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Formerly Utilized Sites Remedial Action Program (FUSRAP)

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# ADMINISTRATIVE RECORD

for Maywood, New Jersey

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U.S. Department of Energy

114902

ORNL/RASA-93/4

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**OAK RIDGE  
NATIONAL  
LABORATORY**

**MARTIN MARIETTA**

**RESULTS OF THE RADIOLOGICAL  
VERIFICATION SURVEY  
of the  
PARTIAL REMEDIATION AT  
90 AVENUE C, LODI, NEW JERSEY  
(LJ079V)**

**R. D. Foley  
C. A. Johnson**

**MANAGED BY  
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FOR THE UNITED STATES  
DEPARTMENT OF ENERGY**

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ORNL/RASA-93/4

## HEALTH SCIENCES RESEARCH DIVISION

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

**Results of the Radiological Verification Survey  
of the Partial Remediation at  
90 Avenue C, Lodi, New Jersey (LJ079V)**

R. D. Foley and C. A. Johnson

Date issued —February 1994

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## ABSTRACT

The property at 90 Avenue C, Lodi, New Jersey is one of the vicinity properties of the former Maywood Chemical Works, Maywood, New Jersey designated for remedial action by the U. S. Department of Energy (DOE). In July 1991, Bechtel National, Inc. performed a partial remedial action on this property. At the request of DOE, a team from Oak Ridge National Laboratory conducted an independent radiological verification survey in July, 1991 at this site. The purpose of the verification survey was to ensure the effectiveness of remedial actions performed within FUSRAP and to confirm the site's compliance with DOE guidelines. The radiological survey included surface gamma scans indoors and outdoors, ground-level beta-gamma measurements, and systematic and biased soil and material sampling.

Results of the verification survey demonstrated that all radiological measurements on the portions of the property that had been remediated were within DOE guidelines. However, there still remains a portion of the property to be remediated that is not covered by this verification survey.

**RESULTS OF THE RADIOLOGICAL  
VERIFICATION SURVEY of the PARTIAL REMEDIATION  
at 90 AVENUE C  
LODI, NEW JERSEY (LJ079V)\***

**INTRODUCTION**

Processing of thorium ores was performed in Maywood New Jersey, between 1916 and 1956 by the Maywood Chemical Works (MCW)<sup>1</sup>. The Maywood Chemical Works ceased thorium processing in 1956 and was sold to Stepan Chemical company in 1959. During the early years of operation, MCW stored wastes and residues in low-lying areas west of the processing facilities. Subsequently, residuals containing radioactive materials migrated off-site (via erosion and other means) to the surrounding area. The Stepan property and several vicinity properties were designated for remedial action by the U.S. Department of Energy (DOE).

The waste produced by the thorium extraction process was a sand-like material containing residual amounts of thorium and its decay products, with smaller quantities of uranium and its decay products. Because some area residents had used these sand-like wastes as mulch or fill in their yards, the property at 90 Avenue C, a 2-story frame house with basement and unattached garage (Figs. 1 & 2), was included in 1984 as a decontamination research and development project under the DOE Formerly Utilized Sites Remedial Action Program (FUSRAP).

A group from Oak Ridge National Laboratory (ORNL), at the request of the U.S. Department of Energy (DOE), conducted an investigative radiological survey of some of these properties. In 1988 a radiological survey was conducted by ORNL on the property at 90 Avenue C and a report was issued in 1989.<sup>2</sup> Results of this survey demonstrated radionuclide concentrations that were in excess of DOE remedial action criteria. In the Significance of Findings, the report (Reference 2) stated that "the source of the high gamma radiation levels on both sides of the eastern wall of the kitchen could not be determined without destruction of the wall. The kitchen was added during a remodeling of the original house. The source of contamination in this wall could be from one or more pieces of lumber used in the remodeling." Based on the results of the 1988 survey it was recommended that the site be considered for inclusion in the DOE remedial action program.

Based on ORNL interviews with family members, it was ascertained that an earlier owner of the property had been an employee of MCW, and that during the 1950s he had used discarded building materials and mulch he had found at MCW to build the kitchen addition and make other improvements of his property at 90 Avenue C. A significant portion of the building materials used in the construction of the kitchen had been used before and were contaminated with <sup>232</sup>Th.

In the fall of 1990, Bechtel National, Inc. (BNI), the project management contractor designated by DOE, conducted a remediation investigation of this property.<sup>3</sup> BNI's investigation confirmed findings of the contaminated parts of the interior of the

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\* The survey was performed by members of the Health Sciences Research Division at Oak Ridge National Laboratory under DOE contract DE-AC05-84OR21400.

house (the kitchen addition, including the basement/foundation), surface and subsurface contamination in the back yard near the garage northwest of the house, and in the garage itself. Additional contamination was discovered in a small ceiling area in an upstairs bedroom where a piece of wood framing was used.

BNI performed a partial remedial action on this residential property during July 1991.<sup>4</sup> Based on drawings showing the extent of contamination, the entire kitchen and basement walls and floor were demolished and the contaminated soil around the foundation was excavated. The soil in one location in front of the house and at the curb adjacent to the street was remediated sometime after the first remedial action and consequently was not part of this verification survey. Also, the rest of the back lawn from the excavated area to the property line had not been remediated at this time (see Fig. 2).

Photos of the property in the remediation process are shown in Figs. 3-8.

The DOE adopted a policy to assign an independent verification contractor to ensure the effectiveness of remedial actions performed within FUSRAP and to confirm the site's compliance with DOE guidelines. The Measurement Applications and Development Group of Oak Ridge National Laboratory (ORNL) was assigned the responsibility at this Lodi property, and in July 1991, the verification survey was conducted by ORNL. This report describes the methods and results of that verification.

## Remediation

A partial remediation of the property by BNI at 90 Avenue C is described as follows:

- The entire kitchen, including the basement walls and floor under the kitchen, was demolished (Figs 3 and 4) and the contaminated material was placed in steel boxes or drums for removal. At the request of DOE-HQ, ORNL verified the radiological condition of the non-contaminated kitchen debris before it was removed from the site. The containers of contaminated material were transported by rail and stored at the Maywood Interim Storage Site (MISS)<sup>5</sup>, adjacent to the Stepan Company plant. The non-contaminated material was taken to a land fill. Contaminated soil was removed from around the foundation walls and also taken to the MISS.
- Two other small, slightly elevated areas were located by ORNL during the verification survey on the second floor: one under the dormer window on the west wall and one in the north wall of the sitting room. A third small area was located on the first floor above the door leading to the kitchen. All three areas were remediated and the contaminated materials removed (Figs 5-7).
- Contaminated materials were removed from the junction of the concrete foundation and wood floor beams at the west corner of the house.
- Three small spots of contamination were remediated in the unattached garage on the southeastern corner of the property. The spots were in the south corner wall, the west corner wall and a small spot in the concrete floor near the south corner (see Fig. 8). The contaminated materials were removed from all three locations.

## VERIFICATION PROCEDURES

### Objectives

The objective of the verification activities was to confirm (1) that available documentation adequately and accurately describes the post-remedial action on the entire property that is to be verified, and (2) that the remedial action reduced contamination levels to within authorized limits. Applicable DOE guidelines for protection against radiation are shown in Table 1.<sup>6,7</sup>

### Survey Methods

The post-remedial action survey was performed on this property as described for a generic site.<sup>8</sup> This survey consists of ground-level beta-gamma measurements, surface gamma measurements, and systematic and biased soil and miscellaneous material sampling.

Using a portable gamma scintillation meter, ranges of measurements were recorded for areas of the property surface and one meter above the surface, as well as in each room of the house. Systematic soil samples were then obtained at randomly selected locations irrespective of gamma exposure rates, and biased soil samples were collected in areas of elevated gamma levels.

## VERIFICATION SURVEY AND ANALYSIS

Typical background radiation levels for the northern New Jersey area are presented in Table 2. The data are provided for purposes of comparison with the survey results presented in this section.

All measurements presented in this report are gross readings; background radiation levels have not been subtracted. Similarly, background concentrations have not been subtracted from radionuclide concentrations in soil and debris samples.

### Surface Radiation Measurements

A detailed survey was conducted on the attic above the second story bedrooms, the attic space under the eaves, the second story living area, first floor living area and the basement of the original house. The survey included a gamma scan and a beta-gamma scan of the ceiling, walls and floor. It was during this survey that the three small areas of contamination in the walls and ceiling were located.

Additionally, after each portion of the remediation was completed, another thorough gamma and beta-gamma scan was conducted. Where feasible, alpha measurements were also taken. Following remedial action, all measurements were within DOE guidelines (see Table 1). In the remediated areas outdoors, a general gamma reading of 9-13  $\mu\text{R/h}$  was measured in the yard around the residence and garage (Fig. 2). This is slightly above typical gamma levels in the northern New Jersey area (Table 2), but well below DOE guidelines.

### Soil and Miscellaneous Material Sampling

Systematic soil samples were taken in the basement under the existing concrete slab (basement floor), and in the yard on the south side of the house (S1-S8, Fig. 2). Two biased samples were taken: one at the west corner retaining wall around the exterior basement steps (B1) and one at the south-east inside corner of the garage ~6 inches above the floor level (B2). The radiological source of these biased samples was then removed in the remedial action process.

Before remediation the gamma measurement at B2 (garage) was ~100  $\mu$ R/h, but after removal of the contaminated portion of the wall (Fig. 8), gamma activity was 12-14  $\mu$ R/h. This slightly elevated level was probably due to the coal ash used as an aggregate in the formulation of the concrete when the garage was built. Locations of the soil samples are shown in Fig. 2.

All samples were analyzed to determine the concentrations of  $^{238}\text{U}$ ,  $^{226}\text{Ra}$ , and  $^{232}\text{Th}$ . Results of the radionuclide analysis are shown in Table 3. Concentrations of radium, thorium, and uranium in the systematic samples ranged from 0.67 to 0.87 pCi/g, 0.76 to 3.1 pCi/g, and 1.4 to 3.2 pCi/g, respectively.

Maximum concentrations in the biased samples were 1.3 and 1.4 pCi/g for  $^{226}\text{Ra}$  and  $^{232}\text{Th}$ , respectively (sample B2), and 1.8 pCi/g for  $^{238}\text{U}$  (sample B1). All biased samples were near or slightly above the background levels for the northern New Jersey area (Table 2), and well below DOE guidelines for surface soil of 5 pCi/g for radium and thorium, and the site specific limits prescribed for uranium (Table 1).

During the verification survey, the miscellaneous samples shown in Table 3 were taken from the materials found in the foundation (M3 & M4) and wood in the upstairs dining room (M5). The materials that were the source of the contamination were removed by BNI in the remediation process, and all radiation measurements taken in these areas after remediation, as well as from the rest of the house, were below DOE guidelines.

### CONCLUSION

Measurements of the gamma exposure levels taken from the remediated portion of the property ranged from 9-13  $\mu$ R/h. For comparison, the background for the northern New Jersey area averages ~ 8  $\mu$ R/h (Table 2).

The results of soil radionuclide analyses for  $^{238}\text{U}$ ,  $^{226}\text{Ra}$ , and  $^{232}\text{Th}$  indicate that all soil concentration measurements are within the limits prescribed by DOE radiological guidelines (Table 1).

Based on the results of the remedial action data and confirmed by the verification survey data, all radiological measurements fall below the limits prescribed by DOE radiological guidelines established for this site. It is concluded that the portion of the site which had been remediated during this action successfully meets the DOE remedial action objectives. It must be noted, however, that a section of the property still exceeds DOE guidelines and remains to be remediated.

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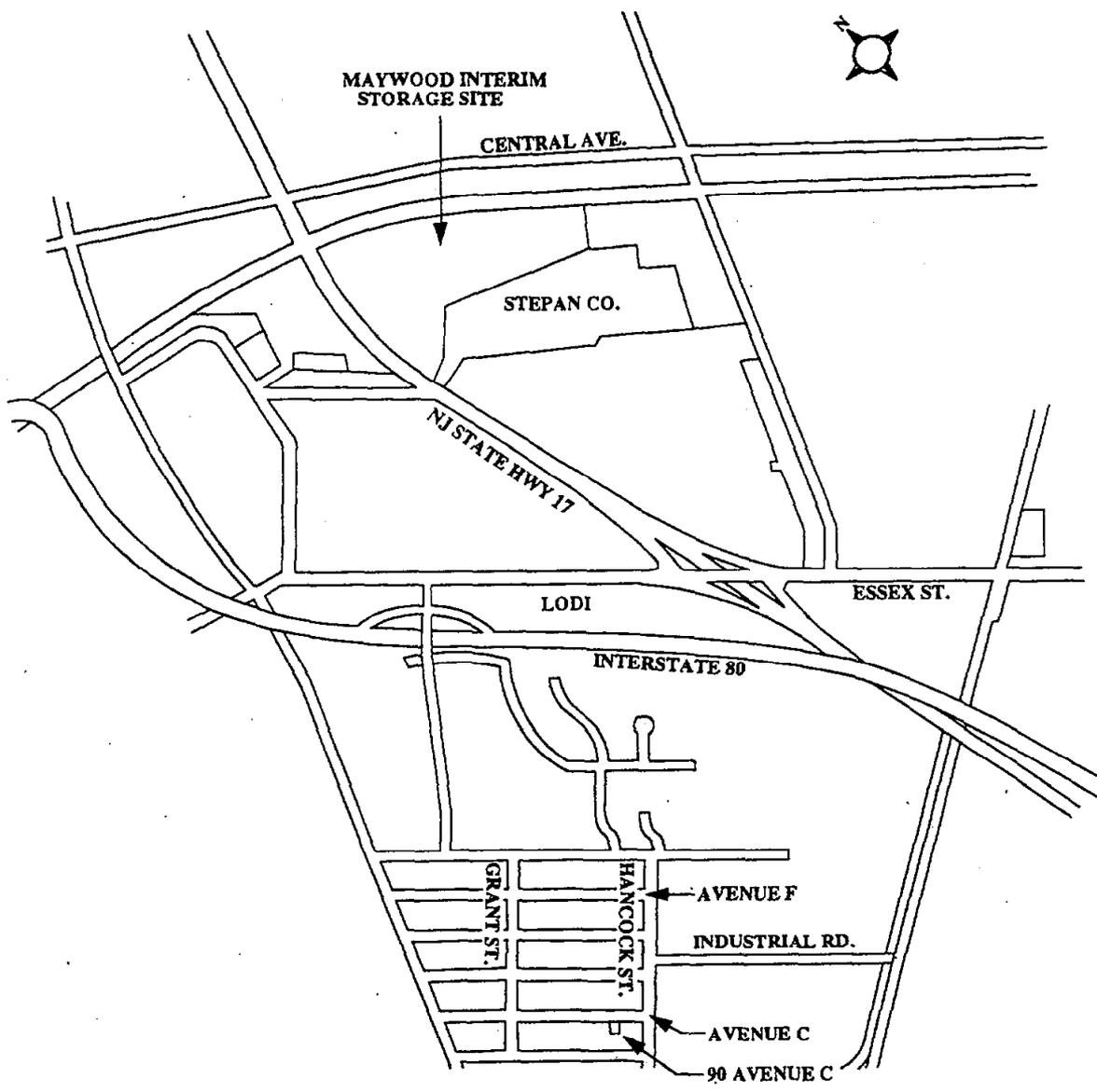


Fig. 1. Diagram showing general location of the property at 90 Avenue C, Lodi, New Jersey relative to the Maywood Interim Storage Site (MISS), Maywood, New Jersey

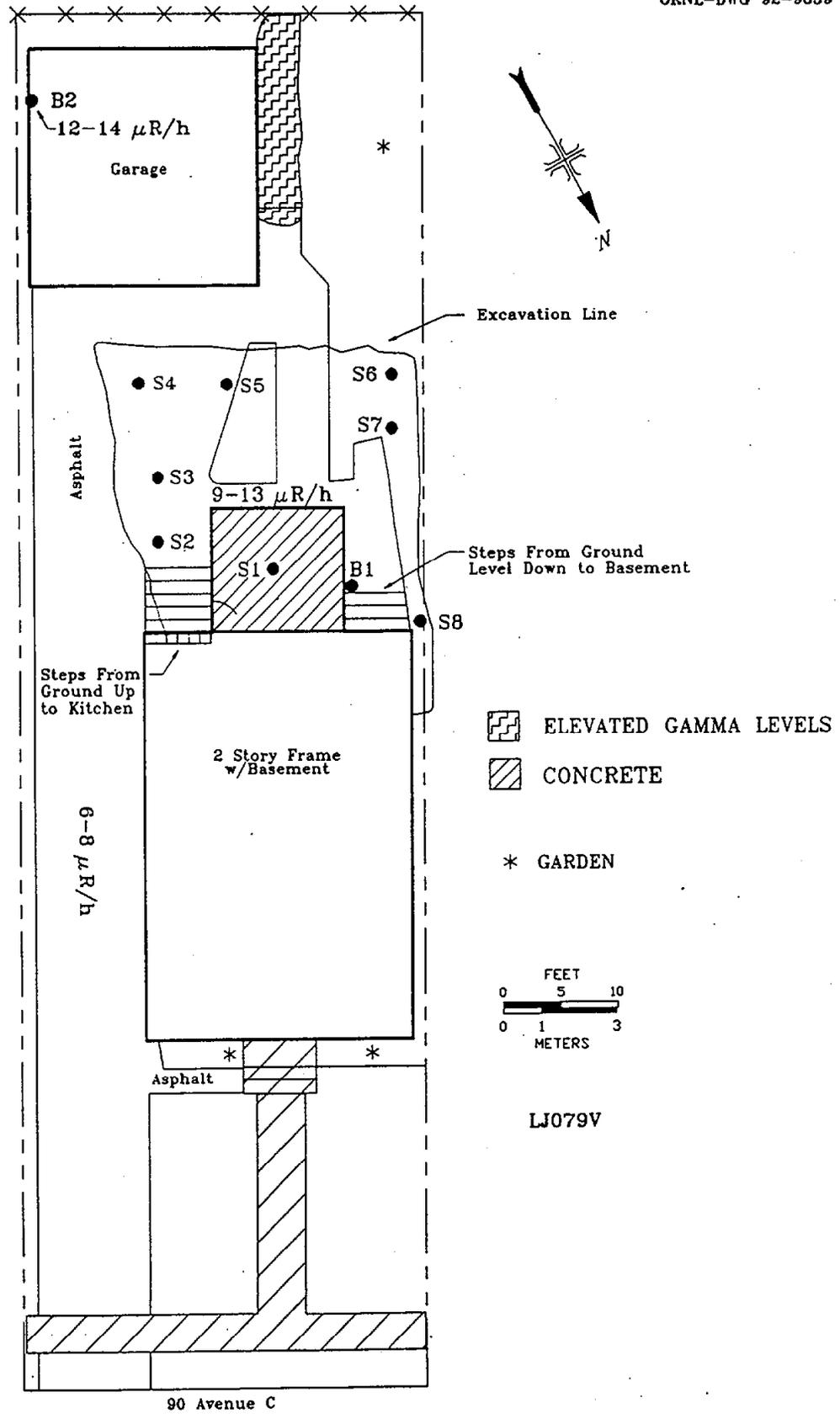


Fig. 2. Diagram showing locations of soil samples and gamma radiation levels taken during verification survey at 90 Avenue C, Lodi, New Jersey.

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Fig. 3. View of the back of the house at 90 Avenue C, Lodi, New Jersey, being remediated. Kitchen and steps to the basement and are being removed.

ORNL-PHOTO 93-11005



Fig. 4. View of back of house at 90 Avenue C where kitchen and steps to basement have been removed.

ORNL-PHOTO 93-11006

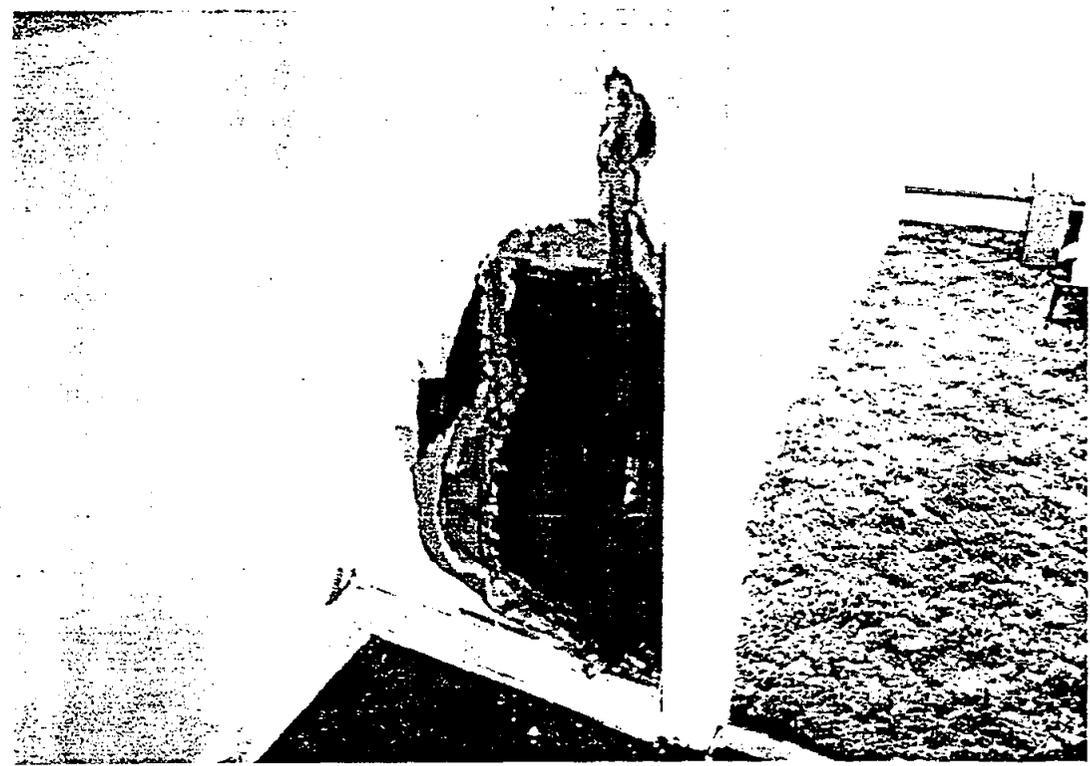


Fig. 5. A portion of the wall beneath the upstairs bedroom window being removed at 90 Avenue C, Lodi, New Jersey.

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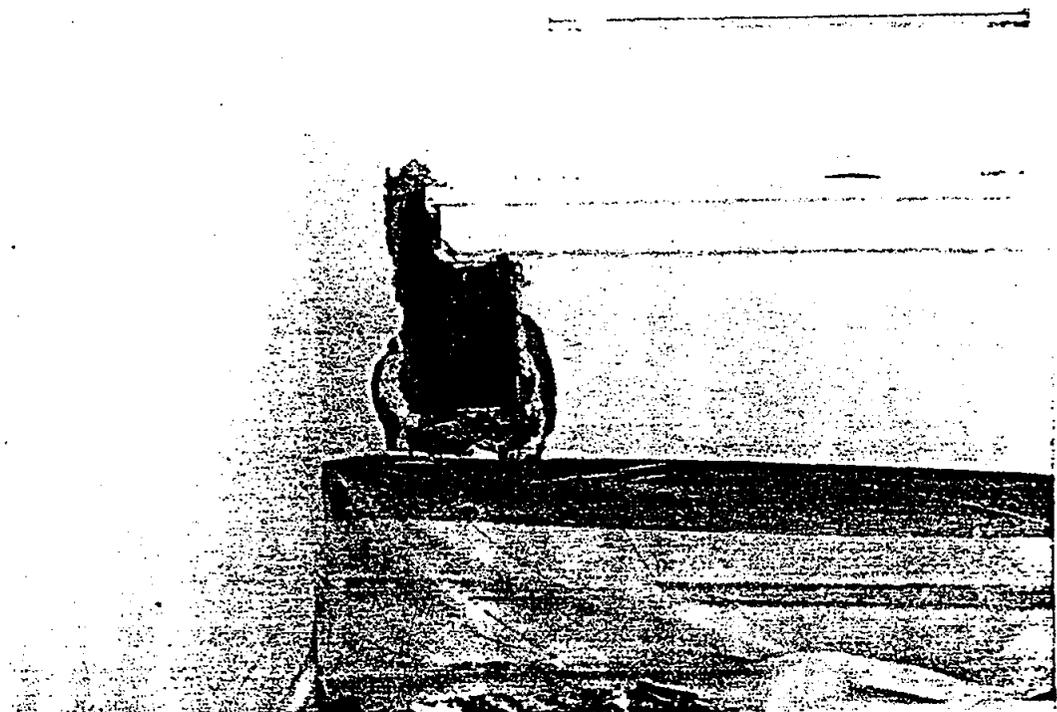


Fig. 6. The removal of a portion of the north wall in the sitting room at 90 Avenue C.

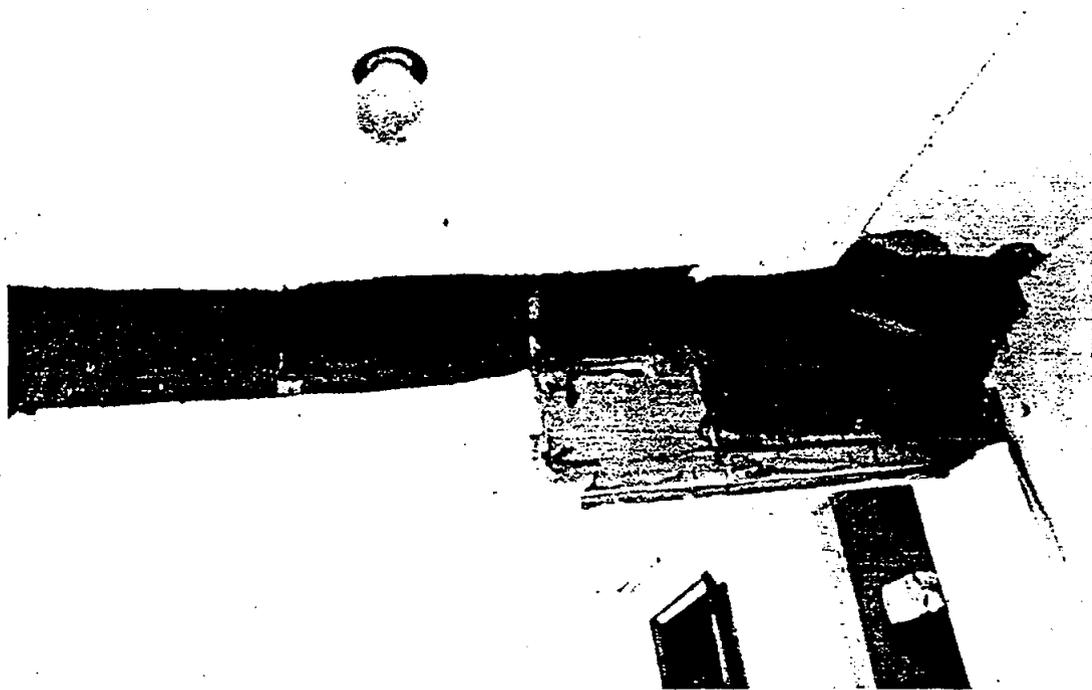


Fig. 7. The removal of a small area on the first floor above the door to the kitchen at 90 Avenue C.



Fig. 8. A portion of the garage wall being removed during remediation of structures on the property at 90 Avenue C, Lodi, New Jersey

**Table 1. 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 $\mu$ R/h <sup>a</sup>
Total residual surface contamination <sup>b</sup>	<sup>238</sup> U, <sup>235</sup> U, U-natural ( <i>alpha emitters</i> ) or Beta-gamma emitters <sup>c</sup>	
	Maximum	15,000 dpm/100 cm <sup>2</sup>
	Average	5,000 dpm/100 cm <sup>2</sup>
	Removable	1,000 dpm/100 cm <sup>2</sup>
	<sup>232</sup> Th, Th-natural ( <i>alpha emitters</i> ) or <sup>90</sup> Sr ( <i>beta-gamma emitter</i> )	
	Maximum	3,000 dpm/100 cm <sup>2</sup>
	Average	1,000 dpm/100 cm <sup>2</sup>
	Removable	200 dpm/100 cm <sup>2</sup>
	<sup>226</sup> Ra, <sup>230</sup> Th, transuranics	
	Maximum	300 dpm/100 cm <sup>2</sup>
Average	100 dpm/100 cm <sup>2</sup>	
Removable	20 dpm/100 cm <sup>2</sup>	
Beta-gamma dose rates	Surface dose rate averaged over not more than 1 m <sup>2</sup>	0.20 mrad/h
	Maximum dose rate in any 100-cm <sup>2</sup> 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 <sup>2</sup> area	5 pCi/g averaged over the first 15 cm of soil below the surface; 15 pCi/g when averaged over 15 cm-thick soil layers > 15 cm below the surface
	<sup>226</sup> Ra <sup>232</sup> Th <sup>230</sup> Th	
Derived concentrations	<sup>238</sup> U	Site specific <sup>d</sup>

Table 1 (continued)

Mode of exposure	Exposure conditions	Guideline value
Guideline for non-homogeneous contamination (used in addition to the 100-m <sup>2</sup> guideline) <sup>c</sup>	Applicable to locations with an area ≤25 m <sup>2</sup> , with significantly elevated concentrations of radionuclides ("hot spots")	$G_A = G_i(100/A)^{1/2},$ where $G_A$ = guideline for "hot spot" of area (A) $G_i$ = guideline averaged over a 100-m <sup>2</sup> area

<sup>a</sup>The 20 μR/h shall comply with the basic dose limit (100 mrem/yr) when an appropriate-use scenario is considered.

<sup>b</sup>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.

<sup>c</sup>Beta-gamma emitters (radionuclides with decay modes other than alpha emission or spontaneous fission) except <sup>90</sup>Sr, <sup>228</sup>Ra, <sup>223</sup>Ra, <sup>227</sup>Ac, <sup>133</sup>I, <sup>129</sup>I, <sup>126</sup>I, <sup>125</sup>I.

<sup>d</sup>DOE guidelines for uranium are derived on a site-specific basis. Guidelines of 35-40 pCi/g have been applied at other FUSRAP sites. Sources: J. L. Marley and R. F. Carrier, *Results of the Radiological Survey at 4 Elmhurst Avenue, Colonie, New York (AL219)*, ORNL/RASA-87/117, Martin Marietta Energy Systems, Inc., Oak Ridge Natl. Lab., February 1988; B. A. Berven et. al., *Radiological Survey of the Former Kellex Research Facility, Jersey City, New Jersey*, DOE/EV-0005/29, ORNL-5734, Martin Marietta Energy Systems, Inc., Oak Ridge Natl. Lab., February 1982.

<sup>e</sup>DOE guidelines specify that every reasonable effort shall be made to identify and to remove any source that has a concentration exceeding 30 times the guideline value, irrespective of area (adapted from *Revised Guidelines for Residual Radioactive Material at FUSRAP and Remote SFMP Sites*, April 1987).

Sources: Adapted from U.S. Department of Energy, *Radiation Protection of the Public and the Environment*, 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; and U. S. Department of Energy *Radiological Control Manual*, DOE N 5480.6 (DOE/EH-256T), June 1992.

Table 2. Background radiation levels for the northern New Jersey area

Type of radiation measurement or sample	Radiation level or radionuclide concentration <sup>a</sup>
Gamma exposure at 1 m above ground surface ( $\mu$ R/h)	8 <sup>b</sup>
Concentration of radionuclides in soil (pCi/g) <sup>c</sup>	
<sup>226</sup> Ra	0.9
<sup>232</sup> Th	0.9
<sup>238</sup> U	0.9

<sup>a</sup> These values represent an average of normal radionuclide concentrations in this part of the state. Actual values may fluctuate.

<sup>b</sup> Source: U. S. Department of Energy, *Radiological Survey of the Middlesex Municipal Landfill, Middlesex, New Jersey*, DOE/EV-00005/20, April 1980.

<sup>c</sup> Source: T. E. Myrick, and B. A. Berven, *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.

Table 3. Concentrations of radionuclides in soil at 90 C Avenue, Lodi, New Jersey (LJ079V)

Sample	Depth (cm)	Radionuclide concentration (pCi/g)		
		<sup>226</sup> Ra <sup>a</sup>	<sup>232</sup> Th <sup>a</sup>	<sup>238</sup> U <sup>b</sup>
<i>Systematic samples<sup>c</sup></i>				
S1 <sup>d</sup>	13-28	0.74 ± 0.04	0.76 ± 0.06	2.7 ± 2
S2	0-15	0.76 ± 0.04	1.1 ± 0.06	<2.4
S3	0-15	0.76 ± 0.04	0.85 ± 0.06	2.20 ± 2
S4	0-15	0.67 ± 0.03	0.87 ± 0.06	<2.2
S5	0-15	0.72 ± 0.04	1.2 ± 0.09	1.4 ± 0.5
S6	0-15	0.73 ± 0.04	1.5 ± 0.07	<3.2
S7	0-15	0.87 ± 0.06	3.1 ± 0.1	<2.3
S8	0-15	0.69 ± 0.04	0.78 ± 0.06	<2.9
<i>Biased samples<sup>e</sup></i>				
B1	0-15	0.94 ± 0.05	1.4 ± 0.09	1.8 ± 0.6
B2	0-15	1.3 ± 0.13	1.4 ± 0.2	1.0 ± 0.6
M3 <sup>f</sup>		<11	12000 ± 1000	290 ± 20
M4 <sup>f</sup>		2.0 ± 1.0	30 ± 6.0	<12
M5 <sup>f</sup>		<1.1	30 ± 5.0	<4.3

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

<sup>b</sup>Total analytical error of measurement results is less than  $\pm 5\%$  (95% confidence level).

<sup>c</sup>Systematic samples are taken at locations irrespective of gamma exposure rates.

<sup>d</sup>S1 sample was taken under the concrete slab.

<sup>e</sup>Biased samples are taken at locations of elevated gamma exposure rates.

<sup>f</sup>M (Miscellaneous) samples were taken before remediation. The sources, from which the samples were taken, were removed during the remedial action.

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