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ORNL/RASA-87/83
(AL137)

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**RESULTS OF THE RADIOLOGICAL SURVEY
AT 16 YARDBORO AVENUE,
COLONIE, NEW YORK (AL137)**

MASTER

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MARTIN MARIETTA ENERGY SYSTEMS, INC.
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Nuclear and Chemical Waste Programs
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RESULTS OF THE RADIOLOGICAL SURVEY AT
16 YARDBORO AVENUE, ALBANY, NEW YORK (AL137)

J. L. Marley

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Investigation Team

B. A. Berven - RASA Program Manager
W. D. Cottrell - FUSRAP Project Director
J. L. Marley - Field Survey Supervisor

Survey Team Members

A. C. Butler, B. S. Ellis, W. Winton (ORNL)
R. Ray, R. Stone, Jr. (D. Stone Associates)

Work performed as part of the
RADIOLOGICAL SURVEY ACTIVITIES PROGRAM

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operated by
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RESULTS OF THE RADIOLOGICAL SURVEY AT 16 YARDBORO AVENUE, ALBANY, NEW YORK (AL137)

INTRODUCTION

Work with depleted uranium began in Colonie, New York, during 1958 at a plant owned by the National Lead Company.¹ Beginning in 1961, the Atomic Energy Commission (AEC), and other federal agencies engaged the National Lead Company (presently NL Industries, Inc.) in numerous contracts and subcontracts for the fabrication of enriched (3.6%) uranium fuel elements for the Hallam Reactor (Chicago Operations Office) and for the chemical processing of unirradiated, enriched uranium scrap (New York Operations Office).^{2,3} Since the termination of the AEC contracts, the work at the plant was devoted to the fabrication of shielding components, ballast weights, and projectiles from depleted uranium.¹ This plant has operated at a reduced level of activity after February 1980, and ownership of the plant and property was transferred to the Department of Energy (DOE) in February 1984.

A number of properties in the Albany/Colonie area have been identified as being potentially contaminated with uranium originating from the former National Lead Company's uranium forming plant in Colonie, New York.⁴ Radiological surveys were performed at 14 properties by members of the Radiological Survey Activities (RSA) group at Oak Ridge National Laboratory (ORNL) during the period May 4-May 16, 1986. The property at 16 Yardboro Avenue in Albany, New York (AL137) was the subject of a radiological investigation initiated May 5, 1986.

The residential property consists of a two-story house located on a rectangular lot. An asphalt driveway was on the east side of the house, with broken paving extending to a building at the rear of the lot. A diagram of the property showing the approximate boundaries and the 5-m grid network established for measurements outside the house is shown in Fig. 1. The lot included in the radiological survey was ~19 m wide by 35 m deep. Front and rear views of the property are shown in Figs. 2 and 3, respectively.

SURVEY METHODS

The radiological survey methods employed in the survey of this property are described in Ref. 5.

The radiological survey of this property included: (1) gamma exposure rates at 1 m above the ground surface and at the ground surface at outdoor grid locations; (2) a gamma scan of the entire ground surface outdoors; (3) samples of outdoor soil; and (4) direct alpha and beta-gamma activity from surfaces of structures outdoors on the property, including asphalt paving. A comprehensive description of the survey methods and instrumentation has been presented in another report.⁶

SURVEY RESULTS

Typical background radiation levels for the Albany area are presented in Table 1. The data is provided for purposes of comparison with the survey results presented in this section.

All measurements presented in this report are gross readings; background radiation levels have not been subtracted. Similarly, background concentrations have not been subtracted from radionuclide concentrations in soil samples.

Gamma Measurements

Results of grid point/grid block measurements are presented in Table 2. Surface gamma exposure rates measured at grid points over the entire outdoor property are shown on Fig. 4. Gamma exposure rates at 1 m above the ground surface ranged from 9 to 14 $\mu\text{R/h}$ (microroentgens* per hour) and averaged 11 $\mu\text{R/h}$. Gamma exposure rates at the ground surface at grid points ranged from 10 to 30 $\mu\text{R/h}$ and averaged 13 $\mu\text{R/h}$. The maximum gamma exposure rate measured on the property was 30 $\mu\text{R/h}$ at the granite-like curb stone at the front.

These elevated exposure rates are not related to residual radioactivity derived from the Colonie site. The differences in measurements of gamma rates at contact with masonry walls, with building foundations of stone or masonry, or at curbing stones of native rock is a common occurrence because most brick and many naturally occurring stones used as construction materials exhibit increases in gamma exposure rates when compared to the soils of a property. The increases are caused by the presence of trace amounts of naturally occurring radioactive elements such as potassium, radium, thorium, and uranium, which can be present in the construction materials. All of these minute sources are portions of the natural background of radioactivity that is a part of our environment.

*The roentgen (R) is a unit which was defined for radiation protection purposes for people exposed to penetrating x-rays or gamma radiation. A microroentgen (μR) is one millionth of a roentgen. A milliroentgen (mR) is one thousandth of a roentgen or one thousand microroentgens.

Soil Sampling

Twenty-eight soil samples were taken at this property from fourteen locations. The samples, taken without strict regard to gamma exposure rates at the sampling points, are denoted as systematic samples (AL137S). The locations of the samples are shown in Fig. 5, and the results of analysis are presented in Table 3.

Samples were taken at 0 to 5 cm and at 5 to 15 cm depths from each location. Concentrations of ^{238}U in the soil samples ranged from 3.9 to 75 pCi/g (picocuries* per gram) and averaged 20 pCi/g. The concentrations of ^{238}U in the 0 to 5 cm samples averaged 25 pCi/g and averaged 15 pCi/g in the 5 to 15 cm depth samples. The ratio of concentration at 0 to 5 cm to concentration at 5 to 15 cm depths was 1.7, indicating that the higher concentrations are located near the surface. The sample from grid location 0+14, 0.5R (AL137S3A) having the maximum concentration found on the property (75 pCi/g) was from depths of 0 to 5 cm. An area estimated at approximately 10 m² contained uranium-238 concentrations in the soil exceeding 35 pCi/g.

Radium was measured in sample AL137S1A. The concentration of ^{226}Ra was 0.75 pCi/g.

Surface Measurements

Alpha and beta-gamma activity was measured at selected locations on the asphalt paving and on the roof of the house. The results of these measurements are listed in Table 4. The alpha activity ranged from 14 to 98 dpm/100 cm² and averaged 44 dpm/100 cm². Beta-gamma activity ranged from 0.02 to 0.06 mrad/h and averaged 0.04 mrad/h.

A summary of the outdoor measurement results is provided in Table 5.

SIGNIFICANCE OF FINDINGS

The background gamma radiation exposure rate for the State of New York averages 9.5 $\mu\text{R}/\text{h}$ ^{8,9} and averages 9 $\mu\text{R}/\text{h}$ for the Albany area (Table 1). The gamma exposure rates measured on this property at 1 m above the ground surface range from 9 to 14 $\mu\text{R}/\text{h}$ and average 11 $\mu\text{R}/\text{h}$ (slightly above range of background for the Albany area). The DOE

*The curie is a unit used to define the radioactivity in a substance and equals that quantity of any radioactive isotope undergoing 2.2×10^{12} disintegrations per minute. The picocurie is one million-millionth of a curie or that amount yielding 2.2 disintegrations per minute.

guidelines¹⁰ state that gamma exposure rates inside occupied or habitable structures shall not exceed 20 $\mu\text{R}/\text{h}$. Gamma exposure rates outside of structures shall be such that these exposure rates, due to residual radioactivity, will not result in potential doses (assuming a conservative but plausible use scenario) in excess of 100 mrem/y for long term exposure. These guidelines are not exceeded at this property.

The DOE guideline for ^{238}U concentration in soil at the Colonie, New York site is: (a) the ^{238}U concentration shall not exceed the limits of 35 pCi/g averaged over an area of 10 m x 10 m (33 ft x 33 ft), and over 5 cm (2 in.) depth; and (b) the concentration shall not exceed the additional restriction of 100 pCi/g maximum at a spot (1 m²) averaged over 5 cm (2 in.) depth.^{11,12} No 10 m x 10 m area was found that averages more than 35 pCi/g of ^{238}U in the soil. The average concentration was 20 pCi/g of ^{238}U in the systematic samples, approximately two-thirds the limit of 35 pCi/g; therefore, the average concentration is below the DOE guideline. The maximum concentration of ^{238}U measured was 75 pCi/g, below the limit of 100 pCi/g averaged over a 1 m² area. The 0.75 pCi/g of ^{226}Ra measured in the soil is less than the Albany area background of 0.85 pCi/g of radium-226. The concentrations of some radionuclides in the soil at this property are above background levels, but are below applicable DOE guidelines.

Surface contamination of the structures on the property, as evaluated by alpha and beta-gamma activity, was well below the DOE guidelines and the State of New York Department of Labor (DOL) Industrial Code, Rule 38.¹³ The average alpha activity of 44 dpm/100 cm² obtained by measurements on the asphalt paving and on the roof of the building is well below the DOE limit of 5000 dpm/100 cm² and the DOL limit of 1000 dpm/100 cm² for fixed alpha activity from natural uranium, uranium-235, or uranium-238. The average and maximum beta-gamma activities of 0.04 and 6.06 mrad/h from these structures are less than the DOE limits of 0.20 and 1.0 mrad/h and the DOL limit of 0.25 mrem at 1 cm, respectively.

In summary, while some radiological measurements were greater than background levels normally encountered in the State of New York and the Albany area, no radiation levels nor radionuclide concentrations exceeded the relevant state and federal guidelines used by the Department of Energy to determine if remedial action is warranted.

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Fig. 1. Diagram showing grid point and grid block locations outdoors on the property at 16 Yardboro Avenue, Albany, New York (AL137).

Fig. 2. Front view of the property at 16 Yardboro Avenue, Albany, New York (AL137) looking northwest.

Fig. 3. Rear view of the property at 16 Yardboro Avenue, Albany, New York (AL137) looking south.

Fig. 4. Surface gamma exposure rates measured at grid points outdoors on the property at 16 Yardboro Avenue, Albany, New York (AL137).

Fig. 5. Locations of soil samples on the property at 16 Yardboro Avenue, Albany, New York (AL137).

Table 1. Background radiation levels in the Albany area

Type of radiation measurement or sample	Radiation level or radionuclide concentration	
	Range	Average
Gamma exposure rate at 1 m above floor or ground surface ($\mu\text{R/h}$) ^a	8-10	9
Concentration of radionuclides in soil (pCi/g) ^b		
²³⁸ U	0.76-1.2	0.96
²²⁶ Ra	0.48-1.2	0.85

^aValues obtained from four locations in the Albany area.

^bSoil samples (NY1-NY6) obtained from six locations
around the Albany area.⁷

Table 2. Results of the gamma exposure rate measurements outdoors on the property at 16 Yardboro Avenue, Albany, New York (AL137)

Grid location ^a	Grid point measurements ^b ($\mu\text{R/h}$)		Range of gamma exposure rate during scan of grid block ^d ($\mu\text{R/h}$)
	Gamma exposure rate at 1 m	Gamma exposure rate at the surface ^c	
0+00, BL	10	20	12-20
0+05, BL	12	13	13-20
0+10, BL	12	13	13-20
0+15, BL	12	12	12-15
0+20, BL	11	12	11-14
0+25, BL	11	13	11-14
0+30, BL	11	11	11-14
0+35, BL	12	14	-
0+05, 1R	12	15	-
0+10, 1R	13	15	-
0+15, 1R	14	14	-
0+00, 5R	9	11	9-14
0+03.5, 5R	12	11	-
0+05, 5R	e	e	10-14
0+10, 5R	e	e	10-14
0+15, 5R	e	e	10-14
0+16, 5R	12	14	-
0+20, 5R	9	10	10-14
0+25, 5R	9	10	-
0+30, 5R	e	e	-
0+35, 5R	e	e	-
0+05, 8R	14	15	-
0+10, 8R	12	13	-
0+15, 8R	12	12	-
0+00, 10R	9	10	10-13
0+05, 10R	11	12	11-14
0+10, 10R	11	11	11-14
0+15, 10R	11	11	11-13
0+20, 10R	10	11	11-14
0+25, 10R	10	11	11-12
0+30, 10R	11	11	11-13
0+35, 10R	11	11	-
0+00, 15R	12	30	11-30
0+05, 15R	11	11	11-15
0+10, 15R	10	11	11-15

Table 2 (continued)

Grid location ^a	Grid point measurements ^b ($\mu\text{R/h}$)		Range of gamma exposure rate during scan of grid block ^d ($\mu\text{R/h}$)
	Gamma exposure rate at 1 m	Gamma exposure rate at the surface ^c	
0+15, 15R	11	11	11-15
0+20, 15R	12	13	12-17
0+25, 15R	11	11	11-15
0+30, 15R	10	10	10-14
0+35, 15R	e	e	-
0+00, 19R	12	21	-
0+05, 19R	13	12	-
0+10, 19R	12	15	-
0+15, 19R	11	12	-
0+20, 19R	11	13	-
0+25, 19R	12	13	-
0+30, 19R	12	11	-
0+35, 19R	e	e	-

^aGrid location shown on Fig. 1.

^bGrid point measurements are discrete measurements at each grid point.

^cThese values are shown on Fig. 4.

^dGrid block measurements are obtained by a gamma scan of the entire block.

^eInaccessible.

Table 3. Results of soil sample analysis on the property at
16 Yardboro Avenue, Albany, New York (AL137)

Sample	Location ^a	Depth (cm)	Radionuclide concentration (pCi/g)	
			²²⁶ Ra ^b	²³⁸ U ^c
<u>Systematic samples^d</u>				
AL137S1A	0+07, 0.5R	0-5	0.75 ± 0.1	58
AL137S1B	0+07, 0.5R	5-15	±	41
AL137S2A	0+11, 0.5R	0-5	±	8.8
AL137S2B	0+11, 0.5R	5-15	±	16
AL137S3A	0+14, 0.5R	0-5	±	75
AL137S3B	0+14, 0.5R	5-15	±	27
AL137S4A	0+15, 14.5R	0-5	±	10
AL137S4B	0+15, 14.5R	5-15	±	9.2
AL137S5A	0+15, 16R	0-5	±	19
AL137S5B	0+15, 16R	5-15	±	3.9
AL137S6A	0+03.5, 5R	0-5	±	29
AL137S6B	0+03.5, 5R	5-15	±	13
AL137S7A	0+03.5, 2.5R	0-5	±	19
AL137S7B	0+03.5, 2.5R	5-15	±	19
AL137S8A	0+10, 15R	0-5	±	11
AL137S8B	0+10, 15R	5-15	±	17
AL137S9A	0+08, 17R	0-5	±	11
AL137S9B	0+08, 17R	5-15	±	6.8
AL137S10A	0+17, 10R	0-5	±	21
AL137S10B	0+17, 10R	5-15	±	17
AL137S11A	0+20, 17.5R	0-5	±	14
AL137S11B	0+20, 17.5R	5-15	±	6.6
AL137S12A	0+25, 10R	0-5	±	12
AL137S12B	0+25, 10R	5-15	±	7.0
AL137S13A	0+30, 18R	0-5	±	13
AL137S13B	0+30, 18R	5-15	±	8.4
AL137S14A	0+27, 4R	0-5	±	44
AL137S14B	0+27, 4R	5-15	±	19

^aLocations of soil samples are shown on Fig. 5.

^bIndicated counting error is at the 95% confidence level ($\pm 2\sigma$).

^cAnalytical error of measurement results is $< \pm 5\%$ (95% confidence level).

^dSystematic samples are taken at grid locations irrespective of gamma exposure.

Table 4. Results of surface analysis of structures at
16 Yardboro Avenue, Albany, New York (AL137)

Structure	Number of measurements	Results		Average	
		(dpm/100 cm ²)	(mrad/h) ^a	(dpm/100 cm ²)	(mrad/h)
<u>Alpha Activity</u>					
Asphalt paving	5	28,14,42,98, 49	-	46	-
Roof of the house	5	63,42,28,49, 28	-	42	-
Total	10	14-98	-	44	-
<u>Beta-Gamma</u>					
Asphalt paving	5	-	0.04,0.04,0.06, 0.05,0.04	-	0.05
Roof of the house	5	-	0.04,0.03,0.03, 0.02,0.02	-	0.03
Total	10	-	0.02-0.06	-	0.04

^aThe rad is the unit of absorbed dose and is defined as the amount of radiation required to cause absorption of 100 ergs per gram of medium. (The erg is a unit of energy. One erg in the form of heat will raise the temperature of 1 gram of water about 2.4×10^{-8} °C.)

Table 5. Summary of outdoor measurements and sample results on the property at 16 Yardboro Avenue, Albany, New York (AL137)

Measurement of sample type	Number of measurements/ samples	Range	Mean
Gamma exposure rate at 1 m ($\mu\text{R/h}$) ^a	41	9-14	11
Gamma exposure rate at surface ($\mu\text{R/h}$) ^a	41	10-30	13
Scan, gamma exposure rate near surface ($\mu\text{R/h}$) ^b	-	9-30	-
Concentration of ^{238}U in surface soil (pCi/g), systematic locations ^c	28	3.9-75	20
Area estimated to contain ^{238}U concentrations exceeding guidelines (m^2)	-	-	None
Concentration of ^{226}Ra in surface soil (pCi/g), systematic locations ^c		-	0.75
<u>Surface measurements^d</u>			
Alpha activity (dpm/100 cm^2)	10	14-98	44
Beta-gamma activity (mrad/h)	10	0.02-0.06	0.04

^aAt grid points.

^bScan of entire property.

^cSystematic samples, Table 3.

^dSurface measurements, Table 4.

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