ORNL/RASA-95/13

ornl

OAK RIDGE
NATIONAL
LABORATORY

MARTIN MARIETTA

RADIOLOGICAL SURVEY RESULTS at 1 SHADY LANE, LODI, NEW JERSEY (LJ095)

R. D. Foley
C. A. Johnson

MANAGED BY
MARTIN MARIETTA ENERGY SYSTEMS, INC.
FOR THE UNITED STATES
DEPARTMENT OF ENERGY

ORNL/RASA-95/13

HEALTH SCIENCES RESEARCH DIVISION
Environmental Restoration and Waste Management Non-Defense Programs
(Activity No. EX 20 20 01 0; ADS317AEX))

Radiological Survey Results at 1 Shady Lane, Lodi, New Jersey (LJ095)

R. D. Foley and C. A. Johnson

Date issued —July 1995

Investigation Team
R. D. Foley — Measurement Applications and Development Manager
M. E. Murray - FUSRAP Project Director
R. D. Foley— Survey Team Leader

Survey Team Members
R. D. Foley P. F. Tiner
W. A. Williams*

*U. S. Department of Energy

Work performed by the
Measurement Applications and Development Group

Prepared by the
OAK RIDGE NATIONAL LABORATORY
Oak Ridge, Tennessee 37831-6285
managed by
LOCKHEED MARTIN ENERGY SYSTEMS, INC.
for the
U. S. DEPARTMENT OF ENERGY
under contract DE-AC05-84OR21400

CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACKNOWLEDGMENTS

Research for this project was sponsored by the Office of Environmental Restoration, U. S. Department of Energy, under contract DE-AC05-84OR21400 with Martin Marietta Energy Systems, Inc. The authors wish to acknowledge the contributions of D. A. Roberts, D. A. Rose, and J. M. Lovegrove of the Measurement Applications and Development Group for participation in the sample preparation and analyses, editing, graphics, and reporting of data for this survey. The surveying assistance of the staff on the survey team is also gratefully acknowledged.

ABSTRACT

The U. S. Department of Energy (DOE) conducted remedial action at the Stepan property in Maywood, New Jersey and several vicinity properties in Lodi, New Jersey as part of the Formerly Utilized Sites Remedial Action Program (FUSRAP). These properties are in the vicinity of the DOE-owned Maywood Interim Storage Site (MISS), adjacent to the former Maywood Chemical Works facility. The property at One Shady Lane, Lodi, New Jersey was not one of these vicinity properties but was surveyed by DOE at the request of the owner.

At the request of DOE, a team from Oak Ridge National Laboratory conducted a radiological survey at this property. The purpose of the survey, conducted in November 1994, was to confirm whether remedial actions were to be performed on the property in order to be in compliance with the identified guidelines. The radiological survey included surface gamma scans and gamma readings at 1 meter, and the collection of soil samples for radionuclide analysis.

Results of the survey demonstrated that all radiological measurements on the property at One Shady Lane, Lodi, New Jersey, were comparable to background levels in the area, and well within the limits prescribed by DOE radiological guidelines. Based on the results of the radiological survey data, this property does not meet guidelines for inclusion under FUSRAP.

RADIOLOGICAL SURVEY RESULTS AT 1 SHADY LANE, LODI, NEW JERSEY (LJ095)*

INTRODUCTION

Thorium ores were processed by the Maywood Chemical Works (MCW)[1], Maywood, New Jersey, between 1916 and 1959. The MCW ceased thorium processing in 1959 and the 30-acre property was sold that same year to Stepan Chemical Company. During the early years of operation, MCW stored wastes and residues in low-lying areas west of the processing facilities, now called the Maywood Interim Storage Site (MISS). Subsequently, residuals containing radioactive materials migrated off-site to the surrounding area, and the Stepan property and several vicinity properties were designated by Congress for remedial action as a result of the 1984 Energy and Water Development Appropriations Act, along with other sites.

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 of the wastes had been carried downstream by Lodi Brook, and some area residents had also used the sand-like wastes as mulch in their yards, the properties in the vicinity of the MCW were included as a decontamination research and development project under the DOE Formerly Utilized Sites Remedial Action Program (FUSRAP). Figure 1 shows the location of Lodi, New Jersey, relative to the former MCW, now the DOE-owned Maywood Interim Storage Site.

At the request of the DOE, a group from Oak Ridge National Laboratory (ORNL) conducted investigative radiological surveys of several properties surrounding the former processing plant. The property at One Shady Lane, Lodi, New Jersey, was not included in the earlier investigations; however, since the property was adjacent to a park which had been surveyed and found to contain some areas above guidelines, the owner requested that his property be surveyed also.

In November 1994, ORNL conducted an ad hoc radiological survey at the request of DOE. A complete gamma scan was performed and four soil samples were collected and analyzed for radionuclide concentrations.

A drawing of the property at One Shady Lane is shown in Fig. 2. Photographs taken in November 1994 of the property are shown in Figs. 3-5.

---

*The survey was performed by members of the Measurement Applications and Development Group of the Health Sciences Research Division of Oak Ridge National Laboratory (ORNL) under DOE contract DE-AC05-84OR21400.

SURVEY METHODS

A comprehensive description of the survey methods and instrumentation used in this survey is given in *Procedures Manual for the ORNL Radiological Survey Activities (RASA) Program,* ORNL/TM-8600 (April 1987)[2], and *Measurement Applications and Development Group Guidelines*, ORNL-6782 (January 1995)[3].

SURFACE RADIATION MEASUREMENTS

Gamma radiation levels were determined using a portable sodium iodide (NaI) gamma scintillation probe connected to a Victoreen ratemeter. Measurements were recorded and converted to microroentgens per hour (μR/h). Because NaI gamma scintillators are energy dependent, measurements of gamma radiation levels in counts per minute (cpm) are normalized to pressurized ionization chamber (PIC) measurements to estimate gamma exposure rates in μR/h.

SOIL SAMPLING AND ANALYSIS

Surface and subsurface soil samples were systematically collected over the back and front yards of the property. Two samples were taken from the front yard and two from the backyard (locations of the samples are shown in Fig. 2). All samples were analyzed for thorium, radium and uranium. At each sampling location, the gamma radiation levels are measured at each six-inch increment in the sample hole. The gamma radiation levels give an indication of possible nearby radioactive materials and their location.

SURVEY RESULTS

Current DOE guidelines for sites included within the FUSRAP are included in Table 1.[4,5] Typical background radiation levels for the northern New Jersey area are given in Table 2.[6,7] 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 in soil samples.

SURFACE RADIATION MEASUREMENTS

A gamma scan was conducted over the grassy areas of the front and back yards, sidewalks, and driveway. Gamma exposure measurements generally ranged from 7-13 μR/h at the surface in the front, side and back yards. A maximum range of 10 to 16 μR/h was measured between the sidewalk and the front of the brick house, where natural constituents in the building materials can influence gamma measurements (see Fig. 2). All the measurements are comparable to the typical background radiation levels found in the northern New Jersey area (Table 2).

SOIL SAMPLING AND ANALYSIS

Systematic soil samples were collected from the front and back yards. All samples were analyzed for uranium, radium and thorium concentrations. Results of the soil analysis showed that radionuclide concentrations in both surface and subsurface samples ranged from 0.71 to 1.1 pCi/g, 0.81 to 1.1 pCi/g, and 0.70 to 2.4 pCi/g for ^{226}Ra, ^{232}Th, and ^{238}U, respectively. Concentrations of radium and thorium are comparable to background levels for the northern New Jersey area (Table 2), and well below DOE guidelines in surface and subsurface soil of 5 and 15 pCi/g, respectively. Concentrations of ^{238}U are also well below the site specific limits prescribed for uranium (Table 1). Sample locations are shown on Fig. 2 and results of radionuclide analysis are listed in Table 3.

SIGNIFICANCE OF FINDINGS

Gamma exposure levels on the property ranged from 7 to 16 μR/h. For comparison, background levels for the northern New Jersey area average ~9 μR/h. Concentrations of uranium, thorium, and radium found in the soil samples taken from the front and back yards were comparable to background levels in the area and are well below DOE guidelines for these radionuclides.

The measurements taken during this radiological survey at One Shady Lane, Lodi, New Jersey indicate results that are well within the limits prescribed by DOE radiological guidelines. Therefore, based on these findings, this property does not meet guidelines for inclusion under FUSRAP.

REFERENCES

1. L. W. Cole, J. Berger, P. Cotten, R. Gosslee, L. Sowell, and C. Weaver, *Radiological Assessment of Ballod Associates Property (Stepan Chemical Company), Maywood, New Jersey*, Oak Ridge Associated Universities, Oak Ridge, Tenn., July 30, 1981.

2. T. E. Myrick, B. A. Berven, W. D. Cottrell, W. A. Goldsmith, and F. F. Haywood, *Procedures Manual for the ORNL Radiological Survey Activities (RASA) Program*, ORNL/TM-86090, Martin Marietta Energy Systems, Inc., Oak Ridge Natl Lab., April 1987.

3. Oak Ridge National Laboratory, Health Sciences Research Division, *Measurement Applications and Development Group Guidelines*, ORNL–6782, Martin Marietta Energy Systems, Inc., January 1995.

4. 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.

5. U. S. Department of Energy, *Radiation Protection of the Public and the Environment*, DOE Order 5400.5, April 1990.

6. 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.

7. S. G. Levin, R. K. Stoms, E. Kuerze, and W. Huskisson, "Summary of Natural Environmental Gamma Radiation Using a Calibrated Portable Scintillation Counter," *Radiological Health Data Report* 9:679-695 (1968).

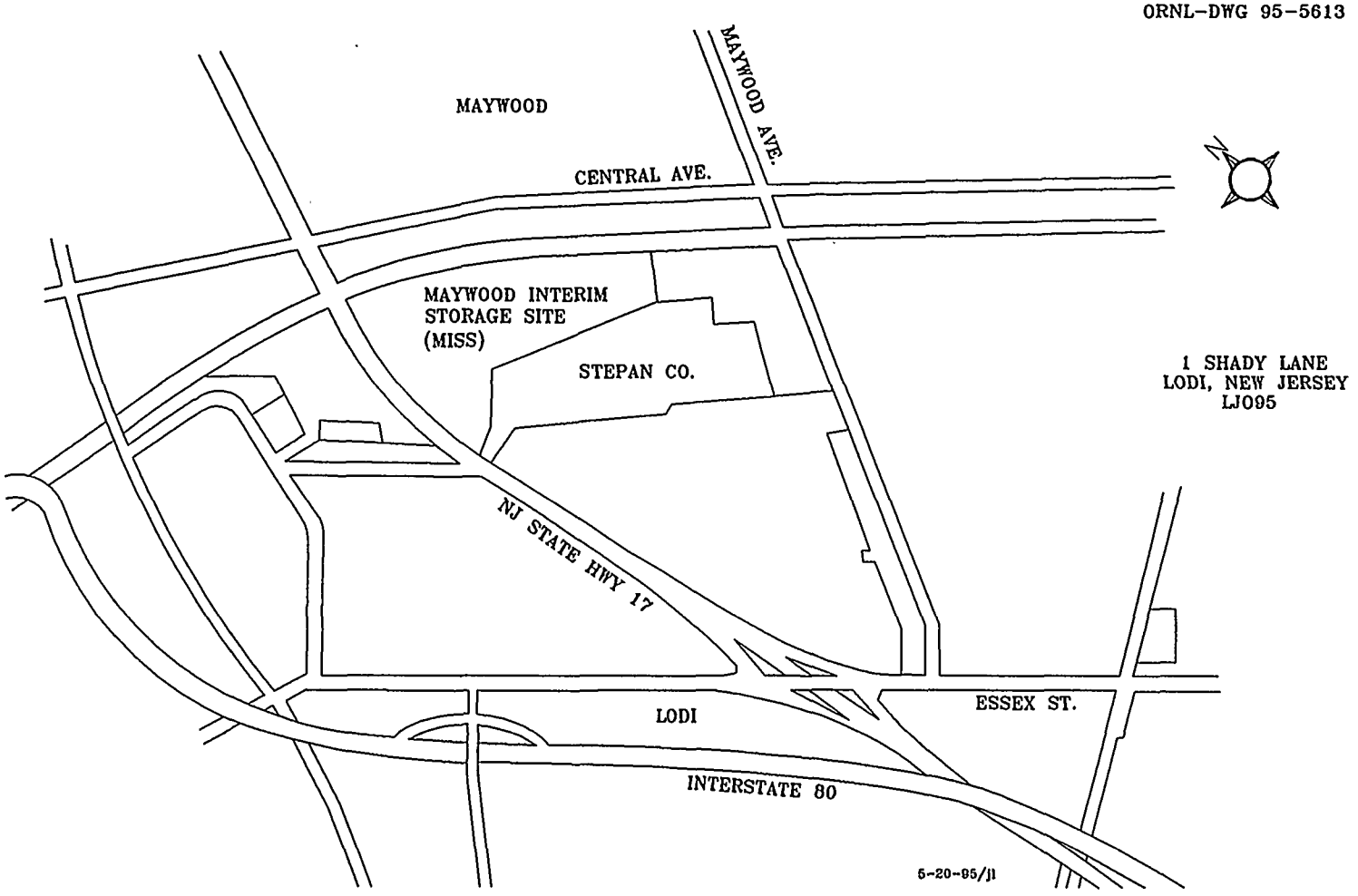

Fig. 1. Diagram showing the general location of Lodi, New Jersey relative to the Maywood Interim Storage Site (MISS).

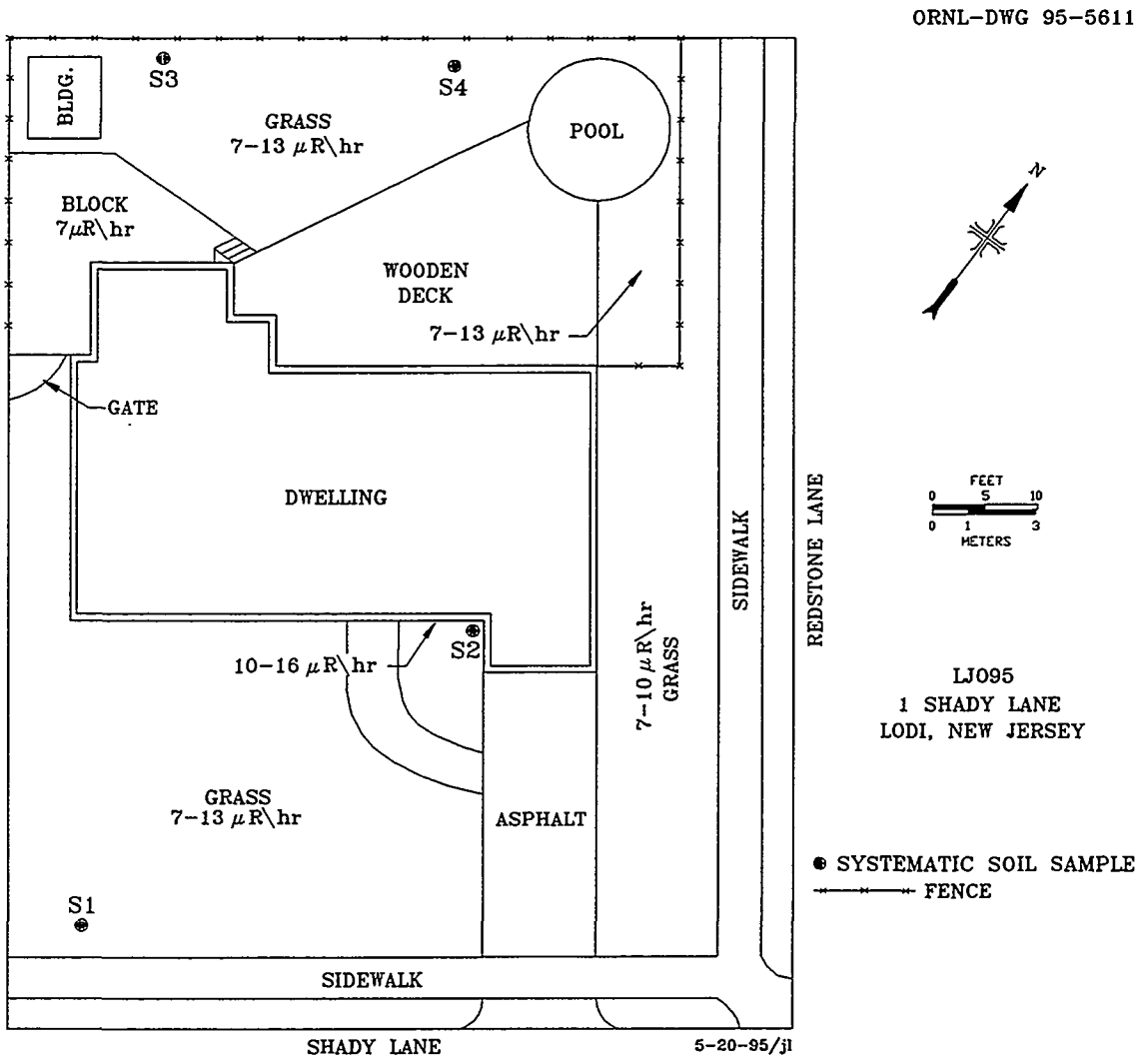

Fig. 2. Diagram showing gamma measurements and soil sampling locations at 1 Shady Lane, Lodi, New Jersey.

ORNL-PHOTO 4497-95

Fig. 3. Photograph of the property at 1 Shady Lane, Lodi, New Jersey facing north towards the front of the house.

ORNL-PHOTO 4498-95

Fig. 4. Photo of the back of the house and yard, facing south. An above-ground swimming pool is in the left foreground.

ORNL-PHOTO 4499-95

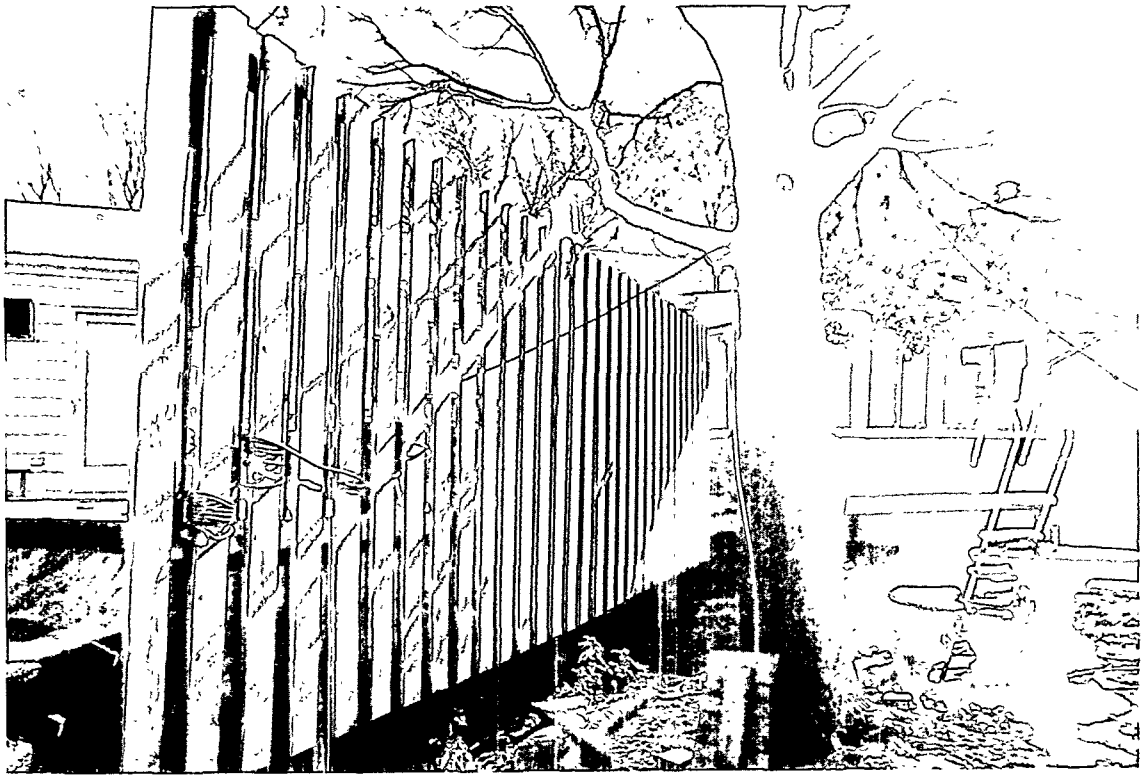

Fig. 5. Photo of the back yard facing the southwest end of the house at 1 Shady Lane, Lodi, New Jersey.

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 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
	^{232}Th, Th-natural (*alpha emitters*) or ^{90}Sr (*beta-gamma emitter*)	
	Maximum	3,000 dpm/100 cm^2
	Average	1,000 dpm/100 cm^2
	Removable	200 dpm/100 cm^2
	^{226}Ra, ^{230}Th, transuranics	
	Maximum	300 dpm/100 cm^2
	Average	100 dpm/100 cm^2
	Removable	20 dpm/100 cm^2
Beta-gamma dose rates	Surface dose rate averaged over not more than 1 m^2	0.20 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	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
	^{226}Ra	
	^{232}Th	
	^{230}Th	
Derived concentrations	^{238}U	Site specific[d]

Table 1. (continued)

Mode of exposure	Exposure conditions	Guideline value
Guideline for non-homogeneous contamination (used in addition to the 100-m^2 guideline)[e]	Applicable to locations with an area ≤25 m^2, 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^2 area

[a]The 20 μR/h shall comply with the basic dose limit (100 mrem/yr) 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 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.

[e]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. Average background radiation levels for the northern New Jersey area

Type of radiation measurement or sample	Radiation level or radionuclide concentration[a]
Gamma exposure at 1 m above ground surface (μR/h)	9[b]
Concentration of radionuclides in soil (pCi/g)[c]	
^{226}Ra	0.9
^{232}Th	0.9
^{238}U	0.9

[a]These values represent an average of normal radionuclide concentrations in this part of the state. Actual values may fluctuate.

[b]Source: U. S. Department of Energy, *Radiological Survey of the Middlesex Municipal Landfill, Middlesex, New Jersey*, DOE/EV-00005/20, April 1980. Values ranging from 8-11 μR/h (average 9 μR/h) were obtained from 35 locations in the Rochelle Park, New Jersey area (Ref. 7).

[c]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 (Ref. 6).

Table 3. Concentrations of radionuclides in soil at 1 Shady Lane, Lodi, New Jersey (LJ095)

Sample number[a]	Depth (cm)	Radionuclide concentration (pCi/g)[b]		
		^{226}Ra	^{232}Th	^{238}U
		Systematic soil samples[c]		
S1A	0-15	0.71 ±0.06	0.85 ±0.1	1.5 ±0.5
S1B	15-30	0.92 ±0.07	1.1 ±0.1	0.72±0.4
S1C	30-45	0.94 ±0.07	0.98 ±0.1	1.2 ±0.3
S2	0-15	0.76 ±0.06	0.82 ±0.1	0.70±0.2
S3	0-15	1.1 ±0.07	0.93 ±0.1	2.4 ±0.3
S4	0-15	0.85 ±0.07	0.81 ±0.1	1.3 ±0.2

[a]Locations of soil samples are shown on Fig. 2.

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

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

INTERNAL DISTRIBUTION

1. B. A. Berven
2. K. J. Brown
3. R. F. Carrier
4-6. R. D. Foley
7-9. C. A. Johnson
10. M. E. Murray
11. P. T. Owen
12. R. E. Rodriguez
13. R. E. Swaja
14. M. S. Uziel
15. J. K. Williams
16. Central Research Library
17-18. Laboratory Records
19. Laboratory Records-RC
20. ORNL Patent Section
21. ORNL Technical Library, Y-12
22-27. MAD Records Center

EXTERNAL DISTRIBUTION

28. W. L. Beck, Oak Ridge Associated Universities, E/SH Division, Environmental Survey and Site Assessment Program, P.O. Box 117, Oak Ridge, TN 37831-0117

29. Jack Russell, Booz-Allen & Hamilton, Inc., Trevion I Bldg., Suite 210, 12850 Middlebrook Rd., Bethesda, MD 20814

30. James J. Fiore, Director, Office of Eastern Area Programs, Office of Environmental Restoration, EM-24, U.S. Department of Energy, 19901 Germantown Rd., Germantown, MD 20874-1290

31-33. R. R. Harbert, Bechtel National, Inc., FUSRAP Department, Oak Ridge Corporate Center, 151 Lafayette Drive, P.O. Box 350, Oak Ridge, TN 37831-0350

34-36. J. King, Science Applications International Corporation, P.O. Box 2501, 301 Laboratory Road, Oak Ridge, TN 37831

37. L. K. Price, Director, Former Sites Restoration Division, Oak Ridge Field Office, U.S. Department of Energy, P.O. Box 2001, Oak Ridge, TN 37831-8723

38. James W. Wagoner II, Director, Division of Off-Site Programs, Office of Eastern Area Programs, Office of Environmental Restoration, EM-421, U.S. Department of Energy, 19901 Germantown Rd., Germantown, MD 20874-1290

39-43. W. Alexander Williams, Designation and Certification Manager, Division of Off-Site Programs, Office of Eastern Area Programs, Office of Environmental Restoration, EM-421, U.S. Department of Energy, 19901 Germantown Rd., Germantown, MD 20874-1290

44-45. Office of Scientific and Technical Information, U.S. Department of Energy, P.O. Box 62, Oak Ridge, TN 37831

46. Office of Assistant Manager, Energy Research and Development, U.S. Department of Energy, DOE Field Office, P.O.Box 2008, Oak Ridge, TN 37831-6269