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OAK RIDGE NATIONAL LABORATORY
MANAGED BY MARTIN MARIETTA ENERGY SYSTEMS, INC.
FOR THE U.S. DEPARTMENT OF ENERGY

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POST OFFICE BOX 2008
OAK RIDGE, TENNESSEE 37831

April 22, 1994

Dr. W. A. Williams
EM-421
Trevion II Building
Department of Energy
Washington, D. C. 20585-0002

Dear Dr. Williams:

Results of Radiological Surveys at 525 South Main Street, Oxford, Ohio (OXO002)

In a letter to you dated August 18, 1993, a summary of the initial radiological survey was provided with only limited information regarding ^{238}U concentrations in soil samples and radiation measurements inside the house. Since then, all of the samples from the initial survey have been analyzed, and additional samples have been collected and analyzed. The results have been provided to you and D. G. Adler informally as they became available. This letter contains all the "as-found" survey results produced by Oak Ridge National Laboratory. This letter does not contain survey results verifying post-remedial action surveys. Independent verification survey results will be provided under a separate cover.

Table 1 gives the analytical results of all soil samples (biased and systematic). Biased samples were either collected because elevated radiation above background was detected, or taken in areas suspected of contamination based on experience at similar sites. Systematic samples were collected to provide data on the overall radiological condition of the property in areas where only background radiation was detected. The systematic data is useful in bounding areas of known contamination and providing a basis to collect additional samples if needed. The corresponding sample locations are shown on Fig. 1 for the outside portion of the property, and Fig. 2 for the crawl space of the house. A total of 62 soil samples representing 45 different locations was collected . The most significant activity was found at B004, with the highest activity of 14,000 pCi/g ^{238}U. The vast majority of the ^{238}U at that location was removed by sampling, and since then many samples have been collected near B004 to ensure the extent of the contamination is known.

Other results from Table 1 require further explanation. Location B006 contained an electrical switch with a radium bead for illumination. Apparently some of the radium had leaked from the radium bead into the soil. The switch was removed for disposal at Oak Ridge National Laboratory. Location B005 showed a ^{137}Cs concentration of approximately 6 pCi/g, which is probably attributable to atmospheric fallout from nuclear weapons testing. B005 is located near a roof downspout where rainwater may have concentrated the ^{137}Cs from the roof into a small area where the cesium adhered to soil particles. The ^{137}Cs values in all the other samples are more representative of general fallout. Neither the radioactivity at B005 or B006 can be attributed to operations at the former Alba Craft facility. Slightly elevated concentrations of ^{238}U can also be found along the driveway (B003 and S011 through S015), while ^{238}U under the driveway is detectable but quite low. Samples at locations B001,

B002, and S018 show elevated ^{238}U near the porch. Figure 2 shows numerous small isolated spots of ^{238}U in the crawl space of the house, mostly removed by sampling (B011 through B013 and spots near the fireplace foundation).

Inside the house the contamination was restricted to the part of the house that appeared to be the original structure. Figure 3 shows the areas where ^{238}U was found in the den, and Figure 4 details the bedroom above the garage. The floors in both these areas were tongue and groove hardwood, with the majority of the ^{238}U found in the joints. The locations on the figures identified with "T" numbers were characterized for alpha and beta radiation using direct reading instruments and were smeared to test for transferable contamination. The results are given in Table 2. The direct measurements are given in dpm/100 cm^2, corrected for background radiation. The values are conservative, in that a conversion factor of 30 was used, which assumes the contamination is uniform over a 100 cm^2 area, although in most cases it was not uniform. Because the contamination was in the floor cracks in small spots, the conversion factor should actually range from 5 to 30, but to be consistent (and conservative), 30 was used. The smear sample results (all less than the minimum detectable activity) indicated the ^{238}U was indeed fixed contamination.

The remaining inside locations where contamination was found were the restroom associated with the garage, and the area under the stairway leading from the garage to the upstairs bedroom. The area under the stairway was sealed off by a partition wall in the restroom. In both areas there were numerous small spots; only a few were above Department of Energy guidelines. The maximum activity found in one spot (located on a shelf under the stairway) was approximately 25,000 dpm/100 cm^2. The shower drain in the restroom also contained contamination up to 280 pCi/g (sample B008). Gamma exposure rates on the property as measured with a pressurized ionization chamber are listed in Table 4.

Again, this data represents the condition "as found" at the time by Oak Ridge National Laboratory staff. Bechtel National, Inc. has conducted additional radiological surveys and initiated remedial actions; therefore, complete information is not provided in this letter. Please contact me if you have any comments or questions.

Sincerely,

Michael E. Murray

Michael E. Murray
Measurement Applications
and Development Group

Enclosures 11

MEM:kjb

c: D. G. Adler, DOE-OR (2)
W. D. Cottrell
R. D. Foley
File-Rc

Table 1. Concentrations of radionuclides in soil samples from 525 South Main Street, Oxford, Ohio

Sample ID[a]	Depth (cm)	Radionuclide concentration (pCi/g)[b]		
		^{137}Cs	^{226}Ra	^{238}U
		Systematic samples[c]		
S1A	0–15	0.40±0.11	1.3±0.1	1.9 ±0.8
S1B	15–30	0.23±0.07	1.2±0.1	2.4 ±0.5
S2A	0–15	0.41±0.07	0.9±0.1	0.9 ±0.5
S2B	15-30	0.16±0.05	1.0±0.1	0.8 ±0.4
S3A	0-15	0.38±0.07	0.9±0.1	1.4 ±0.4
S3B	15-30	0.09±0.02	0.8±0.1	1.1 ±0.5
S4A	0–15	0.35±0.09	1.0±0.1	1.1 ±0.6
S4B	15-30	0.25±0.07	1.0±0.1	1.0 ±0.4
S5A	0–15	0.49 ±0.12	1.0 ±0.1	1.8 ±0.5
S5B	15–30	0.10 ±0.05	0.8 ±0.1	0.7 ±0.5
S6A	0–15	0.54 ±0.09	1.0±0.1	2.4 ±0.5
S6B	15-30	<0.15	1.0±0.1	2.1 ±0.5
S7	10-25	<0.03	0.6±0.1	0.6 ±0.3
S8	15–30	<0.03	0.7±0.1	0.9 ±0.2
S9	15–30	<0.05	0.7±0.1	2.0 ±0.7
S10	17–33	0.37±0.07	0.9±0.1	4.9±0.6
S11	0–15	0.77±0.10	1.3±0.1	25 ±5
S12	0–15	1.38±0.11	1.4±0.1	27 ±5
S13A	0–15	<0.80	1.4±0.1	24 ±5
S13B	15–30	<0.15	1.1±0.1	8.5 ±1.0
S14	0–15	0.59±0.09	1.4±0.1	12 ±2
S15	0–15	<0.80	1.2 ±0.1	10 ±2
S16	0–15	0.38 ±0.07	1.3±0.1	2.1 ±0.6
S17	0–15	0.43±0.06	1.2±0.1	3.6 ±1.0
S18A	0–15	0.17 ±0.06	1.2±0.1	1.6 ±0.5
S18B	15–30	0.64 ±0.11	1.3±0.1	10 ±2
S18C	30–45	0.16 ±0.06	1.3±0.1	3.8 ±1.0
S19	0–15	0.20 ±0.06	1.2±0.1	1.7±0.6
S20	0–15	<1.1	1.5±0.2	2.5 ±0.6
S21	0–15	0.51 ±0.11	1.3 ±0.1	2.7 ±0.8

Table 1 (continued)

Sample ID[a]	Depth (cm)	Radionuclide concentration (pCi/g)[b]		
		^{137}Cs	^{226}Ra	^{238}U
S22	0–15	0.69 ±0.09	1.4±0.1	2.1 ±0.5
S23	0–15	0.34 ±0.09	0.9 ±0.1	1.6 ±0.5
S24	0–15	0.43 ±0.08	1.2±0.1	1.8±0.6
S25	0–15	0.55 ±0.11	1.4±0.1	1.5±0.6
S26	0–15	<0.70	1.4±0.1	1.2 ±0.5
S27	0–15	<0.90	1.3±0.1	1.3 ±0.6
S28	0–15	0.41 ±0.07	1.2 ±0.1	2.7 ±0.5
S29	0–15	<0.05	0.8±0.1	0.8 ±0.3
S30	0–15	<0.05	1.1±0.1	1.4 ±0.6
S31	0–15	<0.06	1.0±0.1	2.0 ±0.5
S32	0–3	<0.05	0.9±0.1	1.7 ±0.6
		Biased samples[d]		
B1A	0–15	0.97±0.2	1.4±0.2	450 ±100
B1B	15–30	0.29±0.081	1.2±0.2	220 ±40
B2A	0–15	0.53±0.08	1.3±0.1	140±40
B2B	15–30	0.21±0.05	1.5±0.1	66±20
B3A	0–15	1.85±0.17	1.3±0.1	27 ±5
B3B	15–30	0.43 ±0.07	1.3 ±0.1	21 ±5
B4A	0–15	<2.7	<4.8	14000±300
B4B	15–30	<1.3	<2.6	3700±300
B5A	0–15	5.97±0.22	1.5±0.1	4.7 ±0.5
B5B	15–25	1.57±0.13	0.9±0.1	2.2 ±0.6
B6A	0–15	0.46 ±0.09	24 ±2	2.2±1.0
B6B	15–30	0.20 ±0.07	3.9 ±0.2	2.3±1.0
B7A	0–15	0.41 ±0.08	1.1±0.1	3.4±1.0
B7B	15–30	<0.20	1.3 ±0.1	2.2±0.6
B8			<3.7	280±30
B9	25–41	<0.20	1.1 ±0.1	59±10
B10A	20–36	<0.13	1.4±0.1	60±5
B10B	35–51	<0.13	1.3±0.1	32 ±5
B11	0–3	<0.14	2.5 ±0.5	31±3
B12	0–3	<0.03	1.1±0.2	46±4

Table 1 (continued)

Sample ID[a]	Depth (cm)	Radionuclide concentration (pCi/g)[b]		
		^{137}Cs	^{226}Ra	^{238}U
B13	0-13	1.52±0.15	0.8±0.1	10±2

[a]Sample locations are shown on Figs 1 and 2.

[b]Indicated counting error is at the 95% confidence level (±2σ).

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

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

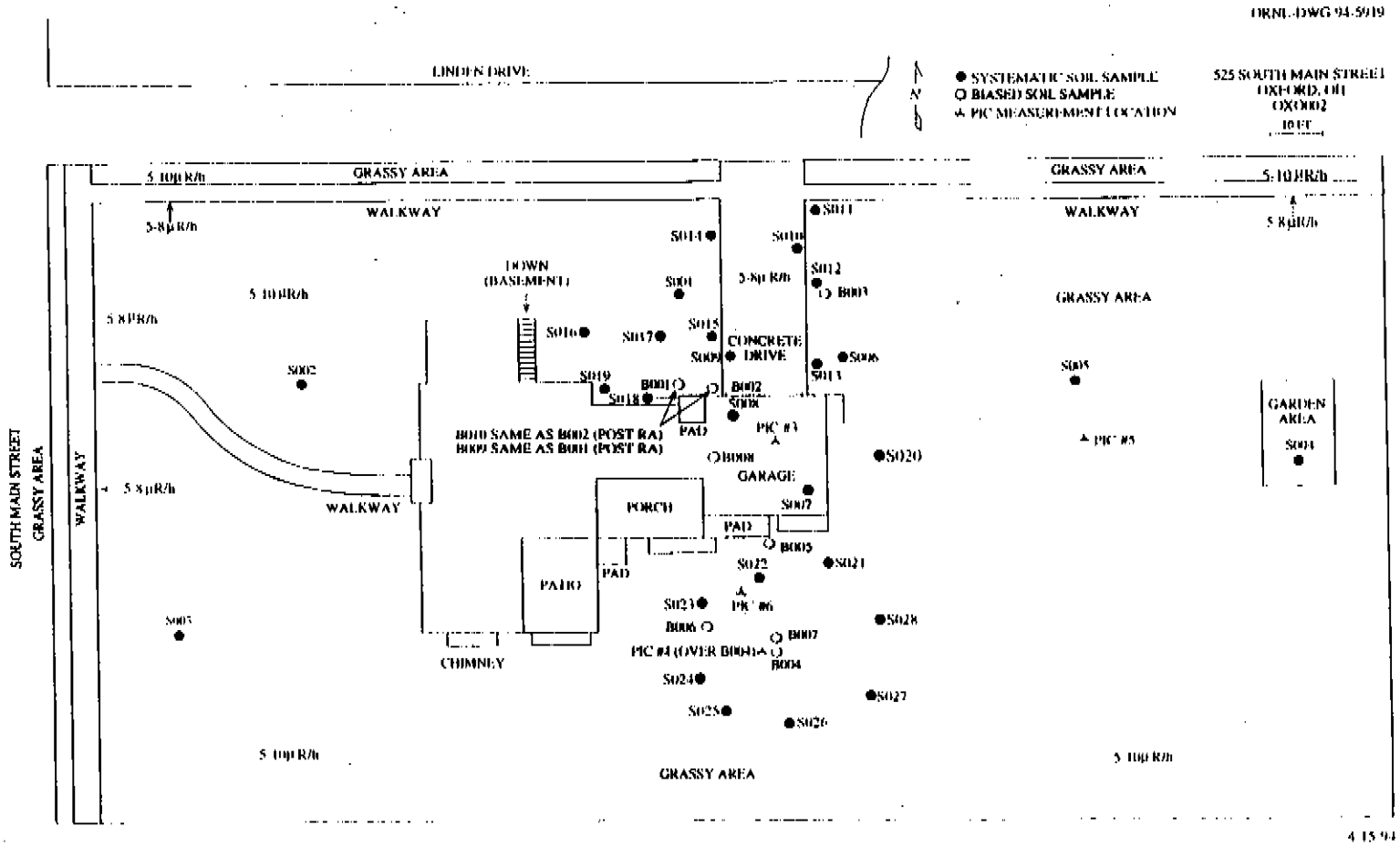

Fig. 1. Sampling locations outside the house at 525 South Main Street, Oxford, Ohio.

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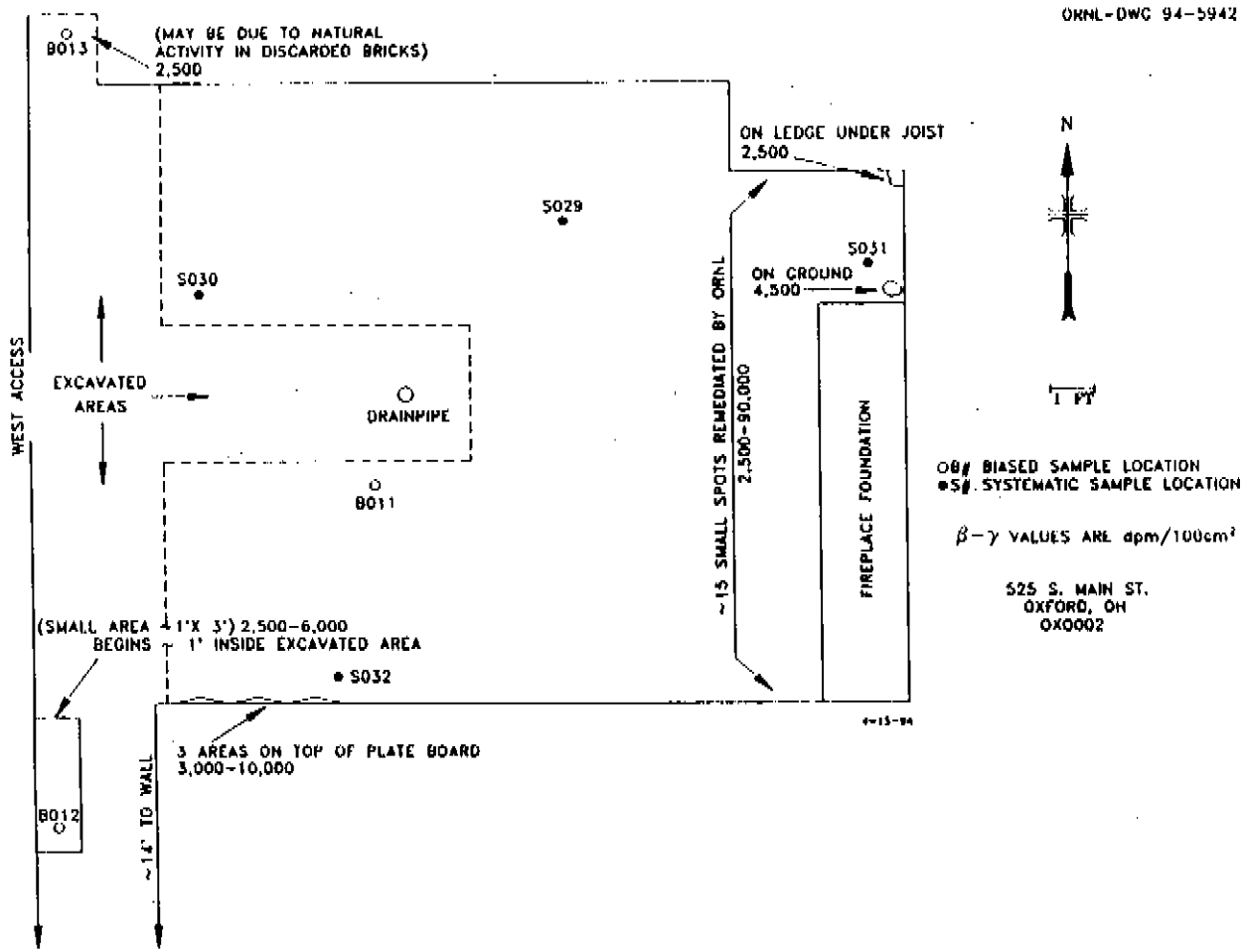

Fig. 2. Sampling locations in the crawl space of the house under the original den.

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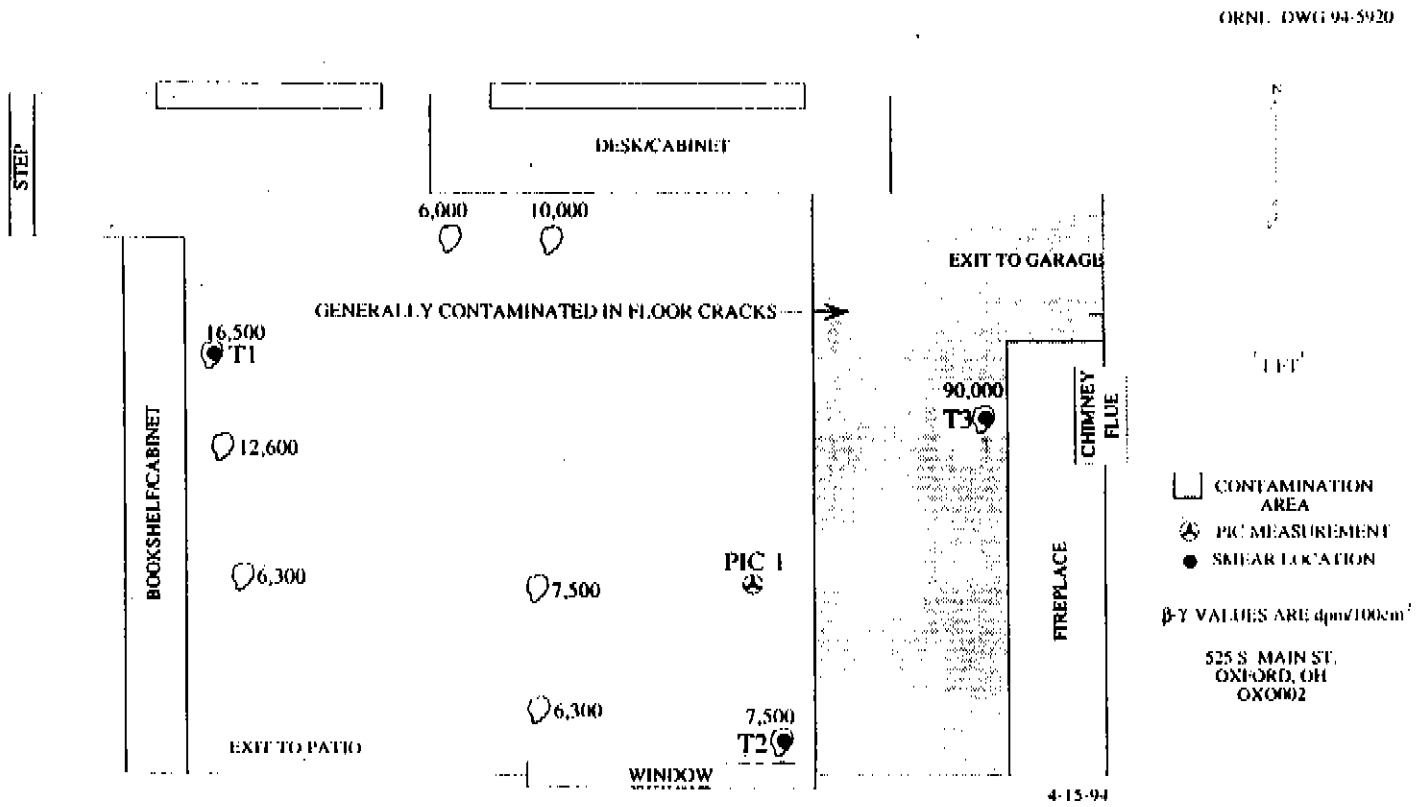

Fig. 3. Radiation/contamination levels in the original den of the house.

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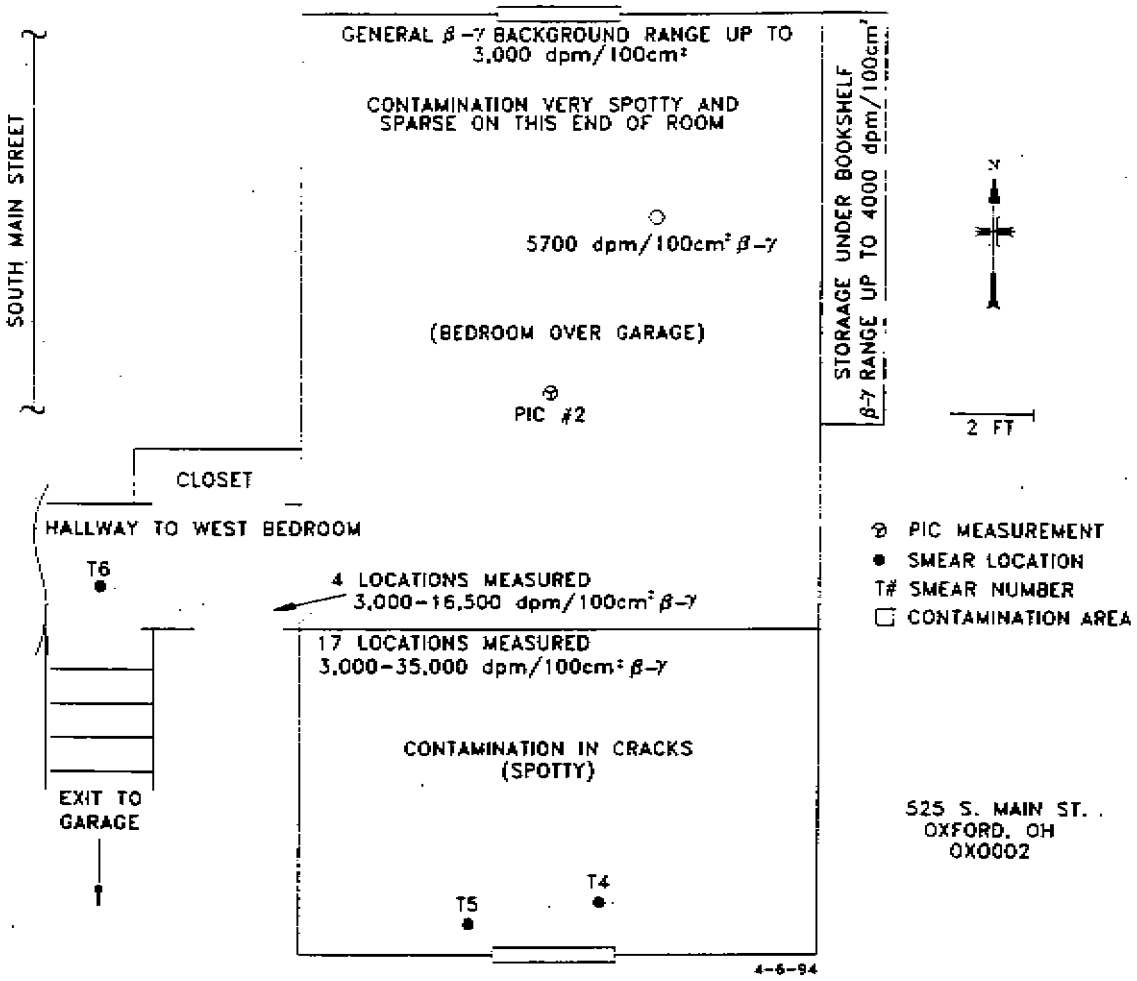

Fig. 4. Radiation/contamination levels in the area above the garage.

Table 2. Contamination characterization of six specific locations inside the house at 525 South Main Street, Oxford, Ohio (OXO002)

T#[a]	Beta-gamma level[b] (dpm/100 cm^2)		Alpha level[c] (dpm/100 cm^2)	
	Direct	Transferable	Direct	Transferable
1	16500	≤MDA	21	≤MDA
2	7500	≤MDA	≤MDA	≤MDA
3	90000	≤MDA	≤MDA	≤MDA
4	21300	≤MDA	14	≤MDA
5	11400	≤MDA	≤MDA	≤MDA
6	15300	≤MDA	21	≤MDA

[a]Locations are shown on Figs. 3 and 4.
[b]Beta-gamma MDA = 100 dpm/100 cm^2.
[c]Alpha MDA = 10 dpm/100 cm^2.

Table 3. Applicable guidelines for protection against radiation
(Limits for uncontrolled areas)

Mode of exposure	Exposure conditions	Guideline value
Gamma radiation	Indoor gamma radiation level (above background)	20 μR/h[a]
Total residual surface contamination[b]	^{238}U, ^{235}U, U-natural (alpha emitters)	
	or	
	Beta-gamma emitters[c]	
	Maximum	15,000 dpm/100 cm^2
	Average	5,000 dpm/100 cm^2
	Removable	1,000 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 (generic)	Maximum permissible concentration of the following radionuclides in soil above background levels, averaged over a 100-m^2 area ^{226}Ra ^{232}Th ^{230}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
Derived concentrations	^{238}U	Site specific[d]

[a]The 20 μR/h shall comply with the basic dose limit (100 mrem/year) when an appropriate-use scenario is considered.

[b]DOE surface contamination guidelines are consistent with *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.

[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, ^{129}I, ^{126}I, ^{125}I.

[d]DOE guidelines for uranium are derived on a site-specific basis. Guidelines of 30 pCi/g have been applied at other FUSRAP sites. *Source:* R. E. Rodriguez et al., *Results of the Radiological Survey at the Town of Tonawanda Landfill, Tonawanda, New York (TNY001)*, ORNL/RASA-92/12, Martin Marietta Energy Systems, Inc., Oak Ridge Natl. Lab., October 1992.

Sources: Adapted from U.S. Department of Energy, DOE Order 5400.5, April 1990, and U.S. Department of Energy, *Guidelines for Residual Radioactive Material at Formerly Utilized Sites Remedial Action Program and Remote Surplus Facilities Management Program Sites*, Rev. 2, March 1987.

Table 4. PIC exposure rate measurements at 525 South Main Street, Oxford, Ohio

Location[a]	PIC (μR/h) at 1 meter
P1	9
P2	8
P3	7
P4	10
P5	10
P6	10

[a]Locations are shown on Figs. 1, 3 and 4.

Table 5. Background radiation and ranges of radionuclide concentrations for Ohio

Type of radiation measurement or sample	Radiation level or radionuclide concentration
Average external gamma exposure rate at 1 m above the ground surface (μR/h)[a]	5
Range of external gamma exposure rates at 1 m above the ground surface (μR/h)[a]	3–11
Concentration range for radionuclides in surface soil (pCi/g)[b]	
^{226}Ra	0.8–2.5 ± 0.2
232Th	0.8–1.5 ± 0.2
^{238}U	0.8–2.2 ± 0.1

[a]Results of three measurements.

[b]Indicated counting error is at the 95% confidence level (± 2σ).

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 Natl. Lab., November 1981.

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B4B	15–30	<1.3	<2.6	3700±300
B5A	0–15	5.97±0.22	1.5±0.1	4.7 ±0.5
B5B	15–25	1.57±0.13	0.9±0.1	2.2 ±0.6
B6A	0–15	0.46 ±0.09	24 ±2	2.2±1.0
B6B	15–30	0.20 ±0.07	3.9 ±0.2	2.3±1.0
B7A	0–15	0.41 ±0.08	1.1±0.1	3.4±1.0
B7B	15–30	<0.20	1.3 ±0.1	2.2±0.6
B8			<3.7	280±30
B9	25–41	<0.20	1.1 ±0.1	59±10
B10A	20–36	<0.13	1.4±0.1	60±5
B10B	35–51	<0.13	1.3±0.1	32 ±5
B11	0–3	<0.14	2.5 ±0.5	31±3
B12	0–3	<0.03	1.1±0.2	46±4

Table 1 (continued)

Sample ID[a]	Depth (cm)	Radionuclide concentration (pCi/g)[b]		
		^{137}Cs	^{226}Ra	^{238}U
B13	0-13	1.52±0.15	0.8±0.1	10±2

[a]Sample locations are shown on Figs 1 and 2.

[b]Indicated counting error is at the 95% confidence level (±2σ).

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

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

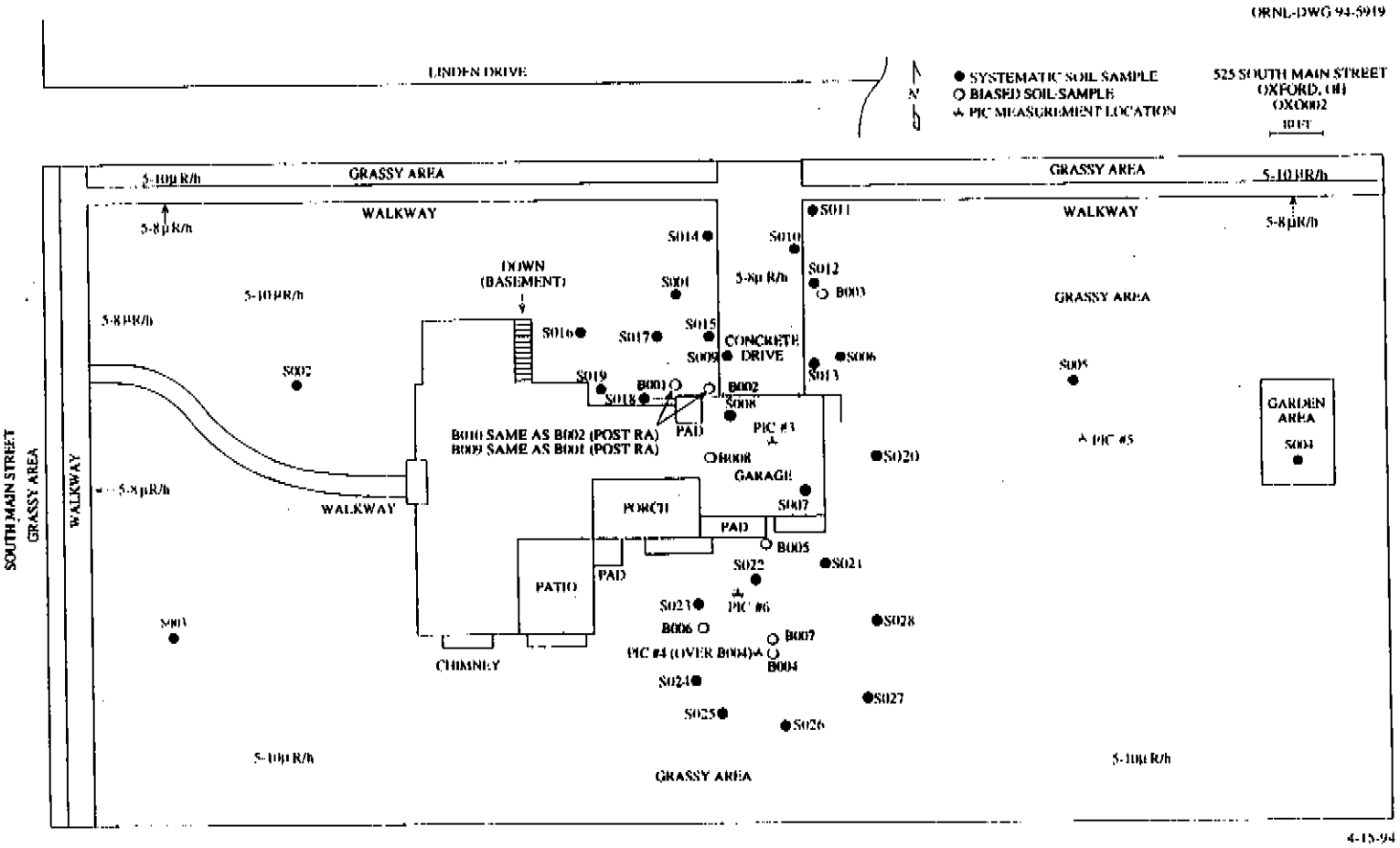

Fig. 1. Sampling locations outside the house at 525 South Main Street, Oxford, Ohio.

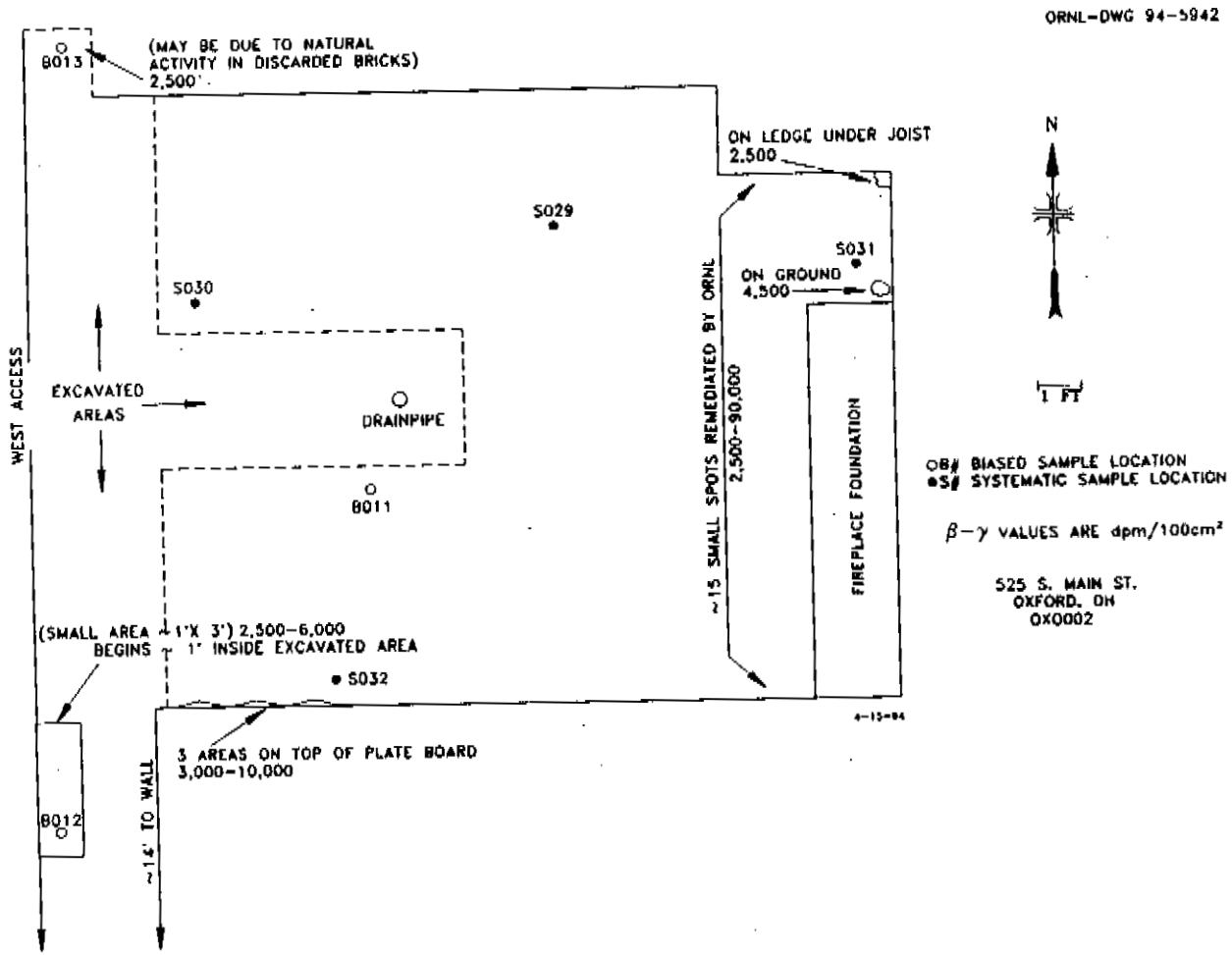

Fig. 2. Sampling locations in the crawl space of the house under the original den.

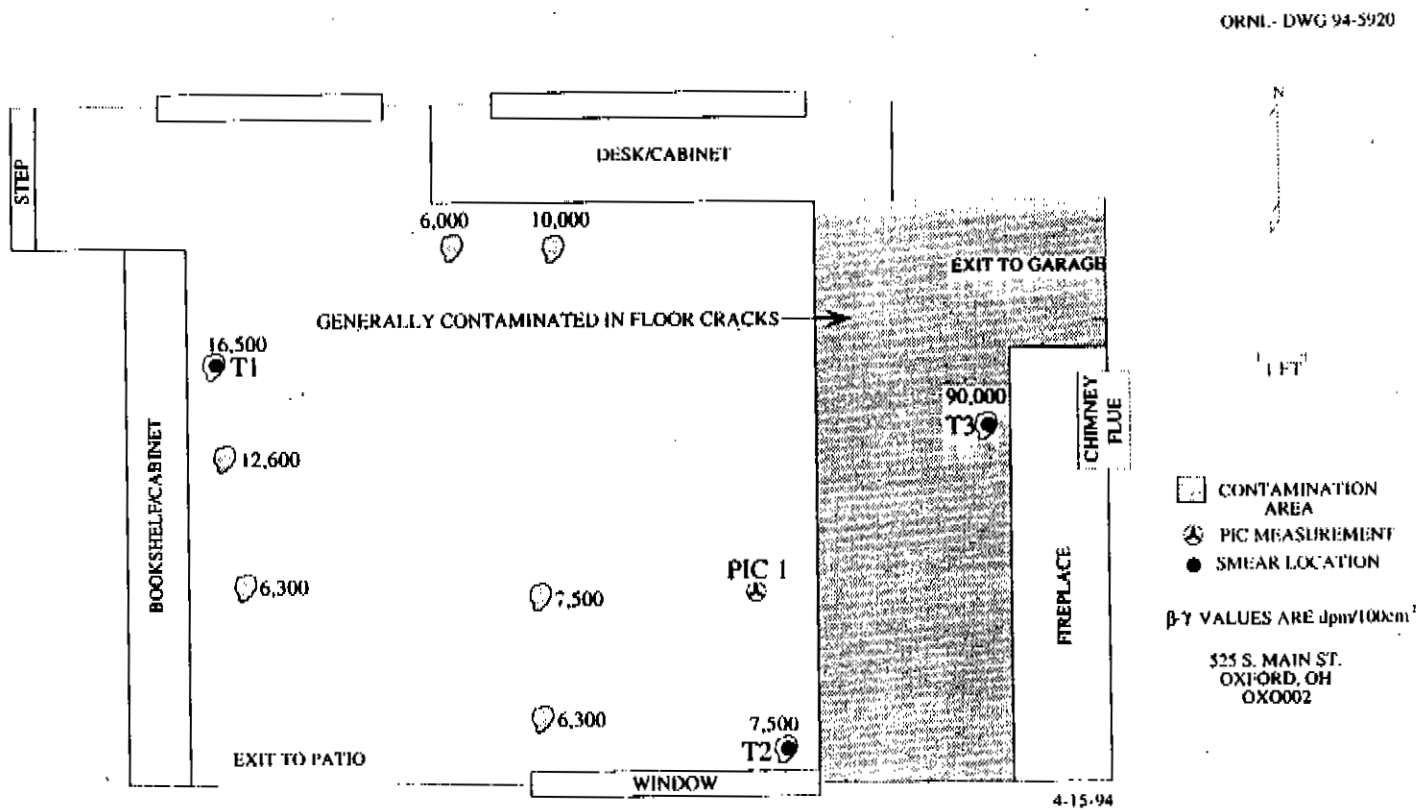

Fig. 3. Radiation/contamination levels in the original den of the house.

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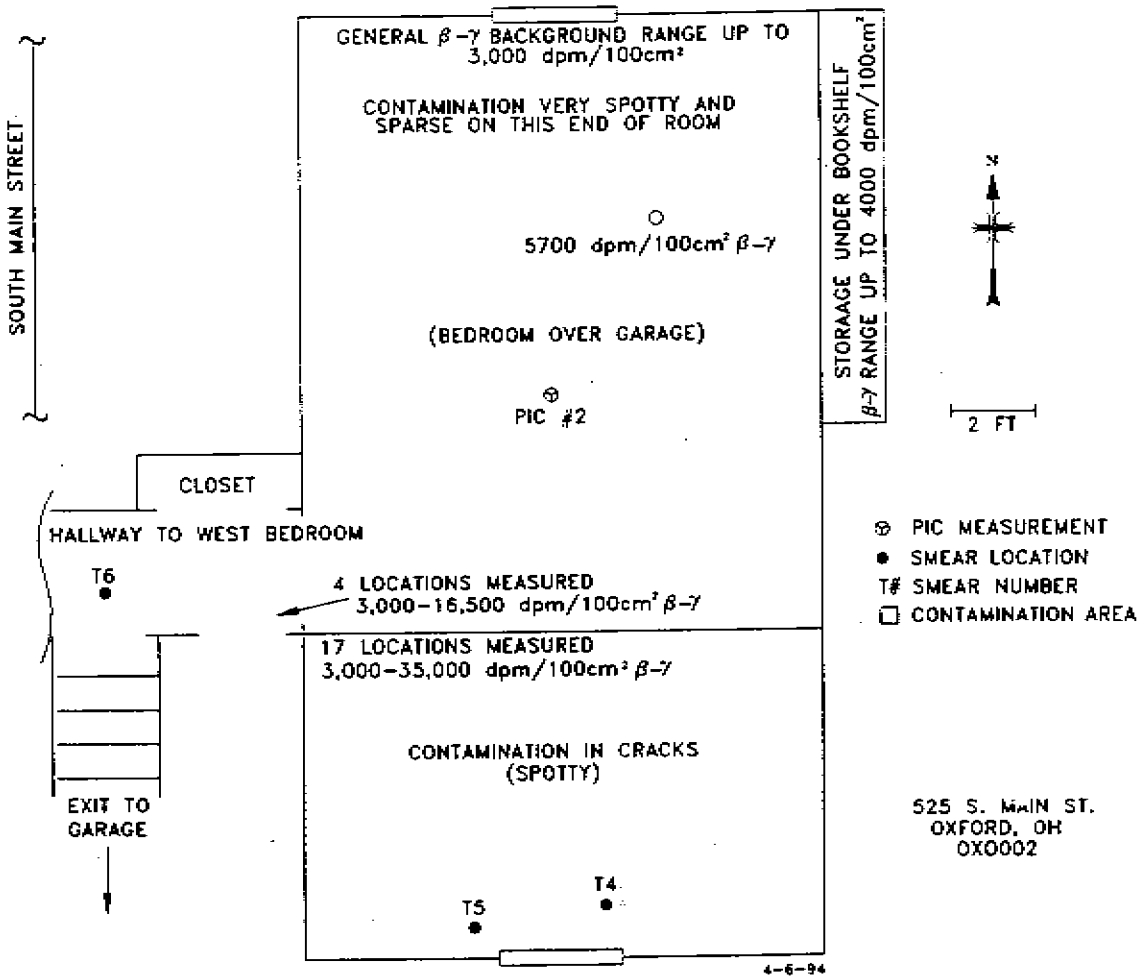

Fig. 4. Radiation/contamination levels in the area above the garage.

Table 2. Contamination characterization of six specific locations inside the house at 525 South Main Street, Oxford, Ohio (OXO002)

T#[a]	Beta-gamma level[b] (dpm/100 cm^2)		Alpha level[c] (dpm/100 cm^2)	
	Direct	Transferable	Direct	Transferable
1	16500	≤MDA	21	≤MDA
2	7500	≤MDA	≤MDA	≤MDA
3	90000	≤MDA	≤MDA	≤MDA
4	21300	≤MDA	14	≤MDA
5	11400	≤MDA	≤MDA	≤MDA
6	15300	≤MDA	21	≤MDA

[a]Locations are shown on Figs. 3 and 4.
[b]Beta-gamma MDA = 100 dpm/100 cm^2.
[c]Alpha MDA = 10 dpm/100 cm^2.

Table 3. Applicable guidelines for protection against radiation
(Limits for uncontrolled areas)

Mode of exposure	Exposure conditions	Guideline value
Gamma radiation	Indoor gamma radiation level (above background)	20 μR/h[a]
Total residual surface contamination[b]	^{238}U, ^{235}U, U-natural (alpha emitters)	
	or	
	Beta-gamma emitters[c]	
	Maximum	15,000 dpm/100 cm^2
	Average	5,000 dpm/100 cm^2
	Removable	1,000 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 (generic)	Maximum permissible concentration of the following radionuclides in soil above background levels, averaged over a 100-m^2 area ^{226}Ra ^{232}Th ^{230}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
Derived concentrations	^{238}U	Site specific[d]

[a]The 20 μR/h shall comply with the basic dose limit (100 mrem/year) when an appropriate-use scenario is considered.

[b]DOE surface contamination guidelines are consistent with *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.

[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, ^{129}I, ^{126}I, ^{125}I.

[d]DOE guidelines for uranium are derived on a site-specific basis. Guidelines of 30 pCi/g have been applied at other FUSRAP sites. *Source:* R. E. Rodriguez et al., *Results of the Radiological Survey at the Town of Tonawanda Landfill, Tonawanda, New York (TNY001)*, ORNL/RASA-92/12, Martin Marietta Energy Systems, Inc., Oak Ridge Natl. Lab., October 1992.

Sources: Adapted from U.S. Department of Energy, DOE Order 5400.5, April 1990, and U.S. Department of Energy, *Guidelines for Residual Radioactive Material at Formerly Utilized Sites Remedial Action Program and Remote Surplus Facilities Management Program Sites*, Rev. 2, March 1987.

Table 4. PIC exposure rate measurements at 525 South Main Street, Oxford, Ohio

Location[a]	PIC (μR/h) at 1 meter
P1	9
P2	8
P3	7
P4	10
P5	10
P6	10

[a]Locations are shown on Figs. 1, 3 and 4.

Table 5. Background radiation and ranges of radionuclide concentrations for Ohio

Type of radiation measurement or sample	Radiation level or radionuclide concentration
Average external gamma exposure rate at 1 m above the ground surface (μR/h)[a]	5
Range of external gamma exposure rates at 1 m above the ground surface (μR/h)[a]	3–11
Concentration range for radionuclides in surface soil (pCi/g)[b]	
^{226}Ra	0.8–2.5 ± 0.2
232Th	0.8–1.5 ± 0.2
^{238}U	0.8–2.2 ± 0.1

[a]Results of three measurements.

[b]Indicated counting error is at the 95% confidence level (± 2σ).

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 Natl. Lab., November 1981.