#### THE RADIOLOGICAL AND ENGINEERING ASSESSMENT

for

PROPERTY #ED-00915-RS

March 1984

(Revised May 1984)

for

URANIUM MILL TAILINGS REMEDIAL ACTION PROJECT OFFICE ALBUQUERQUE OPERATIONS OFFICE

DEPARTMENT OF ENERGY

by

ARIX, A PROFESSIONAL CORPORATION Architects . Engineers . Planners

under subcontract to

BENDIX FIELD ENGINEERING CORPORATION P. O. Box 1569 Grand Junction, Colorado 81502

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#### 1.0 EXECUTIVE SUMMARY

The Department of Energy (DOE) has contracted with Bendix Field Engineering Corporation (BFEC) of Grand Junction, Colorado, to provide architect-engineering services in assessing the problems resulting from the existence of radioactive uranium mill tailings at off-site locations in Edgemont, South Dakota. The property located at 1004 F Street #ED-00915-RS, has been included for remedial action under Public Law 95-604 because radioactive mill tailings contamination in excess of EPA standards has been discovered at that location. The property is a private residence.

In this assessment, the extent and severity of contamination from tailings used as fill material at this property are evaluated. A brief description of the remedial action is provided. The quantities of material that would be removed and the associated costs are estimated.

#### 1.1 Evaluation and Recommendation

The recommended action for this property is to remove all identified residual radioactive mill tailings to the maximum evident depth, and restore the property back to its original condition. The estimated volume of contaminated material found on this property is as follows:

- . Interior none
- . Exterior 19.2 cubic yards

The estimated cost to perform the remedial action is \$2,839.00, and the time required to complete the design work is approximately 2 weeks. After the construction documents are approved, sent out to bid, and the Notice to Proceed is issued, it will take approximately 30 days to perform the remedial action on this property.

#### 2.0 PROPERTY DESCRIPTION

2.1 General Description

Address: 1004 F Street Edgemont, South Dakota

Lot Size: Approximately 15,675 square feet

Point of Reference: Subject property is located approximately 1/2 mile to the west of the TVA millsite repository. The location of this property relative to its surroundings is shown in Figure 2.1.

Bordering Properties: North - private residence South - private residence East - private residence West - F Street

2.2 Existing Facilities and Structures

This is a well constructed single story log frame structure built on a north-south grade with a full 1,830 square foot basement. The garage is located in the basement level and opens to grade on the north. A concrete driveway joins the north side of the house. Concrete stoops and steps join the east and west sides of the house on the main level. A concrete patio, descending flight of stairs and curving walk are located outside the east foundation. Evergreen hedges are located outside the south and west exterior walls and flower beds are situated outside the north and east foundations. A small pool and attached masonry planter are located along the north side of the house.



#### 3.0 RADIOLOGICAL SURVEYS

#### 3.1 Introduction

Radiological data were collected by ARIX Engineers, Architects and Planners at location ED-00915-RS on June 13, 1980 under contract with the State of South Dakota Department of Health. The data were collected as part of a radiological engineering assessment to determine the extent of identified residual radioactive uranium mill tailings contamination on the property.

Historical information indicates that this property was originally identified as a probable tailings location during an above ground gamma radiation survey conducted by the U. S. Environmental Protection Agency (EPA) in 1971, 1972 and 1978. Subsequent to this survey, the State of South Dakota measured an indoor radon daughter concentration of 0.098 gross working levels (WL) in the basement based on Radon Progeny Integrating Sampling Unit (RPISU) data collected over a 189-hour period during April/May 1980.

This report section presents the survey data accumulated by ARIX and summarizes the results of this data.

#### 3.2 Exterior Radiation Surveys and Explorations

#### 3.2.1 Surface Area Gamma Surveys

Portable scintillometers incorporating 1" x 1" sodium iodide (thallium activated) detector crystals were used to scan the entire surface area of the property. Resulting data are used to identify contaminated areas and to assist in defining the perimeter of tailings deposits. Observed meter readings, both near contact with the surface and at about 3 feet above the surface, were recorded on an approximate (stepped off) 10-foot grid basis and additional readings were recorded off the grid when survey revealed significant change between grid points. Recorded data is meter readings in "micro-R/hr"; true exposure

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rates can be estimated by applying a scintillometer/gas proportional ionization chamber cross-calibration factor (meter reading x 0.56 + 6 = true exposure rate). Recorded data indicate that the true gamma exposure rate background on the property is about 13 micro-R/hr and the maximum true gamma exposure rate measured on the exterior property is about 68 micro-R/hr. Results of the exterior gamma radiation survey are shown on Figure 3.1.

#### 3.2.2 Subsurface Explorations

A total of 7 boreholes, 4" diameter, were drilled at exterior locations shown on Figure 3.1. These boreholes were gamma logged using a 1" x 2" sodium iodide (thallium-activated) detector crystal incorporating a recording count rate meter. Relative gross gamma radiation intensities were recorded at 2-inch increments down each borehole to determine depth of tailings contamination. The recorded gamma logs were converted to equivalent radium-226 (pCi/g) using cross-calibration factors determined through use of the Bendix Technical Measurements Laboratory calibration test wells and experimental data (gamma log count rate compared to representative laboratory analysis of soil samples) obtained in and around the Edgemont Uranium Mill Site.

Data from the exterior borehole logs are shown on Figure 3.1. This data shows tailings contamination exceeding EPA criteria under a decorative paving brick/antique wagon located in the east (back) yard and along the north edge of the concrete driveway to 14 inches deep. This contamination exceeds the radium-226 criteria; however, the deposit along the north edge of the driveway does not exceed the criteria when averaged over a 10 square meter area. The equivalent radium-226 concentration at borehole locations measures to 15 pCi/g in the top 15 cm soil layer and to 26 pCi/g in some subsurface layers.

In addition to borehole gamma logging, surface gross gamma and delta gamma measurements were recorded at each borehole location using a portable scintillometer (micro-R meter). The

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delta scintillometer readings provide a differential gamma measurement by observing the reading with an unshielded detector, and then placing a 1/8 inch lead shield between the detector and surface of interest and observing the reading; the difference between the two measurements is the delta reading representing radiation emanating from the area directly below the detector. The delta gamma measurements have been cross-calibrated with laboratory soil analysis to accommodate converting the delta to equivalent pCi Ra-226/g in the surface 6" layer of scil. The delta gamma measurement is used in conjunction with borehole gamma logging to estimate radium-226 concentrations in the top 6" (15 cm) layer of soil. Delta gamma measurements related to the 7 borehole locations are shown on Figure 3.1.

#### 3.3 Interior Radiation Surveys and Explorations

#### 3.3.1 Surface Area Gamma Surveys

Portable scintillometers (micro-R meters) were used to scan the entire interior surface area. Gross gamma and delta gamma meter readings were recorded in sufficient numbers to characterize each habitable area of the structure that is contiguous to the ground, i.e., basement level, slab-on-grade level and/or crawl space level. Measurements were taken on floor surfaces and the foundation walls to assess tailings locations relative to these structural components. Figure 3.2 shows the results of the interior gamma survey. Data indicate that there are no gamma anomalies within the structure.

Interior gamma measurements were not taken at 3 feet above the surface, hence, exposure rate data is not available. However, the maximum interior gamma measurement (converted to true exposure) observed in contact with floor surfaces is 14 micro-R/hr; this data indicates the structure does not exceed EPA criteria for indoor gamma exposure.

#### 3.3.2 Subsurface Explorations

On the basis of negative interior gamma data, no interior explorations were performed.

#### 3.3.3 Radon/Radon Daughter Concentrations

The State of South Dakota measured the indoor radon daughter concentration using a RPISU as follows:

Date	Location	Hours Sampled	Working Level
4/30-5/8/80	Basement	189.6	0.098

To confirm the elevated radon daughter concentration measured by the State, ARIX performed grab sampling using calibrated radon scintillation cells and high volume (25 1/min) filter samples. The 0.5 liter scintillation cells were analyzed by allowing a 4-hour decay time after collection and then counting on a photomultiplier/scaler. The filter samples were analyzed using the modified Kusnetz method. Sampling locations and resulting data are shown on Figure 3.2. The grab sampling cor irmed elevated concentrations averaging 12 pCi Rn-222/1 an 0.022 gross working levels measured in the southeast basement bedroom. Elevated radon gas concentrations averaging 10.3 pCi Rn-222/1 were measured in two basement locations and one main floor location indicating an anomaly that could create daughter concentrations exceeding criteria throughout the structure if the structure leak-rate should be decreased. A minimum of two sample sets, one with structure closed and one with normal ventilation, were collected from each of the three sampling locations to accommodate condition weighted averaging of data.

#### 3.4 Extent of Contamination

Figure 3.1 shows the apparent deposition of exterior tailings contamination on the property and there is no apparent tailings

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contamination within the habitable structure. The extent of apparent tailings contamination on the property is summarized as follows:

- . Contaminated soil to a depth of 14 inches adjoins the north edge of the concrete driveway; this deposit does not appear to extend beneath the concrete.
- . Contaminated soil is 12 inches deep beneath decorative paving brick located adjacent to the east (back) property boundary.
- . Contaminated soil is estimated to be 6 inches deep in a spot located in the northeast corner of the yard.

As summarized above, the apparent contaminated soil deposits are in the exterior yard area only, and they are completely separated from the structure by areas of clean soil extending out a minimum of 50 feet into the yard.

This property is located in the southwest section of Edgemont where naturally elevated indoor radon daughter concentrations have been documented by the State and EPA. Several locations in the vicinity of this property have indoor radon daughter concentrations measuring from 0.02 to 0.04 working levels (RPISU data) without any indication of cultural source material (tailings or other gamma anomalies) on the property. It is apparent that natural geology, i.e., subsurface mineralization, is the source of these elevated concentrations. Because of this elevated natural background, all identified residual radioactive mill tailings should be excavated to the maximum depth of apparent contaminated soil outside the structure. This would essentially eliminate the possibility of tailings contamination contributing to the indoor radon daughter concentration.

Referencing Figure 3.1, the volume of contaminated material to be removed from the property is about 19.2 cubic yards from the exterior yard area (reference Table 3.1 for volume calculations).



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## TABLE 3.1

## Volume Calculations

# Exterior

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(Reference Figure 3.1)

Area	Calculations	Cubic Yards
East paving brick area	20' x 20' x 1' deep = 400	= 14.8
Northeast yard area	10' x 12' x 0.5' deep = 60	= 2.2
North driveway edge	10' x 5' x 1.2' deep = 60	= 2.2
	TOTAL EXTERIOR	19.2 CY

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#### 4.0 REMEDIAL ACTION

#### 4.1 Introduction

As discussed in Chapter 3.0 of this report, contaminated soil exceeding the EPA radium-226 criteria, but below the area size criteria, is located in the east and northeast yard area away from the house. Additionally, radiological data indicate the structure exceeds the EPA criteria for indoor radon daughter concentration.

#### 4.2 Remedial Action Requirements

Remedial action would involve removal and replacement of the paving brick located in the east yard and the excavation of the underlying tailings. Clean structural fill will be used to replace the tailings. Tailings identified in the yard will be excavated and replaced with clean fill and topsoil. Lawn areas damaged during the removal work will be replaced with grass sod. Figure 4.1 shows this remedial action plan.

Since remedial action involves the exterior yard area only, dislocation is not required. Safe access in and out of the structure will be provided.

All exterior contaminated areas would be excavated to maximum depths of all contamination. This would require removal of about 19.2 cubic yards from the exterior areas.

The estimated costs of implementing this remedial action are \$2,839.00 (reference Table 4.1).

### 4.3 Evaluation of Remedial Action

Removal of all identified residual radioactive mill tailings to the maximum evident depth would completely eliminate the possibility of tailings contaminated soil contributing to the indoor RDC. Implementation of this action should assure that additional remedial action will not be required even if the indoor RDC remained elevated.





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Estimated Cost of Decontamination and Resto	bration
Remove/replace brick patio 252 sf @ \$5/sf	\$ 1,260.00
Remove/replace exterior tailings 19.2 cy @ \$30/cy	576.00
Replace grass sod 398 sf @ \$0.35/sf	130.00
Subtotal	\$ 1,975.00
Contingency @ 15%	256.00
Subtotal	\$ 2,271.00
Contractor Overhead & Profit @ 25%	568.00
Grand Total	\$ 2,839.00