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August 26, 2008

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Subject: Transmittal of the Supplemental Standards Application for the Gas Line Adjacent to the Off-Pile Remediation of the Moab Mill Site

Dear Mr. Fliegel:

Enclosed for your review are four copies of the *Supplemental Standards Application for the Gas Line Adjacent to the Off-Pile Remediation of the Moab Mill Site*. During the off-pile remediation, data was collected to support a supplemental standards application for a high-pressure gas line which borders the northern edge of the site. Remediation of this area would cause an economic impact since the gas line would have to be shut down.

After all areas of the site have been remediated, a final completion report will be prepared to summarize all remedial action activities.

If you have any questions, please call me on my new office number, (970) 257-2115.

Sincerely,

Donald R. Metzler
Moab Federal Project Director

cc w/o enclosures:
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Project File MOA 44.2

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SM-4224-081210

Supplemental Standards Application for the Gas Line Adjacent to the Off-Pile Remediation of the Moab Mill Site

August 2008

Stoller

Work Performed by S.M. Stoller Corporation Under Purchase Order No.4064 for Energy*Solutions*, Moab, Utah. Energy*Solutions* Performs Work for the U.S. Department of Energy Under Task Order No. DE-AT30-07CC00014

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1.0 Introduction

The Moab Uranium Mill Tailings Remedial Action (UMTRA) Project Site (Moab mill site) is a former uranium-ore processing facility located about 3 miles northwest of the city of Moab in Grand County, Utah. It is located on the west bank of the Colorado River at the confluence with Moab Wash. It encompasses approximately 400 acres, of which approximately 130 acres are covered by a uranium mill tailings pile. The Moab mill site is managed by the U.S. Department of Energy (DOE) Office of Environmental Management.

Between November of 2007 and March of 2008, an area of the Moab mill site referred to as the Off-Pile Remediation (OPR) was remediated. During the remediation, data was collected to support a supplemental standards application for a high pressure gas line which borders the northern edge of the remediated area (Figure 1). Supplemental standards applications for other sections of this gas line will be submitted at a later date. Remediation of this area would require that the line be shut down for an extended period. Because of the economic impact of shutting down the line, the owner will not allow remediation of the area.

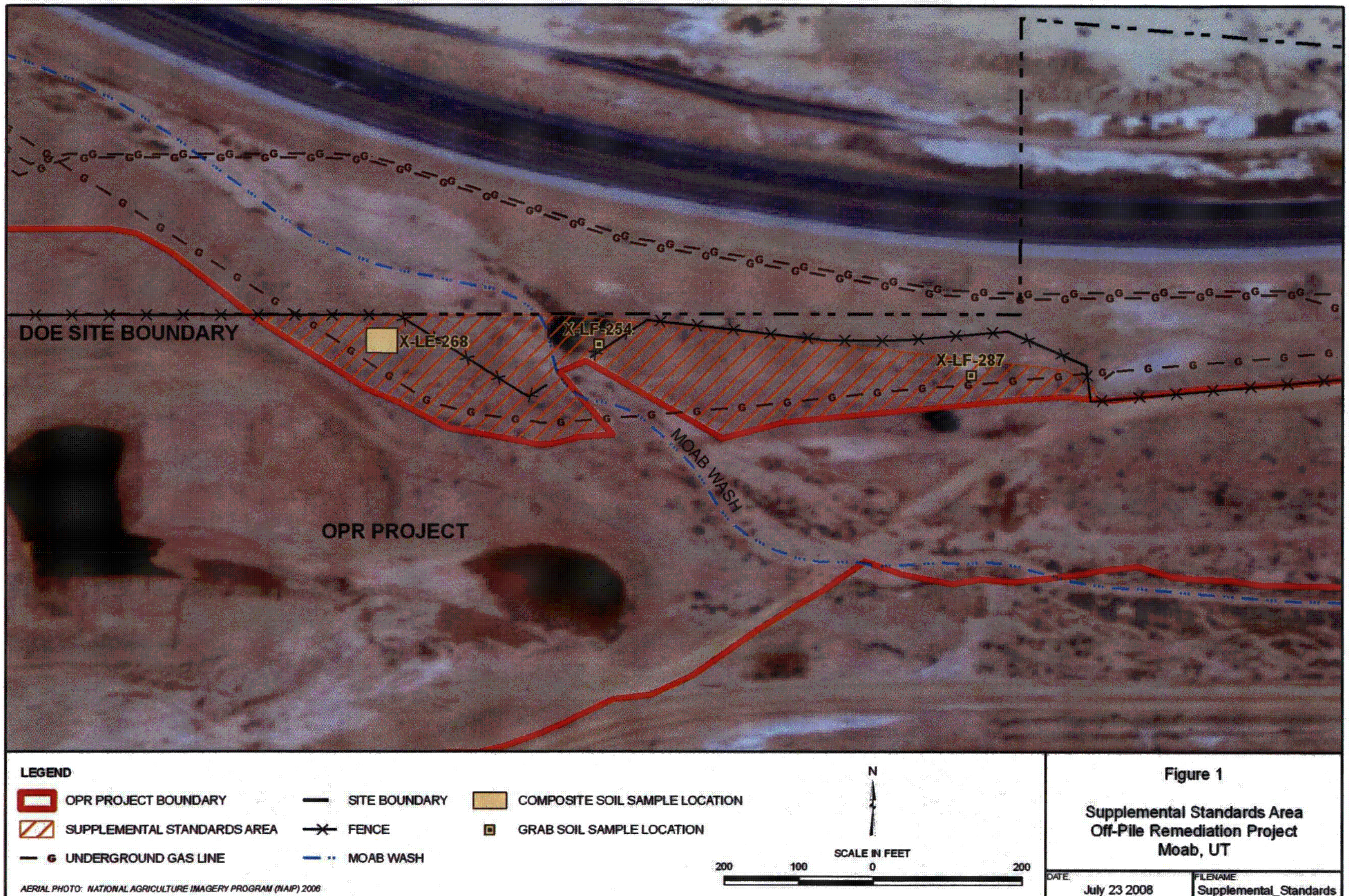

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Figure 1. Site Location Map Showing the Supplemental Standards Area for the Off-Pile Remediation

2.0 Applicable EPA Criteria

This Supplemental Standards Application is in accordance with the regulations set by Environmental Protection Agency (EPA) in 40 CFR 192. The potential and applicable criteria as stated in CFR 192.21 are as follows:

_________ (a) Remedial actions required to satisfy subpart A or B would pose a clear and present risk of injury to workers or to members of the public, notwithstanding reasonable measures to avoid or reduce risk.

________ (b) Remedial actions to satisfy the cleanup standards for land, §192.12(a), and groundwater, §192.12(c), or the acquisition of minimum materials required for control to satisfy §§192.02(b) and (c), would, notwithstanding reasonable measures to limit damage, directly produce health and environmental harm that is clearly excessive compared to the health and environmental benefits, now or in the future. A clear excess of health and environmental harm is harm that is long-term, manifest, and grossly disproportionate to health and environmental benefits that may reasonably be anticipated.

____X_____ (c) The estimated cost of remedial action to satisfy §192.12(a) at a "vicinity" site (described under section 101(6)(B) of the Act) is unreasonably high relative to the long-term benefits, and the residual radioactive materials do not pose a clear present or future hazard. The likelihood that buildings will be erected or that people will spend long periods of time at such a vicinity site should be considered in evaluating this hazard. Remedial action will generally not be necessary where residual radioactive materials have been placed semi-permanently in a location where site-specific factors limit their hazard and from which they are costly or difficult to remove, or where only minor quantities of residual radioactive materials are involved. Examples are residual radioactive materials under hard surface public roads and sidewalks, around public sewer lines, or in fence post foundations. Supplemental standards should not be applied at such sites, however, if individuals are likely to be exposed for long periods of time to radiation from such materials at levels above those that would prevail under §192.12(a).

__________ (d) The cost of a remedial action for cleanup of a building under §192.12(b) is clearly unreasonably high relative to the benefits. Factors that should be included in this judgment are the anticipated period of occupancy, the incremental radiation level that would be affected by the remedial action, the residual useful lifetime of the building, the potential for future construction at the site, and the applicability of less costly remedial methods than removal of residual radioactive materials.

___________ (e) There is no known remedial action.

___________ (f) The restoration of groundwater quality at any designated processing site under §192.12(c) is technically impracticable from an engineering perspective.

___________ (g) The groundwater meets the criteria of §192.11(e).

___________ (h) Radionuclides other than radium-226 and its decay products are present in sufficient quantity and concentration to constitute a significant radiation hazard from residual radioactive materials.

2.1 Location

This application is for residual radioactive material at a portion of the Moab mill site adjacent to the OPR. The address of the Moab mill site is 2021 North Highway 191. The area where supplemental standards will be applied is shown on Figure 1. The area is associated with the trench for a buried high-pressure gas line. It is bounded on the north by the DOE site property boundary; on the south it abuts the OPR. The area of application is approximately 8,112 square meters (m^2) [87,320 square feet (ft^2)].

2.2 Major Physical Features

This area consists of vacant land dissected approximately through the middle by Moab Wash, an intermittent stream with a relief of several feet in this section. The areas outside of the wash are flat, sandy, and sparsely vegetated. A wire fence runs along the north boundary, but turns south to intersect a more favorable crossing point on Moab Wash. This leaves a small portion of the supplemental standards area outside the fence.

2.3 Land Use

The property is currently vacant land, and no land use change is anticipated that would disturb or affect the supplemental standards area. It lies within the boundary of the Moab mill site and all but a small section is fenced. Surface soils have been remediated to the south of the supplemental standards area. There is no public access to the site and the site has no particular attraction for an intruder. Therefore, the most likely exposure pathway would be to a worker engaged in repair of the gas line.

2.4 Owner and Local Agency Input

The property owner is the DOE, they concur with the application of supplemental standards and are presenting this application. The owner of the high pressure gas line is Williams Energy Company. They have refused permission to remediate the area due to the economic cost of shutting down the line during remediation.

2.5 Radiological Data

Remaining residual radioactive material is probably windblown mill tailings from the former Atlas mill and decomposed uranium ore. Ra-226 concentrations in the top 15 centimeters (cm) of soil range from 83.4 to 979.5 picocuries per gram (pCi/g). Soil sample locations are shown in Figure 1. Soil samples were analyzed on-site using the Opposed Crystal System (OCS).

Ambient gamma radiation in this area ranges from 28 to 754 microroentgen/hour (µR/h) at ground level and from 25 to 36 µR/h at 1 meter (m) above ground level (waist level). Radiological data is based on direct gamma exposure rate measurements. The data is summarized in Table 1.

Table 1. Radiological Data

Location	Parameter	Value	Type of Sample
X-LF-287	Ra-226	979.5 pCi/g	Grab 0 to 15 cm
X-LF-254	Ra-226	494.4 pCi/g	Grab 0 to 15 cm
X-LE-268	Ra-226	83.4 pCi/g	Composite from 10 by 10 m block, 0 to 15 cm
Supplemental standards area	Gamma	28 to 754 μR/h (average 36 μR/h)	Ground level
Supplemental standards area	Gamma	25 to 36 μR/h (average 30 μR/h)	Waist level (1 m above ground level)

3.0 Health Risk Analysis

Radiation doses to members of the public from residual radioactive materials were calculated using the parameters shown in Table 2. The radium concentrations and average exposure rate data were generated during the remediation of the OPR. Appendix One details the equations and calculations.

Table 2. Parameter Values Used in the Estimate of Dose

Parameter	Assumed or Measured Value
Exposure time per event	40 h (5 days)
Soil ingestion	0.1 g per day
Airborne dust concentration	0.15 mg/m^3
Ra-226 concentration	83 to 980 pCi/g
Average gamma exposure rate	30 μR/h

There is no access to the site for the public for most of the area and the site has no particular attraction to an intruder. Therefore, the most likely exposure pathway would be to a worker engaged in repair of the gas line or some inadvertent intruder to the site. The gas company evaluates the integrity of the line using an internal probe sent through the pipe from a remote location so no site access is required. Therefore, no exposure is assumed for routine maintenance. The gas line company probed the line in 2007 and no problems with the line were identified that required any repairs. Gas line repair at an adjacent property (VP018) required 5 days of work. An estimate of 10 years was used for the frequency of gas-line repairs. However, based on the recent probe by the gas line company, repairs may be less frequent.

3.1 Potential Exposure Pathways

The potential exposure pathways for gas line workers on the site are as follows:

- Direct gamma exposure.
- Inhalation of dust from radionuclides while traversing or passing by the site.
- Ingestion of windblown radionuclides in soil while traversing and passing by the site.

Exposure pathways explicitly not considered in the analysis include inhalation of radon decay products, consumption of vegetation grown on the site, and ingestion of water from sources on the site. Radon gas from the site would diffuse off-site before a significant concentration of radon decay products could build up. There is no edible vegetation in the area and it is highly unlikely that the area would be used to grow edible plants. Moab Wash flows intermittently and is not used for drinking water.

For the purpose of calculating the direct gamma radiation dose it was assumed that an adult gas line worker might spend a maximum of 40 hours in a given year involved in repair of the line. Given the reliability of such facilities, this is likely an overly conservative assumption. The dose was calculated for a one-time, 40-hour event.

3.2 Results

The dose was calculated using the assumptions for the parameters listed in Table 2. The minimum dose (Ra-226 equals 83 pCi/g) would be 1.68 millirem (mrem) as shown in Table 3. The maximum dose (Ra-226 equals 980 pCi/g) would be 10.7 mrem. For the situation with the minimum Ra-226 concentration, the major single component to dose is external exposure. However, for the maximum concentrations of Ra-226 in soil, the calculated dose is dominated by inhalation of suspended dust and ingestion of soil.

Table 3. Summary of Exposures to a Gas Line Repair Worker for a Single Event

Pathway	mrem	
	Minimum Ra-226 in Soil = 83 pCi/g	**Maximum Ra-226 in Soil = 980 pCi/g**
Direct exposure	0.84	0.84
Dust inhalation	0.44	5.18
Soil ingestion	0.40	4.70
Total	1.68	10.7

4.0 Remediation Alternatives

4.1 Alternative 1 – No Remediation (Supplemental Standards)

No additional work is required under this alternative. The health risks associated with this alternative is approximately 11 mrem per event to gas line repair workers. The event is assumed to occur every 10 years so the annual average dose would be 1.1 mrem per year. No additional costs would be incurred if this alternative is chosen. Because the gas line right-of-way is part of the Moab mill site and is actively managed, the land use will not change in the foreseeable future. Areas outside the gas line right-of-way will be remediated as part of the cleanup of the Moab mill site.

4.2 Alternative 2 – Full Remediation

Remediation of this area would require permission and extensive support from the gas line owner. The gas line service would be interrupted, which will be costly to the gas line owner. Implementing this alternative would require removal of all soil contaminated in excess of the EPA standards. The area is 8,112 m^2 and estimated at 15 cm deep based on remediation of the adjacent OPR. The estimated volume of material to be removed would be 1,217 cubic meters (m^3) [1,592 cubic yards (yd^3)] of material. The gas company has not allowed DOE access to work within the gas line corridor.

If access was allowed, the cost to remediate would be approximately $123,000. This does not include the loss of business if Williams Energy Company has to lower the pressure in the line to allow the work to occur.

5.0 Summary and Recommendations

The adjacent areas of the Moab mill site have been remediated to EPA standards contained in 40 CFR 192. An area totaling approximately 8,112 m^2 (87,320 ft^2) and a volume of 1,217 m^3 (1,592 yd^3) has not been remediated as it is associated with a high-pressure gas line. This area is vacant land and will remain vacant land with controlled access. The contamination remaining on the site would not pose a significant present or future health risk due to the low levels of radioactivity and limited use by members of the public. Near term removal of the residual radioactive material would be unduly costly with very little health benefit.

Energy*Solutions* recommends that Alternative 1 – No Remediation be approved. The estimated gamma exposure rate for a member of the public (gas line worker) under this alternative is approximately 11 mrem per event. This exposure is a less than half of the Nuclear Regulatory Commission (NRC) 25 mrem per year decommissioning standard even when very conservative assumptions are used. Assuming the repairs would occur every 10 years the average annual dose would be 1.1 mrem per year.

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Appendix One

Assessment of Potential Public Dose from Residual Radioactive Materials Adjacent to the Off-Pile Remediation of the Moab Mill Site (2021 North Highway 191)

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Introduction

Radiation doses to members of the public from residual radioactive materials adjacent to the OPR of the Moab mill site (2021 North Highway 191) were calculated using data generated during the remedial action site surveys. These surveys included direct gamma exposure rate measurements and on-site spectral gamma analysis of soils collected from the property.

Current and future land use of the region under consideration includes a buried high pressure gas line, currently enclosed in a fenced area. Contamination on the property likely consists of windblown materials from the adjacent mill tailings pile, although there is some evidence that decomposed ore is also present on the property. Ra-226 concentrations on the surface are probably due to windblown material from the adjacent mill site. Any ore present on the site is likely from historic hauling of ore. Because of the high-pressure gas line, surface soils have not been remediated. Ambient gamma exposure at the site averages 36 μR/h at ground level. At 1 m above ground level the gamma exposure averages 30 μR/h. There are no measurements of radionuclide concentrations in the bottom of the trench.

There is no access to the site for the public and the site has no particular attraction to an intruder. Therefore, the most likely exposure pathway would be to a worker engaged in repair of the gas line or some inadvertent intruder to the site. The gas line will likely require repair only every 10 to 20 years. The gas company evaluates the integrity of the line using an internal probe sent through the pipe from an off-site location, so no exposure is assumed for routine maintenance. The gas line company probed the line in 2007 and no problems with the line were identified that required any repairs. Gas line repair at an adjacent property required 5 days of work. Based on the recent probe by the gas line company, repairs may be less frequent than every 10 years.

Potential exposure pathways

The potential exposure pathways for a gas line worker on the site are as follows:

- Direct gamma exposure.
- Inhalation of radionuclides contained in dust while the gas line is being repaired.
- Ingestion of radionuclides in soil while repairing the line.

Exposure pathways explicitly not considered in the analysis include inhalation of radon decay products, consumption of vegetation grown on the site, and ingestion of water from sources on the site. Radon gas from the site would diffuse off-site before a significant concentration of radon decay products could build up. There is no edible vegetation in the area and it is highly unlikely that the area could be used to grow edible plants. The only water source on the site, Moab Wash, flows intermittently and is not suitable for drinking.

Dose Equations

The total dose to a worker is described by:

DT = DG + DD + DS

Where :

DT = total dose
DG = dose from direct radiation exposure
DD = dose from inhalation of radionuclides in airborne dust
DS = dose from soil ingestion.

The basic equations for calculating the dose by each exposure pathway are as follows:

Direct radiation exposure:

DG = [X] [0.7 mrem/mR] [t] [1.0E-3 mR/μR]

Where:

X = measured exposure rate (μR/h)
t = time of exposure (h)

The conversion factor for exposure (mR) to dose (mrem) of 0.7 for an adult to account for self-shielding of critical organs by the body is taken from values summarized in UNSCEAR (2000).

For the purpose of calculating the direct gamma radiation dose it was assumed that an adult gas line worker might spend a maximum of 40 hours in a given year involved in repair of the line. Given the reliability of such facilities, this is likely an overly conservative assumption. The dose was calculated for a one-time, 40-hour event.

Inhalation of dust:

$DD = [t]\ [I_{inh}]\ [C_d]\ [\Sigma\ (C_{si})\ (DC(_{inh})_i)]\ [2.5]\ [3.7E\text{-}2\ Bq/pCi]\ [1E{+}5\ mrem/Sv]$

Where:

t = time of exposure (h)
I_{inh} = inhalation rate = 1.7 cubic meters/hour (m^3/h)
C_d = total dust concentration in air ($grams/m^3$)
C_{si} = concentration of radionuclide i in soil (pCi/g)
$DC(inh)_i$ = ICRP-72 inhalation dose coefficient for radionuclide i for an adult [seivert/becquerel (Sv/Bq)]

An enhancement factor of 2.5 was used in the analysis to account for the fact that the radionuclide concentrations in airborne dust may be greater than the concentrations in soil. This factor is generally accepted and is used in the dose analyses performed by the MILDOS code (ANL 1998).

The ICRP-72 dose coefficients for an adult (ICRP 1996) were used for inhalation and ingestion dose calculations. The coefficients are given below. The coefficients for Ra-226 and its decay products, Po-210 and Pb-210, were summed and applied to the Ra-226 intake.

ICRP 72 Dose Coefficients for Uranium and its Decay Products

Nuclide	Inhalation (Sv/Bq)[a]	Ingestion (Sv/Bq)
U-238	8.0E-6	4.5E-8
Th-234	7.7E-9	3.4E-9
U-234	9.4E-6	4.9E-8
Adjusted Sum U-235+D[b]	5.6E-6	8.4E-8
Sum U-238+D and U-235+D	2.3E-5	1.8E-7
U-235	8.5E-6	4.7E-8
Pa-231	3.4E-5	7.1E-7
Ac-227	7.2E-5	1.1E-6
Th-227	1.0E-5	8.8E-9
Sum U-235+D	1.3E-4	1.9E-6
Adjusted Sum U-235+D = Sum U235+D x 0.045	5.6E-6	8.4E-8
Th-230	1.4E-5	2.1E-7
Ra-226	9.5E-6	2.8E-7
Pb-210	5.6E-6	6.9E-7
Po-210	4.3E-6	1.2E-6
Sum Ra-226+D	1.9E-5	2.2E-6

[a] Assumes least soluble class and 1 micrometer (μm) AMAD (activity median aerodynamic diameter)
[b] D = decay products

The mass concentration of airborne dust was assumed to be a 0.15 milligram/m^3(mg/m^3), which is the value used by the RESRAD dose calculation code (Yu et al. 2001).

The concentrations of Ra-226 in soil were measured. Concentrations of other radionuclides were assumed to be equal to the Ra-226 concentration. The dose coefficients were summed and applied to the Ra-226 intake as shown in the table above.

Ingestion of soil:

The gas line worker was assumed to ingest a small amount of soil during his/her time in the gas line trench. The dose due to soil ingestion was calculated as follows:

$D_S = [t] [I_{ing}] [\Sigma (C_{si})(DC(ing)_i)] [3.7E\text{-}2 \text{ Bq/pCi}] [1E\text{+}5 \text{ mrem/Sv}]$

Where:

- t = length of event (days)
- I_{ing} = soil ingestion rate (grams per day)
- C_{si} = concentration of radionuclide i in soil (pCi/g)
- $DC(ing)_i$ = ICRP 72 ingestion dose coefficient for radionuclide i for an adult (Sv/Bq)

ICRP-72 ingestion dose coefficients were used in the calculation (ICRP 1996). The amount of soil ingested while in the gas line trench was assumed to be 0.1 gram per day, the daily soil ingestion rate generally assumed for adults.

Inputs to Dose Calculation

Estimates for dose to a gas line worker from direct gamma radiation, inhalation of airborne radionuclides in dust, and ingestion of soil were calculated using the equations above. As mentioned previously, material in the trench below grade is unknown, so it is assumed to be decomposed ore in equilibrium at the measured concentrations of Ra-226. Concentration values shown below are assumed to be the average concentration inside a trench that would be excavated to access the pipeline for repair purposes.

Parameter Values Used in the Estimate of Dose

Parameter	Assumed Value
Exposure time period	40 h (5 days)
Soil ingestion	0.1 grams per day
Airborne dust concentration	0.15 milligram/m^3
Ra-226 concentration	83 to 980 pCi/g
Net gamma exposure rate	30 µR/h

Results

Using the assumptions listed above, the calculated doses are as shown below.

Type	mrem	
	Minimum	Maximum
External	0.84	0.84
Ingested	0.40	4.70
Inhaled	0.44	5.18
Total	1.68	10.7

For the situation in which the minimum Ra-226 concentration equals 83 pCi/g, the major single component to dose is external exposure. However, for the maximum concentrations of Ra-226 (980 pCi/g) in soil, the calculated dose is dominated by inhalation of suspended dust and ingestion of soil. The maximum calculated dose is approximately 11 mrem for a repair event.

Conclusions

The most probable future use of the property in question is as vacant land housing a buried gas line. Using conservative assumptions and assuming no protective devices or practices, the above calculations demonstrate that the projected dose to a worker involved in repair of the gas line would range from about 7 percent to as much as 43 percent of the 25 mrem per year decommissioning standard. However, these calculations assumed a one-time event and it is unlikely that exposures to gas line workers would occur more frequently than every 10 years or so. Hence, it could be considered that a hypothetical gas line worker might receive approximately 1 mrem per year from this sort of repair work.

There is no current evidence that radiation doses below 10 rem increase the risk of cancer to humans. However, the Interagency Steering Committee on Radiation Standards (ISCORS 2002) published guidance for estimating risk from effective dose equivalent. The ISCORS guidance recommends use of a conversion factor of 6×10^{-4} fatal cancers per TEDE (total effective dose equivalent) rem (6×10^{-7} fatal cancers per mrem). Applying that conversion to the dose from a single event calculated above would lead to a fatal cancer risk to the gas line worker of 6.4×10^{-6}, or approximately 6 chances in a million.

References

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