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**RESULTS OF THE  
RADIOLOGICAL SURVEY  
AT CONVIBER INC.,  
644 GARFIELD STREET,  
SPRINGDALE, PENNSYLVANIA  
(CVP001)**

**R. D. Foley  
W. D. Cottrell  
J. W. Crutcher**

**MANAGED BY  
MARTIN MARIETTA ENERGY SYSTEMS, INC.  
FOR THE UNITED STATES  
DEPARTMENT OF ENERGY**

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**HEALTH AND SAFETY RESEARCH DIVISION**

Environmental Restoration and Waste Management Non-Defense Programs  
(Activity No. EX 20 20 01 0; ADS3170000)

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CONVIBER INC., 644 GARFIELD STREET,  
SPRINGDALE, PENNSYLVANIA (CVP001)**

R. D. Foley, W. D. Cottrell, and J. W. Crutcher

Date published— October 1991

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for the  
**U.S. DEPARTMENT OF ENERGY**  
under Contract No. DE-AC05-84OR21400

**MASTER**

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## **ACKNOWLEDGMENTS**

Research for this project was sponsored by the U.S. Department of Energy's Office of Environmental Restoration under Contract No. DE-AC05-84OR21400 with Martin Marietta Energy Systems, Inc. The authors wish to acknowledge the contributions of T. R. Stewart and D. A. Roberts, of the Measurement Applications and Development group, and J. M. Fielden, of the Environmental Remediation group, for participation in the analyses, graphics, and reporting of data for this survey.

## ABSTRACT

As part of the Formerly Utilized Sites Remedial Action Program (FUSRAP), the U.S. Department of Energy (DOE) is implementing a radiological survey program to determine the radiological conditions at sites that were used by the department's predecessor agencies. During the mid-1940s, and possibly continuing until 1951, the Conviber site in Springdale, Pennsylvania, was used to machine extruded uranium in support of government efforts. In 1980 a radiological scanning survey of this site was conducted by DOE and Argonne National Laboratory (ANL) staffs. Their report noted one anomaly: elevated radiation levels over a small area inside the building where uranium had been machined. Because much of the floor was inaccessible for surveying and because of the lack of definitive records documenting use of this site, a comprehensive radiological assessment was recommended.

The radiological survey discussed in this report for the site of Conviber, Inc., Springdale, Pennsylvania, was conducted by members of the Measurement Applications and Development Group of Oak Ridge National Laboratory in June of 1989. The survey included a surface gamma scan, collection of concrete and soil samples, and measurement of direct and removable alpha and beta-gamma contamination. One indoor location with a gamma measurement of 20  $\mu$ R/h was found. In June of 1990 ORNL staff returned to investigate the location with elevated gamma. A hole was drilled through the concrete, gamma measurements were taken, and soil samples were obtained for analyses. In these eight indoor soil samples, concentrations of  $^{238}\text{U}$  ranged from 90 to 20,000 pCi/g. However, under current site use, residual uranium covered by concrete does not pose a health risk.

Based on the above findings, it is recommended that this site be considered for inclusion under FUSRAP.



**RESULTS OF THE RADIOLOGICAL  
SURVEY AT CONVIBER, INC.,  
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SPRINGDALE, PENNSYLVANIA (CVP001)\***

**INTRODUCTION**

The U.S. Department of Energy (DOE) is conducting a program to determine radiological conditions at former Manhattan Engineer District and Atomic Energy Commission sites used for operations involving radioactive materials. Although much of the government-sponsored research was centered at the national laboratories, commercial facilities were used for storage and processing of uranium and thorium ores and for fabricating and machining metal made from these ores. As a result of these activities, in some instances equipment, buildings, and land became contaminated with radionuclides. These sites were later decontaminated in accordance with contemporary standards. However, subsequent radiological criteria, guidelines, and proposed guidelines have become more stringent for the release of such sites without radiological restrictions, and records documenting decontamination are sometimes not adequate for determining final radiological conditions. Thus, the Formerly Utilized Sites Remedial Action Program (FUSRAP) was initiated to identify these sites and to reevaluate their radiological status.<sup>1</sup> The radiological survey discussed in this report for the site of Conviber Inc., Springdale, Pennsylvania, is part of the FUSRAP effort and was conducted by members of the Measurement Applications and Development Group of Oak Ridge National Laboratory (ORNL).

The Conviber site is located at 644 Garfield Street in Springdale, Pennsylvania (Figs. 1 and 2). During the mid-1940s, the property was owned by C. A. Schnorr and Company and was used to machine extruded uranium for the Hanford Pile Project, a project whose objective was to produce an alternate charge for the Hanford Reactor. The uranium operation may have continued until the spring of 1951, when the building was sold to a manufacturer of toys and coat hangers. In 1967 the property was acquired by the Unity Railway Supply Company, who founded the Premier Manufacturing Company and used the site to manufacture journal lubricators for railroad cars. The current owner, Premier Manufacturing, uses the site for the fabrication of industrial drive and conveyer belts.

The original site (areas labeled "old" on the drawings) consisted of a concrete block building and a loading dock. Over the years this building has been enlarged and a new loading dock added. During the uranium machining period, materials were reportedly received through the Garfield Street entrance and stored near the loading dock, where uranium spills and fires may have occurred.

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\*The survey was performed by members of the Measurement Applications and Development Group of the Health and Safety Research Division at Oak Ridge National Laboratory under DOE contract DE-AC05-84OR21400.

In October 1980 a radiological scanning survey was conducted by DOE and Argonne National Laboratory (ANL) staffs. The only anomaly noted in this survey was a "hot spot," measuring about 300  $\mu\text{R/h}$  on contact [20  $\mu\text{R/h}$  at  $\sim 1$  m (3 ft)] and with an associated beta-gamma measurement of 4000 cpm per 61  $\text{cm}^2$ .<sup>2,3</sup> At that time, the concrete block building housed a manufacturing operation, and these measurements were taken on the lunchroom floor. The survey noted that this room was part of the old building and was located near the site of the former uranium machining activities and that the elevated measurements were near what appeared to be an asphalt-covered drain. The contaminated area was described as small ( $\sim 0.1$   $\text{m}^2$  or  $\sim 1$   $\text{ft}^2$ ). However, it was noted that much of the floor was inaccessible to the survey team. Because of this inaccessibility and because of the lack of definitive records documenting operations conducted at this site, a comprehensive radiological assessment was recommended.<sup>2,3</sup>

A radiological survey of the commercial property, Conviber Inc., 644 Garfield Street, Springdale, Pennsylvania, was conducted by members of ORNL's Measurement Applications and Development Group on June 6, 1989. Additional samples were taken on June 21, 1990.

## SURVEY METHODS

The radiological survey included (1) a surface-level gamma scan of accessible areas of the interior of the concrete block building and of most of the property outdoors; (2) measurement of direct and removable alpha and beta-gamma contamination inside the building and on the roof of the building; (3) sampling of concrete chips from the floor of the concrete block building; (4) collection of surface and subsurface soil samples; and (5) drilling an auger hole, with gamma logging and soil sampling, to define the extent of possible contamination under the concrete floor.

Using a portable gamma scintillation meter, ranges of surface measurements were recorded inside the concrete block building, inside the Quonset building east of the concrete block building, and for areas of the property outdoors. Alpha and beta-gamma activity measurements were taken at selected surface locations in the building and on the roof. Smears were also obtained to establish activity levels for removable alpha and beta-gamma contamination.

A sample of concrete chips was taken from an indoor area with elevated gamma measurements. Biased soil samples were taken outdoors at locations with elevated gamma readings.

A comprehensive description of the survey methods and instrumentation has been presented in another report.<sup>4</sup>

## SURVEY RESULTS

Applicable DOE residual guidelines for protection against radiation are summarized in Table 1.<sup>5</sup> Normal background radiation levels for the area near Springdale, Pennsylvania, are presented in Table 2.<sup>6</sup> These data are provided for comparison with survey results presented in this section. With the exception of measurements of removable radioactive contamination, which are reported as net disintegrations rates, all direct 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.

### INDOOR SURVEY RESULTS

#### Gamma Radiation Levels

Surface gamma exposure levels measured over the major area of the floor of the concrete block building ranged from 4 to 8  $\mu\text{R/h}$ . Part of the floor of this building was being used to store machinery and large rolls of industrial belting material and was inaccessible to the survey team. One higher gamma level, 20  $\mu\text{R/h}$ , was noted in a work area in the northeast quadrant of the concrete block building (Fig. 3). At this location, alpha and beta-gamma measurements were taken, a smear was taken to measure removable alpha and beta-gamma contamination, and a sample of concrete chips was taken to be analyzed for specific radionuclide content.

It could not be confirmed that this 20- $\mu\text{R/h}$  area and the 300- $\mu\text{R/h}$  "hot spot" reported in the 1980 ANL survey are the same, because the building had been extensively remodeled between the ANL and ORNL surveys. Also, significant areas of the floor were inaccessible for survey.

Gamma measurements were also taken on the floor of the Quonset building (Fig. 3, east of the concrete block building). These measurements ranged from 5 to 6  $\mu\text{R/h}$ .

#### Alpha and Beta-Gamma Measurements

Direct alpha and beta-gamma measurements were taken at seven locations inside the concrete block building. Locations of these measurements are given in Fig. 3. Direct alpha measurements ranged from <25 to 36 dpm/100  $\text{cm}^2$ , and direct beta-gamma measurements ranged from 0.02 to 0.04 mrad/h. These values are well below the guideline values given in Table 1 for fixed-on-surface contamination (5000 dpm/100  $\text{cm}^2$ ) and beta-gamma dose rates (1.0 mrad/h in any 100- $\text{cm}^2$  area).

Seven smear samples were obtained from inside the concrete block building at the same locations as the direct measurements shown in Fig. 3. Analysis of these smear samples for removable alpha and beta-gamma contamination resulted in levels below the minimum detectable activity for the instrument used (10 dpm/100  $\text{cm}^2$  for removable alpha contamination and 200 dpm/100  $\text{cm}^2$  for removable beta-gamma contamination). The DOE guideline for removable surface contamination from uranium residuals is 1000 dpm/100  $\text{cm}^2$  (Table 1).

### Concrete Sample

A sample of concrete chips (M1) was taken from the floor of the work area in the concrete block building at the location of the 20  $\mu\text{R/h}$  gamma measurement (Figs. 3 and 4). This sample was analyzed for radionuclide concentrations and the results tabulated (Table 3). Concentrations of  $^{137}\text{Cs}$ ,  $^{226}\text{Ra}$ , and  $^{232}\text{Th}$  were 0.25, 1.4, and 1.3 pCi/g, respectively. Concentrations of  $^{238}\text{U}$  were less than 18 pCi/g.

### Additional Indoor Sampling

Following analyses of the above data, the ORNL Measurements Applications and Development Group elected to return to the Conviber site for further sampling of the 20- $\mu\text{R/h}$  location in the work area of the concrete block building. On June 21, 1990, an auger hole was drilled beneath the concrete, at the location of the elevated gamma measurement and the concrete chip sample, to a depth of 64 cm (25 in.). Eight soil samples were taken at ~8-cm (~3-in.) increments, and gamma measurements were recorded at or near each sampling depth. These readings are in thousand counts per minute\* (kcpm) and range from 52 to 480 kcpm, with the highest measurement taken at 33 cm (13 in.). A gamma profile of this auger hole is presented graphically in Fig. 5.

These samples were analyzed for concentrations of  $^{137}\text{Cs}$ ,  $^{226}\text{Ra}$ ,  $^{232}\text{Th}$ , and  $^{238}\text{U}$ . Results are given in Table 3. For  $^{137}\text{Cs}$  analysis, all measurements were <1.2 pCi/g. For  $^{226}\text{Ra}$  analysis, the surface soil sample (A1A) showed 1.7 pCi/g, and the subsurface samples ranged from 1.1 to 5.2 pCi/g. The surface sample showed 1.3 pCi/g of  $^{232}\text{Th}$ , and values for the subsurface samples ranged from 0.89 to 1.6 pCi/g. These values are below DOE guidelines for  $^{137}\text{Cs}$ ,  $^{226}\text{Ra}$ , and  $^{232}\text{Th}$  concentrations in surface and subsurface soils (Table 1).

Uranium-238 concentrations were 2800 pCi/g in the surface sample, and ranged from 90 to 20,000 in the subsurface samples. Concentration limits for uranium at FUSRAP remedial action sites are site specific and are derived in accordance with DOE guidelines. The process ensures that doses to individuals using the sites are well below the 100 mrem/yr dose limit. The  $^{238}\text{U}$  concentrations found in the eight samples taken from the work area location exceed typical site-specific uranium guidelines for soil that were derived for similar DOE FUSRAP sites (35-150 pCi/g).

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\*Counts show relative gamma intensity, not exposure.

## OUTDOOR SURVEY RESULTS

### Gamma Radiation Levels

Gamma exposure rates measured during a scan of the surface of the property outdoors are shown in Fig. 6. Over the major portion of the property, gamma radiation levels ranged from 4 to 10  $\mu\text{R/h}$ . Gamma exposure rates were measured on the roof of the concrete block building, and ranged from 6 to 8  $\mu\text{R/h}$ . Two higher gamma measurements were taken near the dripline on the east and south sides of the concrete block building (14 and 13  $\mu\text{R/h}$ , respectively). The 13  $\mu\text{R/h}$  gamma measurement from the south side of the building was taken near the old loading dock where, reportedly, uranium spills and fires may have occurred. Biased soil samples were obtained from the 13 and 14  $\mu\text{R/h}$  locations.

### Soil Samples

During the June 1989 survey, four biased soil samples, taken from the two outdoor locations with 13 and 14  $\mu\text{R/h}$  measurements, were analyzed for radionuclide concentrations. In June 1990, following the analysis of the four biased samples, three additional samples (B3A, B3B, and B3C) were taken at the B1 location (Fig. 6). Results of radionuclide analysis are given in Table 3. Locations of all biased (B) samples are shown on Fig. 6.

The  $^{226}\text{Ra}$  concentrations ranged from 0.84 to 2.5 pCi/g. Concentrations of  $^{232}\text{Th}$  ranged from 0.84 to 1.8 pCi/g. All of these values are below the DOE guidelines given in Table 1. Concentrations of  $^{226}\text{Ra}$  and  $^{232}\text{Th}$  are at or near background soil concentrations for the area near Springdale, Pennsylvania (Table 2). Concentration of  $^{238}\text{U}$  ranged from 2.2 to 83 pCi/g, with the higher concentrations (33 to 83 pCi/g) found at soil sample location B1/B3. These values are within the typical site-specific uranium guidelines for soil derived for similar DOE FUSRAP sites (35-150 pCi/g).

Results of laboratory analysis for  $^{137}\text{Cs}$  ranged from 0.18 to 11 pCi/g. Samples collected from locations B1/B3 and B2 were taken near the foundation of the building which was indicated to the survey team as being the "old" or "original" section of the current building. The  $^{137}\text{Cs}$  levels in soil at these two locations is within the range of values of cesium measured in soil from roof driplines and downspouts of other properties in the eastern United States and attributed to fallout from nuclear weapons testing. The current building does not have external downspouts. However, based on the sample locations and the proximity to the original building, it is probable that the slightly elevated cesium is due to fallout in roof runoff.

### Alpha and Beta-Gamma Measurements

A beta-gamma scan of the roof of the concrete block building was performed, revealing a range of 0.02 to 0.04 mrad/h (Fig. 7). The background beta-gamma, measured in air, was determined to be approximately 0.02 mrad/h. While these direct beta-gamma measurements are slightly above background measured at this site, they are well within DOE guidelines (Table 1).

Four smears were obtained from the roof and analyzed for removable alpha and beta-gamma contamination. Analysis of these smear samples resulted in levels below the minimum detectable activity for the instrument used (10 dpm/100 cm<sup>2</sup> for removable alpha contamination and 200 dpm/100 cm<sup>2</sup> for removable beta-gamma contamination).

Copper flashings on the roof of the concrete block building were observed to have direct alpha measurements that ranged to approximately 500 dpm/100cm<sup>2</sup>. These measurements are well below the guideline for fixed-on-surface contamination (5000 dpm/100 cm<sup>2</sup>). Two smears were taken from the copper (smears # 23 and 25, Fig. 7). Results indicated no detectable transferable contamination on either sample.

### SIGNIFICANCE OF FINDINGS

Radiological assessment of outdoor soil samples from Conviber Inc., Springdale, Pennsylvania, demonstrated near background concentrations of <sup>226</sup>Ra and <sup>232</sup>Th. Concentration of <sup>238</sup>U in the seven outdoor soil samples ranged from 2.2 to 83 pCi/g. Two of the samples are within typical site-specific uranium guidelines for soil, derived for similar DOE FUSRAP sites (35-150 pCi/g).

Direct beta-gamma measurements taken inside the building and on the roof are within DOE guidelines.

One elevated surface gamma measurement (20 μR/h) was taken on the floor inside the concrete block building. A sample of concrete chips was taken at this site. When the radionuclide analysis of this sample failed to determine the source of radiation, the ORNL survey team returned to the Conviber site and core drilled through the concrete floor to a depth of ~64 cm (25 in.) at this indoor location. Gamma measurements and eight soil samples were taken at approximately 8-cm (3-in.) increments. The gamma levels ranged from 52 to 480 kcpm. Results of analysis of the eight soil samples for radionuclide concentrations showed <sup>238</sup>U concentrations ranging from 90 to 20,000 pCi/g.

Under current site use, residual uranium that is covered by concrete does not pose a health risk. However, concentrations of <sup>238</sup>U found in soil samples taken from the location of the elevated gamma measurement exceed typical site-specific uranium guidelines for soil that were derived for similar DOE FUSRAP sites. Based on these findings, it is recommended that this site be considered for inclusion under FUSRAP.

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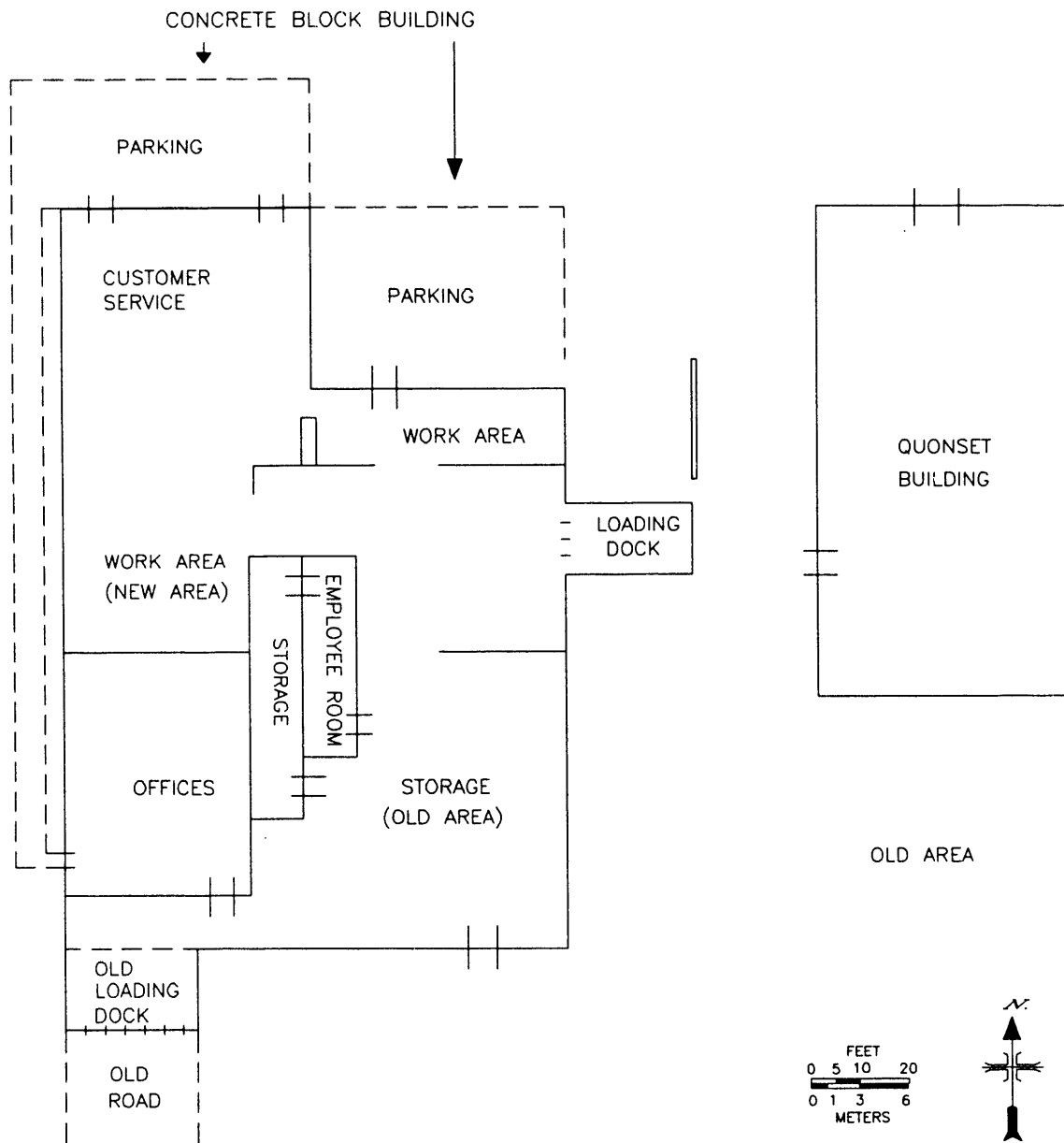
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**Fig. 1. Conviber, Inc., 644 Garfield Street, Springdale, Pennsylvania.**





**Fig. 2. Diagram showing building locations at Conviber, Inc., 644 Garfield Street, Springdale, Pennsylvania.**

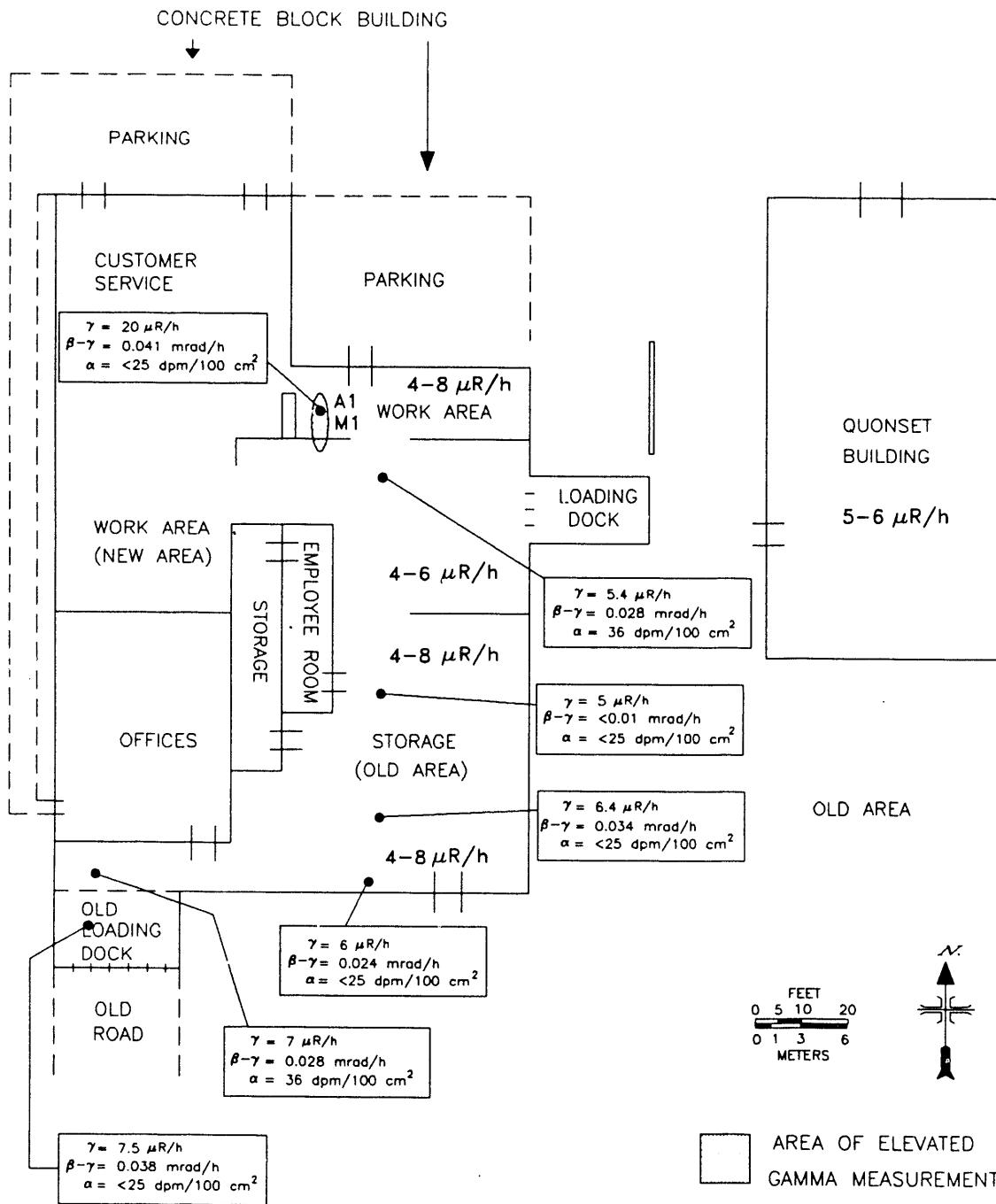
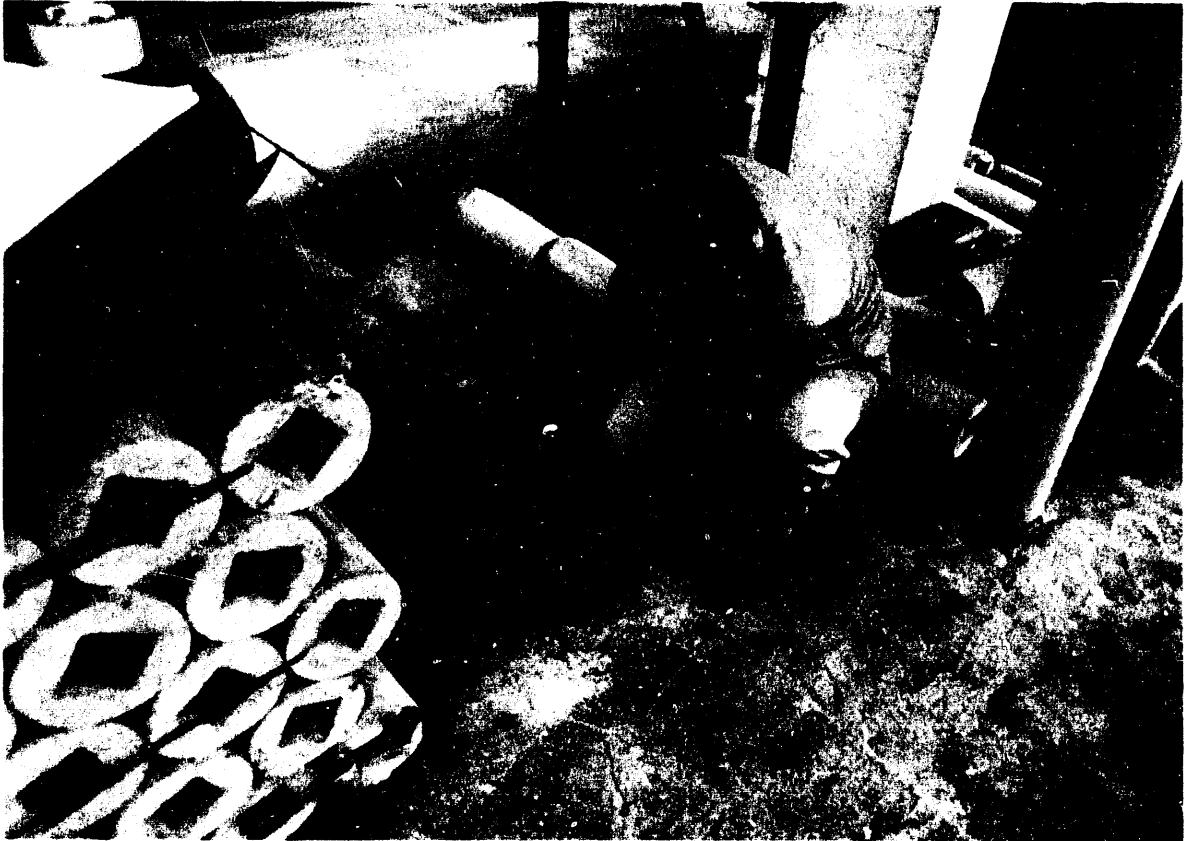


Fig. 3. Locations of gamma exposure rate measurements and direct alpha and beta-gamma measurements taken indoors at Conviber, Inc., 644 Garfield Street, Springdale, Pennsylvania.

ORNL-PHOTO 7853-91



**Fig. 4.** Location of elevated gamma measurements in a work area, Conviber, Inc., 644 Garfield Street, Springdale, Pennsylvania. A survey team member takes a sample of concrete chips.

ORNL-DWG 91-14162

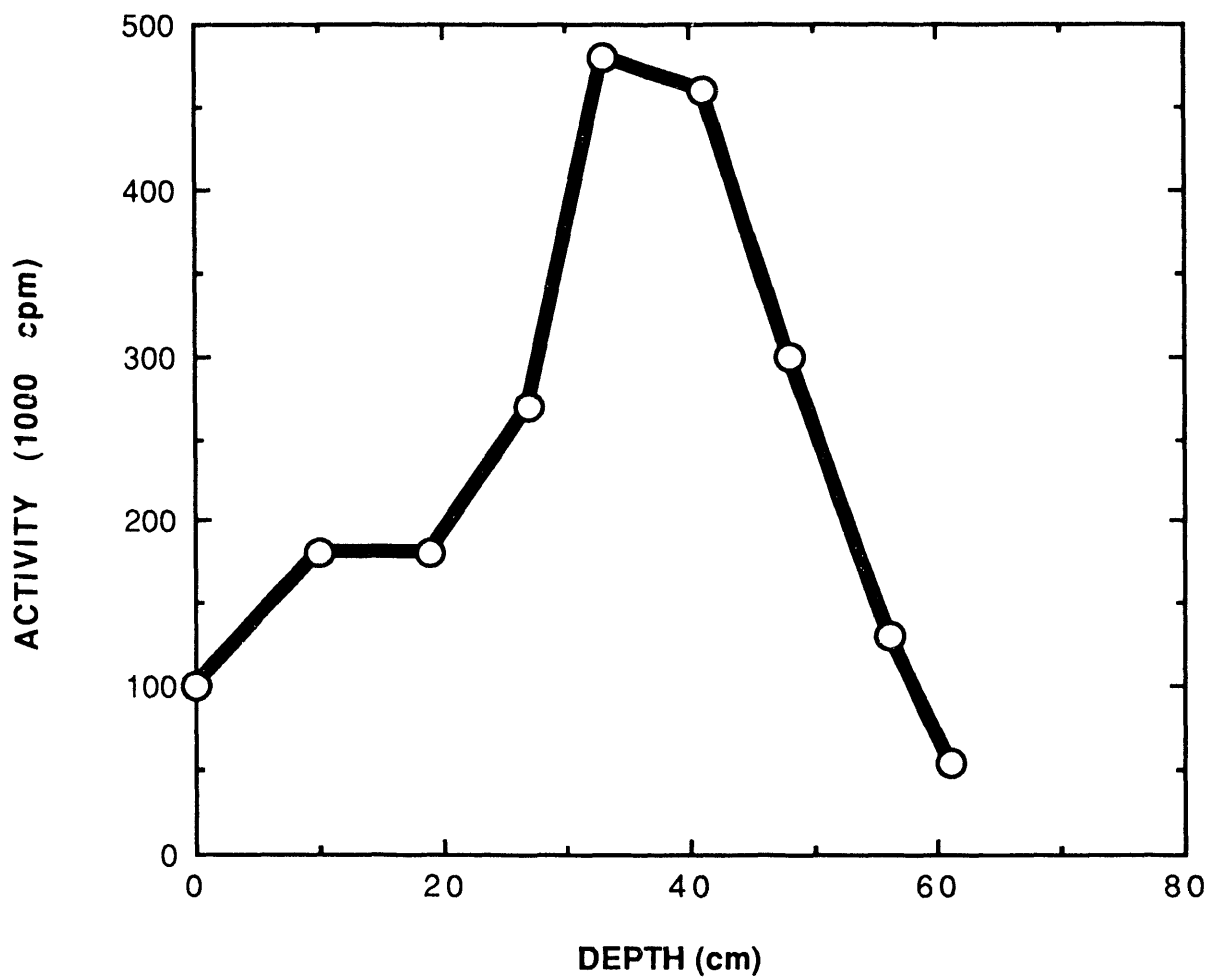
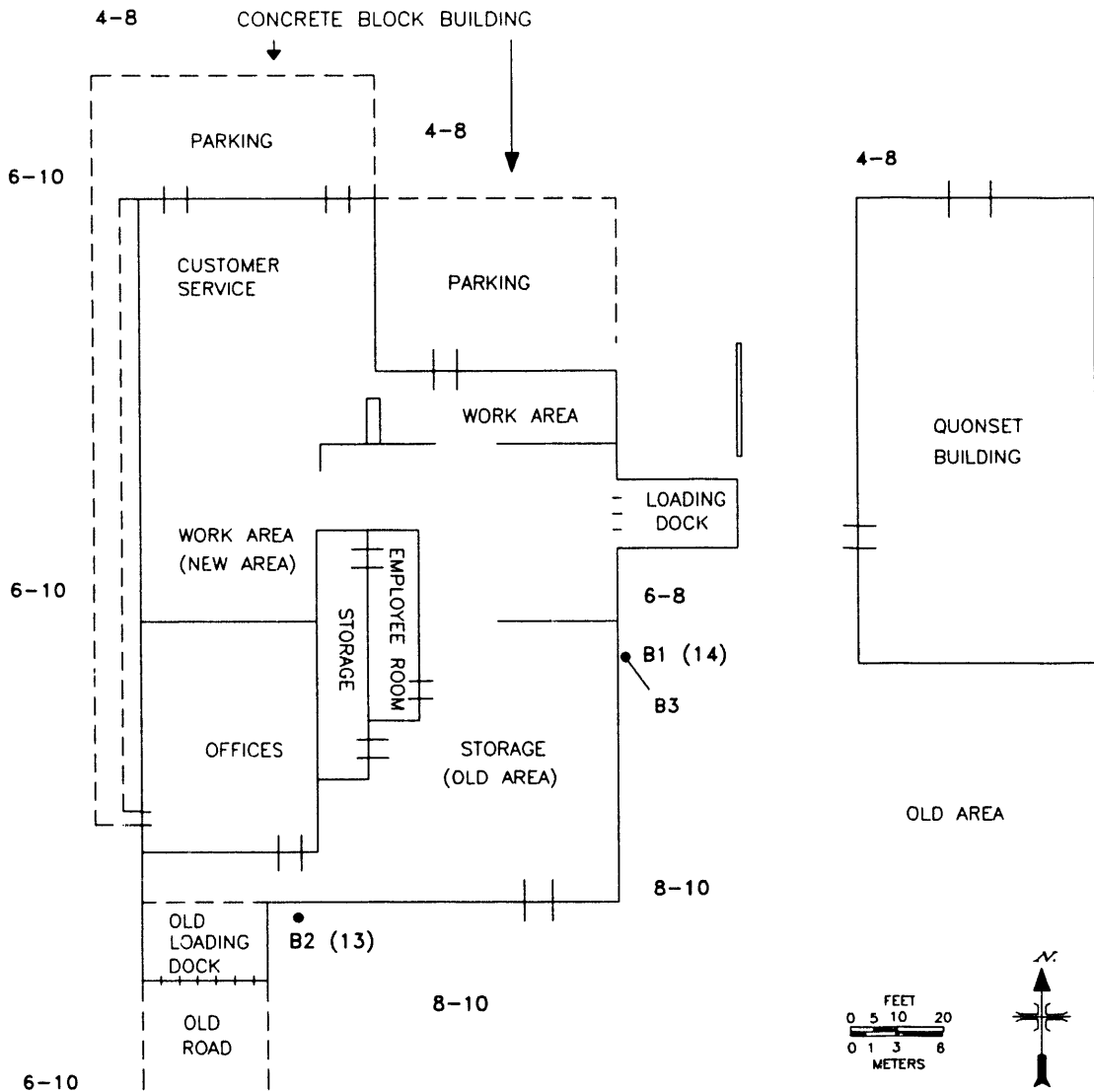


Fig. 5. Gamma logging of auger hole drilled at the location of elevated gamma inside the concrete building, Conviber, Inc., 644 Garfield Street, Springdale, Pennsylvania.



**Fig. 6. Gamma exposure rates ( $\mu\text{R/h}$ ) measured outdoors on the surface, and locations of soil samples taken at Conviber, Inc., 644 Garfield Street, Springdale, Pennsylvania.**

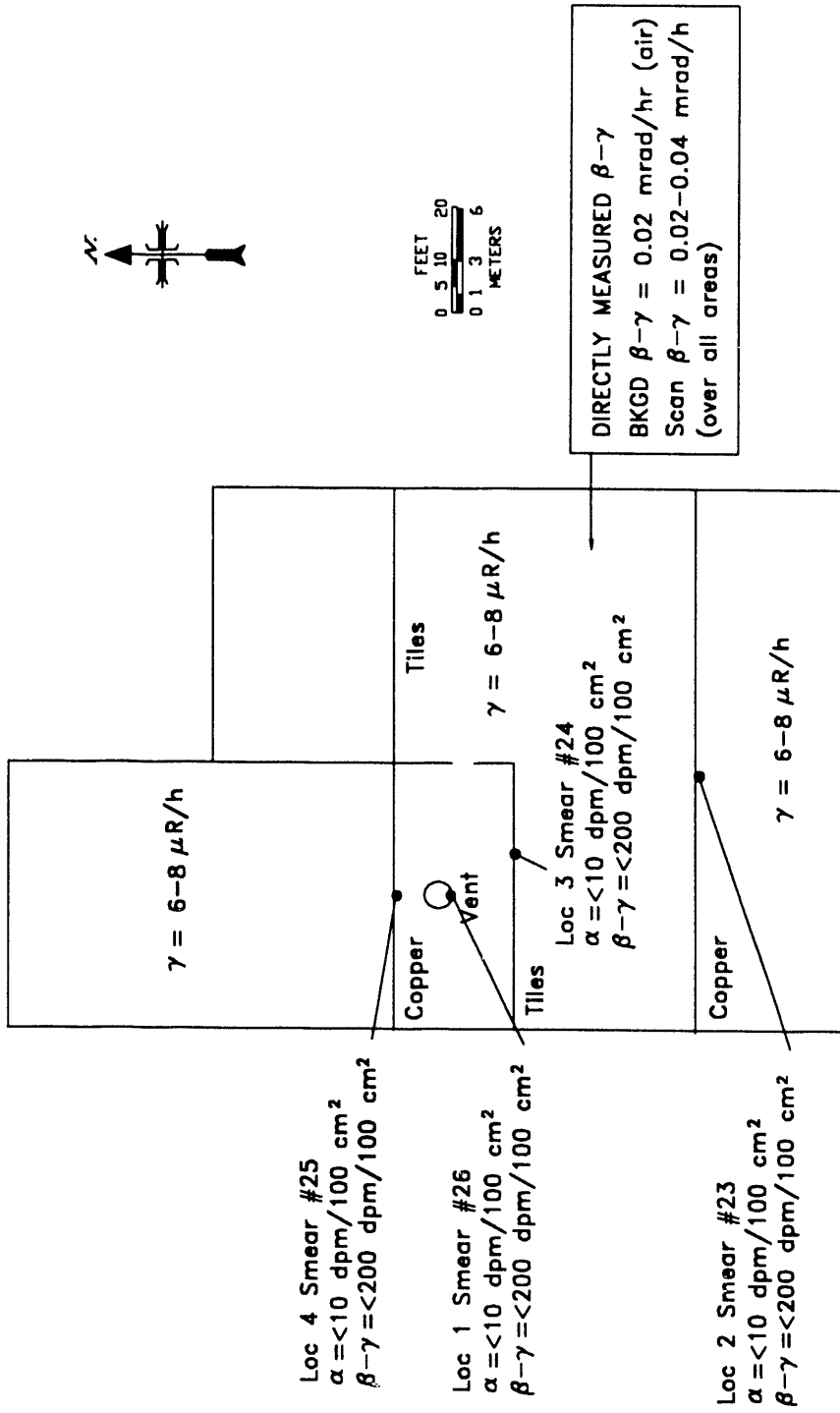


Fig. 7. Gamma exposure rate measurements, transferable alpha and beta-gamma measurements, and direct beta-gamma measurements taken on the roof of the concrete block building at Conviber, Inc., 644 Garfield Street, Springdale, Pennsylvania.

Table 1. Applicable guidelines for protection against radiation

Mode of exposure	Exposure conditions	Guideline value
Gamma radiation	Indoor gamma radiation levels (above background)	20 $\mu$ R/h
Surface contamination <sup>a</sup>	U-natural, <sup>235</sup> U, <sup>238</sup> U, and associated decay products	
	Fixed on surface	5000 dpm/100 cm <sup>2</sup>
	Removable	1000 dpm/100 cm <sup>2</sup>
Beta-gamma dose rates	Surface dose rate averaged over not more than 1 m <sup>2</sup>	0.2 mrad/h
	Maximum dose rate in any 100-cm <sup>2</sup> area	1.0 mrad/h
Radionuclide concentrations in soil	Maximum permissible concentration of the following radionuclides in soil above background levels, averaged over a 100-m <sup>2</sup> area	5 pCi/g averaged over the first 15 cm of soil below the surface; 15 pCi/g when averaged over 15-cm-thick soil layers more than 15 cm below the surface
	<sup>226</sup> Ra	
	<sup>232</sup> Th	
	<sup>238</sup> U	Derived (site specific) <sup>b</sup>
	Concentration limit in surface soil above background levels based on dose estimates from major exposure pathways	
	<sup>137</sup> Cs	80 pCi/g over a 100-m <sup>2</sup> area of contamination

<sup>a</sup>As used in this table, disintegrations per minute (dpm) means the rate of emission by radioactive material as determined by correcting the counts per minute measured by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.

<sup>b</sup>DOE guidelines for uranium are derived on a site-specific basis. While none have been derived for this site, guidelines of 35–40 pCi/g for <sup>238</sup>U have been applied at other FUSRAP sites.

Sources: Adapted from *Guidelines for Residual Radioactive Material at Formerly Utilized Sites Remedial Action Program and Remote Surplus Facilities Management Program Sites*, Rev. 2, U.S. Department of Energy, March 1987. Cesium-137 exposure conditions and guideline value from J. W. Healy, J. C. Rodgers, and C. L. Wienke, *Interim Soil Limits for D&D Projects*, Los Alamos Scientific Laboratory, LA-UR-79-1865-Rev., Los Alamos, N.M., 1979. Cited in U.S. Department of Energy, *Radiological Guidelines for Application to DOE's Formerly Utilized Sites Remedial Action Program*, Oak Ridge Operations, ORO-831, March 1983.

**Table 2. Background radiation levels for the area near Springdale, Pennsylvania**

Type of radiation measurement or sample	Radiation level or radionuclide concentration
Gamma exposure rate at 1 m ( $\mu\text{R/h}$ )	6
Concentration of radionuclides in soil (pCi/g)	
$^{226}\text{Ra}$	1.9
$^{232}\text{Th}$	1.3
$^{238}\text{U}$	1.7

*Source:* T. E. Myrick, B. A. Berven, and F. F. Haywood, *State Background Radiation Levels: Results of Measurements Taken During 1975-1979*, ORNL/TM-7343, Martin Marietta Energy Systems, Inc., Oak Ridge Nat'l Lab., November 1981.



**Table 3. Concentrations of radionuclides in soil and concrete samples from Conviber Inc., 644 Garfield Street, Springdale, Pennsylvania**

Sample ID <sup>a</sup>	Depth (cm)	Radionuclide concentration (pCi/g) <sup>b</sup>			
		<sup>137</sup> Cs	<sup>226</sup> Ra	<sup>232</sup> Th	<sup>238</sup> U
<i>Biased soil samples<sup>c</sup></i>					
B1A	0-5	11 ± 0.3	1.3 ± 0.1	1.1 ± 0.2	33 ± 4
B1B	5-15	7.3 ± 0.06	1.2 ± 0.03	1.2 ± 0.04	77 ± 1
B2A	0-5	5.4 ± 0.04	2.5 ± 0.03	1.8 ± 0.03	2.2 ± 0.5
B2B	5-15	4.7 ± 0.05	2.2 ± 0.04	1.4 ± 0.06	2.9 ± 1
B3A <sup>d</sup>	0-15	6.1 ± 0.1	1.3 ± 0.05	1.3 ± 0.08	13 ± 2
B3B <sup>d</sup>	15-25	0.52 ± 0.06	0.84 ± 0.07	0.94 ± 0.1	83 ± 8
B3C <sup>d</sup>	25-33	0.18 ± 0.01	0.92 ± 0.02	0.84 ± 0.03	19 ± 0.7
<i>Concrete sample<sup>e</sup></i>					
M1	<sup>f</sup>	0.25 ± 0.2	1.4 ± 0.6	1.3 ± 0.9	<18
<i>Auger soil samples<sup>g</sup></i>					
A1A	0-10	<0.24	1.7 ± 0.2	1.3 ± 0.3	2,800 ± 40
A1B	10-19	<0.08	1.6 ± 0.1	1.5 ± 0.2	530 ± 20
A1C	19-27	<0.05	1.4 ± 0.07	1.6 ± 0.1	90 ± 7
A1D	27-33	<1.2	4.3 ± 1	<3.7	12,000 ± 300
A1E	33-41	<0.80	5.2 ± 2	<2.5	20,000 ± 200
A1F	41-48	<0.10	1.5 ± 0.1	1.5 ± 0.2	490 ± 20
A1G	48-56	<0.06	1.2 ± 0.09	1.2 ± 0.2	280 ± 10
A1H	56-64	<0.02	1.1 ± 0.03	0.89 ± 0.04	120 ± 3

<sup>a</sup>Unless otherwise noted, locations are shown on Fig. 3.

<sup>b</sup>Indicated counting error is at the 95% confidence level ( $\pm 2\sigma$ ).

<sup>c</sup>Biased samples are taken from areas shown to have elevated gamma exposure rates (Fig. 6).

<sup>d</sup>Biased samples from location B3 (A-C) were taken in June 1990 from the biased sample B1 location, shown on Fig. 6. Biased samples B1 (A-B) were taken in June 1989.

<sup>e</sup>A sample of concrete chips was taken from the floor in the work area of the concrete block building (Fig. 3) at the area of the elevated gamma measurement.

<sup>f</sup>Surface (Fig. 3).

<sup>g</sup>An auger sample was taken from a hole drilled to further define the depth and extent of radioactive material. These eight samples were taken in June 1990 from the work area shown in Fig. 3 (20- $\mu$ R/h location), which is also the location from which the concrete sample was taken in June 1989.

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