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RESULTS OF THE RADIOLOGICAL SURVEY AT THE JESSOP STEEL COMPANY SITE, 500 GREEN STREET, WASHINGTON, PENNSYLVANIA (JSP001)

W. D. Cottrell
R. D. Foley
L. M. Floyd

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ORNL/RASA-89/20

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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ABSTRACT

At the request of the U.S. Department of Energy (DOE), a group from Oak Ridge National Laboratory conducted investigative radiological surveys at the Jessop Steel Company, 500 Green Street, Washington, Pennsylvania (JSP001) in 1989. The purpose of the surveys was to determine whether the property was contaminated with radioactive residues, principally ^{238}U, as a result of work contracted to the Atomic Energy Commission. The survey included gamma scans; direct and transferable measurements of alpha and beta-gamma radiation levels; and soil, dust, debris, grinding wheel, and air sampling for radionuclide analyses. The survey and sampling covered portions of the exterior ground surface, the roof and gutter section above the saw shop and rolling mill area of building D, and the interiors of buildings A, B, C, and D.

Results of the survey demonstrated no radionuclide concentrations in excess of the DOE Formerly Utilized Sites Remedial Action Program guidelines for radium, thorium, and uranium. The radionuclide distributions were not significantly different from typical background levels in the Pennsylvania area.

RESULTS OF THE RADIOLOGICAL SURVEY AT THE JESSOP STEEL COMPANY SITE, 500 GREEN STREET, WASHINGTON, PENNSYLVANIA (JSP001)*

INTRODUCTION

As lead agency in the development of nuclear energy for defense-related projects, the Atomic Energy Commission (AEC) subcontracted the processing and fabrication of uranium ores, oxides, and metals. Raw materials containing uranium ores were procured, stored, and processed into various uranium oxides, salts, and metals. Fabricators were contracted as needed to form (roll and machine) the metal into various shapes. At contract termination, sites used by contractors were decontaminated according to the criteria and health guidelines then in use. In some instances, however, documentation was limited and insufficient to establish the current radiological conditions at a site. Therefore, it was necessary to reevaluate the current radiological conditions at these sites under the U.S. Department of Energy (DOE) Formerly Utilized Sites Remedial Action Program (FUSRAP).

In the early 1950s, the Jessop Steel Company received shipments of uranium metal, as nickel scrap, via the DuPont Company. The Jessop plant annealed, out-gassed, rolled and ground the metal into rods and plates for use at AEC's Fernald Area operations.[1] This commercial property is located at 500 Green Street, Washington, Pennsylvania.

The Jessop plant is a complex of buildings covering approximately 18 acres. The layout of the southern half of the plant is shown in Fig. 1. The work for AEC was conducted in only four areas of this complex, shown in Fig. 1 as buildings A through D. As seen in Figs. 2 through 10, the buildings are predominately one-story structures with steel framing and sheet metal siding on either concrete, firebrick, or metal floors. The material to be processed was shipped to the plant via motor freight. Figures 3 through 10 show the former equipment areas still in existence. Old furnaces and straighteners which might have been contaminated from the uranium processing were removed on completion of the project. The old pickling building was demolished in the early 1960s. Some of the large timbers were salvaged and subsequently used in the private sector. The remainder of the building was reduced to rubble and burned. The concrete floor was also torn up. The rubble, concrete, and ash remains were buried on site. Currently, these scraps lie under approximately 10 to 15 feet of fill. This burial area is indicated in Fig. 1 and photographed in Fig. 2.

During conversations with the property owner's representatives, a recipient of approximately one-third of the salvaged timbers was identified. Approximately 445 linear feet of these timbers were used to build a patio at 201 Winona Avenue, Washington, Pennsylvania.

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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 the Jessop uranium metal fabrication was apparently related to AEC activities, verification of existing conditions was needed to determine whether the site met current radiological guidelines, then, if necessary and appropriate, to correct these conditions. The principal radionuclide of concern is ^{238}U.

On June 5, 1989, the preliminary radiological survey at 500 Green Street, Washington, Pennsylvania, was conducted by members of the Measurement Applications and Development Group of the Oak Ridge National Laboratory (ORNL) at the request of DOE. The survey and sampling at this site covered accessible portions of the southern half of the plant outdoors and the interiors of buildings A, B, C, and D, as indicated in Fig. 11. Survey emphasis was on the interior floors, overhead beams, and air in these possible uranium fabrication areas. The furnaces in building D were not surveyed by request of the Jessop management due to possible safety hazards the team members could encounter in this area. On December 13, 1990, an ORNL survey team examined the patio at 201 Winona Avenue. The timbers used in this patio were of varying lengths but otherwise measured 8" x 12", 4" x 7", and 4" x 8".

SURVEY METHODS

The radiological survey included: (1) a surface gamma scan in selected areas of the property outdoors and indoors, as well as sections of the roof and gutter on the north side of building D over the rolling mill area; (2) collection and radionuclide analyses of indoor floor debris, grinding wheel fragments, and overhead beam dust samples, as well as outdoor soil samples; (3) direct and removable alpha and beta-gamma activity levels indoors and outdoors; and (4) air sampling in building D. The survey methods followed the basic plan outlined in a correspondence from W. D. Cottrell to A. J. Whitman.[2]

Using a portable Victoreen gamma scintillation meter, a gamma scan was performed indoors in the accessible areas of buildings A, B, C, and D and in selected areas outdoors. The detectors were held approximately three inches above the floor/ground surface, and ranges of measurements were recorded and then converted to μR/h. Systematic dust, debris, grinding wheel, and soil samples were taken at various locations, irrespective of gamma radiation levels; biased soil samples were taken outdoors near the Chartiers Creek bank (Fig. 11). The samples were analyzed for ^{226}Ra, ^{232}Th, and ^{238}U content.

Direct alpha and beta-gamma radiation measurements were taken outdoors on the roof and gutter of building D (north side), selected exterior walls of buildings B and C, and indoors on overhead beams and an exterior furnace vent inside building B. A beer-mug type probe (ZnS) with an ORNL meter was used to measure alpha activity levels, and a GM pancake type probe was used to determine beta-gamma dose rates. Smears from 100 cm^2 areas were taken at some of the indoor locations to establish removable alpha and beta-gamma activity levels. Smear sample locations are shown in Fig. 11. Comprehensive descriptions of all survey methods and instrumentation have been presented in another report.[3]

SURVEY RESULTS

DOE guidelines are summarized in Table 1.[4,5,6] The typical background radiation levels for the Pennsylvania area are presented in Table 2.[7] These data are provided for comparison with survey results presented in this section. 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 measured in soil and dust/debris samples. Removable radioactivity levels (smears) are reported as net counts with background subtracted.

Outdoor Survey Results

Gamma Exposure Rate Measurements

Gamma radiation levels measured during a scan of selected areas outdoors including the creek bank are given in Fig. 11. Gamma exposure rates generally ranged from 3 to 6 μR/h, with the block walls showing the highest values of 8 to 16 and 20 μR/h. The roof and gutter on the north side of building D measured 3 to 4 μR/h. The slight elevations in gamma levels can be attributed to naturally occurring radioactive substances present in bricks, concrete, granite, and other such materials used in paving and building construction. Otherwise, none of the outdoor measurements were elevated.

Systematic and Biased Soil Samples

Systematic and biased soil samples were collected near Chartiers Creek bank for radionuclide analyses; laboratory results are provided in Table 3. Their locations are shown in Fig. 11 as S1, B1, and B2. Concentrations of radium, thorium, and uranium in these samples ranged from 0.28 to 1.2 pCi/g, from 0.35 to 1.4 pCi/g, and from <0.82 to 1.5 pCi/g, respectively. All samples were below DOE guidelines (Table 1) and near or below typical background levels for the Pennsylvania area (Table 2).

Alpha and Beta-Gamma Activity Levels

Measurements of direct radioactivity levels were taken on the creek bank, the north roof and gutter section of building D, and the south block wall of building C (Fig. 11). All 5 direct alpha measurements were below the minimum detectable activity (MDA)* level of 25 dpm/100 cm^2 and well below the DOE guideline of 5000 dpm/100 cm^2 for uranium alpha emitters (Table 1). Direct beta-gamma activity levels for the 5 measurements were also below the MDA of 0.01 mrad/h and well below the DOE surface dose rate limit of 0.20 mrad/h averaged over not more than 1 m^2 (Table 1).

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*The instrument-specific MDA's for directly measured and removable alpha radiation levels are 25 and 10 dpm/100 cm^2, respectively. For directly measured and removable beta-gamma radiation the respective MDA's are 0.01 mrad/h and 200 dpm/100 cm^2.

On the follow-up survey at 201 Winona Avenue, the timbers in the patio were scanned for gamma radiation, as well as beta-gamma activity. Direct alpha measurements were also taken. No elevated activity was found on any of the wooden timbers. The gamma range was 7 to 9 μR/h, beta-gamma levels were <MDA, and alpha activity ranged from <MDA to 37 dpm/100 cm^2. The highest gamma measurement found on the patio was from the firebrick in the outdoor grill; the activity level here was 24 μR/h. The slight elevation in the gamma level is from naturally occurring radioactive substances present in bricks, some concrete, granite, and other such materials used in paving and building construction. Otherwise, none of the outdoor measurements were elevated.

Indoor Survey Results

Gamma Exposure Rate Measurements

Gamma radiation levels measured on overhead beams and during floor scans inside buildings A, B, C, and D are given in Fig. 11. Gamma exposure rates generally ranged from 3 to 5 μR/h in building A, from 2 to 4 μR/h in building B, and from 3 to 10 μR/h in building D. Measurements were 4 μR/h in building C. The highest radiation level in building D was found around a stack of grinding wheels, measuring 40 μR/h. A sample of the grinding wheel was taken for analysis of radionuclide concentrations. Other areas of slightly elevated exposure rates in building D were found on the firebrick and debris inside the excavation site of the old mill, ranging from 8 to 12 μR/h; areas of the firebrick and concrete flooring, measuring 6 to 10 and 8 to 10 μR/h; and one portion of block wall showing 10 μR/h. With the exception of the grinding wheels, the highest levels in building B were from the block wall, measuring 10 μR/h. The slight elevations in gamma levels are typical of the naturally occurring radioactive substances present in bricks, concrete, granite, and other such materials used in paving and building construction. With the exception of the grinding wheels, none of the indoor measurements were elevated above DOE guidelines (Table 1).

Systematic Dust and Debris Samples

Eight dust samples from overhead beams, two floor debris samples from the old mill excavation area in building D, and one grinding wheel sample, as well as one dust sample from the exterior furnace vent in building B, were collected for radionuclide analyses; laboratory results are provided in Table 4. The sample locations are shown in Fig. 11 as M1 through M12. Concentrations of radium, thorium, and uranium in samples M1 through M11 ranged from 0.24 to 1.6 pCi/g, from 0.39 to 2.1 pCi/g, and from 0.67 to 3.6 pCi/g, respectively. Concentrations of the same radionuclides in the grinding wheel sample (M12) were 20, 6.2, and 19 pCi/g, respectively. The radioactivity in this wheel is part of the material used to manufacture the wheel. These wheels are being used in an ongoing industrial process, and the observed radioactivity is not related to the prior use of the facility by DOE's predecessor. With the exception of the grinding wheels, all samples were below DOE guidelines (Table 1) and near or below typical background levels for the Pennsylvania area (Table 2).

Alpha and Beta-Gamma Activity Levels

Measurements of direct and removable radioactivity levels were taken from overhead beams near or in the same areas as the dust samples and from the exterior furnace vent in building B (Fig. 11). All direct alpha measurements were below the MDA level of 25 dpm/100 cm^2 and well below the DOE guideline of 5000 dpm/100 cm^2 for uranium alpha emitters (Table 1). All direct beta-gamma measurements except one in building D were below the MDA of 0.01 mrad/h. This location in building D measured 0.02 mrad/h. All measurements were well below the DOE guideline of 0.20 mrad/h averaged over not more than 1 m^2 (Table 1). Thirteen smear samples were obtained from the same areas; their locations are indicated in Fig. 11 as D1 through D13. Analyses of the smears showed all measurements of removable alpha and beta-gamma contamination from a 100-cm^2 area were below the MDA's of 10 dpm and 200 dpm, respectively, as well as below the DOE guideline of 1000 dpm/100 cm^2 for removable uranium contamination (Table 1).

Air Samples

Two indoor air samples were collected in building D. The location of the air sampling instrument is indicated in Fig. 11 as Z1 and Z2. The samples were taken between two columns on the north side of the building to measure airborne dust from the grinders in that area. Both samples were analyzed for gross alpha and beta radiation. The alpha activity for a one-minute count was below the MDA level of 1.0 E-12 μCi/cc. The beta activity for a one-minute count was also below the MDA level of 1.8 E-11 μCi/cc for beta radioactivity.

SIGNIFICANCE OF FINDINGS

With the exception of the grinding wheel, results of soil, dust, and debris sample analyses taken at 500 Green Street, indicate that the site contained no radionuclide concentrations above DOE guidelines (Table 1). The radioactivity in the grinding wheel is part of the material used to manufacture the wheel. These wheels are being used in an ongoing industrial process, and the observed radioactivity is not related to the prior use of the facility by DOE's predecessor. Gamma radiation levels of 40 μR/h from the grinding wheels in building D and other slight elevations in gamma levels are typical of the naturally occurring radioactive substances present in bricks, concrete, granite, and other such materials used in paving and building construction. With the exception of the grinding wheels, none of the indoor measurements were elevated above DOE guidelines (Table 1). Air samples taken in building D were below MDA for alpha and beta levels of radioactivity. Radionuclide concentrations in the surveyed areas (Table 3) were not significantly different from typical background values in the Pennsylvania area (Table 2). The patio at 201 Winona Avenue was examined and no elevated levels of radioactivity were detected on any of the wooden timbers.

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3. 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*, Oak Ridge National Laboratory, ORNL/TM-8600 (April 1987).

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6. Nuclear Regulatory Commission, *NRC Guidelines for Decontamination at Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for By-Product, Source, or Special Nuclear Material* (May 1987).

7. 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).

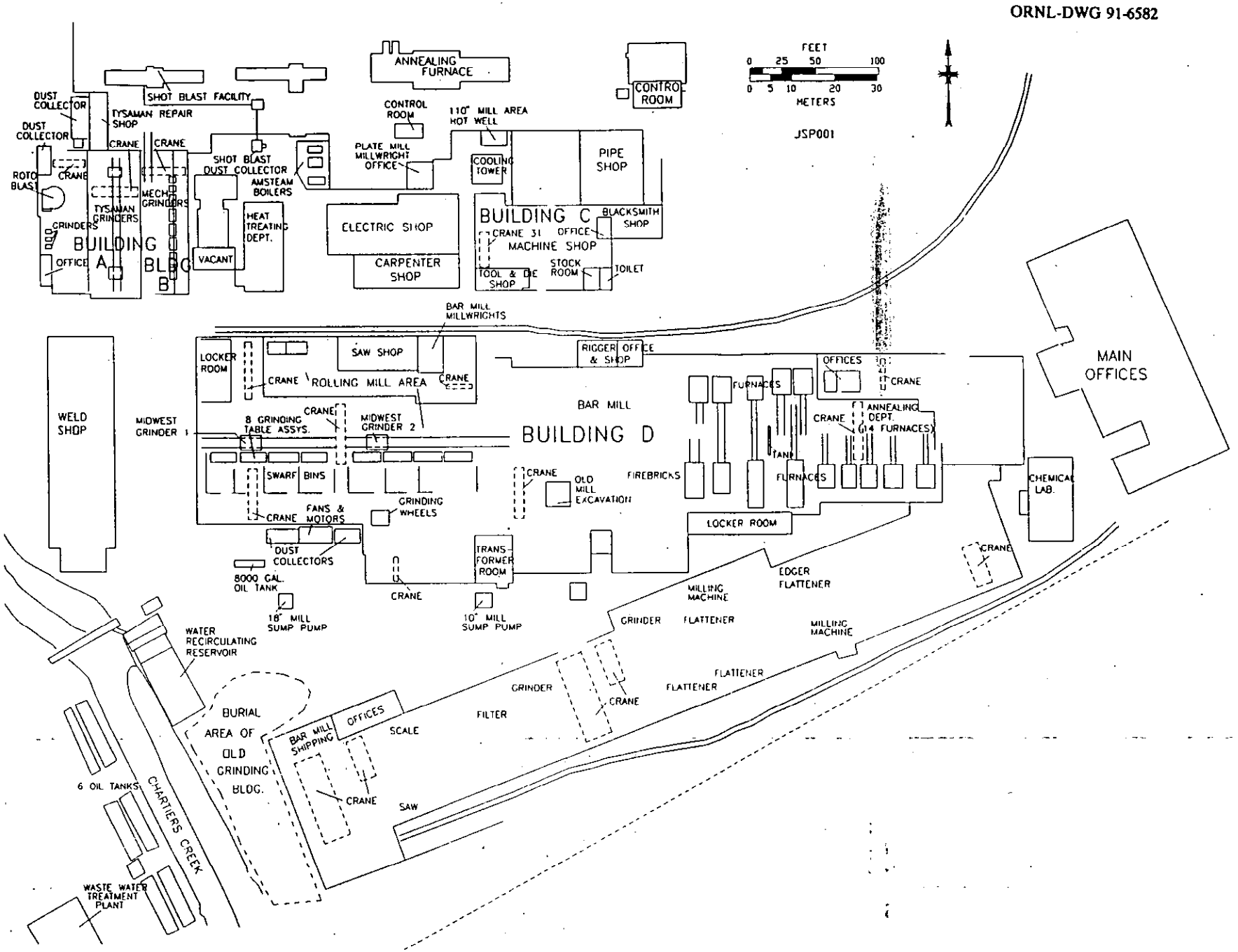

Fig. 1. Map of the southern half of Jessop Steel Company, 500 Green Street, Washington, Pennsylvania (JSP001). Buildings marked as A, B, C, and D were the areas of uranium operations.

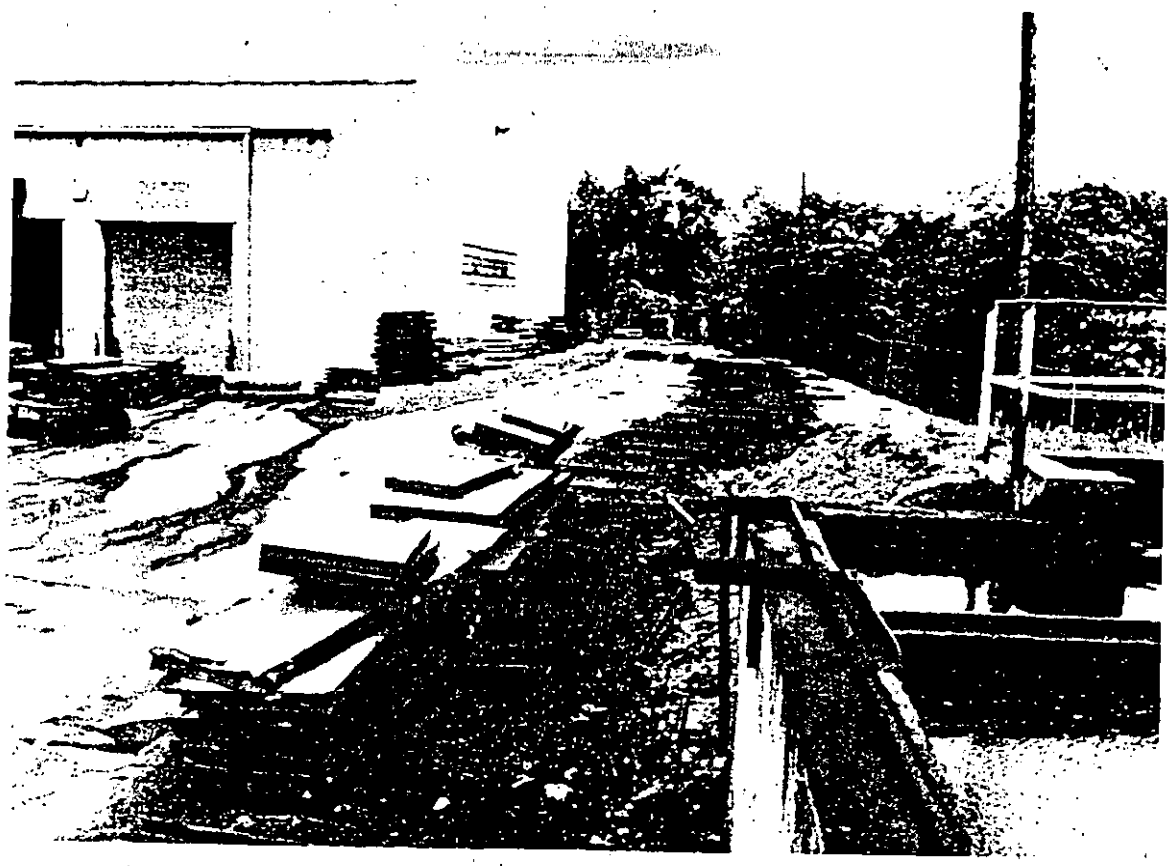

Fig. 2. Southward view of the area used to bury scrap from the old grinding building at Jessop Steel Company, 500 Green Street, Washington, Pennsylvania (JSP001).

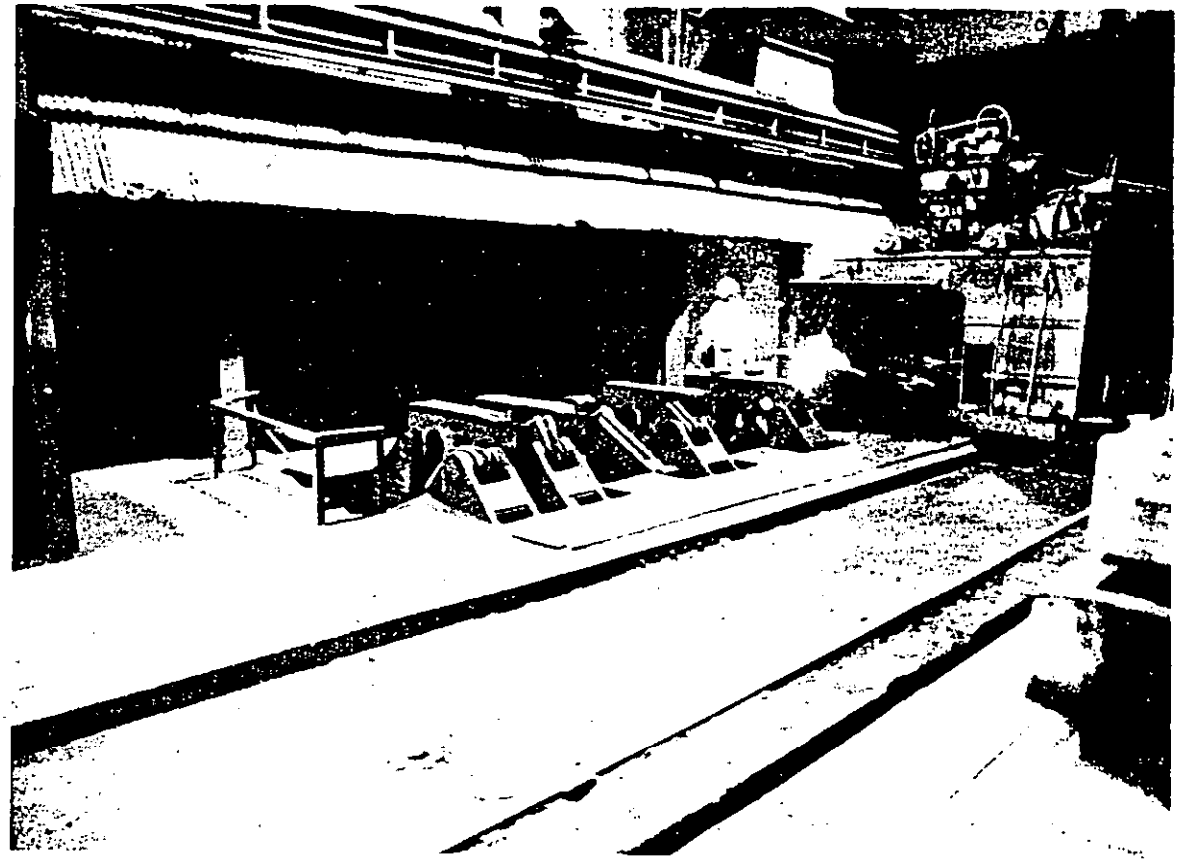

Fig. 3. Northwestward view in building A of the Tysaman grinders at Jessop Steel Company, 500 Green Street, Washington, Pennsylvania (JSP001).

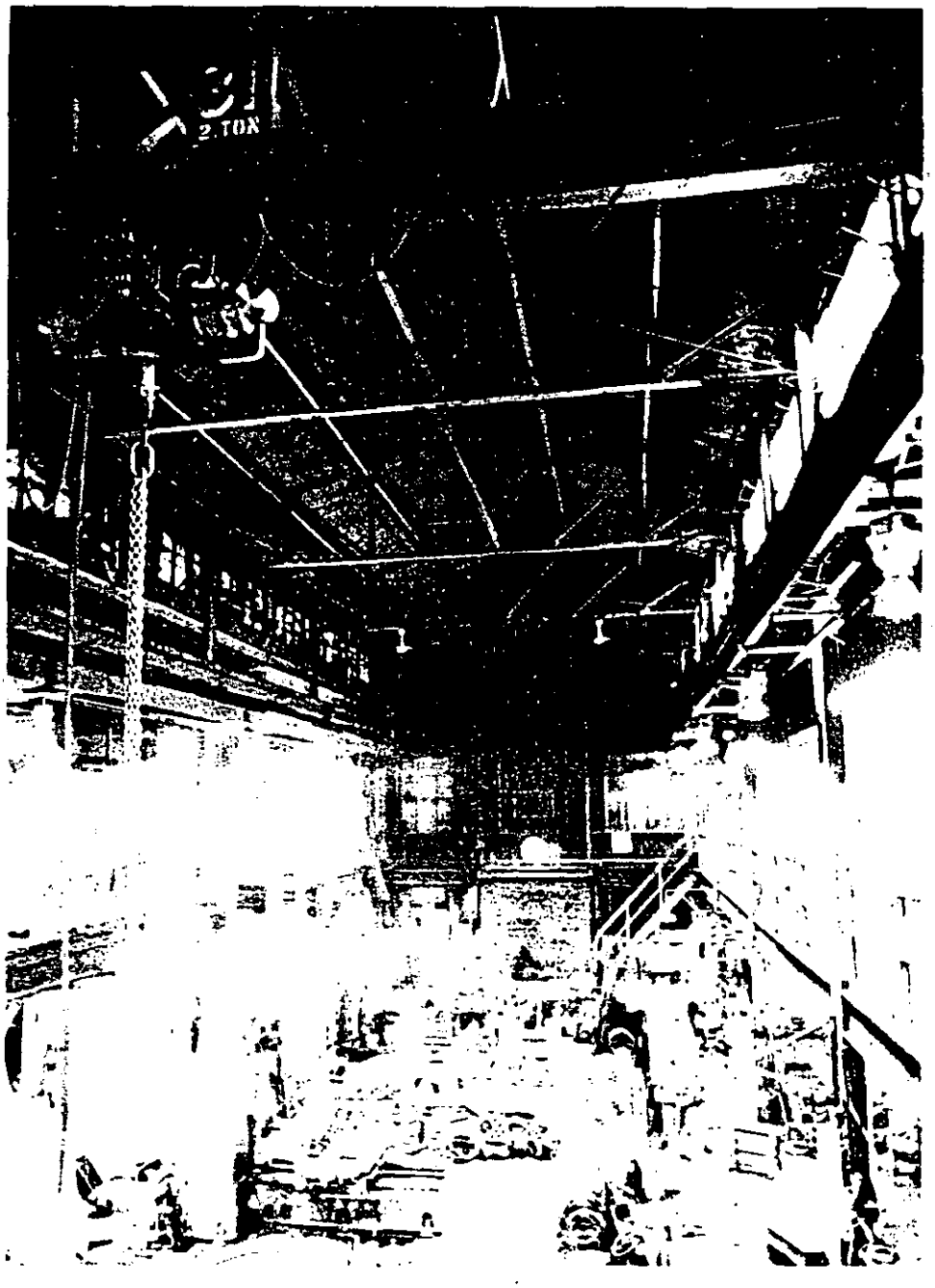

Fig. 4. Northward view in building B at Jessop Steel Company, 500 Green Street, Washington, Pennsylvania (JSP001).

Fig. 5. Eastward view in building C of the machine shop at Jessop Steel Company, 500 Green Street, Washington, Pennsylvania (JSP001).

Fig. 6. Eastward view in building D of the billets of scrap metal in the foreground and the annealing furnaces on the left at Jessop Steel Company, 500 Green Street, Washington, Pennsylvania (JSP001).

Fig. 7. Eastward view in building D of the old mill excavation area at Jessop Steel Company, 500 Green Street, Washington, Pennsylvania (JSP001).

Fig. 8. View in building D of stacks of grinding wheels at Jessop Steel Company, 500 Green Street, Washington, Pennsylvania (JSP001).

Fig. 9. Eastward view in building D of the rolling mill and storage area at Jessop Steel Company, 500 Green Street, Washington, Pennsylvania (JSP001).

Fig. 10. Eastward view in building D of the SWARF bins at Jessop Steel Company, 500 Green Street, Washington, Pennsylvania (JSP001).

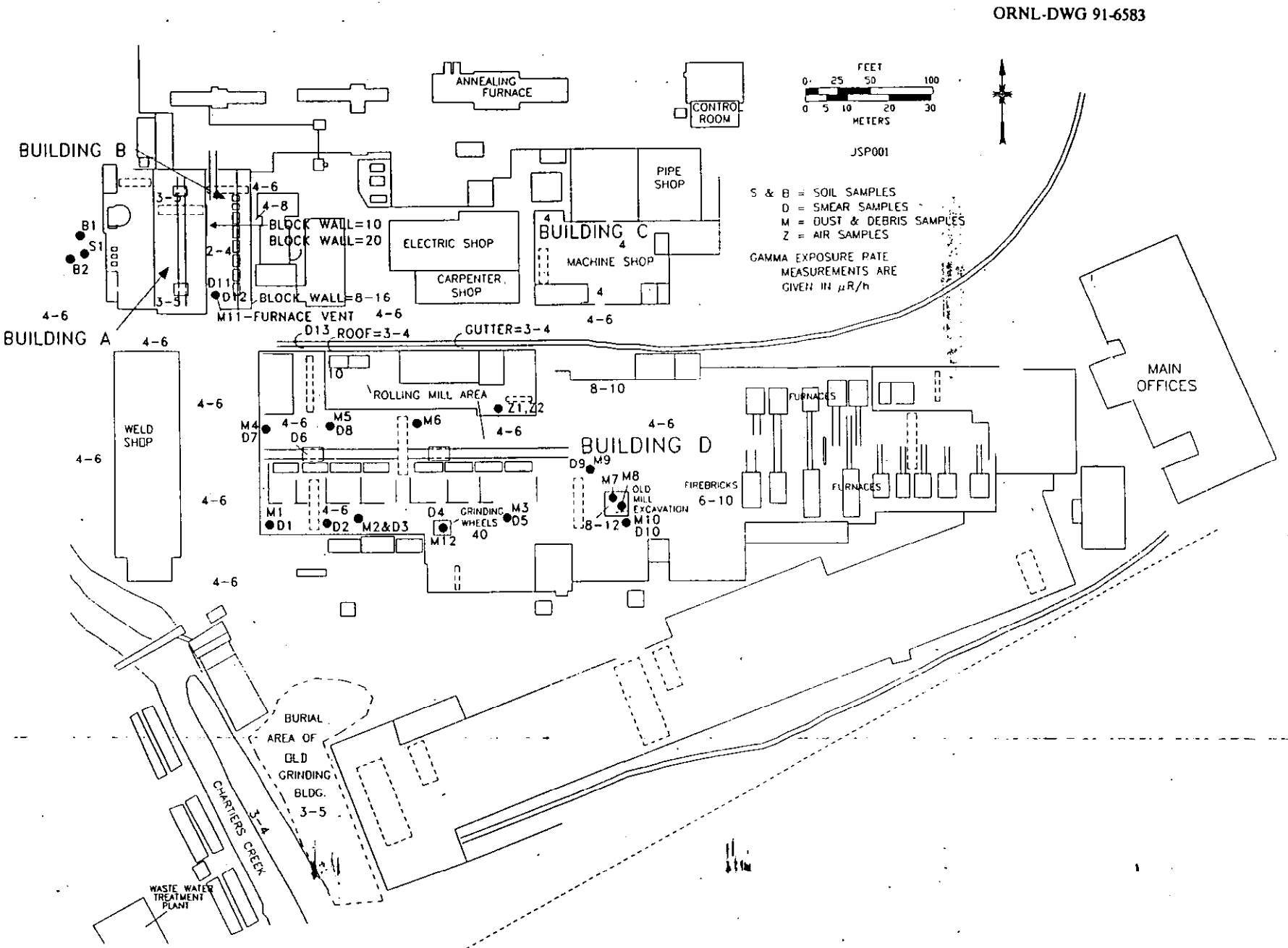

Fig. 11. Surface gamma radiation levels (μR/h) and sampling locations at Jessop Steel Company, 500 Green Street, Washington, Pennsylvania (JSP001). Locations of the 3 soil samples are shown as S1, B1, and B2; the 12 dust, debris, and grinding wheel samples as M1 through M12; the 13 smear samples as D1 through D13; and the 2 air samples as Z1 and Z2.

Table 1. DOE guidelines for protection against radiation[a]

Mode of exposure	Exposure conditions	Guideline value
Gamma radiation	Indoor gamma radiation level (above background)	20 μR/h
Surface contamination[b]	^{238}U, U-natural(Alpha emitters), or Beta-gamma emitters[c]	
	Total residual maximum	15,000 dpm/100 cm^2
	Total residual average	5,000 dpm/100 cm^2
	Total residual removable	1,000 dpm/100 cm^2
	^{232}Th, Th-natural	
	Total residual maximum	3,000 dpm/100 cm^2
	Total residual average	1,000 dpm/100 cm^2
	Total residual removable	200 dpm/100 cm^2
	^{226}Ra	
	Total residual maximum	300 dpm/100 cm^2
	Total residual average	100 dpm/100 cm^2
	Total residual removable	20 dpm/100 cm^2
Beta–gamma dose rates[c]	Surface dose rate averaged over not more than 1 m^2	0.20 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 the soil above background levels averaged over 100 m^2 area: ^{226}Ra, ^{228}Ra, ^{230}Th, ^{232}Th	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.
	^{238}U	Derived (site specific)[d]

[a]References 4 and 5.

[b]DOE surface contamination guidelines are consistent with the Nuclear Regulatory Commission guidelines found in Reference 6.

[c]Beta–gamma emitters (radionuclides with decay modes other than alpha emission or spontaneous fission) except ^{90}Sr, ^{228}Ra, ^{223}Ra, ^{227}Ac, ^{133}I, ^{131}I, ^{129}I, ^{126}I, ^{125}I.

[d]DOE guidelines for uranium are derived on a site-specific basis. While none have been derived for this site, guidelines for ^{238}U typically range between 35 and 150 pCi/g.

Table 2. Average background radiation levels for the Pennsylvania area[a]

Type of radiation measurement or sample	Radiation level or radionuclide concentration
Gamma exposure at 1 m above ground surface	μR/h 8
Concentration of radionuclides in soil	pCi/g[b]
^{226}Ra	1.2
^{232}Th	1.1
^{238}U	1.2

[a]Reference 7.

[b]These values represent an average of normal radionuclide concentrations in this state.

Table 3. Concentrations of radionuclides in outdoor soil samples from Jessop Steel Company, 500 Green Street, Washington, Pennsylvania (JSP001)

Sample[b]	Depth (cm)	Radionuclide concentration (pCi/g)[a]		
		^{226}Ra	^{232}Th	^{238}U
		Systematic samples[c]		
S1	0–15	0.28±0.01	0.35±0.02	<0.82
		Biased samples[d]		
B1	0–15	1.0 ±0.03	1.1 ±0.04	1.5 ±0.86
B2	0–15	1.2 ±0.02	1.4 ±0.04	1.1 ±0.52

[a]Indicated counting error is at the 95% confidence level ($\pm 2\sigma$).

[b]Locations of soil samples are shown on Fig. 11.

[c]Systematic samples are taken at locations irrespective of gamma exposure rates.

[d]Biased samples are taken from areas with elevated gamma exposure rates.

Table 4. Concentrations of radionuclides in indoor dust and debris samples from Jessop Steel Company, 500 Green Street, Washington, Pennsylvania (JSP001)

Sample[b]	Depth (cm)	Radionuclide concentration (pCi/g)[a]		
		^{226}Ra	^{232}Th	^{238}U
		Systematic samples[c]		
M1	0–5	0.56 ± 0.02	1.1 ± 0.05	< 1.3
M2	0–5	0.44 ± 0.04	0.73 ± 0.07	1.3 ± 1.0
M3	0–5	0.24 ± 0.03	0.39 ± 0.05	3.6 ± 1.2
M4	0–5	0.48 ± 0.03	0.74 ± 0.06	< 2.3
M5	0–5	0.62 ± 0.03	0.86 ± 0.05	1.1 ± 0.67
M6	0–5	0.50 ± 0.02	0.68 ± 0.04	1.2 ± 0.68
M7	0–5	1.2 ± 0.03	1.3 ± 0.05	1.1 ± 0.61
M8	0–5	1.6 ± 0.02	2.1 ± 0.03	2.1 ± 0.76
M9	0–5	0.39 ± 0.03	0.54 ± 0.05	< 1.9
M10	0–5	0.33 ± 0.04	0.44 ± 0.06	< 3.7
M11	0–5	0.43 ± 0.02	0.76 ± 0.03	0.67 ± 0.31
M12[d]	n/a	20 ± 0.34	6.2 ± 0.60	19 ± 6.9

[a]Indicated counting error is at the 95% confidence level ($\pm 2\sigma$).

[b]Locations of indoor samples are shown on Fig. 11.

[c]Systematic samples are taken at locations irrespective of gamma exposure rates.

[d]Grinding wheel fragments taken in building D.

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