOMMISSIONED PER YEAR	10										
LENGTH OF 10-INCH NOMINAL DIAMETER CASING PER BOREHOLE	50	FEET									
LENGTH OF 8-INCH NOMINAL DIAMETER CASING PER BOREHOLE	200	FEET									
TOTAL SURFACE AREA OF EQUIVALENT BOREHOLE	97.08	FEET*2									
ASSUMED CONTAMINATED SOIL THICKNESS	1/84	INCH									
OUTSIDE UNIFORM SOIL COVERAGE VOLUME PER BOREHOLE	0.72	FEET*3									
OUTSIDE UNIFORM SOIL COVERAGE VOLUME PER YEAR	7.17	FEET*3									
OUTSIDE FRACTION OF SURFACE CONTAMINATED	0.15										
INSIDE FRACTION OF SURFACE CONTAMINATED	0.015										
ESTIMATED SOIL COVERAGE VOLUME	1.183	FEET*3									
DENSITY OF SOIL	110	POUNDS/FEET*3	(AVERAGE FOR COMPACTED, DRY SAND & GRAVEL - MARKS STANDARD HANDBOOK FOR MECHANICAL ENGINEERS								
WEIGHT OF SOIL	130.17	POUNDS									
WEIGHT OF SOIL	59.044.05	GRAMS									
RELEASE FRACTION	1.00E-03										
HEPA FILTER EFFICIENCY	0.00%										
ISOTOPE	AVERAGE CURIES PER GRAM OF SOIL	TOTAL POSSESSION QUANTITY CURIES PER YEAR	TOTAL UNABATED RELEASE CURIES PER YEAR	TOTAL ABATED RELEASE CURIES PER YEAR	200-EAST AREA CAP88 OFFSITE DOSE CONVERSION FACTOR MREM/CURIE	UNABATED OFFSITE DOSE MREM PER YEAR	ABATED OFFSITE DOSE MREM PER YEAR	PERCENT OF UNABATED DOSE	PERCENT ABATED DOSE		
3H	2.91E-12	1.72E-07	1.72E-10	1.72E-10	2.19E-05	3.76E-15	3.76E-15	0.00%	0.00%		
14C	8.05E-13	4.75E-08	4.75E-11	4.75E-11	2.62E-03	1.25E-13	1.25E-13	0.00%	0.00%		
59Ni	1.94E-12	1.15E-07	1.15E-10	1.15E-10	2.85E-04	3.26E-14	3.26E-14	0.00%	0.00%		
63Ni	1.89E-10	1.11E-05	1.11E-08	1.11E-08	2.03E-04	2.26E-12	2.26E-12	0.00%	0.00%		
60Co	3.65E-12	2.16E-07	2.16E-10	2.16E-10	2.90E-02	6.25E-12	6.25E-12	0.00%	0.00%		
90Sr	7.81E-08	4.61E-03	4.61E-06	4.61E-06	4.38E-02	2.02E-07	2.02E-07	26.80%	26.80%		
90Y	7.81E-08	4.61E-03	4.61E-06	4.61E-06	3.77E-04	1.74E-09	1.74E-09	0.23%	0.23%		
93Zr	9.11E-13	5.38E-08	5.38E-11	5.38E-11	4.51E-03	2.43E-13	2.43E-13	0.00%	0.00%		
99Tc	1.34E-11	7.94E-07	7.94E-10	7.94E-10	1.09E-03	8.65E-13	8.65E-13	0.00%	0.00%		
106Ru	6.46E-15	3.81E-10	3.81E-13	3.81E-13	2.09E-02	7.97E-15	7.97E-15	0.00%	0.00%		
125Sb	2.74E-12	1.62E-07	1.62E-10	1.62E-10	4.15E-03	6.72E-13	6.72E-13	0.00%	0.00%		
125Sf	3.01E-13	1.78E-08	1.78E-11	1.78E-11	8.63E-03	1.54E-13	1.54E-13	0.00%	0.00%		
128I	6.50E-14	3.84E-09	3.84E-12	3.84E-12	2.91E-01	1.12E-12	1.12E-12	0.00%	0.00%		
134Cs	5.59E-14	3.30E-09	3.30E-12	3.30E-12	3.13E-02	1.03E-13	1.03E-13	0.00%	0.00%		
137Cs	7.00E-09	4.13E-04	4.13E-07	4.13E-07	2.39E-02	9.88E-09	9.88E-09	1.31%	1.31%		
151Sm	7.05E-10	4.16E-05	4.16E-08	4.16E-08	8.06E-04	3.36E-11	3.36E-11	0.00%	0.00%		
152Eu	1.56E-12	9.22E-08	9.22E-11	9.22E-11	1.54E-02	1.42E-12	1.42E-12	0.00%	0.00%		
154Eu	3.29E-11	1.94E-06	1.94E-09	1.94E-09	1.83E-02	3.55E-11	3.55E-11	0.00%	0.00%		
155Eu	8.87E-11	5.83E-06	5.83E-09	5.83E-09	1.65E-03	1.08E-11	1.08E-11	0.00%	0.00%		
226Ra	1.40E-16	8.24E-12	8.24E-15	8.24E-15	5.45E-01	4.49E-15	4.49E-15	0.00%	0.00%		
228Ra	7.25E-15	4.28E-10	4.28E-13	4.28E-13	5.44E-01	2.33E-13	2.33E-13	0.00%	0.00%		
227Ac	1.72E-15	1.02E-10	1.02E-13	1.02E-13	4.90E+01	4.98E-12	4.98E-12	0.00%	0.00%		
229Th	2.94E-16	1.73E-11	1.73E-14	1.73E-14	1.66E+01	2.86E-13	2.86E-13	0.00%	0.00%		
232Th	2.87E-16	1.70E-11	1.70E-14	1.70E-14	6.68E+00	1.13E-13	1.13E-13	0.00%	0.00%		
231Pa	1.79E-15	1.06E-10	1.06E-13	1.06E-13	8.67E+00	9.15E-13	9.15E-13	0.00%	0.00%		
232U	2.22E-14	1.31E-09	1.31E-12	1.31E-12	1.16E+01	1.52E-11	1.52E-11	0.00%	0.00%		
233U	6.52E-14	5.03E-09	5.03E-12	5.03E-12	3.23E+00	1.63E-11	1.63E-11	0.00%	0.00%		
234U	1.68E-12	9.94E-08	9.94E-11	9.94E-11	3.19E+00	3.17E-10	3.17E-10	0.04%	0.04%		
235U	7.45E-14	4.40E-09	4.40E-12	4.40E-12	2.96E+00	1.30E-11	1.30E-11	0.00%	0.00%		

ATTACHMENT E--AIR DRILLING

238U	1.72E-14	1.02E-09	1.02E-12	1.02E-12	3.02E+00	3.07E-12	3.07E-12	0.00%
238U	1.70E-12	1.00E-07	1.00E-10	1.00E-10	2.84E+00	2.84E-10	2.84E-10	0.00%
238Pu	1.34E-14	7.92E-10	7.92E-13	7.92E-13	1.19E+01	9.41E-12	9.41E-12	0.00%
238Pu	1.34E-12	7.92E-07	4.91E-10	4.91E-10	8.02E+00	3.93E-09	3.93E-09	0.00%
238Pu	1.34E-10	4.48E-07	4.48E-10	4.48E-10	8.67E+00	3.88E-07	3.88E-07	0.52%
240Pu	7.98E-11	4.72E-06	4.72E-09	4.72E-09	8.68E+00	4.08E-08	4.08E-08	51.46%
241Pu	4.73E-10	2.78E-05	2.78E-08	2.78E-08	8.68E+00	3.88E-09	3.88E-09	5.42%
242Pu	2.28E-15	1.34E-10	1.34E-13	1.34E-13	8.22E+00	1.02E-07	1.02E-07	0.00%
241Am	1.32E-10	7.78E-06	7.78E-09	7.78E-09	1.31E+01	2.27E-12	2.27E-12	0.00%
241Am	7.93E-15	1.73E-10	1.73E-13	1.73E-13	1.31E+01	8.03E-10	8.03E-10	13.51%
241Am	1.09E-12	6.08E-08	6.08E-11	6.08E-11	1.32E+01	1.89E-11	1.89E-11	0.11%
243Cm	1.12E-09	1.12E-09	2.12E-12	2.12E-12	8.93E+00	1.37E-10	1.37E-10	0.00%
244Cm	3.39E-11	9.79E-11	9.79E-11	9.79E-11	6.94E+00	1.37E-10	1.37E-10	0.02%
TOTAL		9.79E-03	9.79E-03	9.79E-03	7.54E+07	7.54E-07	7.54E-07	100.00%

SOURCE TERM FOR CLOSING BOREHOLES USING CABLE OR SONIC DRILLING										
NUMBER OF BOREHOLES DECOMMISSIONED PER YEAR	10									
LENGTH OF 10-INCH NOMINAL DIAMETER CASING PER BOREHOLE	50	FEET								
LENGTH OF 8-INCH NOMINAL DIAMETER CASING PER BOREHOLE	200	FEET								
TOTAL SURFACE AREA OF EQUIVALENT BOREHOLE	97.08	FEET^2								
ASSUMED CONTAMINATED SOIL THICKNESS	1/64	INCH								
OUTSIDE UNIFORM SOIL COVERAGE VOLUME PER BOREHOLE	0.72	FEET^3								
OUTSIDE UNIFORM SOIL COVERAGE VOLUME PER YEAR	7.17	FEET^3								
OUTSIDE FRACTION OF SURFACE CONTAMINATED	0.15									
INSIDE FRACTION OF SURFACE CONTAMINATED	0.015									
ESTIMATED SOIL COVERAGE VOLUME	1.183	FEET^3								
DENSITY OF SOIL	110	POUNDS/FEET^3	(AVERAGE FOR COMPACTED, DRY SAND & GRAVEL - MARKS STANDARD HANDBOOK FOR MECHANICAL ENGINEERS)							
WEIGHT OF SOIL	130.17	POUNDS								
WEIGHT OF SOIL	59,044.05	GRAMS								
RELEASE FRACTION	1.00E-03									
ISOTOPE	AVERAGE CURIES PER GRAM OF SOIL	TOTAL POSSESSION QUANTITY CURIES PER YEAR	TOTAL UNABATED RELEASE CURIES PER YEAR	TOTAL ABATED RELEASE CURIES PER YEAR	200-EAST AREA CAP8 OFFSITE DOSE CONVERSION FACTOR MREM/CURIE	UNABATED OFFSITE DOSE MREM PER YEAR	ABATED OFFSITE DOSE MREM PER YEAR	PERCENT OF UNABATED DOSE	PERCENT OF ABATED DOSE	
3H	2.91E-09	1.72E-04	1.72E-07	1.72E-07	2.19E-05	3.76E-12	3.76E-12	0.00%	0.00%	
14C	8.05E-10	4.75E-05	4.75E-08	4.75E-08	2.62E-03	1.25E-10	1.25E-10	0.00%	0.00%	
59Ni	1.94E-09	1.15E-04	1.15E-07	1.15E-07	2.85E-04	3.26E-11	3.26E-11	0.00%	0.00%	
63Ni	1.89E-07	1.11E-02	1.11E-05	1.11E-05	2.03E-04	2.26E-09	2.26E-09	0.00%	0.00%	
60Co	3.65E-09	2.16E-04	2.16E-07	2.16E-07	2.90E-02	6.25E-09	6.25E-09	0.00%	0.00%	
90Sr	7.81E-05	4.61E+00	4.61E-03	4.61E-03	4.38E-02	2.02E-04	2.02E-04	26.80%	26.80%	
90Y	7.81E-05	4.61E+00	4.61E-03	4.61E-03	3.77E-04	1.74E-06	1.74E-06	0.23%	0.23%	
93Zr	9.11E-10	5.39E-05	5.39E-08	5.39E-08	4.51E-03	2.43E-10	2.43E-10	0.00%	0.00%	
99Tc	1.34E-06	7.94E-04	7.94E-07	7.94E-07	1.05E-03	8.65E-10	8.65E-10	0.00%	0.00%	
106Ru	6.46E-12	3.81E-07	3.81E-10	3.81E-10	2.09E-02	7.97E-12	7.97E-12	0.00%	0.00%	
125Sb	2.74E-09	1.62E-04	1.62E-07	1.62E-07	4.15E-03	6.72E-10	6.72E-10	0.00%	0.00%	
126Sn	3.01E-10	1.78E-05	1.78E-08	1.78E-08	8.63E-03	1.54E-10	1.54E-10	0.00%	0.00%	
129I	6.50E-11	3.84E-06	3.84E-09	3.84E-09	2.91E-01	1.12E-09	1.12E-09	0.00%	0.00%	
134Cs	5.59E-11	3.30E-06	3.30E-09	3.30E-09	3.13E-02	1.03E-10	1.03E-10	0.00%	0.00%	
137Cs	7.00E-06	4.13E-01	4.13E-04	4.13E-04	2.39E-02	9.88E-06	9.88E-06	1.31%	1.31%	
151Sm	7.05E-07	4.16E-02	4.16E-05	4.16E-05	8.06E-04	3.36E-08	3.36E-08	0.00%	0.00%	
152Eu	1.56E-09	9.22E-05	9.22E-08	9.22E-08	1.54E-02	1.42E-09	1.42E-09	0.00%	0.00%	
154Eu	3.28E-08	1.94E-03	1.94E-06	1.94E-06	1.83E-02	3.55E-08	3.55E-08	0.00%	0.00%	
155Eu	9.87E-08	5.83E-03	5.83E-06	5.83E-06	1.85E-03	1.08E-08	1.08E-08	0.00%	0.00%	
226Ra	1.40E-13	8.24E-09	8.24E-12	8.24E-12	5.45E-01	4.49E-12	4.49E-12	0.00%	0.00%	
228Ra	7.25E-12	4.28E-07	4.28E-10	4.28E-10	5.44E-01	2.33E-10	2.33E-10	0.00%	0.00%	
227Ac	1.72E-12	1.02E-07	1.02E-10	1.02E-10	4.90E+01	4.98E-09	4.98E-09	0.00%	0.00%	
229Th	2.94E-13	1.73E-08	1.73E-11	1.73E-11	1.66E+01	2.88E-10	2.88E-10	0.00%	0.00%	
232Th	2.87E-13	1.70E-09	1.70E-11	1.70E-11	6.89E+00	1.13E-10	1.13E-10	0.00%	0.00%	
231Pa	1.79E-12	1.06E-07	1.06E-10	1.06E-10	8.67E+00	9.15E-10	9.15E-10	0.00%	0.00%	
232U	2.22E-11	1.31E-06	1.31E-09	1.31E-09	1.16E+01	1.52E-08	1.52E-08	0.00%	0.00%	
233U	8.52E-11	5.03E-06	5.03E-09	5.03E-09	3.23E+00	1.62E-08	1.62E-08	0.00%	0.00%	
234U	1.68E-09	9.94E-05	9.94E-08	9.94E-08	3.19E+00	3.17E-07	3.17E-07	0.04%	0.04%	
235U	7.45E-11	4.40E-06	4.40E-09	4.40E-09	2.96E+00	1.30E-08	1.30E-08	0.00%	0.00%	
238U	1.72E-11	1.02E-06	1.02E-09	1.02E-09	3.02E+00	3.07E-09	3.07E-09	0.00%	0.00%	

ATTACHMENT E - CABLE TOOL

238U	1.70E-09	1.00E-04	1.00E-07	1.00E-07	2.84E+00	3.84E-07	3.84E-07	0.04%	100.00%
237Np	1.34E-11	7.92E-10	7.92E-10	7.92E-10	1.19E+01	9.41E-09	9.41E-09	0.04%	0.04%
238Pu	8.31E-09	4.91E-07	4.91E-07	4.91E-07	8.02E+00	3.93E-06	3.93E-06	0.52%	0.52%
239Pu	7.58E-07	4.48E-05	4.48E-05	4.48E-05	8.67E+00	3.88E-04	3.88E-04	51.46%	51.46%
240Pu	1.55E-03	2.72E-05	2.72E-05	2.72E-05	8.66E+00	4.09E-05	4.09E-05	5.42%	5.42%
241Pu	4.71E-07	2.19E-02	2.19E-02	2.19E-02	1.38E+01	3.85E-06	3.85E-06	0.51%	0.51%
242Pu	2.26E-12	1.34E-07	1.34E-07	1.34E-07	9.32E+00	1.10E-09	1.10E-09	0.00%	0.00%
241Am	1.32E-07	7.78E-03	7.78E-03	7.78E-03	1.32E+01	2.72E-09	2.72E-09	0.01%	0.01%
243Am	2.93E-12	1.73E-10	1.73E-10	1.73E-10	1.31E+01	1.02E-04	1.02E-04	13.51%	13.51%
243Cm	1.00E-09	6.08E-08	6.08E-08	6.08E-08	1.32E+01	8.03E-07	8.03E-07	0.00%	0.00%
245Cm	3.58E-11	2.12E-06	2.12E-06	2.12E-06	8.93E+00	1.89E-08	1.89E-08	0.00%	0.00%
246Cm	3.34E-10	1.97E-05	1.97E-05	1.97E-05	6.94E+00	1.37E-07	1.37E-07	0.02%	0.02%
TOTAL		9.79E-03	9.79E-03	9.79E-03		7.54E-04	7.54E-04	100.00%	100.00%

SOURCE TERM FOR CLOSING BOREHOLES BASED ON CLOSED END PROBE AND CONE PENETROMETER									
NUMBER OF BOREHOLES DECOMMISSIONED PER YEAR	10								
LENGTH OF 10-INCH NOMINAL DIAMETER CASING PER BOREHOLE	50	FEET							
LENGTH OF 8-INCH NOMINAL DIAMETER CASING PER BOREHOLE	200	FEET							
TOTAL SURFACE AREA OF EQUIVALENT BOREHOLE	97.08	FEET*2							
ASSUMED CONTAMINATED SOIL THICKNESS	1/64	INCH							
OUTSIDE UNIFORM SOIL COVERAGE VOLUME PER BOREHOLE	0.72	FEET*3							
OUTSIDE UNIFORM SOIL COVERAGE VOLUME PER YEAR	7.17	FEET*3							
OUTSIDE FRACTION OF SURFACE CONTAMINATED	0.15								
INSIDE FRACTION OF SURFACE CONTAMINATED	0.015								
ESTIMATED SOIL COVERAGE VOLUME	1.183	FEET*3							
DENSITY OF SOIL	110	POUNDS/FEET*3							
WEIGHT OF SOIL	130.17	POUNDS							
WEIGHT OF SOIL	59,044.05	GRAMS							
RELEASE FRACTION	1.00E-03								
ISOTOPE	AVERAGE CURIES PER GRAM OF SOIL	TOTAL POSSESSION QUANTITY CURIES PER YEAR	TOTAL UNABATED RELEASE CURIES PER YEAR	TOTAL ABATED RELEASE CURIES PER YEAR	200-EAST AREA CAP88 OFFSITE DOSE CONVERSION FACTOR MREM/CURIE	UNABATED OFFSITE DOSE MREM PER YEAR	ABATED OFFSITE DOSE MREM PER YEAR	PERCENT OF UNABATED DOSE	PERCENT OF ABATED DOSE
3H	1.37E-07	8.09E-03	8.09E-08	8.09E-08	2.19E-05	1.77E-10	1.77E-10	0.00%	0.00%
14C	3.79E-08	2.24E-03	2.24E-06	2.24E-06	2.62E-03	5.87E-09	5.87E-09	0.00%	0.00%
59Ni	9.15E-08	5.40E-03	5.40E-06	5.40E-06	2.85E-04	1.54E-09	1.54E-09	0.00%	0.00%
63Ni	8.90E-06	5.25E-01	5.25E-04	5.25E-04	2.03E-04	1.07E-07	1.07E-07	0.00%	0.00%
60Co	1.72E-07	1.02E-02	1.02E-05	1.02E-05	2.90E-02	2.95E-07	2.95E-07	0.00%	0.00%
90Sr	3.68E-03	2.18E+02	2.18E-01	2.18E-01	4.38E-02	9.53E-03	9.53E-03	26.80%	26.80%
90Y	3.68E-03	2.18E+02	2.18E-01	2.18E-01	3.77E-04	8.20E-05	8.20E-05	0.23%	0.23%
93Zr	4.29E-08	2.54E-03	2.54E-06	2.54E-06	4.51E-03	1.14E-08	1.14E-08	0.00%	0.00%
99Tc	6.24E-07	3.74E-02	3.74E-05	3.74E-05	1.09E-03	4.08E-08	4.08E-08	0.00%	0.00%
106Ru	3.05E-10	1.80E-05	1.80E-08	1.80E-08	2.09E-02	3.76E-10	3.76E-10	0.00%	0.00%
125Sb	1.29E-07	7.64E-03	7.64E-06	7.64E-06	4.15E-03	3.17E-08	3.17E-08	0.00%	0.00%
126Sn	1.42E-08	8.39E-04	8.39E-07	8.39E-07	8.63E-03	7.24E-09	7.24E-09	0.00%	0.00%
129I	3.06E-09	1.81E-04	1.81E-07	1.81E-07	2.91E-01	5.26E-08	5.26E-08	0.00%	0.00%
134Cs	2.64E-09	1.56E-04	1.56E-07	1.56E-07	3.13E-02	4.87E-09	4.87E-09	0.00%	0.00%
137Cs	3.30E-04	1.95E+01	1.95E-02	1.95E-02	2.39E-02	4.66E-04	4.66E-04	1.31%	1.31%
151Sm	3.30E-06	1.96E-00	1.96E-03	1.96E-03	8.06E-04	1.58E-06	1.58E-06	0.00%	0.00%
152Eu	7.36E-08	4.35E-03	4.35E-06	4.35E-06	1.54E-02	6.69E-09	6.69E-09	0.00%	0.00%
154Eu	1.55E-06	9.13E-02	9.13E-05	9.13E-05	1.83E-02	1.67E-06	1.67E-06	0.00%	0.00%
155Eu	4.65E-06	2.75E-01	2.75E-04	2.75E-04	1.85E-03	5.08E-07	5.08E-07	0.00%	0.00%
226Ra	6.58E-12	3.88E-07	3.88E-10	3.88E-10	5.45E-01	2.12E-10	2.12E-10	0.00%	0.00%
228Ra	3.42E-10	2.02E-05	2.02E-08	2.02E-08	5.44E-01	1.10E-08	1.10E-08	0.00%	0.00%
227Ac	8.11E-11	4.79E-06	4.79E-09	4.79E-09	4.90E+01	2.35E-07	2.35E-07	0.00%	0.00%
229Th	1.39E-11	8.17E-07	8.17E-10	8.17E-10	1.66E+01	1.39E-08	1.39E-08	0.00%	0.00%
232Th	1.35E-11	8.00E-07	8.00E-10	8.00E-10	8.69E+00	5.34E-09	5.34E-09	0.00%	0.00%
231Pa	8.43E-11	4.97E-06	4.97E-09	4.97E-09	8.67E+00	4.31E-08	4.31E-08	0.00%	0.00%
232U	1.05E-09	6.18E-05	6.18E-08	6.18E-08	1.16E+01	7.17E-07	7.17E-07	0.00%	0.00%
233U	4.02E-09	2.37E-04	2.37E-07	2.37E-07	7.66E-07	7.66E-07	7.66E-07	0.00%	0.00%
234U	7.94E-08	4.69E-03	4.69E-06	4.69E-06	3.19E+00	1.49E-05	1.49E-05	0.04%	0.04%
235U	3.51E-09	2.07E-04	2.07E-07	2.07E-07	2.96E+00	6.14E-07	6.14E-07	0.00%	0.00%
236U	8.11E-10	4.79E-05	4.79E-08	4.79E-08	3.02E+00	1.45E-07	1.45E-07	0.00%	0.00%

ATTACHMENT E - OTHER METHODS

ISOTOPE	AVERAGE CURIES PER GRAM OF SOIL	TOTAL POSSESSION QUANTITY PER YEAR	TOTAL UNABATED RELEASE CURIES PER YEAR	TOTAL ABATED RELEASE CURIES PER YEAR	200-EAST AREA CAP88 OFFSITE DOSE CONVERSION FACTOR MREM/CURIE	UNABATED OFFSITE DOSE MREM PER YEAR	ABATED OFFSITE DOSE MREM PER YEAR	PERCENT OF UNABATED DOSE	PERCENT OF ABATED DOSE
238U	6.00E-08	4.72E-05	4.72E-05	4.72E-05	2.84E+00	1.34E-05	1.34E-05	0.04%	0.04%
237Np	6.32E-10	3.72E-05	3.72E-05	3.72E-05	1.19E+01	4.44E-07	4.44E-07	0.00%	0.00%
238Pu	3.92E-07	2.31E-05	2.31E-05	2.31E-05	8.02E+00	1.85E-04	1.85E-04	0.52%	0.52%
239Pu	3.71E-07	2.11E-05	2.11E-05	2.11E-05	8.67E+00	1.83E-04	1.83E-04	51.46%	51.46%
240Pu	3.71E-08	2.11E-05	2.11E-05	2.11E-05	8.67E+00	1.83E-04	1.83E-04	5.42%	5.42%
241Pu	2.23E-05	1.32E-05	1.32E-05	1.32E-05	8.23E+00	4.86E-03	4.86E-03	0.51%	0.51%
242Pu	1.07E-10	6.30E-06	6.30E-06	6.30E-06	8.23E+00	5.19E-08	5.19E-08	13.51%	13.51%
241Am	6.21E-06	3.67E-01	3.67E-04	3.67E-04	1.31E+01	4.86E-03	4.86E-03	0.00%	0.00%
243Am	1.38E-10	8.16E-05	8.16E-05	8.16E-05	1.32E+01	3.78E-05	3.78E-05	0.11%	0.11%
240Cm	4.65E-08	2.87E-05	2.87E-05	2.87E-05	8.98E+00	8.91E-07	8.91E-07	0.00%	0.00%
242Cm	1.65E-05	9.98E-05	9.98E-05	9.98E-05	6.45E+00	6.45E-06	6.45E-06	0.02%	0.02%
244Cm	1.30E-08	8.23E-07	8.23E-07	8.23E-07	6.94E+00	3.55E-02	3.55E-02	100.00%	100.00%
TOTAL		4.81E-02	4.81E-01	4.81E-01					

ATTACHMENT F

**SUMMARY OF POTENTIAL-TO-EMIT ASSUMPTIONS
DRILLING BOREHOLES/CLOSING BOREHOLES AND REMOVING CASING**

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SUMMARY OF OVERALL EMISSIONS USING AIR DRILLING METHOD ONLY									
ISOTOPE	TOTAL POSSESSION QUANTITY CURIES PER YEAR	TOTAL UNABATED RELEASE CURIES PER YEAR	TOTAL ABATED RELEASE CURIES PER YEAR	200-EAST AREA CAP88 OFFSITE DOSE CONVERSION FACTOR MRM/CURIE	UNABATED OFFSITE DOSE MRM PER YEAR	ABATED OFFSITE DOSE MRM PER YEAR	PERCENT OF UNABATED DOSE	PERCENT OF ABATED DOSE	
3H	1.63E-05	1.61E-05	1.61E-05	2.19E-05	3.53E-10	3.5E-10	0.00%	0.05%	
14C	4.51E-06	4.47E-06	4.47E-06	2.62E-03	1.17E-08	1.17E-08	0.00%	1.53%	
59Ni	1.09E-05	1.08E-05	1.15E-10	2.85E-04	3.07E-09	3.26E-14	0.00%	0.00%	
60Co	1.00E-03	1.09E-03	1.11E-08	2.05E-04	2.13E-07	2.86E-12	0.00%	0.00%	
90Sr	2.03E-05	2.03E-05	2.16E-10	2.90E-02	6.88E-07	6.26E-12	0.00%	0.00%	
90Y	4.38E-01	4.34E-01	4.61E-06	4.38E-02	1.90E-02	2.02E-07	26.80%	26.38%	
93Zr	5.11E-08	5.05E-08	5.05E-08	3.77E-04	1.63E-04	1.74E-09	0.23%	0.23%	
99Tc	7.54E-03	7.46E-03	7.46E-03	4.52E-03	2.28E-08	2.43E-13	0.00%	0.00%	
108Ru	3.32E-08	3.35E-08	3.32E-08	4.52E-03	9.13E-08	8.95E-13	0.00%	0.00%	
125Sb	1.54E-05	1.52E-05	3.81E-13	2.05E-02	6.33E-09	7.97E-15	0.00%	0.00%	
128Sn	1.69E-06	1.67E-06	1.78E-11	4.15E-03	1.44E-08	1.55E-13	0.00%	0.00%	
129I	3.64E-07	3.61E-07	3.84E-12	2.91E-01	1.05E-07	1.17E-12	0.00%	0.00%	
134Cs	3.14E-07	3.10E-07	3.30E-12	3.13E-02	9.71E-09	1.03E-13	0.00%	0.00%	
137Cs	3.92E-02	3.88E-02	4.13E-07	2.39E-02	9.28E-07	9.88E-09	0.00%	0.00%	
151Sm	3.95E-03	3.91E-03	4.16E-08	6.00E-04	3.15E-06	3.38E-11	0.00%	0.00%	
154Eu	5.54E-04	5.49E-04	1.83E-09	1.54E-02	1.44E-02	1.42E-12	0.00%	0.00%	
155Eu	7.82E-10	7.74E-10	8.45E-15	1.52E-03	1.33E-07	1.43E-12	0.00%	0.00%	
228Ra	4.02E-08	4.02E-08	4.28E-13	1.03E-02	3.33E-06	3.55E-11	0.00%	0.00%	
228Ac	9.65E-09	9.55E-09	1.02E-13	1.03E-02	3.33E-06	3.55E-11	0.00%	0.00%	
229Ac	1.63E-09	1.63E-09	1.02E-13	1.86E-01	1.03E-06	1.08E-11	0.00%	0.00%	
229Th	1.61E-09	1.59E-09	1.73E-14	1.86E-01	4.22E-10	4.49E-15	0.00%	0.00%	
232Th	1.00E-08	9.92E-09	1.09E-13	6.86E+00	2.19E-08	2.39E-13	0.00%	0.00%	
231Pa	1.29E-07	1.29E-07	1.31E-12	8.67E+00	2.39E-13	2.39E-13	0.00%	0.00%	
232U	4.73E-07	4.73E-07	5.03E-12	1.16E+01	1.05E-08	1.13E-13	0.00%	0.00%	
234U	9.18E-07	9.18E-07	9.94E-11	3.23E+00	2.70E-07	4.98E-12	0.00%	0.00%	
235U	4.18E-07	4.13E-07	4.45E-12	1.53E+00	1.22E-06	1.30E-11	0.00%	0.00%	
235U	9.65E-08	9.55E-08	1.02E-12	3.02E+00	2.88E-07	3.07E-12	0.00%	0.00%	
238U	9.51E-06	9.41E-06	1.00E-10	2.84E+00	2.67E-05	2.85E-10	0.04%	0.04%	
237Np	7.52E-08	7.44E-08	7.82E-13	1.98E+01	8.64E-07	9.41E-12	0.00%	0.00%	
238Pu	4.66E-05	4.61E-05	4.91E-10	8.02E+00	3.70E-04	3.93E-09	0.51%	5.05%	
239Pu	4.25E-03	4.21E-03	4.48E-08	8.02E+00	3.65E-02	3.88E-07	51.46%	50.65%	
240Pu	4.48E-04	4.44E-04	4.72E-09	8.65E+00	3.84E-07	4.05E-08	5.42%	5.44%	
241Pu	2.69E-03	2.62E-03	2.79E-08	1.38E+01	3.62E-04	3.85E-09	0.51%	5.48%	
242Pu	1.29E-08	1.28E-08	1.34E-13	8.23E+00	1.03E-07	1.10E-12	0.00%	0.00%	
243Am	7.78E-09	7.78E-09	1.78E-13	9.57E+00	9.57E-03	1.02E-07	13.51%	13.51%	
244Am	1.84E-08	1.82E-08	1.82E-13	9.57E+00	2.13E-07	2.27E-12	0.00%	0.00%	
242Cm	5.71E-06	5.71E-06	1.95E-11	1.32E+01	7.54E-05	8.05E-10	0.11%	0.10%	
243Cm	2.01E-07	1.99E-07	2.12E-12	8.93E+00	1.78E-06	1.89E-11	0.00%	0.00%	
244Cm	1.87E-06	1.85E-06	1.97E-11	8.93E+00	1.78E-06	1.89E-11	0.00%	0.00%	
TOTAL	9.30E-01	9.20E-01	3.04E-05	6.94E+00	7.66E-02	7.66E-07	100.00%	100.00%	

SUMMARY OF OVERALL EMISSIONS USING TRADITIONAL CABLE TOOL AND SONIC DRILLING									
ISOTOPE	TOTAL POSSESSION QUANTITY CURIES PER YEAR	TOTAL UNABATED RELEASE CURIES PER YEAR	TOTAL ABATED RELEASE CURIES PER YEAR	200-EAST AREA CAP288 CONVERSION FACTOR MILICURIE	UNABATED OFFSITE DOSE MREM PER YEAR	ABATED OFFSITE DOSE MREM PER YEAR	PERCENT OF UNABATED DOSE	PERCENT OF ABATED DOSE	
3H	1.63E-02	1.63E-05	1.63E-05	3.57E-10	3.57E-10	3.57E-10	0.00%	0.00%	
14C	4.51E-03	4.51E-06	4.51E-06	2.83E-03	3.10E-09	1.19E-08	0.00%	0.00%	
59Ni	1.09E-02	1.09E-05	1.09E-05	2.85E-04	3.10E-09	2.15E-07	0.00%	0.00%	
63Ni	1.06E-00	1.06E-03	1.06E-03	2.03E-04	2.15E-07	5.94E-07	0.00%	0.00%	
90Co	2.05E-02	2.05E-05	2.05E-05	2.90E-02	5.64E-07	5.94E-07	0.00%	0.00%	
90Y	4.38E-02	4.38E-05	4.38E-05	4.38E-02	1.92E-02	1.92E-02	28.95%	0.00%	
93Zr	5.11E-02	4.38E-01	4.38E-01	3.77E-04	1.65E-04	1.65E-04	0.23%	0.00%	
99Tc	7.54E-02	7.54E-02	7.54E-02	4.51E-03	2.30E-08	2.30E-08	0.00%	0.00%	
106Ru	7.24E-05	7.24E-05	7.24E-05	1.09E-03	8.22E-08	8.22E-08	0.00%	0.00%	
125Sb	3.67E-05	3.67E-08	3.67E-08	2.03E-02	7.57E-10	7.57E-10	0.00%	0.00%	
128Sb	1.54E-02	1.54E-05	1.54E-05	1.69E-06	6.39E-08	6.39E-08	0.00%	0.00%	
134Cs	3.64E-04	3.64E-07	3.64E-07	8.93E-01	1.69E-08	1.69E-08	0.00%	0.00%	
137Cs	3.14E-04	3.14E-07	3.14E-07	3.13E-02	1.69E-08	1.69E-08	0.00%	0.00%	
137Cs	3.92E-01	3.92E-02	3.92E-02	2.39E-02	9.38E-04	9.38E-04	0.00%	0.00%	
137Cs	3.95E-00	3.95E-03	3.95E-03	8.06E-04	3.19E-06	3.19E-06	0.00%	0.00%	
137Cs	8.75E-06	8.75E-06	8.75E-06	1.54E-02	1.35E-07	1.35E-07	0.00%	0.00%	
154Eu	5.54E-01	5.54E-04	5.54E-04	1.85E-02	3.37E-06	3.37E-06	0.00%	0.00%	
155Eu	5.54E-01	5.54E-04	5.54E-04	1.85E-02	3.37E-06	3.37E-06	0.00%	0.00%	
226Ra	7.82E-07	7.82E-10	7.82E-10	1.85E-05	1.02E-06	1.02E-06	0.00%	0.00%	
228Ra	4.06E-05	4.06E-08	4.06E-08	5.43E-01	4.26E-10	4.26E-10	0.00%	0.00%	
228Ac	9.65E-06	9.65E-09	9.65E-09	4.95E-01	2.21E-08	2.21E-08	0.00%	0.00%	
228Th	1.65E-09	1.65E-09	1.65E-09	1.65E-09	2.73E-07	2.73E-07	0.00%	0.00%	
232Th	1.61E-08	1.61E-09	1.61E-09	8.93E-01	4.73E-07	4.73E-07	0.00%	0.00%	
232Th	1.00E-05	1.00E-08	1.00E-08	6.98E+00	1.09E-08	1.09E-08	0.00%	0.00%	
232Th	1.24E-04	1.24E-07	1.24E-07	8.07E+00	8.69E-08	8.69E-08	0.00%	0.00%	
232Th	4.78E-07	4.78E-07	4.78E-07	1.18E+01	1.44E-08	1.44E-08	0.00%	0.00%	
232Th	8.44E-06	8.44E-06	8.44E-06	3.39E+00	1.54E-06	1.54E-06	0.00%	0.00%	
232Th	9.65E-05	9.65E-08	9.65E-08	3.95E+00	3.01E-05	3.01E-05	0.04%	0.00%	
232Th	9.51E-03	9.51E-08	9.51E-08	3.02E+00	1.24E-06	1.24E-06	0.00%	0.00%	
238Pu	7.52E-05	7.52E-08	7.52E-08	2.91E-07	2.91E-07	2.91E-07	0.00%	0.00%	
238Pu	4.66E-02	4.66E-05	4.66E-05	2.94E+00	2.70E-05	2.70E-05	0.04%	0.00%	
239Pu	4.25E-03	4.25E-03	4.25E-03	8.92E+00	8.94E-07	8.94E-07	0.00%	0.00%	
240Pu	4.48E-01	4.48E-04	4.48E-04	8.92E+00	3.74E-04	3.74E-04	0.52%	0.00%	
241Pu	2.65E+00	2.65E-04	2.65E-04	8.92E+00	3.88E-03	3.88E-03	51.48%	0.00%	
241Am	1.27E-08	1.27E-08	1.27E-08	3.66E-04	3.66E-04	3.66E-04	5.42%	0.00%	
241Am	1.85E-03	1.85E-03	1.85E-03	1.98E-01	1.04E-07	1.04E-07	0.00%	0.00%	
243Am	7.38E-04	7.38E-04	7.38E-04	8.33E+00	9.67E-03	9.67E-03	13.51%	0.00%	
243Cm	5.77E-03	5.77E-03	5.77E-03	1.31E+01	2.15E-07	2.15E-07	0.00%	0.00%	
243Cm	2.01E-07	2.01E-07	2.01E-07	1.92E+01	7.62E-05	7.62E-05	0.11%	0.00%	
244Cm	1.87E-03	1.87E-06	1.87E-06	9.39E+00	1.79E-06	1.79E-06	0.00%	0.00%	
TOTAL	9.30E+02	9.30E-01	9.30E-01	6.94E+00	1.30E-05	1.30E-05	0.02%	0.00%	
					7.18E-02	7.18E-02	100.00%		

SUMMARY OF OVERALL EMISSIONS USING CLOSED END PROBE AND CONE PENETROMETER									
ISOTOPE	TOTAL POSSESSION QUANTITY CURIES PER YEAR	TOTAL UNABATED RELEASE CURIES PER YEAR	TOTAL ABATED RELEASE CURIES PER YEAR	200 EAST AREA CAP88 CONVERSION FACTOR MRAD/CURIE	UNABATED OFFSITE DOSE MRHM PER YEAR	ABATED OFFSITE DOSE MRHM PER YEAR	PERCENT OF UNABATED DOSE	PERCENT OF ABATED DOSE	
3H	3.79E-02	1.11E-05	1.11E-05	2.19E-05	2.43E-10	2.43E-10	0.00%	0.00%	
14C	1.05E-02	3.07E-06	3.07E-06	2.62E-03	6.03E-09	6.03E-09	0.00%	0.00%	
60Ni	2.53E-02	7.39E-06	7.39E-06	2.85E-04	2.11E-09	2.11E-09	0.00%	0.00%	
60Co	2.48E+00	7.19E-04	7.19E-04	2.03E-04	1.46E-07	1.46E-07	0.00%	0.00%	
90Sr	1.07E-02	1.39E-05	1.39E-05	2.90E-02	4.04E-07	4.04E-07	0.00%	0.00%	
90Y	1.02E-03	2.89E-01	2.89E-01	4.38E-02	1.30E-02	1.30E-02	26.80%	26.80%	
30Zr	1.19E-02	2.99E-01	2.99E-01	3.77E-04	1.12E-04	1.12E-04	0.23%	0.23%	
99Tc	1.75E-01	3.17E-06	3.17E-06	4.51E-03	1.57E-08	1.57E-08	0.00%	0.00%	
106Ru	8.43E-05	5.12E-05	5.12E-05	1.08E-03	5.59E-08	5.59E-08	0.00%	0.00%	
135Ba	3.58E-02	2.46E-06	2.46E-06	2.15E-03	5.14E-10	5.14E-10	0.00%	0.00%	
128Sn	3.93E-03	1.05E-05	1.05E-05	4.15E-03	9.91E-08	9.91E-08	0.00%	0.00%	
129I	8.48E-04	2.48E-07	2.48E-07	2.91E-01	7.21E-08	7.21E-08	0.00%	0.00%	
134Cs	7.30E-04	2.19E-07	2.19E-07	3.13E-02	6.67E-09	6.67E-09	0.00%	0.00%	
137Cs	9.13E+01	2.67E-02	2.67E-02	2.39E-02	6.37E-04	6.37E-04	1.31%	1.31%	
152Sm	2.89E-03	2.69E-03	2.69E-03	8.06E-04	2.17E-06	2.17E-06	0.00%	0.00%	
152Eu	2.04E-03	5.59E-06	5.59E-06	1.54E-02	9.16E-08	9.16E-08	0.00%	0.00%	
154Eu	4.28E-01	1.22E-04	1.22E-04	1.93E-02	2.29E-06	2.29E-06	0.00%	0.00%	
155Eu	1.29E+00	3.70E-04	3.70E-04	1.95E-03	6.96E-07	6.96E-07	0.00%	0.00%	
226Ra	1.82E-06	5.31E-10	5.31E-10	1.95E-03	2.90E-10	2.90E-10	0.00%	0.00%	
228Ra	9.46E-05	2.76E-08	2.76E-08	5.45E-01	1.50E-08	1.50E-08	0.00%	0.00%	
228Ac	2.24E-05	6.55E-09	6.55E-09	4.00E-01	1.86E-08	1.86E-08	0.00%	0.00%	
228Th	3.83E-06	1.12E-09	1.12E-09	1.69E+01	7.31E-09	7.31E-09	0.00%	0.00%	
232Th	3.75E-06	1.09E-09	1.09E-09	6.98E+00	5.90E-09	5.90E-09	0.00%	0.00%	
232Pa	2.33E-05	6.81E-09	6.81E-09	8.97E+00	9.81E-07	9.81E-07	0.00%	0.00%	
232U	8.49E-08	8.49E-08	8.49E-08	1.06E+01	1.05E-06	1.05E-06	0.00%	0.00%	
233U	1.11E-04	3.25E-07	3.25E-07	3.19E+00	2.05E-05	2.05E-05	0.00%	0.00%	
234U	2.20E-02	2.84E-07	2.84E-07	3.38E+00	8.40E-07	8.40E-07	0.00%	0.00%	
235U	9.72E-04	6.56E-08	6.56E-08	2.39E+00	1.98E-07	1.98E-07	0.00%	0.00%	
238U	2.25E-04	6.46E-06	6.46E-06	2.89E+00	1.84E-05	1.84E-05	0.00%	0.00%	
237Np	2.21E-02	5.11E-08	5.11E-08	1.98E+01	2.54E-04	2.54E-04	0.00%	0.00%	
238Pu	1.08E-01	3.17E-05	3.17E-05	3.02E+00	2.65E-02	2.65E-02	0.52%	0.52%	
239Pu	9.89E+00	2.89E-03	2.89E-03	8.67E+00	2.64E-03	2.64E-03	0.00%	0.00%	
240Pu	1.04E+00	3.05E-04	3.05E-04	8.66E+00	2.48E-04	2.48E-04	0.51%	0.51%	
241Pu	2.95E-03	1.80E-03	1.80E-03	1.39E-01	7.10E-08	7.10E-08	0.00%	0.00%	
241Am	1.05E-03	6.03E-09	6.03E-09	8.23E+00	6.57E-03	6.57E-03	13.51%	13.51%	
243Am	3.82E-05	5.02E-04	5.02E-04	1.31E+01	1.46E-07	1.46E-07	0.00%	0.00%	
243Cm	1.72E+00	1.17E-06	1.17E-06	1.31E+01	5.18E-05	5.18E-05	0.11%	0.11%	
244Cm	4.84E-04	3.95E-06	3.95E-06	8.05E+00	1.22E-06	1.22E-06	0.00%	0.00%	
244Cm	1.37E-07	1.37E-07	1.37E-07	8.05E+00	5.83E-06	5.83E-06	0.02%	0.02%	
TOTAL	4.35E-03	1.27E-06	1.27E-06	5.94E+00	4.86E-02	4.86E-02	100.00%	100.00%	

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ATTACHMENT G

POTENTIAL-TO-EMIT EXAMPLE CALCULATION

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Vadose Zone Sampling Example Calculation**NOTE: Torit is a registered trademark of Donaldson Company, Inc. - Minneapolis, MN****Unit Definitions not defined in MathCad 7.0:**

$$\text{disintegration} := 1 \quad \text{curie} := 3.7 \cdot 10^{10} \cdot \frac{\text{disintegration}}{\text{sec}} \quad \text{rem} := 1 \quad \text{millirem} := .001 \cdot \text{rem}$$

The first step is to determine the actual possession quantity which corresponds to the actual volume of soil to be removed. Based on field experience, the volume of soil that has been removed is observed to expand approximately 15% because the soil is no longer compacted.

$$\text{Diameter}_{10_inch} := 10\text{-in}$$

$$\text{Length}_{10_inch} := 50\text{-ft}$$

$$\text{Diameter}_{8_inch} := 8\text{-in}$$

$$\text{Length}_{8_inch} := 200\text{-ft}$$

$$\text{Borehole} := \frac{10}{\text{yr}}$$

$$\text{Volume}_{10_inch} := \pi \cdot \left[\frac{\text{Diameter}_{10_inch}}{2} \right]^2 \cdot \frac{12\text{ in}}{\text{ft}} \cdot \text{Length}_{10_inch}$$

$$\text{Volume}_{10_inch} = 27.271 \cdot \text{ft}^3$$

$$\text{Volume}_{8_inch} := \pi \cdot \left[\frac{\text{Diameter}_{8_inch}}{2} \right]^2 \cdot \frac{12\text{ in}}{\text{ft}} \cdot \text{Length}_{8_inch}$$

$$\text{Volume}_{8_inch} = 69.813 \cdot \text{ft}^3$$

$$\text{Volume}_{\text{Actual}} := 1.15 \cdot (\text{Volume}_{10_inch} + \text{Volume}_{8_inch})$$

$$\text{Volume}_{\text{Actual}} = 111.647 \cdot \text{ft}^3$$

The average vertical span of soil contamination is assumed to be 20 feet. This 20 feet can be anywhere along the depth of the borehole. For conservatism assume that the 20 feet of soil contamination corresponds to the 10 inch diameter.

$$\text{Length}_{\text{contamination}} := 20 \text{ ft}$$

$$\text{Volume}_{\text{contamination}} := 1.15\pi \left[\frac{\frac{\text{Diameter}_{10_inch}}{2}}{12 \frac{\text{in}}{\text{ft}}} \right]^2 \cdot \text{Length}_{\text{contamination}}$$

$$\text{Volume}_{\text{contamination}} = 12.545 \text{ ft}^3$$

The average density of loose soil is 97.5 pounds per cubic feet (Marks' Standard Handbook for Mechanical Engineers, 9th Edition)

$$\rho_{\text{soil}} := 97.5 \frac{\text{lb}}{\text{ft}^3}$$

$$\text{Soil}_{\text{contamination}} := \text{Volume}_{\text{contamination}} \cdot \rho_{\text{soil}} \quad \text{Soil}_{\text{contamination}} = 1.223 \times 10^3 \text{ lb}$$

The amount of soil that challenges the HEPA filter per borehole is provided below. The amount of soil collected by the torit and not discharged to the air treatment control system is based on previous previous experience.

$$\eta_{\text{torit}} := .9996 \quad \text{torit}_{\text{collection}} := 4 \text{ gal} \quad \text{torit}_{\text{collection}} = 0.535 \text{ ft}^3$$

$$\text{torit}_{\text{inlet}} := \frac{\text{torit}_{\text{collection}}}{\eta_{\text{torit}}} \quad \text{torit}_{\text{inlet}} = 0.535 \text{ ft}^3$$

$$\text{HEPA}_{\text{challenge}} := \text{torit}_{\text{inlet}} - \text{torit}_{\text{collection}} \quad \text{HEPA}_{\text{challenge}} = 2.14 \times 10^{-4} \text{ ft}^3$$

The calculated efficiency of the cyclone is as follows:

$$\eta_{\text{cyclone}} := \frac{\text{Volume}_{\text{Actual}} - \text{torit}_{\text{inlet}}}{\text{Volume}_{\text{Actual}}} \quad \eta_{\text{cyclone}} = 0.9952$$

The estimated fraction of soil that challenges the HEPA filter is:

$$\text{HEPA}_{\text{fraction}} := (1 - \eta_{\text{torit}}) \cdot (1 - \eta_{\text{cyclone}}) \quad \text{HEPA}_{\text{fraction}} = 1.917 \cdot 10^{-6}$$

The amount of contaminated soil that reaches the HEPA filter in one year is as follows:

$$\text{HEPA}_{\text{contamination}} := \text{HEPA}_{\text{fraction}} \cdot \text{Soil}_{\text{contamination}} \cdot \text{Borehole}$$

$$\text{HEPA}_{\text{contamination}} = 0.023 \frac{\text{lb}}{\text{yr}} \quad \text{HEPA}_{\text{contamination}} = 10.633 \frac{\text{gm}}{\text{yr}}$$

Air Rotary Drilling Annual Possession Quantity Calculation for Pu-239:

$$\eta_{\text{HEPA}} := .9995 \quad \text{Cs}_{\text{contamination}} := 7.0 \cdot 10^{-9} \frac{\text{curie}}{\text{gm}}$$

$$\text{Pu239_Cs_137}_{\text{ratio}} := 1.08 \cdot 10^{-1}$$

$$\text{Pu239}_{\text{PQ}} := \text{Soil}_{\text{contamination}} \cdot \text{Cs}_{\text{contamination}} \cdot \text{Pu239_Cs_137}_{\text{ratio}} \cdot \text{Borehole}$$

$$\text{Pu239}_{\text{PQ}} = 4.194 \cdot 10^{-3} \frac{\text{curie}}{\text{yr}}$$

Air Rotary Drilling Unabated and Abated Release/Dose Calculation for Pu-239 using a conservative 40 CFR 61 Appendix D release fraction of 1.00 for particulates and liquids:

$$\text{RF} := 1.00$$

$$\text{Pu239}_{\text{unabated}} := \text{Pu239}_{\text{PQ}} \cdot \text{RF} \quad \text{Pu239}_{\text{unabated}} = 4.194 \cdot 10^{-3} \frac{\text{curie}}{\text{yr}}$$

$$\text{Pu239}_{\text{abated}} := \text{Pu239}_{\text{unabated}} \cdot (1 - \eta_{\text{cyclone}}) \cdot (1 - \eta_{\text{torit}}) \cdot (1 - \eta_{\text{HEPA}})$$

$$\text{Pu239}_{\text{abated}} = 4.019 \cdot 10^{-12} \frac{\text{curie}}{\text{yr}}$$

$$\text{DoseFactor}_{\text{Pu}_{239}} := 8.67 \frac{\text{millirem}}{\text{curie}}$$

$$\text{Pu}_{239}_{\text{unabated_dose}} := \text{Pu}_{239}_{\text{unabated}} \cdot \text{DoseFactor}_{\text{Pu}_{239}}$$

$$\text{Pu}_{239}_{\text{unabated_dose}} = 0.036 \frac{\text{millirem}}{\text{yr}}$$

$$\text{Pu}_{239}_{\text{abated_dose}} := \text{Pu}_{239}_{\text{abated}} \cdot \text{DoseFactor}_{\text{Pu}_{239}}$$

$$\text{Pu}_{239}_{\text{abated_dose}} = 3.48 \times 10^{-11} \frac{\text{millirem}}{\text{yr}}$$

For the other drilling techniques (e.g., closed end probe and cone penetrometer) the source of airborne emissions is expected to come from the volume of soil extracted during sampling activities. The maximum soil sample volume from each borehole is based on obtaining up to 10, 4-inch diameter by 2 feet long samples.

$$\text{Sample_volume} := 10 \cdot 2 \cdot \text{ft} \cdot \pi \cdot \left(\frac{4 \cdot \text{in}}{2 \cdot 12 \cdot \frac{\text{in}}{\text{ft}}} \right)^2$$

$$\text{Sample_volume} = 1.745 \text{ft}^3$$

The total fraction of samples from the contaminated zone is expected to be 0.25. Since the samples are being extracted from the well, the samples are compacted; therefore, an average density for compacted soil was used. The average density of loose soil is 97.5 pounds per cubic feet (Marks' Standard Handbook for Mechanical Engineers, 9th Edition) The maximum volume of contaminated soil per year is calculated below.

$$\text{fraction}_{\text{contaminated_zone}} := .25$$

$$\rho_{\text{soil_compacted}} := 110 \frac{\text{lb}}{\text{ft}^3}$$

$$\text{Soil}_{\text{contaminated}} := \text{Sample_volume} \cdot \text{fraction}_{\text{contaminated_zone}} \cdot \rho_{\text{soil_compacted}} \cdot \text{Borehole}$$

$$\text{Soil}_{\text{contaminated}} = 479.966 \frac{\text{lb}}{\text{yr}}$$

$$\text{Soil}_{\text{contaminated}} = 2.177 \cdot 10^5 \frac{\text{gm}}{\text{yr}}$$

Other Drilling Techniques Annual Possession Quantity Calculation for Pu-239:

$$\text{Cs}_{\text{contamination}} := 3.30 \cdot 10^{-4} \frac{\text{curie}}{\text{gm}}$$

$$\text{Pu239_Cs_137_ratio} := 1.08 \cdot 10^{-1}$$

$$\text{Pu239}_{\text{PQ}} := \text{Soil}_{\text{contaminated}} \cdot \text{Cs}_{\text{contamination}} \cdot \text{Pu239_Cs_137_ratio}$$

$$\text{Pu239}_{\text{PQ}} = 7.759 \frac{\text{curie}}{\text{yr}}$$

Other Drilling Techniques Unabated and Abated Release/Dose Calculation for Pu-239 using a conservative 40 CFR 61 Appendix D release fraction of $1\text{E-}03$ for particulates and liquids and that only 10% of the contaminated soil is exposed to atmosphere:

$$\text{RF} := 1 \cdot 10^{-3} \quad \text{Fraction}_{\text{exposed}} := .1$$

$$\text{Pu239}_{\text{unabated}} := \text{Pu239}_{\text{PQ}} \cdot \text{RF} \cdot \text{Fraction}_{\text{exposed}}$$

$$\text{Pu239}_{\text{unabated}} = 7.759 \cdot 10^{-4} \cdot \frac{\text{curie}}{\text{yr}}$$

$$\text{Pu239}_{\text{abated}} := \text{Pu239}_{\text{unabated}}$$

$$\text{Pu239}_{\text{abated}} = 7.759 \cdot 10^{-4} \cdot \frac{\text{curie}}{\text{yr}} \quad \text{DoseFactor}_{\text{Pu}_{239}} := 8.67 \cdot \frac{\text{millirem}}{\text{curie}}$$

$$\text{Pu239}_{\text{unabated_dose}} := \text{Pu239}_{\text{unabated}} \cdot \text{DoseFactor}_{\text{Pu}_{239}}$$

$$\text{Pu239}_{\text{unabated_dose}} = 6.727 \cdot 10^{-3} \cdot \frac{\text{millirem}}{\text{yr}}$$

$$\text{Pu239}_{\text{abated_dose}} := \text{Pu239}_{\text{abated}} \cdot \text{DoseFactor}_{\text{Pu}_{239}}$$

$$\text{Pu239}_{\text{abated_dose}} = 6.727 \cdot 10^{-3} \cdot \frac{\text{millirem}}{\text{yr}}$$

For Casing Removal:

Assumed contaminated soil thickness on casing:

$$\text{soil}_{\Delta} := \frac{1}{.64} \cdot \text{in}$$

For 10-inch casing, the estimated soil volume is:

$$\text{Volume}_{10} := .25 \text{ Length}_{10_inch} \cdot \pi \cdot \left[\left(\frac{(\text{Diameter}_{10_inch} + 2 \cdot \text{soil}_{\Delta})}{12 \cdot \frac{\text{in}}{\text{ft}}} \right)^2 - \left(\frac{\text{Diameter}_{10_inch}}{12 \cdot \frac{\text{in}}{\text{ft}}} \right)^2 \right]$$

$$\text{Volume}_{10} = 0.171 \cdot \text{ft}^3$$

For 8-inch casing, the estimated soil volume is:

$$\text{Volume}_8 := .25 \text{ Length}_{8_inch} \cdot \pi \cdot \left[\left(\frac{(\text{Diameter}_{8_inch} + 2 \cdot \text{soil}_{\Delta})}{12 \cdot \frac{\text{in}}{\text{ft}}} \right)^2 - \left(\frac{\text{Diameter}_{8_inch}}{12 \cdot \frac{\text{in}}{\text{ft}}} \right)^2 \right]$$

$$\text{Volume}_8 = 0.546 \cdot \text{ft}^3$$

The total soil volume on the casing if uniformly coated is:

$$\text{Volume}_{\text{uniform}} := \text{Borehole} \cdot (\text{Volume}_{10} + \text{Volume}_8)$$

$$\text{Volume}_{\text{uniform}} = 7.172 \frac{\text{ft}^3}{\text{yr}}$$

Based on previous experience, approximately 15% of the exterior surface of the casing is contaminated. For conservatism, an extra 10% of the exterior surface contamination is added to account for any potential contamination that may be within the interior of the casing. Therefore, the adjusted soil volume is:

$$\text{fraction}_{\text{exterior}} := .15$$

$$\text{fraction}_{\text{interior}} := .1 \cdot \text{fraction}_{\text{exterior}} \quad \text{fraction}_{\text{interior}} = 0.015$$

$$\text{fraction}_{\text{total}} := \text{fraction}_{\text{exterior}} + \text{fraction}_{\text{interior}} \quad \text{fraction}_{\text{total}} = 0.165$$

$$\text{Volume}_{\text{adjusted}} := \text{fraction}_{\text{total}} \cdot \text{Volume}_{\text{uniform}}$$

$$\text{Volume}_{\text{adjusted}} = 1.183 \frac{\text{ft}^3}{\text{yr}}$$

The average density of compacted soil is 110 pounds per cubic feet
(Marks' Standard Handbook for Mechanical Engineers, 9th Edition)

$$\rho_{\text{soil_compacted}} := 110 \frac{\text{lb}}{\text{ft}^3}$$

The total weight of soil on the casing is:

$$\text{Weight}_{\text{soil_casing}} := \text{Volume}_{\text{adjusted}} \cdot \rho_{\text{soil_compacted}}$$

$$\text{Weight}_{\text{soil_casing}} = 59044.1 \frac{\text{gm}}{\text{yr}}$$

Possession Quantity Calculation for Pu-239 associated with casing removal:

$$Cs_{\text{contamination}} := 3.30 \cdot 10^{-4} \frac{\text{curie}}{\text{gm}}$$

$$Pu239_Cs_137_{\text{ratio}} := 1.08 \cdot 10^{-1}$$

$$Pu239_{PQ} := \text{Weight}_{\text{soil_casing}} \cdot Cs_{\text{contamination}} \cdot Pu239_Cs_137_{\text{ratio}}$$

$$Pu239_{PQ} = 2.104 \frac{\text{curie}}{\text{yr}}$$

$$RF := .001$$

Casing Removal Unabated Release/Dose Calculation for Pu-239:

$$Pu239_{\text{unabated}} := Pu239_{PQ} \cdot RF$$

$$Pu239_{\text{unabated}} = 2.104 \cdot 10^{-3} \frac{\text{curie}}{\text{yr}}$$

$$\text{DoseFactor}_{Pu_239} := 8.67 \frac{\text{millirem}}{\text{curie}}$$

$$Pu239_{\text{unabated_dose}} := Pu239_{\text{unabated}} \cdot \text{DoseFactor}_{Pu_239}$$

$$Pu239_{\text{unabated_dose}} = 0.018 \frac{\text{millirem}}{\text{yr}}$$

$$Pu239_{\text{unabated_dose}} = 1.82 \cdot 10^{-2} \frac{\text{millirem}}{\text{yr}}$$

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ATTACHMENT H

DISCUSSION OF BEST AVAILABLE RADIONUCLIDE CONTROL TECHNOLOGY

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**DISCUSSION OF BEST AVAILABLE RADIONUCLIDE CONTROL TECHNOLOGY
(REQUIREMENT 16)**

Providing cost factors for construction, operation, and maintenance of the proposed control technology components is not required because the following BARCT discussion is provided. The BARCT is defined by WAC 246-247-030 as follows:

“Technology that will result in a radionuclide emission limitation based on the maximum degree of reduction for radionuclides from any proposed newly constructed or significantly modified emission units that the licensing authority determines is achievable on a case-by-case basis. A BARCT compliance demonstration must consider energy, environmental, and economic impacts, and other costs through examination of production processes, and available methods, systems and techniques for control of radionuclide emissions. A BARCT compliance demonstration is the conclusion of an evaluative process that results in the selection of the most effective control technology from all know feasible alternatives. In no event shall application of BARCT result in emissions of radionuclides that could exceed the applicable standards of WAC 246-247-040. Control technology that meets BARCT requirements also meets ALARCT requirements.”

As stated in WAC 246-247-120, only those radionuclides comprising more than 10 percent of the unabated dose need to be evaluated. All of the dose is due to particulate radionuclides. The Washington State Department of Health has provided guidance that HEPA filters generally are considered BARCT for particulate emissions (WDOH 1992).

It is proposed, pursuant to the quoted citation, that the ventilation system described in Section 8.0 and the controls (engineering and administrative) (described in Section 9.0) be approved as BARCT for the proposed activities.

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