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RESULTS OF THE RADIOLOGICAL SURVEY AT DIEBOLD SAFE COMPANY, 1550 GRAND BOULEVARD, HAMILTON, OHIO (HO001)

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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 Diebold Safe Company, 1550 Grand Boulevard, Hamilton, Ohio (HO001) in 1988 and 1989. The purpose of the surveys was to determine whether the property was contaminated with radioactive residues, principally ^{238}U, derived from the former Manhattan Engineer District (MED) project. The surveys included gamma scans; direct and transferable measurements of alpha, beta, and gamma radiation levels; and dust, debris, air, and soil sampling for radionuclide analyses.

Results of the survey demonstrated no radionuclide concentrations in excess of the DOE Formerly Utilized Sites Remedial Action Program criteria for air and soil samples remaining at the site. All but three dust and debris samples were below federal guidelines and contained very low levels of radium, thorium, and uranium. Small fragments of uranium metal left from the machining operation were believed to be the source of elevated radionuclides in the three samples above DOE criteria. After removal of these samples, no beta or gamma radiation above background could be detected.

RESULTS OF THE RADIOLOGICAL SURVEYS AT DIEBOLD SAFE COMPANY, 1550 GRAND BOULEVARD, HAMILTON, OHIO (HO001)*

INTRODUCTION

Under jurisdiction of the Army Corps of Engineers in the early 1940s, the Manhattan Engineer District (MED) was established as the lead agency in the development of nuclear energy for defense-related projects. 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. The radiological criteria for releasing sites to unrestricted use were generally site specific and clearly defined. In some instances, however, documentation was limited or nonexistent and conditions at these sites were unknown. 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).

Intermittently from the 1940s to the early 1950s, the Herring–Hall–Marvin Safe Company (HHMSC) in Hamilton, Ohio machined uranium slugs from rolled stock under subcontract to the MED. This commercial property was later purchased by the Diebold Safe Company and is located at 1550 Grand Boulevard, Hamilton, Ohio.

The facility is a large, roughly rectangular building ($\sim$ 300,000 ft^2), constructed mostly of wood (Figs. 1 and 2). The interior is an open design with few walls and a support structure of columns and beams with cross braces (Figs. 3 and 4). High bays are offset by rows of windows at the ceiling (Fig. 3). The uranium metal was delivered via the former railroad tracks through the western side of the building and brought into the machining area (Fig. 5). The approximate area in which the uranium had been machined was established through conversations with Corporate officials and from marked drawings furnished by them (Fig. 5). The operation was carried out in the midst of a large machine room. In a correspondence dated August 4, 1943, three machines used in this process were identified by number.[1] Two of these machines were located on old floor plans of the HHMSC. One Cleveland Automatic Machine, No. 115, was just north of column P/10. One J.&L. Turret Lathe, No. 282, was located north of and between columns P/16–17. Two Acme Turret Lathes were located north of and between columns P/20–21 and S/20–21, respectively. These lathes were used in machining the $1\frac{3}{8}$-inch billets of uranium. The metal was flooded with a water-soluble cooling oil while being machined. However, company correspondence indicated that occasionally limited quantities of the pyrophoric uranium spontaneously ignited.

*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.

The uranium machining activity was relatively small scale and appears to have covered short periods of time. Therefore, levels of residual uranium and any resulting exposure were expected to be insignificant. Radiological surveys of the facility were necessary to verify whether the site meets current radiological guidelines. As a result of the Energy and Water Appropriations Act of Fiscal Year 1984, this property was included as a possible decontamination research and development project under FUSRAP. The principal radionuclide of concern is ^{238}U.

On August 29 and 30, 1988, a radiological survey at 1550 Grand Boulevard was conducted, at the request of DOE, by members of the Measurement Applications and Development Group of the Oak Ridge National Laboratory (ORNL). The surveys and sampling covered portions of the exterior ground surface, roof section above the uranium machining area, and the interior of the building. Survey emphasis was on the interior floor, the mezzanine, overhead beams of the uranium work station and the adjacent area, as well as the air in the uranium work station area. The rest of the building was also surveyed but with less intensity. On April 24, 1989, an ORNL survey team returned to the Diebold site for additional indoor sampling.

SURVEY METHODS

The radiological surveys included: (1) a gamma scan of the surface of the entire property outdoors and indoors, as well as the section of the roof over the machining area; (2) collection and radionuclide analyses of indoor debris scraped from the floor near the machining area, composite dust samples from selected beams in and around this area, a sample of Bison Satin Finish Buffing and Polishing Compound, one sanding belt, and outdoor surface soil samples; (3) direct and transferable alpha and beta-gamma activity levels in this and adjacent areas and on the roof above; and (4) air sampling of the same areas.

To provide better definition of the area to be surveyed, the site was subdivided into grid blocks based on the existing columns, as shown in Fig. 5. The columns were numbered, west to east, and lettered, south to north. The columns represent the intersection of grid lines. These intersections are referenced in the text with a slash, as T/18. Using a portable Victoreen gamma scintillation meter, a gamma scan was performed indoors in each accessible grid block, outdoors adjacent to the building, and on the roof above the machining area between columns P and T. The detectors were held approximately three inches above the ground surface or floor, and ranges of measurements were recorded. If the gamma levels were elevated, a biased sample was taken at the point showing the highest gamma radiation level. These samples are more likely to contain elevated radioactivity than systematic samples. Systematic samples were taken at various locations, both indoors and outdoors, irrespective of gamma radiation levels. Systematic, composite dust samples were collected from the tops of preselected beams and combined (Fig. 6). The composite dust samples were also taken independently of gamma activity; they were collected to obtain a general representation of the radionuclide levels above and surrounding the machining area. The samples were analyzed for ^{232}Th and ^{238}U content, and in some cases, ^{226}Ra.

High bays between columns K and P, as well as T and W, generally prevented scanning or collecting dust samples from the beams in these areas, except for the beams accessible from the mezzanine (Fig. 3). The beams above the mezzanine at column P were surveyed to some extent from the roof through the windows.

On surfaces in areas of possible contamination and/or where exposure rates were elevated, beta–gamma dose rate measurements were determined using a GM pancake type probe with either a Technical Associates Instrument or a Rascal; and alpha activity levels were determined using a beer–mug type probe with an alpha scintillation meter. Smears from 100 cm^2 areas were also obtained from selected surfaces of the beams in the composite areas and on the roof. The purpose of the smears was to establish transferable alpha and beta–gamma activity levels.

In the April survey of the site, three indoor air samples were taken approximately 1.5 m above floor level using two Gast vacuum pumps with milipore paper filters (0.8 μm) at a rate of 22.6 L/min. Air samples were taken near areas of elevated gamma activity or radionuclide concentrations. Additional systematic and biased samples were taken indoors also. These survey methods followed the plan outlined in Reference 2. A comprehensive description of the survey methods and instrumentation has been presented in another report.[3]

SURVEY RESULTS

Applicable DOE residual radioactivity guidelines for protection of the general public are summarized in Table 1.[4 and 5] The normal background radiation levels for the Ohio area are presented in Table 2.[6] 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 environmental samples. Transferable radioactivity levels (smears) are reported as net counts with background subtracted.

Outdoor Survey Results

Gamma Radiation Levels

Gamma radiation levels measured during a scan of the surface of the property outdoors are given in Fig. 5. Gamma exposure rates ranged from 7 to 8 μR/h. Measurements on the roof between columns P and T and also from the window ledges above the mezzanine ranged from 2 to 4 μR/h; however, a new roof had been installed within the last five years. None of the levels were elevated.

Systematic Soil Samples

Systematic soil samples were taken from three locations on the property outdoors for radionuclide analyses. Locations of the systematic (S) samples are shown in Fig. 6, with results of laboratory analyses provided in Table 3. Since elevated gamma levels were not detected outdoors, biased samples were not taken.

Concentrations of radium, thorium, and uranium in these samples ranged from 0.97 to 1.22 pCi/g, 0.59 to 0.78 pCi/g, and 1.38 to 1.55 pCi/g, respectively. 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. Radionuclide concentrations in all samples were below DOE criteria (Table 1) and were not significantly different from normal background levels for the Ohio area (Table 2).

Alpha and Beta-Gamma Measurements

Measurements of direct and transferable radioactivity levels were taken on the roof above columns Γ through T and from the window ledges above the mezzanine. All direct alpha measurements (six) in these areas were at or near the minimum detectable amount (MDA) of <30 disintegrations per minute (dpm) per 100 cm^2 and well below DOE guidelines for fixed uranium concentration (Table 1). Direct beta-gamma surface activity levels for the six measurements in these areas were also below the MDA of 0.05 mrad/h and were well below government criteria for beta-gamma dose rates (Table 1).

Three smear samples were obtained from the same areas as the direct measurements. Analyses of the smears showed all measurements of transferable alpha and beta-gamma radiation from a 100 cm^2 area were below the MDA's of 10 dpm and 120 dpm, respectively, as well as below DOE guidelines for removable uranium (Table 1).

Indoor Survey Results

Gamma Radiation Levels

Gamma radiation levels measured during a scan of the floor inside the building are given in Fig. 5. Gamma exposure rates generally ranged from 2 to 13 μR/h. The highest gamma levels were 20 to 22 μR/h from a skid of rock salt, located at column V/9; such measurements are common in compounds containing potassium. The brick walls measured from 7 to 16 μR/h, and the concrete floor generally ranged from 2 to 3 μR/h. This slight elevation in gamma levels emanating from the brick is typical of the naturally occurring radioactive substances present in bricks, granite, and other such materials used in building construction.

A second area of slight elevation was detected near a skid containing a polishing compound. The Bison polishing compound measured 15 μR/h; a biased sample of it was taken for analyses. An opened box of sanding belts found in a supply storage area between columns S/14-17 and T/14-18 measured 11 μR/h. Several other factory sealed boxes of these belts gave approximately the same levels. One new belt was taken for gamma spectrographic analysis. The rock salt, polishing compound, and sanding belts were items used by the building owner in current operations.

Another slightly elevated level of 13 μR/h was in an area formerly equipped with an Acme turret lathe near column S/21; a scraping of the floor was taken from this location. This elevated area consisted of two small spots, totaling approximately 0.4 m^2 in surface area, and appeared to be underlain by debris and loose

concrete. The contamination was ascertained to be on top of the tar-like debris and loose concrete. The last spot of slight elevation was found between columns T/18 and T/19, a second floor scraping was taken here. Only these last two areas on the floor were indicative of residual radioactivity associated with the former MED/AEC activities in the building. None of the direct measurements were above DOE guidelines for indoor gamma radiation levels (Table 1).

Systematic and Biased Samples

In August and again in April, dust and debris samples collected from various surfaces inside the building were analyzed for specific radionuclides; these results are provided in Table 4. Their locations are shown in Fig. 6 (S and B).

In the August survey, two systematic dust samples were taken from the tops of two beams off the mezzanine (sample S2 from a diagonal brace at column P/20 and sample S3 from the beam north of P/10). In addition, three composite dust samples (S1, S4, and S5) were systematically taken from the locations shown in Fig. 6 as variously shaded areas. The composite dust samples were made up of dust collected from several locations and combined. Each shading type represents the beams from which dust was collected for one composite sample Concentrations of radium, thorium, and uranium in the systematic and composite samples ranged from 0.40 to 1.19 pCi/g, 0.22 to 0.89 pCi/g, and 1.72 to 14.67 pCi/g, respectively. The highest value of 14.67 pCi/g for systematic samples was from sample S3 near column P/10, the former location of the Cleveland Automatic Machine. In April, two more systematic dust samples (S9 and S10) were taken in the same manner as samples S2 and S3, near the S3 sample location. Sample S9 was taken from an area approximately 1 m above and 1 m south of the sample S3. Sample S10 was taken approximately 1 m east and 2 m above the S3 location. Radionuclide concentrations in both of these later samples were less than the concentrations in S3. With the exception of sample S3, all systematic sample values were below applicable government guidelines (Table 1).

As mentioned previously, the first two biased debris samples were scraped from the floor during the August survey; sample B1 was near column S/21 and sample B2 was between columns T/18 and T/19. These debris samples were a combination of oil, dirt, dust, and sanding residue which had been compacted on the concrete floor over the years into a tarry, asphalt-like material. The debris samples were analyzed for thorium and uranium content, with concentrations ranging from 0.09 to 0.48 pCi/g for thorium-232 and from 26 to 2000 pCi/g for uranium-238. The maximum uranium concentration for the B1 debris sample was greater than the concentration limit derived by DOE for nonhomogeneous contamination at several other sites; these guidelines are summarized in Table 1. However, the contaminated area proved to be isolated and small in surface area (approximately 0.4 m^2). As discussed in the next paragraph, further sampling removed any remaining contaminated debris.

During the April survey, the B1 sample location was resurveyed. Two small areas within this location were identified containing gamma activity slightly above background levels. The areas measured approximately 18 x 24 in. and 10 x 18 in. This part of the floor had been patched some time in the past. The contamination

was on the original concrete and on the patch. The concrete and the patch material were chipped out and removed from these two elevated sections. Dust and fines resulting from the chipping operation were swept from the bottom of the holes and analyzed for uranium as sample B4. This material had a ^{238}U concentration of 38 pCi/g, down from the original concentration of 2000 pCi/g in sample B1 during the first survey of the same area. Concrete and patch material were removed until the direct beta–gamma surface measurements in the chipping zone were indistinguishable from the background levels of unaffected concrete in other parts of the building. Though not specifically derived for this site, guidelines for ^{238}U at other sites typically range between 35 and 150 pCi/g. Radionuclide concentrations in sample B4 were below DOE criteria for isolated areas of less than 1 m^2 (Table 1).

Biased sample B3 was from the Bison polishing compound. The polishing compound sample was found to have 2.05 pCi/g of thorium–232 and 0.68 pCi/g of uranium–238. One of the sanding belts was analyzed for radium, thorium, and uranium content. Assuming 100% of the belt mass contained radioactive materials, the radionuclide concentrations were 1.85, 2.54, and 3.11 pCi/g, respectively. Assuming only 40% of the belt mass contained radioactive materials, the values were 5.13, 7.03, and 8.57 pCi/g, respectively.

Alpha and Beta–Gamma Measurements

Measurements of direct and transferable radioactivity levels were taken from selected beam surfaces in the composite sample areas. All 37 direct alpha measurements on these beams were below the MDA of <30 dpm/100 cm^2 and well below DOE guidelines for fixed uranium (Table 1). Direct beta–gamma surface activity levels for the 37 measurements on these beams were also below the MDA of 0.05 mrad/h and well below government criteria for beta–gamma dose rates (Table 1).

Thirty seven smear samples were obtained from the same areas as the direct measurements. Analyses of the smears showed all measurements of transferable alpha and beta–gamma radiation from a 100 cm^2 area were below the MDA's of 10 dpm and 120 dpm, respectively, as well as below DOE guidelines for removable uranium (Table 1).

Air Samples

During the April survey, three indoor air samples were collected; results are given in Table 5. The locations of the air samples (Z) are shown in Fig. 6. Samples Z1 and Z3 were taken at column S/21, approximately five feet from sample location B1. Sample Z2 was taken at column S/11, near sample location S3. The samples were analyzed for gross alpha and beta radiation. The alpha activity for a one-minute count was below the MDA level of 1.03 E–12 μCi/cc for alpha. The beta activity for a one-minute count was not statistically different from the MDA level of 1.77 E–11 μCi/cc for beta.

SIGNIFICANCE OF FINDINGS

Radiological assessments of dust and debris samples from 1550 Grand Boulevard demonstrated very low levels of radium, thorium, and uranium, with the exception of dust sample S3 and the two biased floor samples B1 and B2. Values for ^{238}U in these three samples (S3, B1, and B2) measured 14.67 pCi/g for S3, 2000 pCi/g for B1, and 26 pCi/g for B2. Since there were no significantly elevated gamma levels in these areas, the source of this elevated radionuclide is believed to be small fragments of the uranium metal itself left from the machining operation and removed with the samples. After removal of the thin layers of debris and concrete at the B1 and B2 locations, no beta or gamma radiation above background could be detected. Based on the S9 and S10 samples taken around S3, the elevated concentration of uranium in dust sample S3 appears to have been confined to a small area and not widespread. Air samples (Z1–3) in these areas were below MDA for alpha and beta levels. All dust sample levels were between 3 and 10% of guidelines for removable surface contamination for ^{238}U. Assuming all activity in the highest composite dust sample (S5) had been collected from one beam, the level would only be 40 % of the DOE guidelines (Table 1). Radionuclide concentrations in soil samples from the site were not significantly different from normal background levels for the Ohio area (Table 2).

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ORNL-PHOTO 89-1420

Fig. 1. View of the main entrance to the building at Diebold Safe Company, 1550 Grand Boulevard, Hamilton, Ohio (HO001), from Mosler Avenue looking west.

ORNL-PHOTO 89-1421

Fig. 2. View of the back of the building at Diebold Safe Company, 1550 Grand Boulevard, Hamilton, Ohio (HO001), from Erie Highway looking north.

ORNL-PHOTO 89-1422

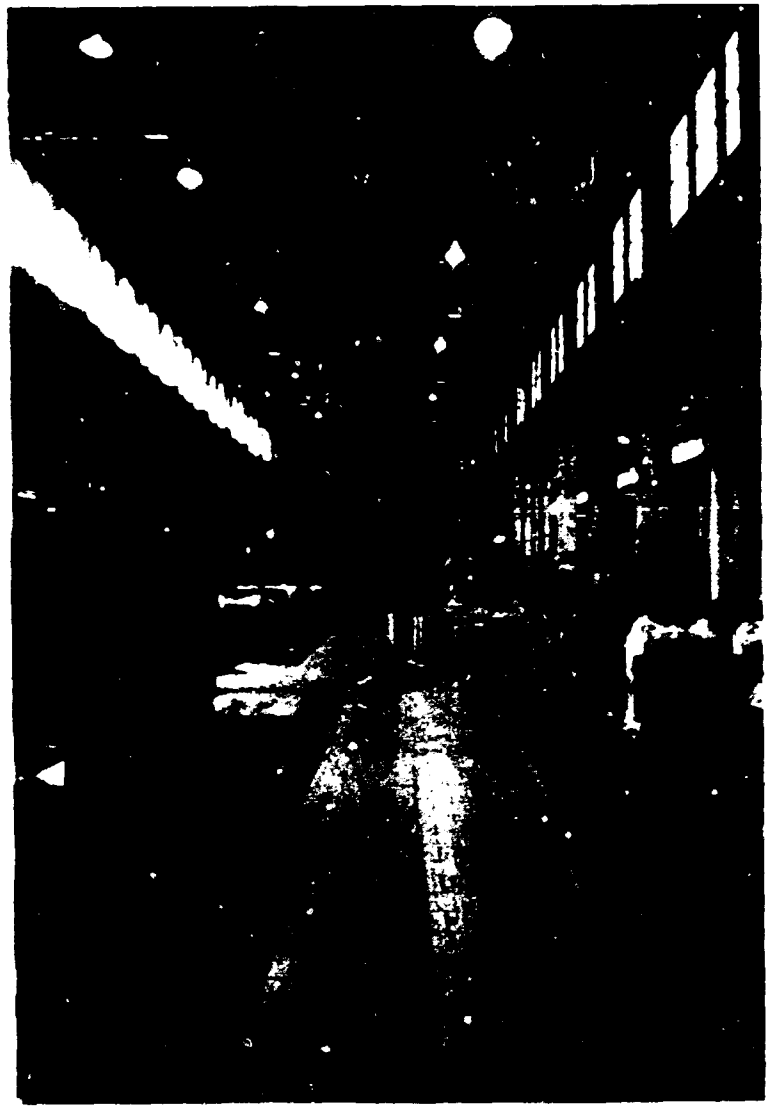

Fig. 3. Interior view of the building at Diebold Safe Company, 1550 Grand Boulevard, Hamilton, Ohio (HO001), showing one high bay area with windows between columns T and V.

ORNL-PHOTO 89-1423

Fig. 4. Interior view of the building at Diebold Safe Company, 1550 Grand Boulevard, Hamilton, Ohio (HO001), showing the cross braces.

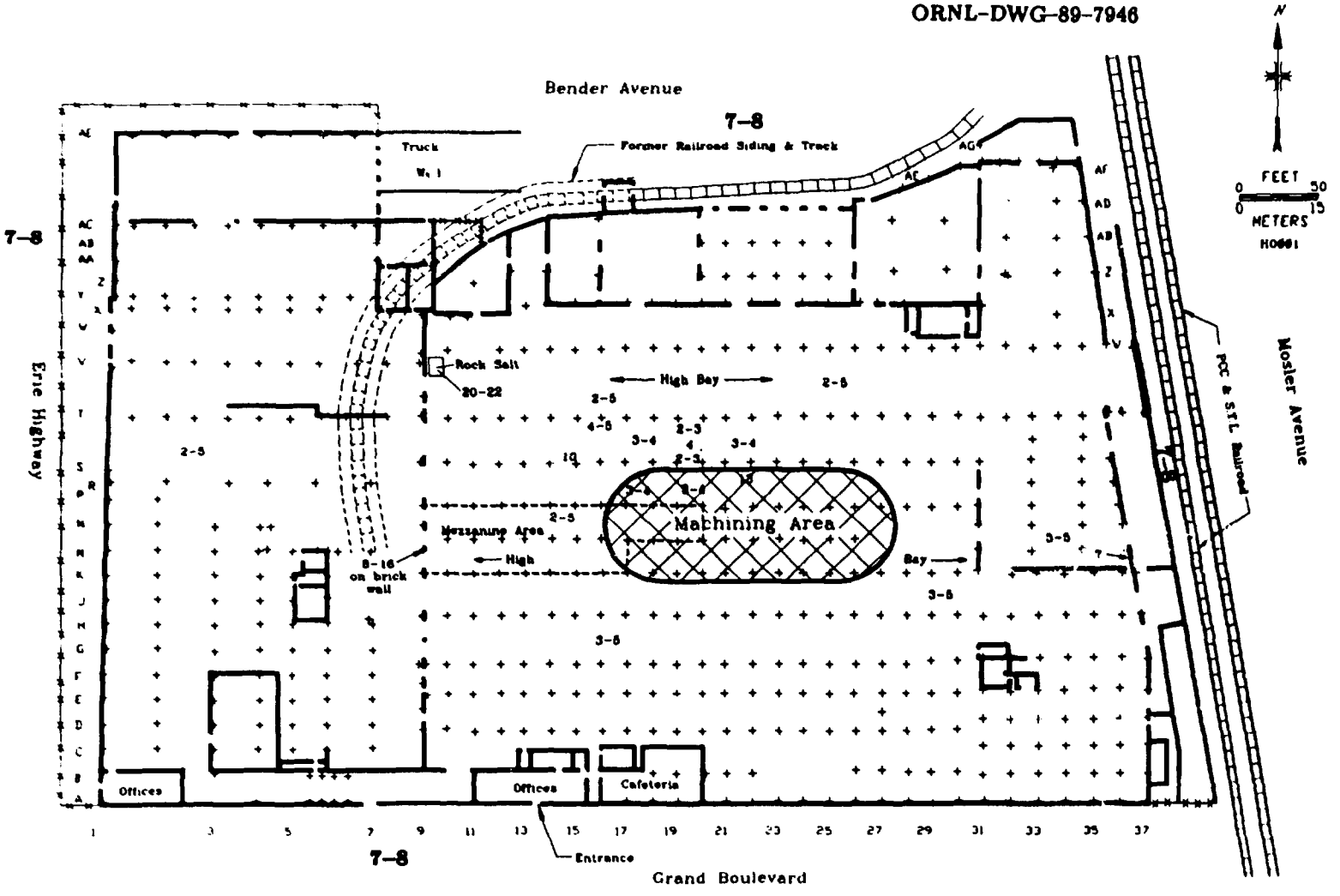

Fig. 5. Gamma radiation levels (μR/h) measured both indoors and outdoors at Diebold Safe Company, 1550 Grand Boulevard, Hamilton, Ohio (HO001).

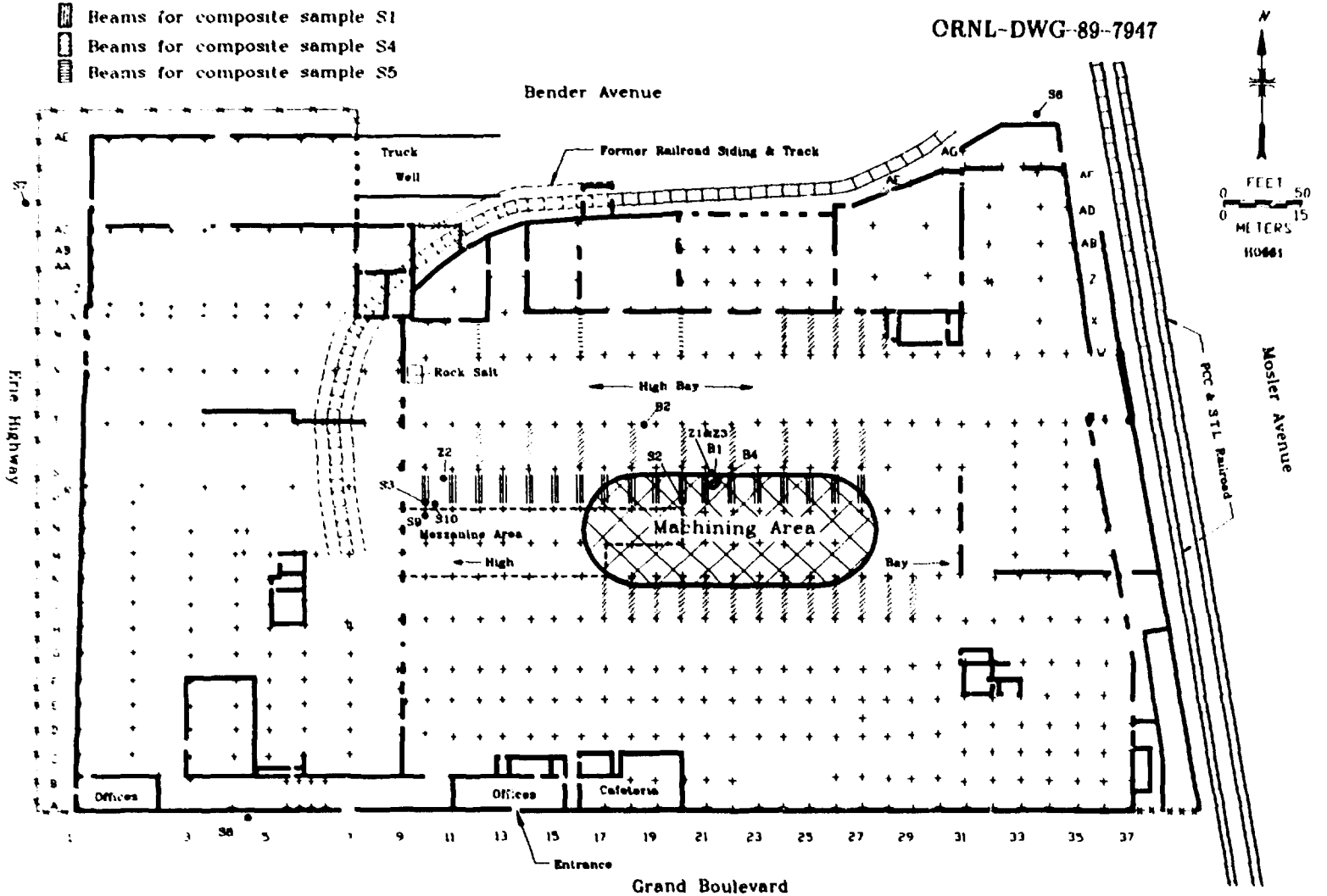

Fig. 6. Diagram showing locations of soil, dust, debris, and air samples taken at Diebold Safe Company, 1550 Grand Boulevard, Hamilton, Ohio (HO001).

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

Mode of exposure	Exposure conditions	Guideline value
Gamma radiation	Indoor gamma radiation levels (above Background)	20μR/h
Surface contamination[b]	^{238}U, U-natural	
	Fixed on surfaces	5000 dpm/100 cm^2
	Removable	1000 dpm/100 cm^2
	Beta-gamma emitters[c]	
	Fixed on surfaces	5000 dpm/100 cm^2
	Removable	1000 dpm/100 cm^2
Beta-gamma dose rates	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 and in various indoor samples[d]	Maximum permissible concentration of the following radionuclides in soil above background levels averaged over 100 m^2 area ^{232}Th ^{230}Th ^{228}Ra ^{226}Ra ^{238}U	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 Derived (site specific)[e]
Guidelines for nonhomogeneous contamination (used in addition to the 100 m^2 guideline)[f]	Applicable to locations meeting the above criterion but $\leq$25 m^2 with significantly elevated concentrations of radionuclides	Concentration limits for application to "hot spots" varying in size as follows: (m^2) (pCi/g)[g] <1 50 1-<3 30 3-<10 15 10-25 10

[a] Reference 4.

[b] DOE surface contamination guidelines are consistent with the Nuclear Regulatory Commission guidelines found in Reference 5.

[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, and ^{125}I.

[d] Indoor samples taken for analyses of radionuclide concentrations consisted of dust samples, floor debris, polishing compound, and sanding belts.

[e] 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.

[f] "Every reasonable effort shall be made to identify and remove any source which has a concentration exceeding 30 times the guideline value, irrespective of area."

[g] These guideline values are applicable to surface concentrations of ^{232}Th, ^{230}Th, ^{228}Ra, and ^{226}Ra only; for other radionuclides and subsurface values, see Reference 5.

Table 2. Background radiation levels for the Ohio area outdoors

Type of radiation measurement or sample	Radiation level or radionuclide concentration
Concentration of radionuclides in soil (pCi/g)	
^{226}Ra	1.5[a]
^{232}Th	1.0[a]
^{238}U	1.4[a]

[a]Reference 6.

Table 3. Concentrations of radionuclides in outdoor soil samples from Diebold Safe Company, 1550 Grand Boulevard, Hamilton, Ohio (HO001)

Sample[a]	Depth (cm)	Radionuclide concentration (pCi/g)		
		^{226}Ra[b]	^{232}Th[b]	^{238}U[b]
		Systematic samples[c]		
S6	0–15	1.06±0.02	0.67±0.03	1.38±0.55
S7	0–15	0.97±0.02	0.59±0.03	1.51±0.42
S8	0–15	1.22±0.02	0.78±0.04	1.55±0.58

[a]Locations of soil samples are shown on Fig. 6.

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

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

Table 4. Concentrations of radionuclides in indoor dust, debris, and polishing compound samples from Diebold Safe Company, 1550 Grand Boulevard, Hamilton, Ohio (HO001)

Sample[a]	Type	Radionuclide concentration (pCi/g)		
		^{226}Ra[b]	^{232}Th[b]	^{238}U[b]
		Systematic samples[c]		
S1[d]	Dust	0.58±0.01	0.51±0.02	2.27± 0.34
S2	Dust	0.40±0.01	0.22±0.02	1.72± 0.29
S3	Dust	1.19±0.08	0.89±0.13	14.67± 2.18
S4[d]	Dust	0.66±0.01	0.60±0.02	3.20± 0.50
S5[d]	Dust	0.74±0.03	0.75±0.05	3.75± 0.51
S9[e]	Dust	0.84±0.04	0.76±0.7	3.1 ± 2.9
S10[e]	Dust	0.77±0.05	0.76±0.07	4.5 ± 2
		Biased samples[f]		
B1	Debris	[g]	0.14±0.014	2000 ±160
B2	Debris	[g]	0.09±0.011	26 ± 1.89
B3[h]	Bison	[g]	2.05±0.14	0.68± 0.08
B4[i]	Debris	0.69±0.06	0.48±0.08	38.2 ± 2.5

[a]Locations of indoor samples are shown on Fig. 6.

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

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

[d]Samples S1, S4, and S5 were three composites of dust collected from the tops of presected beams.

[e]Dust samples S9 and S10 were taken near S3 at a later date and contained radionuclide concentrations below those of S3. See text for details.

[f]Biased samples are taken from areas shown to have elevated gamma exposure rates.

[g]Sample was not analyzed for ^{226}Ra.

[h]Sample B3 was the Bison Corporation Satin Finish Buffing and Polishing Compound.

[i]Debris sample B4 was taken at a later date from the same location as sample B1. See text for details.

Table 5. Concentrations of radionuclides in air samples from Diebold Safe Company, 1550 Grand Boulevard, Hamilton, Ohio (HO001)

Sample[a]	Date	Location	Time	Elapsed Time (minutes)	Volume (liters)	Activity[b] (dpm)
			Air samples[c]			
Z1	4/24/89	S-21	16:50	96	2175	<MDA[d]
Z2	4/24/89	S-11	15:05	127	2877	<MDA
Z3	4/24/89	S-21	18:53	55	1246	<MDA

[a]Locations of air samples are shown on Fig. 6.

[b]Gross radionuclide activity is reported in disintegrations per minute (dpm).

[c]Air samples are taken at 1.5 m above floor level.

[d]Minimum detetable amount (MDA) for ^{238}U is <5% of the U.S. DOE Order 5480.11, December 21, 1988, via inhaled air, Y-Class.