U.S. Department of Energy

2597 B³⁄₄ Road Grand Junction, CO 81503

November 14, 2005

PHMSA 2005-23246-1

Associate Administrator for Hazardous Materials Safety Pipeline and Hazardous Materials Administration U.S. Department of Transportation 400 7th Street, S.W. Washington, DC 20590-0001

Attention: Special Permits, PHH-31

The U.S. Department of Energy Office of Environmental Management (DOE EM) is hereby submitting a new application for a U.S. Department of Transportation (DOT) Special Permit in accordance with 49 CFR 107.105, to replace the exemption for the transportation of uranium mill tailings that was allowed to expire in February of 2000 (DOT-E 10594). Please find attached, two copies of the application for a DOT Special Permit.

The DOE-EM in Grand Junction, Colorado may be starting to haul Moab mill tailings from surrounding vicinity properties to the Moab Project Site as early as March of 2006.

The DOE agent for purposes of this application is Mr. Donald Metzler. He can be reached at the address and phone number below.

Mr. Donald R. Metzler Moab Federal Project Director U.S. Department of Energy 2597 B ³/₄ Road Grand Junction, Colorado 81503 Phone Number: (970) 248-7612

During the period from September 3, 1996, until February 29, 2000, under the previous Exemption, no spills exceeding DOT reporting thresholds occurred.

The DOE EM is currently in compliance with transportation security laws and regulations as they apply to our activities. During the removal of tailings material from Moab, Utah, DOE will maintain compliance with DOE emergency response plans, training requirements, and security procedures, which will include an assessment of transportation risks, and measures to reduce risks, personnel security, unauthorized access, and en route security as applicable to the Moab Project transportation activities.





If you have any questions or require additional information, please contact me at the above address or phone number.

Sincerely,

Donald R. Metzler Moab Federal Project Director

cc w/enclosure: Project File MOA 59.1 (D. Osborne)

cc w/o enclosure: J. Berwick, DOE (e) J. Elmer, Stoller (e) K. Karp, Stoller (e)

DRM\MOAB\Legal\DOTSpecialPermit PHH-31

Application for a Department of Transportation Special Permit

(Reference DOT-Exemption 10594 [DOE 1998])

1. <u>Submitted To (2 Copies)</u>

Associate Administrator for Hazardous Materials Safety Pipeline and Hazardous Material Safety Administration U.S. Department of Transportation 400 7th Street, S.W. Washington, DC 20590-0001 Attention: Special Permits, PHH-31

2. Regulation Affected

Title 49 CFR Parts 106 and 107, and Subchapter C - Hazardous Materials Regulations – 171 through 178, including the requirements for the proper shipping name, hazard class, identification number, marking, labels, placards and packaging, notification, and some emergency response requirements to transport uranium mill tailings by rail and truck to a U.S. Department of Energy (DOE)-owned disposal cell.

3. Applicants

U.S. Department of Energy Environmental Management (EM-34) Donald R. Metzler, Moab Federal Project Director 2597 B ³/₄ Road Grand Junction, CO 81503 Telephone Number: (970) 248-7612

DOE Contractor and Subcontractors Jefferson O. Neff, S.M. Stoller Contract Manager 2597 B ³/₄ Road Grand Junction, CO 81503 Telephone Number: (937) 620-6761

4. Name and Hazard Class

Radioactive material, low specific activity (LSA-I) non fissile, Class 7, UN2912 Radioactive material, low specific activity (LSA-II) non fissile, Class 7, UN3321

5. Regulations for Which Special Permit is Requested

49 CFR Part 172, Subpart C, except for 172.203(a), in that no manifests will be used under the special permit, and a single special permit document containing the information required by this application will serve as the shipping papers; 172.302(a) and (b) in that only marking requirements of 172.302(c) will be used; 172.310; 172.331; 172.332; Part 172, Subparts E,

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no Tst labeling and F, placarding; 173.403 (only as it relates to the definition of closed transport vehicle); 173.427 (a)(6); 173.433, in that radionuclide values for each railcar or truckload will not be determined; 173.443 in that contamination controls for dedicated-use transport vehicles are specified in the special permit; 174.24 in that a single special permit document containing the information required by this application will serve as the shipping papers; 174.59; 174.750(a) in that requirements for shipper and carrier reporting of releases are specified in the special permit; 177.843 in that these procedures are described in the special permit.

6. Modes of Transportation

Railroad and Highway

7. Request

The purpose of this request is to allow DOE and trained and qualified contractors and subcontractors to transport uranium mill tailings and other residual radioactive materials (RRM) based on a level of safety consistent with public interest and equivalent to levels of safety of the Hazardous Materials Regulations. The mill tailings are located in Moab, Utah, at the former Atlas uranium processing facility, and require relocation to a disposal site to be constructed two miles north of Crescent Junction, Utah (see Figure 1).

8. Background and Description of Activities

Uranium mill tailings are present in Moab at the former Atlas processing and disposal site and may be at some surrounding locations (see Figure 2). The Uranium Mill Tailings Radiation Control Act (UMTRCA) legislation was amended per the Floyd D. Spence Act, to include the Moab site under the DOE Uranium Mill Tailings Remedial Action (UMTRA) Program. Remedial action is conducted pursuant to U.S. Environmental Protection Agency regulations in 40 CFR Part 192.

The Environmental Impact Statement (EIS) and Record of Decision (ROD) (DOE 2005a) documented DOE activities to date, and proposed the relocation of the existing tailings cell and uranium mill tailings (including RRM) 30 miles to an area just north of Crescent Junction, Utah (see Figure 3). Transportation by rail is proposed for the majority of tailings contaminated material. Approximately 120,000 rail cars (12 million tons) over a 5- to 10-year period will be required to complete tailings removal from Moab. Trucks will be used to transport tailings and debris, and to stage tailings materials from vicinity properties at the Moab site prior to rail transport. Transportation by truck would be accomplished by using existing Highways US-191 and CR-175. Approximately 50,000 tons of debris (35,000 yd³) are expected to be transported by 20-ton trucks. Transportation activities are expected to begin as early as February 2006. Completion of transport of uranium mill tailings to a permanent engineered disposal facility (see Figure 4) has been determined through the EIS and the ROD to be in the best interest of the public and the environment, and has strong public support.

A significant quantity of the uranium mill tailings meet the DOT definition of "radioactive material" (see Attachment 1) and have been historically transported consistent with cost-effective bulk transport methods through the original DOT exemption issued in June 1991 (DOT-E 10594). These mill tailings, if not exempted, would be classified as "Radioactive material, low specific activity LSA I or LSA II," and would be subject to the applicable shipping and packaging requirements of 49 CFR 172 and 173. This special permit request seeks to have DOE uranium mill tailings shipments managed in the same fashion as the previous DOT exemption while incorporating additional compliance requirements under the revised Hazardous Material regulations (October 2004), as applicable.

DOE has a large database of tailings material characterization from over 22 sites. From preliminary evaluations, characterization data for mill tailings at Moab appears to be consistent with that of other tailings material at previously remediated mill sites. DOE has an excellent uranium mill tailings transportation history of over two decades, most of which was conducted under the original DOT exemption that expired in February 2000. No incidents or occurrences exceeded DOT reporting thresholds during the last renewal period (September 1996 through February 2000).

DOE has reviewed the security plan requirements with respect to the transportation of radioactive material. It is DOE's position that transportation of tailings material does not pose a significant threat to the safety of U.S. citizens during the transportation process. There is no criticality issue associated with these tailings materials, nor is there enough radioactivity to pose a significant environmental threat. This material has a low specific activity; therefore, dispersion devices would be useless. Based on the nature of this material, security requirements are minimal and will include the following:

- All rail transport is exclusive use with DOE-owned rail cars and a dedicated railroad line called the Cane Creek Branch.
- All shipments by truck are exclusive use with a subcontracted trucking firm trained to this special permit and evaluated by the DOE's Motor Carrier Evaluation Program.
- All conveyances are covered with either a hard cover, a tarpaulin, or a tested surfactant to prevent releases.
- Applicable surface contamination testing and decontamination procedures will be used when transporting material from contamination areas to or through clean areas in accordance with DOE Order 5400.5.
- All hazarouds material personnel will be adequately trained in handling and preventing the release of radioactively contaminated materials and waste.

All transportation activities are located within the State of Utah, which is very familiar with historical DOE transportation practices for uranium mill tailings.

9. Typical Activity Ranges for Uranium Mill Tailings Materials

Activity concentration of radium-226 (Ra-226) varies based on the amount of other material present. Typically, mill tailings are distributed in various types of soil and debris. Uranium mill tailings in the pile at the Moab site range from 0.18 bequerels/gram (Bq/g) to 85.1 Bq/g

(5 picoCuries/gram [pCi/g] to 2,300 pCi/g) Ra-226 (DOE 2003) with average concentrations at about 12.21 Bq/g (330 pCi/g) Ra-226 (SRK 2000). (See Attachment 2 for characterization data tables.) Uranium mill tailings concentrations of 0.18 Bq/g to 7.4 Bq/g (5 pCi/g to 200 pCi/g) Ra-226 (DOE 2005b) are typical at the vicinity properties around the Moab site.

10. Authorized Material

Materials allowed by this special permit are uranium mill tailings or any mill tailings resulting from the processing of uranium or thorium ore to remove one or more radioactive isotopes from the ore, any remaining ore material containing elevated radioactivity, and RRM (legal definition under UMTRCA)—including soil, debris, or processing materials that may contain other hazardous substances, and construction materials contaminated with uranium mill tailings resulting from historical processing and current remedial activities at the Moab site

11. Safety Control Measures

Uranium mill tailings to be shipped in bulk shipments must be in covered conveyances with additional controls as follows:

- Shipments must be loaded by the consignor and unloaded by the consignee from the conveyance in which originally loaded.
- There must be no leakage of radioactive materials or liquids from packages.
- Surface contamination levels of packages offered for shipment must not exceed limits specified in 49 CFR 173.443(a) and (d).
- The conveyance is to be marked on at least two opposite sides as follows:

"For Radioactive Materials Use Only" Low-level radioactivity in mill tailings DOE - E XXXXX Emergency Contact and Phone Number

- The marking may not be removed until the vehicle is radiologically released in accordance with DOE requirements.
- The vehicle operator or train engineer must maintain a copy of the special permit in the cab of the conveyance while transporting uranium mill tailings.
- The vehicle operator will:
 - immediately report spills to the DOE contractor responsible for the overall management of the specific clean up project;
 - o isolate the area as necessary to protect the public; and
 - clean up the spill as required by the prime DOE contractor and DOE requirements, State, and/or local requirements as applicable.

- The DOE contractor will report the spill in accordance with DOE requirements. Spills
- of Reportable Quantities of a Hazardous Substance (49 CFR 171) must also be reported to applicable Federal agencies as soon as practicable.
- The DOE contractor shall ensure compliance with applicable regulations in 49 CFR Chapter II—Federal Railroad Administration, DOT and in 49 CFR Part 174 for shipments by rail except for those citations specifically exempted.

12. Basis of the Proposal

DOE is requesting a new special permit in accordance with 49 CFR Part 107.105 because the regulations have changed, the previous exemption was allowed to expire, and because the scope of DOE tailings removal has changed in locations and volumes. The basis as presented in the original exemption, DOT-E 10594, and subsequent renewals is referenced and relevant to this new application for special permit because it demonstrates over two decades of DOE's safety and compliance history in the transportation of uranium mill tailings.

13. Worker Protection Concerns

In case of an accident, the low specific activity of mill tailings would likely prevent a member of the public from reaching the Allowable Limit for Intake (ALI) of any of the isotopes of concern, even for thorium-230 (Th-230), which is the most restrictive isotope. Years of experience in excavating, loading, and dumping tailings from trucks and rail cars have shown this to be true. While contamination of the skin or personal clothing from tailings would not represent a significant health hazard, legal requirements require that it be prevented to the extent practicable. Administrative and engineering controls, including the use of personal protective clothing such as cotton coveralls, shoe covers, and gloves, are usually employed to prevent contamination of the skin or personal clothing from tailings. The radiation levels are checked by survey crews before and during the clean up. Radiation dose rates are typically below 0.004 millisieverts/hour (mSV/hr) (0.4 mrem/hr) with some high dose rates noted near 0.05 mSV/hr (5 mrem/hr).

Because of the low external radiation does rates from mill tailings, most of the risk to the public in the event of an accident would be attributable to ingestion of radioparticulates. Tailings have a smaller particle size when compared with ore, "sand versus stones". However, even though the particle size of tailings is smaller, it still has a low specific activity, 0.18 Bq/g to 85.1 Bq/g (5 to 2,300 pCi/g) Ra-226. Because of the low specific activity, this risk is no greater than for uranium ore. Based on available technical literature, it is inconceivable that an intake could occur which would give rise to a significant radiation hazard (Page 83, International Atomic Energy Agency, Explanatory Material for the IAEA Regulations for the Safe Transport of Radioactive Material [1985 Edition]: Second Edition, Safety Series No. 7, IAEA, Vienna [1987]).

Based on the work practices and requirements for the protection of the workers involved in the clean-up efforts, including the vehicle drivers, dose rate monitoring on each load is not necessary. Since it is inconceivable that dose rates could exceed levels specified in 49 CFR 173.441, the measurement of the dose rates would not result in any change in the method of transport or other protective actions.

14. Communications Requirements

The purpose of shipping papers, marking, labeling, and placards is to communicate the hazards and controls necessary for the safe handling of hazardous materials. The clean up, hauling, and disposal of mill tailings are performed in a more controlled environment than the routine shipment of hazardous materials. DOE and DOE Contractor Program personnel work closely with federal, state, and local health officials to ensure the work is performed safely.

Appropriate personnel are dispatched to the scene of any spill. Once on the scene, they evaluate the volume and activity of the spill. The area is secured by the subcontractor with the assistance of local law enforcement officials if necessary. Other than traffic control, local hazardous material response teams have not been required to respond to a mill tailings spill, nor do they anticipate such a response. The public has been involved since the beginning of these mill tailings cleanup programs in the 1980s, and have given significant input. The public strongly supports the movement of uranium mill tailings from Moab 30 miles north to the Crescent Junction site. They recognize the overall benefit they receive by the eventual removal of this material.

Because of the availability of radios and cell phones, the common knowledge of the community, state, county and local agencies, and the emergency response training and capabilities of the DOE contractor, shipping papers, marking, labeling, and placarding required in 49 CFR 172 should not be required as a result of historically implemented and proven equivalent measures.

15. Reporting Spills and Incidents

DOE requirements mandate contractors to report spills and environmental releases at a threshold significantly below other regulatory agency requirements. Depending on the significance of the event, it is investigated to determine the cause of the occurrence, define the root cause, evaluate corrective actions, and implement them to prevent recurrence. The DOE occurrence reporting system exceeds DOT reporting requirements specified in 49 CFR 171.15 and 171.16. Additionally, the Safety Control Measures in Section 11 require the reporting of any spill or release involving a reportable quantity (49 CFR 172.101) of a hazardous substance as defined by 49 CFR 171. Descriptions of historical spills or releases applicable to DOT- E 10594 are provided below.

Since 1983, the DOE UMTRA Program transported over 20 million cubic yards of mill tailings over more than 14 million miles of public roads during its history of remediation of processing sites and vicinity properties across the United States. Early in the program there were periods of frequent spills and releases. These were tracked in accordance with DOE requirements and corrective actions were taken based on root causes. Most of these releases were due to operator error and mechanical failures associated with belly-dump haul trucks and tailgate release devices. Increased awareness through intensive training and review of the truck release mechanisms significantly reduced the number and severity of reportable occurrences and incidents. Additionally, operating procedures were modified to require additional precautions, and equipment modifications were made where appropriate to prevent inadvertent spills of tailings material. Operators were monitored for compliance with safety procedures, and the lessons learned from incidents were incorporated into training programs for new personnel. The DOE has had no reportable spills of uranium mill tailings or contaminated materials in transport since 1992. Two haulage vehicle accidents occurred in 1993 and in 1996. The first was an empty haul truck in transit and the second was at the repository during unloading. No transportation incidents or occurrances have taken place since 1996; therefore, no DOT reporting thresholds were exceeded during the last renewal period (September 1996 through February 2000.

16. References

Title 10 CFR, Energy, Part 835, Occupational Radiation Protection.

Title 29 CFR, Part 1910, Occupational Safety and Health Standards-General Industry.

Title 49 CFR, Parts 171-185, Transportation, October 2004.

Title 49 CFR, Parts 106 and 107, Transportation, October 2004.

DOE Order 5400.5, Radiation Protection of the Public and the Environment, January 1993, EH.

DOE (U.S. Department of Energy), 2003. *Site Observational Work Plan for the Moab, Utah, Site*, http://gj.em.doe.gov/moab, December.

DOE (U.S. Department of Energy), 2005a. *Record of Decision for the Remediation of the Moab Uranium Mill Tailings, Grand and San Juan Counties, Utah*, http://gj.em.doe.gov/moab, September.

DOE (U.S. Department of Energy) 2005b. *Remediation of the Moab Uranium Mill Tailings, Grand and San Juan Counties, Utah, Final Environmental Impact Statement*, DOE/EIS-0355, http://gj.em.doe.gov/moab, July.

Tailings Geochemistry, Atlas Mill Site, Moab, Utah, prepared by Steffen Robertson and Kirsten, January 2001.

U.S. Department of Transportation, Washington, D.C., DOT-E 10594, June 1991.



Figure 1. Transportation Routes

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Figure 3. Crescent Junction Site Plan





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Attachment 1

Shipping Determinations for Materials Containing Uranium and Uranium Mill Tailings

Shipping Determinations for Materials Containing Uranium and Uranium Mill Tailings

1.0 Definitions

Limited Quantity of Radioactive Material (solid) - A package with:

- 1. A total activity not exceeding 10^{-3} A₂ from Table 173.435.
- 2. A radiation level at any point on the external package not exceeding 0.5 mrem/hr.
- 3. Removable radioactive surface contamination less than 22 disintegrations per centimeter squared (dpm/cm²) (alpha) and 220 dpm/cm² (beta/gamma).

Low Specific Activity (LSA) material and Surface Contaminated Objects (SCO) - LSA material means Class 7 material with limited specific activity which satisfies the description and limits set forth in 49 CFR 173.403. For uranium mill tailings, the preamble to the new regulations (effective October 2004) specifically refer to LSA-I (iv), as the most applicable definition.

"Other radioactive material, excluding fissile material in quantities not excepted under 173.453, in which the activity is distributed throughout and the estimated average specific activity does not exceed 30 times the values for activity concentration specified in 173.436..."

Radioactive Material - Any material containing radionuclides where both the activity concentration and the total activity in the consignment exceed the values specified in the table at 49 CFR Part 173.436.

U(nat), from tables 173.435 and 173.436 - Uranium containing the naturally occurring distribution of uranium isotopes (U-238, U-235, U-234). The definition of "Natural uranium" in 173.403 does not apply to entries in Tables 173.435 and 173.436. Note that U(nat) is listed including progeny in Table 173.436, but without progeny in Table 173.435.

2.0 Assumptions (Tailings)

- 2.1 The activity concentration of radionuclides in mill tailing is estimated from the activity concentration of Ra-226.
- 2.2 Uranium mill tailings contain Th-230 and uranium at activity concentrations equal to or less than the activity concentration of Ra-226.

3.0 Exempt (non-radioactive) Material

3.1 Materials containing uranium mill tailings are shipped as non-radioactive material if the average activity concentration and the total activity of the consignment is less than the values listed in Table 173.436. Based on the assumptions in 2.0, the values for U(nat) are used from the table. The material is shipped as non-radioactive if the average activity concentration of Ra-226 for the consignment is

less than 1.0 Bq/g (27 pCi/g) or the total activity of Ra-226 for the consignment is less than 1,000 Bq (27,000pCi).

3.2 For materials known or suspected to contain uranium concentrates, the assumptions in 2.0 are not valid and an estimate of the uranium activity concentration is needed. The material is shipped as non-radioactive if the average activity concentration of uranium for the consignment is less than 1.0 Bq/g (27 pCi/g) or the total activity of uranium for the consignment is less than 1,000 Bq (27,000pCi).

4.0 Limited Quantity

Materials with an activity per package that does not exceed the limited quantity package limits $(10^{-3} A_2 \text{ from table } 173.435)$ are excepted from most packaging and labeling requirements.

4.1 The A_2 value for the radionuclide mixture found in uranium ore and uranium mill tailings is calculated as specified in 173.433.

A₂ for mixture =
$$\frac{1}{\sum_{i} \frac{f(i)}{A_2(i)}}$$

f(i) is the fraction of the activity of radionuclide *i* in the mixture

 $A_2(i)$ is the appropriate A₂ for radionuclide *i* in the mixture

The A_2 for the radionuclides in the mixture are listed in Table 1.

Symbol of radionuclide	A ₂ (TBq)	A2 (Ci)		
U(nat)	Unlimited	Unlimited		
Th-234 (a)	3.0×10^{-1}	8.1		
Th-230	1.0×10^{-3}	2.7×10^{-2}		
Ra-226 (a)	3.0×10^{-3}	8.1 × 10 ⁻²		
Pb-210 (a)	5.0 × 10 ⁻²	1.4		
Po-210	2.0×10^{-2}	5.4×10^{-1}		

Table 1. Values for A_2

(a) Values include contributions from progeny radionuclides with half-lives less than 10 days.

TBq – Terabequerels

Ci – Curies

U(nat) is not included in the calculation because of the unlimited A_2 value. If all of the other radionuclides have equal activities, then the A_2 value for the mixture is 4.18×10^{-3} TBq (1.13×10^{-1} Ci).

The activity limit for Ra-226 in an excepted package is:

$$4.18x10^{-3} \times \frac{10^{-3}}{6} = 6.966x10^{-7} TBq = 1.88x10^{-5} Ci$$

4.2 The A₂ value for uranium concentrate is unlimited. This material is shipped in excepted packaging provided that the dose rate and surface contamination criteria are satisfied.

5.0 Low Specific Activity

Per the definition of LSA, uranium mill tailings would be regulated as LSA-I if the activity concentration of the material does not exceed 30 times the values for activity concentration specified in Table 173.436.

Uranium mill tailings in the pile at the Moab site have Ra-226 activity concentrations ranging from 0.18 Bq/g to 85.1 Bq/g (5 pCi/g to 2,300 pCi/g). Shipments of uranium mill tailings with an average Ra-226 activity concentration greater than 1.0 Bq/g (27 pCi/g) and a total Ra-226 activity that exceeds 6.966×10^{-7} TBq (18,800,000 pCi) are classified as LSA material.

Material with a Ra-226 activity concentration that does not exceed 3.0×10^{-11} TBq/g (810 pCi/g) is shipped as LSA-I. Material with a Ra-226 activity concentration greater than 3.0×10^{-11} TBq/g (810 pCi/g), but less than 4.18×10^{-7} TBq/g (9.6 x 10^{6} pCi/g) is shipped as LSA-II.

Attachment 2

Characterization Data Tables

Sample Location	Radiu	m-226 Concentra (pCi/g)	Depth (ft/bas)	Soils Description	
	Analysis 1	Analysis 2	Average	(10093)	
434-39	1.5	- 0.8	1.2	39-39.25	silty sand, red
434-41	2.4	1.9	2.2	41-41.25	clayey silt
434-51	1.9	0.9	1.4	51-51.25	sand, red
434-57	2.8	2.6	2.7	57-57.25	sandy gravel
437-41	2,094.2	2,295.6	2,194.9	40.75-41	tailings
437-42	3.9	4.0	4.0	42-42.25	sand and silt, red
437-43	11.1	11.3	11.2	43-43.25	sand and silt, red
437-44	130.1	140.8	135.5	44-44.25	sand and silt, red
437-45	17.7	19.5	18.6	45-45.25	sand and silt, red
437-46	4.4	0.5	2.5	46-46.25	sand and silt, red
437-47	1.1	2.6	1.9	47-47.25	sand and silt, red
438-73	1,785.0	1,998.3	1,891.7	72.75-73	tailings
438-74	123.5	145.1	134.3	74-74.25	sand, red
438-75	93.6	91.9	92.8	75-75.25	sand, red
438-76	29.6	32.9	31.3	76-76.25	sand, red
438-78	111.8	124.9	118.4 *	78-78.25	sand, red
439-82	1,993.9	2,321.0	2,157.5	82-82.25	tailings
439-83	2.7	3.9	3.3	83-83.25	silty sand, red
439-84	3.6	3.9	3.8	84-84.25	silty sand, red
439-87	24.0	23.7	23.9	87-87.25	silty sand, red
439-88	1.7	1.4	1.6	88-88.25	sand, red

Ra-226 OCS Gamma Spectral Analysis of Solids (DOE 2003)

Notes: pCi/g = picocuries per gram ft/bgs = feet below ground surface

Parameter	Lithology	Gross Alpha pCi/g	Gross Beta pCi/g	Radium 226 pCi/g	Radium 228 pCi/g	Lead 210 pCi/g	Polonium 210 pCi/g	Thorium 230 pCi/g
AR10-33 TO 40	Consolidated silt	1196.5	2464.7		3.69	600.43		
AR2-5.5 TO 10	Consolidated silt	1787.1	3595.9	786.5	5.63	548.69		
AR7-20 TO 25	Consolidated silt	925.6	1179.3	562.21	5.46	421.03	350.0	510.92
AR9-50 TO 55	Consolidated silt	695.3	1459.3	543.57	1.76	366.99		
AR9-60 TO 62	Consolidated silt	299.6	679.3	239.12	0.87	144.4		
AR4-30 TO 35	Unconsolidated silt	1410	3675.2		5.1	814.74		
AR4S-20 TO 21	Unconsolidated silt	815.4	1873.6	530.61	5.14	530.61	1293.33	1010.14
AR8-21 TO 22	Unconsolidated silt	821.1	1778.8	594.85	20.5	461.08	1	
AR8-25 TO 35	Unconsolidated silt	956	1989.8	639.92	6.09	451.97		
AR5-0 TO 1	Cover	133.5	325.7	84.31	1.0	55.37		
AR6-0 TO 1	Cover	68	117	17.3	0.53	21.68		
AR10-75 TO 86	Dry clay	1857.9	3370.5	588.76	2,88	516.93	317.23	358.71
AR10-20 TO 25	Dry sand	131.5	243.3	98	0.39	64.11		
AR1-3 TO 4	Dry sand	546.5	1010.8	311.85	1.87	251.58		
AR3-2.5 TO 3	Dry sand	215.6	415.6		0.37	89.3		
AR9-10 TO 11	Dry sand	204.2	315.2	320.2	2.87	222.77		
IMPOUNDMENT 2	Imp	110.6	277.2	12.68	0.44	5.64		
IMPOUNDMENT 3	Imp	161.1	208.3	87.45	0.93	44.82		
AR1-25 TO 29	Sand	452.1	1007.5		1.62	243.33		
AR6-35 TO 40	Sand	205.9	327	100.35	0.81	64.93		
AR9-30 TO 32	Sand	514	1050.2	87.23	0.71	68.51	91.59	106.35

Radionuclide Analysis in Tailings Solids (SRK 2000)

Ave Ra-226 concentration = 330 pCi/g