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RESULTS OF THE RADIOLOGICAL SURVEY AT THE FORMER HEPPENSTALL COMPANY SITE, 4620 HATFIELD STREET, PITTSBURGH, PENNSYLVANIA

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ABSTRACT

As part of the Formerly Utilized Sites Remedial Action Program, the U.S. Department of Energy (DOE) is implementing a program to determine the radiological conditions at sites that were used to process radioactive materials under contract with the department's predecessor agencies. During 1955 the former Heppenstall Company site in Pittsburgh, Pennsylvania, was used by an Atomic Energy Commission contractor to process approximately 100,000 lbs of normal uranium metal. Because of insufficient records to document cleanup procedures and to verify the radiological condition of this site, DOE requested a survey.

The radiological survey discussed in this report for the site of the former Heppenstall Company, Pittsburgh, Pennsylvania, was conducted by members of the Measurement Applications and Development Group of Oak Ridge National Laboratory in July of 1989. The survey included a surface gamma scan of the warehouse, collection of indoor soil and dust samples and one outdoor soil sample, and measurement of direct and transferrable alpha and beta-gamma activity. Results of this radiological assessment indicate no detection of radiation levels or radionuclide concentrations above DOE guidelines.

RESULTS OF THE RADIOLOGICAL SURVEY AT THE FORMER HEPPENSTALL COMPANY SITE, 4620 HATFIELD STREET, PITTSBURGH, PENNSYLVANIA*

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 (AEC) 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, equipment, buildings, and land became contaminated with technically enhanced, naturally occurring radioactive nuclides. 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.[1] The radiological survey discussed in this report for the former Heppenstall Company site in Pittsburgh, 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 former Heppenstall Company site is located at 4620 Hatfield Street, Pittsburgh, Pennsylvania (Fig. 1). In 1955 Mallinckrodt Chemical Company, an AEC contractor, used the Heppenstall site for approximately six months to heat, press, and water quench uranium metal. According to records, during this period the plant processed approximately 100,000 lbs of normal uranium metal (i.e., uranium that has been processed from natural ores and contains uranium isotopes in ratios approximately equal to their naturally occurring abundances). Although the Heppenstall plant is a large facility, the uranium operation was restricted to a small area of the plant (Fig. 2). Reportedly, protective clothing was worn by all workers handling the material, and thorough cleanup procedures were followed when the operation ceased.[2]

In 1979 Tippins Inc. purchased the Heppenstall plant to use as an equipment storage warehouse. All equipment used in the uranium processing activities was sold at auction or private sale.[3]

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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.

Because of insufficient records to verify the radiological condition of the former Heppenstall Company site, DOE requested a radiological survey. This survey was conducted by members of ORNL's Measurement Applications and Development Group on July 19, 1989.

SURVEY METHODS

The radiological survey of the equipment storage warehouse included (1) a gamma scan at the surface of accessible areas of the building; (2) collection of indoor surface soil samples and one outdoor surface soil sample; (3) collection of dust samples from wall and support beams inside the building; and (4) measurement of direct and removable alpha and beta-gamma surface activity levels inside the building and on the roof.

Using a portable gamma scintillation meter, ranges of measurements were recorded inside accessible areas of the warehouse building. Beta-gamma activity measurements were taken at selected surface locations in the building and on the roof. Smears were taken from selected areas to determine removable alpha and beta-gamma activity levels.

The survey methods followed the plan outlined in Reference 4. A comprehensive description of the survey methods and instrumentation used has been presented in another report.[5]

SURVEY RESULTS

Applicable DOE guidelines for protection against radiation are summarized in Table 1.[6] Typical background radiation levels for the area near Pittsburgh, Pennsylvania, are presented in Table 2.[7] These data are provided for comparison with survey results presented in this section. With the exception of measurements of removable radioactivity, which are reported as net disintegrations rates, all direct measurement results 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

Gamma exposure rate measurements taken over accessible portions of the warehouse area generally ranged from 4 to 6 μR/h. These measurements are shown on Fig. 2. Because the warehouse area is used to store equipment, much of the floor area was inaccessible to survey team members conducting the gamma scan. A view of the warehouse interior is presented in Fig. 3. Higher gamma levels (12 to 16 μR/h) were measured near Furnaces 2 and 3 (see Fig. 2). Fire bricks used to line these furnaces were identified as the source of the elevated gamma radiation levels. Because naturally occurring radioactive substances are sometimes present in the raw materials used to make bricks and concrete, they typically exhibit higher-than-background gamma exposure rates.

These levels ranged from 12 to 16 μR/h. For unrestricted use of a building or habitable structure, the DOE guideline for gamma radiation is 20 μR/h above background level (Table 1). All the indoor gamma measurements are below DOE guidelines.

Soil Samples

Inside the warehouse, five systematic soil samples were taken from five locations without flooring. Locations of these samples [labeled (S), 1-5] are shown on Fig. 2. Laboratory analyses for radionuclide concentrations were performed, and results for ^{226}Ra, ^{232}Th, and ^{238}U are shown in Table 3. For these five indoor samples, concentrations of ^{226}Ra and ^{232}Th ranged from 0.45 to 1.6 pCi/g and 0.50 to 1.9 pCi/g, respectively. These values are near the background concentrations given in Table 2, and are well below the 5 pCi/g guideline for surface soil given in Table 1. Concentrations of ^{238}U ranged from 0.64 to 2.1 pCi/g, which, when the percentage error is taken into account, are values near background.

Alpha and Beta-Gamma Measurements

Direct beta-gamma measurements were taken at 13 locations inside the warehouse. Locations of these measurements are given in Fig. 2. Direct beta-gamma measurements ranged from 0.020 to 0.068 mrad/h. These values are well below the guideline value of 0.2 mrad/h (averaged over ≤1 m^2) given in Table 1 for beta-gamma dose rates.

Two smear samples were obtained from inside the warehouse, one from a support beam and the other from a wall beam (locations M1 and M2 on Fig. 2). Analysis of these two smear samples for removable alpha and beta-gamma surface contamination resulted in levels below the minimum detectable activity for the instrument used.* The DOE guideline for removable surface contamination from uranium residuals is 1000 dpm/100 cm^2 (Table 1).

Dust Samples

Two dust samples were taken from inside the warehouse and analyzed for radionuclide concentrations. These samples were taken from a wall beam and a support beam, at the same location as the smears. The samples are identified as M1 and M2 on Fig. 2, and results of laboratory analyses are given in Table 3. Concentrations of ^{226}Ra were 0.57 and 0.78 pCi/g, and concentrations of ^{232}Th were 0.52 and 0.68 pCi/g. These values are well below DOE guidelines. Concentrations of ^{238}U were 1.2 and 2.2 pCi/g.

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*The instrument-specific minimum detectable activity (MDA) for removable alpha surface contamination is 10 dpm/100 cm^2. For removable beta-gamma surface contamination, the MDA is 200 dpm/100 cm^2.

Outdoor Survey Results

Gamma Radiation Levels

One small, outdoor area showed a gamma exposure rate measurement of 16 μR/h. This measurement was taken at the corner of the warehouse, southeast of the Power House shown in Figs. 1 and 2, at the surface of bricks, near a door. This measurement, which is higher than the warehouse average of 4 to 6 μR/h and the background gamma exposure rate for the Pittsburgh area, approximately 6 μR/h (at 1 m), was believed to result from the raw materials used in the bricks. To determine if any residual radioactive material from the former uranium processing activities was present, a soil sample was taken from this location.

Soil Sample

One outdoor biased soil sample was taken near the building, from the location of the 16-μR/h gamma measurement. The location of this sample (B1) is shown in Fig. 2. Laboratory analysis of this soil sample showed ^{226}Ra concentrations of 0.65 pCi/g and ^{232}Th concentrations of 0.69 pCi/g. Both values are well below the 5-pCi/g DOE guideline value for surface soils. Concentration of ^{238}U was 0.95 pCi/g, which is near the background uranium concentration for the Pittsburgh area.

Alpha and Beta-Gamma Measurements

Direct beta-gamma measurements were taken at various locations on the roof of the warehouse. Locations and measured values are given in Fig. 4. Direct beta-gamma measurements ranged from 0.02 to 0.04 mrad/h. These values are well below the guideline value of 0.2 mrad/h (averaged over ≤1 m^2) given in Table 1 for beta-gamma dose rates.

Six smear samples were obtained from the roof. Locations of these smears are shown in Fig. 4, and a photograph of the roof is given as Fig. 5. Analysis of the six smear samples for removable alpha and beta-gamma contamination resulted in levels below the minimum detectable activity for the instrument used (10 dpm/100 cm^2 for removable alpha contamination and 200 dpm/100 cm^2 for removable beta-gamma contamination). The DOE guideline for removable surface contamination from uranium residuals is 1000 dpm/100 cm^2 (Table 1).

SIGNIFICANCE OF FINDINGS

Results of laboratory analyses for radionuclide concentrations in indoor soil samples taken from the former Heppenstall Company site demonstrated concentrations of ^{226}Ra, ^{232}Th, and ^{238}U below or near background values for the Pittsburgh area. Measurements of gamma radiation levels inside the warehouse were below DOE guidelines for unrestricted use of a building or habitable structure. Higher-than-background gamma

levels were noted near Furnaces 2 and 3 (Fig. 2). These levels appear to have resulted from naturally occurring radioactive materials used in the production of the fire bricks that line the furnaces. One higher-than-background gamma level was noted outdoors, near an entrance to the warehouse, at the surface of bricks. A biased soil sample was taken from this location, and the laboratory results revealed radionuclide concentrations slightly below background for soils in the Pittsburgh area. All direct and removable alpha and beta-gamma measurements were well below DOE guidelines.

For the former Heppenstall Company site, measurement of gamma radiation levels, concentrations of radionuclides in soil and dust samples, and direct and removable alpha and beta-gamma measurements are all below DOE guidelines. Therefore, based on the results of this radiological assessment, it is recommended that this site be eliminated from consideration for inclusion in the DOE remedial action program.

REFERENCES

1. U.S. Department of Energy, *A Background Report for the Formerly Utilized Manhattan Engineer District/Atomic Energy Commission Sites Program,* DOE/EV-0097, September 1980.

2. Memorandum, Paul H. Daley, President and CEO, Heppenstall Company, Pittsburgh, Penn., to Andrew Wallo III, U.S. DOE, Division of Facility and Site Decommissioning Projects, Office of Nuclear Energy, Washington, D.C., November 10, 1987.

3. Memorandum, George Tippins, Chairman and CEO, Tippins Inc., Pittsburgh, Penn., to Harry L. Crouse, Earth Sciences Consulting, Triangle Park, Export, Penn., November 18, 1987.

4. W. D. Cottrell, Oak Ridge National Laboratory, correspondence to A. J. Whitman, U.S. Department of Energy, Headquarters, "Radiological Survey of Private Properties in Lodi, New Jersey," August 15, 1984.

5. T. E. Myrick, B. A. Berven, W. D. Cottrell, W. A. Goldsmith, and F. F. Haywood, *Procedures Manual for the ORNL Radiological Survey Activities (RASA) Program,* ORNL/TM-8600, Oak Ridge National Laboratory, Oak Ridge, Tenn., April 1987.

6. *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.

7. T. E. Myrick, B. A. Berven, and F. F. Haywood, *State Background Radiation Levels: Results of Measurements Taken During 1975–1979,* ORNL/TM-7343, Oak Ridge National Laboratory, Oak Ridge, Tenn., November 1981.

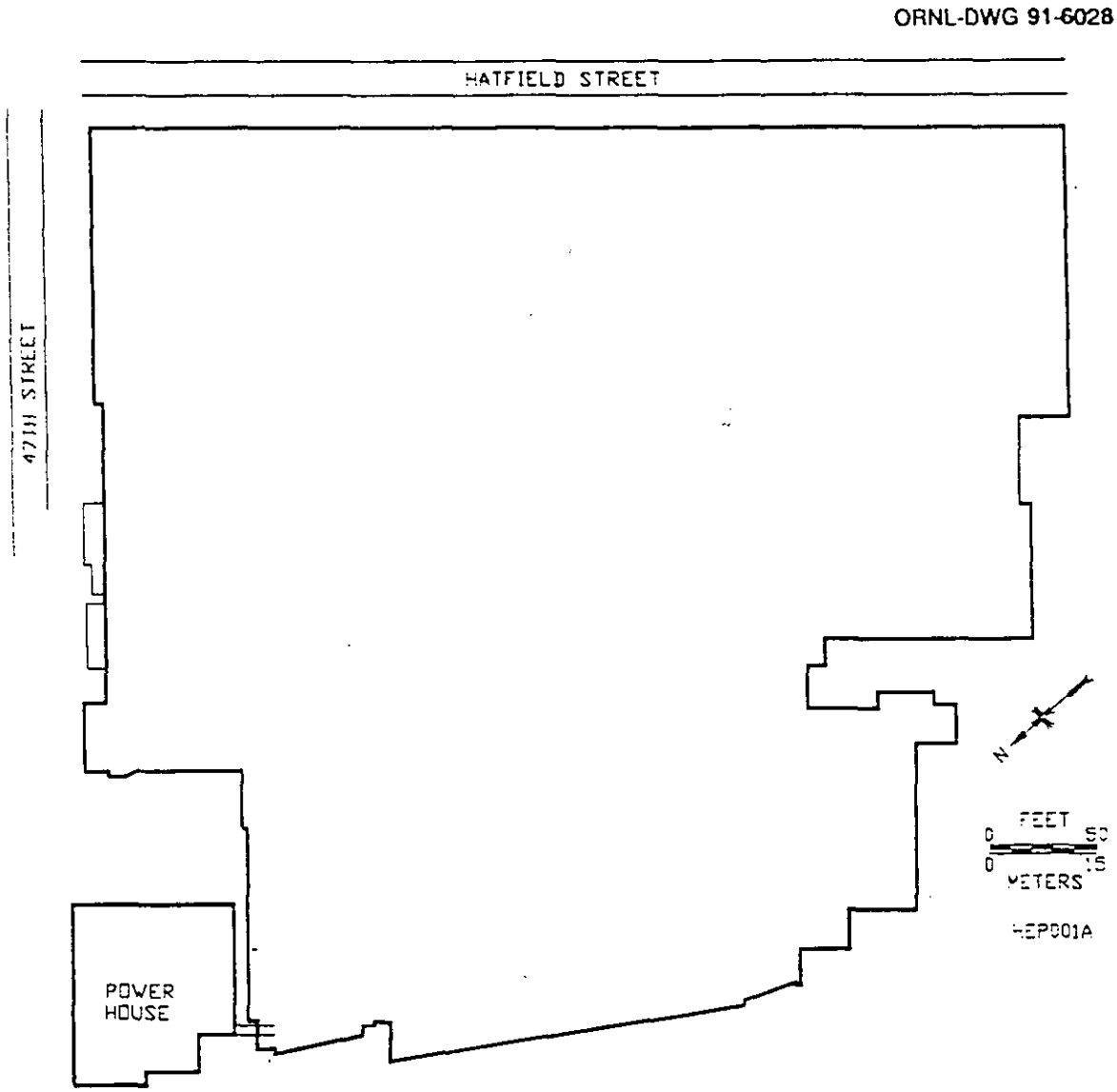

Fig. 1. Diagram showing location of the former Heppenstall Company site, 4620 Hatfield Street, Pittsburgh, Pennsylvania.

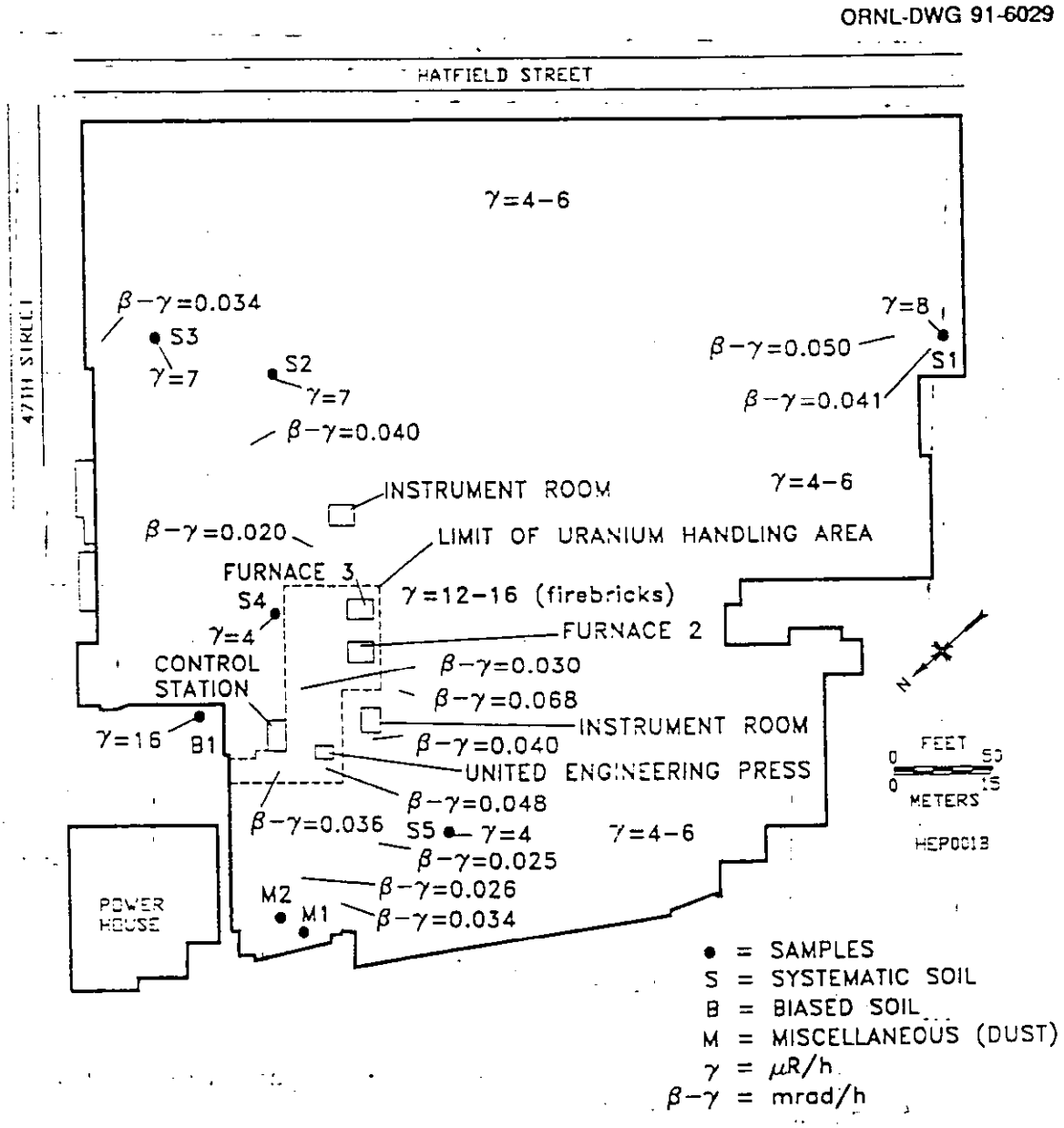

Fig. 2. Gamma exposure rates (μR/h) measured on the surface; locations of soil (S and B) samples, dust (M) samples, and smears; and location of direct beta-gamma measurements taken at the former Heppenstall Company site, 4620 Hatfield Street, Pittsburgh, Pennsylvania.

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Fig. 3. Equipment stored in the warehouse at the former Heppenstall Company site, 4620 Hatfield Street, Pittsburgh, Pennsylvania. Much of the floor area was inaccessible to the ORNL survey team.

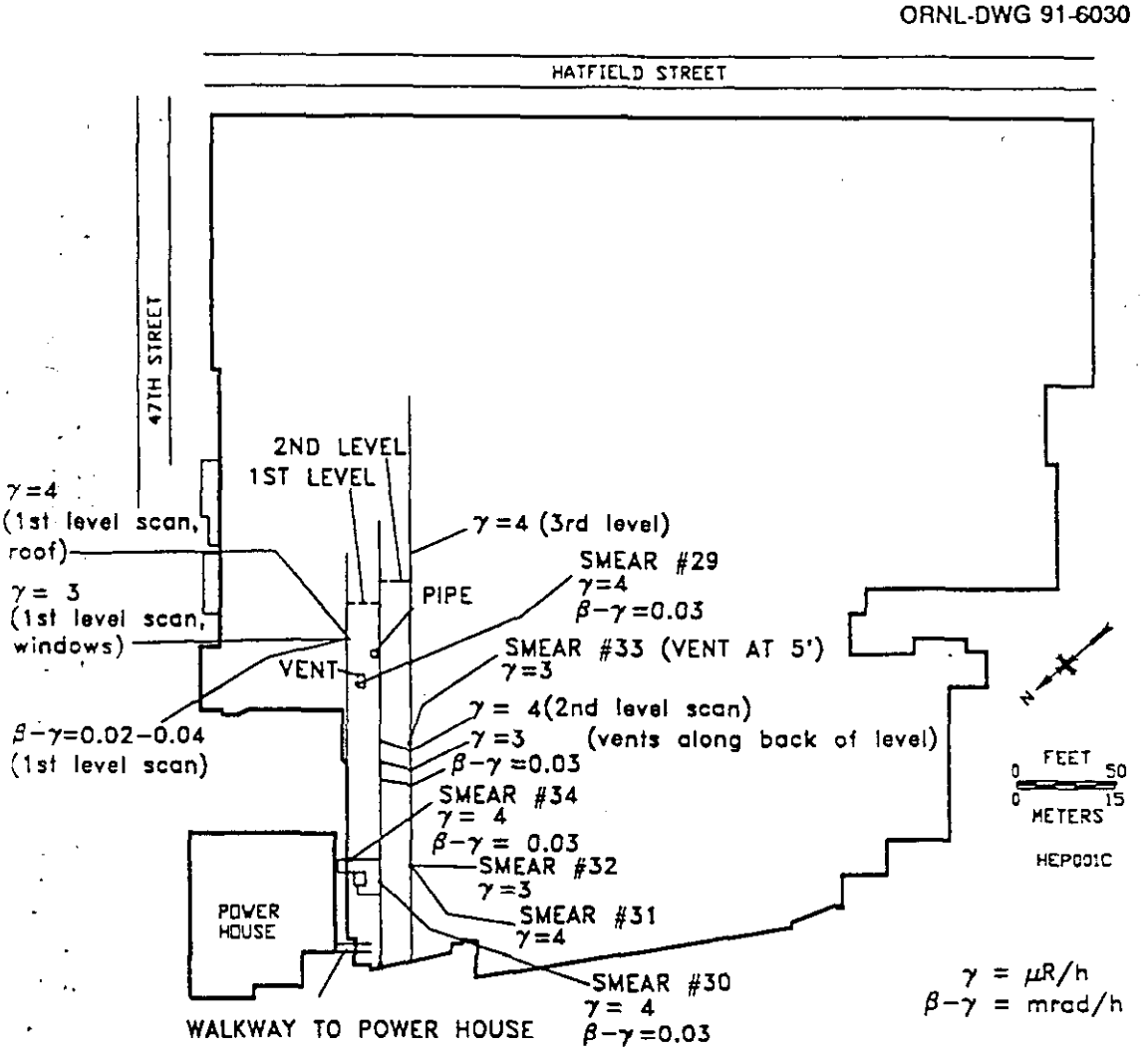

Fig. 4. Gamma exposure rates (μR/h) and locations of direct and transferable alpha and beta-gamma measurements taken on the roof of the warehouse at the former Heppenstall Company site, 4620 Hatfield Street, Pittsburgh, Pennsylvania.

ORNL-PHOTO 424-91

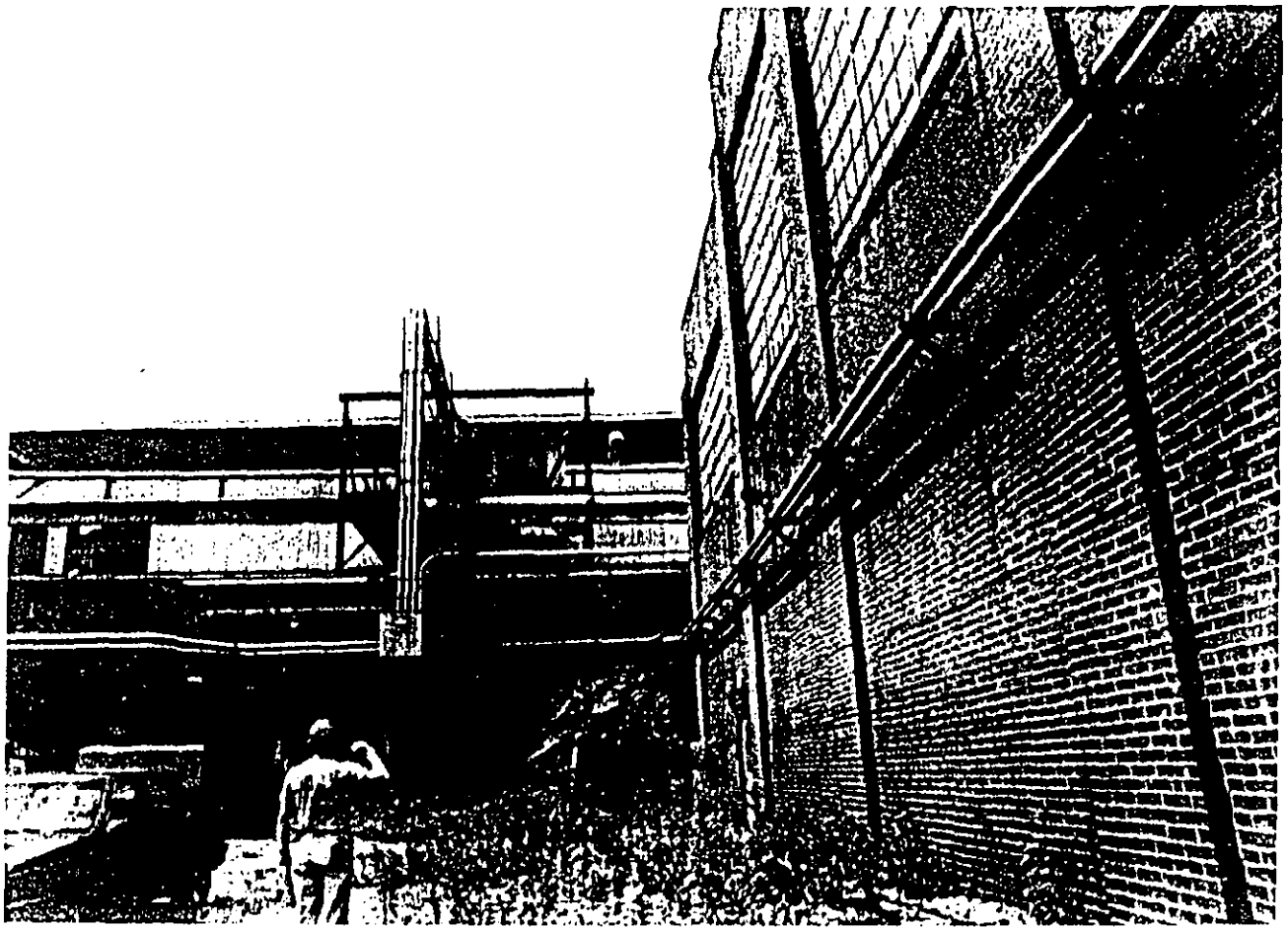

Fig. 5. Photograph of a survey team member taking measurements on the roof of the warehouse at the former Heppenstall Company site, 4620 Hatfield Street, Pittsburgh, Pennsylvania.

Table 1. Applicable guidelines for protection against radiation

Mode of exposure	Exposure conditions	Guideline value
Gamma radiation	Indoor gamma radiation levels (above background)	20 μR/h
Surface contamination[a]	^{238}U and U-natural	
	Fixed on surfaces	5000 dpm/100 cm^2
	Removable	1000 dpm/100 cm^2
	^{232}Th and Th-natural	
	Fixed on surfaces	1000 dpm/100 cm^2
	Removable	200 dpm/100 m^2
	^{226}Ra	
	Fixed on surfaces	100 dpm/100 cm^2
	Removable	20 dpm/100 cm^2
Beta-gamma dose rates	Surface dose rate averaged over not more than 1 m^2	0.2 mrad/h
	Maximum dose rate in any 100 cm^2 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^2 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
	^{226}Ra	
	^{228}Ra	
	^{230}Th	
	^{232}Th	
	^{238}U	Derived (site specific)

[a]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.

Source: 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.

Table 2. Background radiation level and radionuclide concentrations for areas near Pittsburgh, Pennsylvania[a]

Type of radiation measurement or sample	Radiation level or radionuclide concentration
Gamma exposure rate at 1 m (μR/h)	6
Concentration of radionuclides in soil (pCi/g)	
^{226}Ra	1.4
^{232}Th	1.3
^{238}U	1.3

[a]Background radiation level and radionuclide concentrations are the average of eight sample designations surrounding Pittsburgh, Pennsylvania.

Source: T. E. Myrick, B. A. Berven, and F. F. Haywood, *State Background Radiation Levels: Results of Measurements Taken During 1975–1979,* Oak Ridge National Laboratory, ORNL/TM-7343 (November 1981).

Table 3. Concentrations of radionuclides in soil and dust samples from the former Heppenstall Company site, Pittsburgh, Pennsylvania

Sample ID[a]	Depth (cm)	Radionuclide concentration (pCi/g)[b]		
		^{226}Ra	^{232}Th	^{238}U
Systematic soil samples[c]				
S1	0–15	1.5 ± 0.04	1.9 ± 0.06	1.8 ± 1.0
S2	0–15	1.6 ± 0.03	1.9 ± 0.1	2.1 ± 0.7
S3	0–15	0.71 ± 0.03	0.69 ± 0.05	<1.7
S4	0–15	0.58 ± 0.01	0.62 ± 0.03	0.64 ± 0.4
S5	0–15	0.45 ± 0.01	0.50 ± 0.02	0.99 ± 0.3
Biased soil sample[d]				
B1	0–15	0.65 ± 0.02	0.69 ± 0.03	0.95 ± 0.6
Dust samples[e]				
M1	*f*	0.78 ± 0.04	0.68 ± 0.06	2.2 ± 2
M2	*f*	0.57 ± 0.03	0.52 ± 0.05	1.2 ± 0.9

[a]Locations are shown on Fig. 2.
[b]Indicated counting error is at the 95% confidence level (± 2σ).
[c]The systematic soil samples were taken irrespective of gamma exposure rates.
[d]The biased sample was taken from an area showing elevated gamma exposure rates.
[e]The dust samples were taken from a wall beam (M1) and a support beam (M2).
[f]The dust samples were collected from the beam surfaces.

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