

HEALTH AND SAFETY RESEARCH DIVISION

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**Radiological Survey Results at 5 Porter Street,
Beverly, Massachusetts (VB019)**

R. D. Foley and C. A. Johnson

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Investigation Team

R. E. Swaja — Measurement Applications and Development Manager
W. D. Cottrell — FUSRAP Project Director
R. D. Foley — Survey Team Leader

Survey Team Members

J. F. Allred	M. E. Murray
A. C. Butler*	V. P. Patania
R. D. Foley	D. E. Rice
D. Mackenzie†	D. A. Rose
W. H. Shinpaugh*	

*D. R. Stone and Associates, Inc.
†H&R Technical Associates

Work performed by the
MEASUREMENT APPLICATIONS AND DEVELOPMENT GROUP

Prepared by the
OAK RIDGE NATIONAL LABORATORY
Oak Ridge, Tennessee 37831-6285
managed by
MARTIN MARIETTA ENERGY SYSTEMS, INC.
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ABSTRACT

At the request of the U.S. Department of Energy (DOE), a team from Oak Ridge National Laboratory conducted a radiological survey at 5 Porter Street, Beverly, Massachusetts. The survey was performed in May 1991. The purpose of the survey was to determine if uranium from work performed under government contract at the former Ventron facility had migrated off-site to neighboring areas. The survey included a surface gamma scan and the collection of soil samples for radionuclide analyses.

Results of the survey demonstrated no radionuclide concentrations or radiation measurements in excess of the DOE Formerly Utilized Sites Remedial Action Program guidelines.

RADIOLOGICAL SURVEY RESULTS AT 5 PORTER STREET, BEVERLY, MASSACHUSETTS (VB019)*

INTRODUCTION

The Metal Hydrides Corporation facility in Beverly, Massachusetts (which became the Ventron Corporation in 1965), was one of many companies performing work during the 1940s associated with the development of nuclear energy for defense-related projects under contract to the Manhattan Engineer District (MED) and the Atomic Energy Commission (AEC). Operations conducted under government contract at such sites included the procurement, storage, and processing of uranium oxides, salts, and metals, and the subsequent machining of these products. As a result of activities involving these materials, equipment, buildings, and land at some of the sites became radiologically contaminated with small amounts of the material resulting in low levels of contamination on the properties. At contract termination, release limits and decontamination operations were typically applied in conformance with standards currently deemed adequate for purposes of health and environmental protection. Subsequent to original assessments and the release of these facilities, new research and information have resulted in the development of more stringent guidelines for release of such facilities for unrestricted use. Furthermore, in some instances, documentation is limited or nonexistent, and conditions at a specific site may be unknown. It is the policy of the Department of Energy (DOE) to verify that radiological conditions at such facilities comply with existing guidelines.¹ The Formerly Utilized Sites Remedial Action Program (FUSRAP) was established by DOE in 1974 to assist in assessment and cleanup activities at these sites.

The radiological survey detailed in this report was performed under the FUSRAP program and is one of several conducted in May, 1991, on properties in the vicinity of the former Ventron facility by members of the Oak Ridge National Laboratory (ORNL) at the request of DOE. The city of Beverly lies on Beverly Harbor approximately 15 miles northeast of the central Boston area. The former Ventron facility, now owned by Morton International, Inc., is located at the confluence of the Bass and Danvers rivers on Congress Street near the Beverly-Salem bridge (Fig. 1, p. 5).

From 1942 through 1948 the Metal Hydrides Corporation (later to become the Ventron facility) converted uranium oxide to uranium metal powder at the facility under contract to the MED in support of the war effort. Other operations conducted at the facility included the recovery of uranium from scrap uranium and turnings from the slug fabrication plant at Hanford, Washington. Contracts between Metal Hydrides and the government were completed in 1954.

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

Following a radiological screening survey at the site in 1977, a comprehensive survey was performed in 1982.² In 1987, DOE contractors removed the uranium-contaminated roof from a Ventron building, which had begun to leak. Radioactive materials remaining on the site do not pose a health hazard under present use conditions, but could cause radiation exposure to workers if excavation or major renovation took place on the property. DOE plans a complete characterization study of the site in 1992 and the initiation of remedial action soon thereafter.

The surveys of the property reported in this document and of other surrounding properties are part of DOE's continuing program to assess the former Ventron site and plan for remedial action. The objective of the surveys was to determine if uranium from plant operations had migrated offsite to neighboring areas including the Beverly Harbor and, if so, to what degree. The relative location of this vicinity property to the former Ventron site is shown in Fig. 2 (p. 6). The radiological surveys consisted of measurements of radiation levels over the ground surface of the properties and analysis of soil, sediment, and other material samples for the presence of radionuclides in concentrations exceeding guidelines.

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).³

SURFACE RADIATION MEASUREMENTS

Gamma radiation levels were determined using a portable NaI gamma scintillation meter. 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 $\mu\text{R/h}$.

SOIL SAMPLING AND ANALYSES

Surface and subsurface soil samples were systematically collected over the property in a pattern sufficient to obtain a characterization of the radionuclide content of the soil. Surface and subsurface soil samples were also collected in any areas of elevated gamma exposure rates. All soil samples were analyzed to determine ^{238}U , ^{232}Th , and ^{226}Ra concentrations.

SURVEY RESULTS

Current guidelines for sites included within the FUSRAP are summarized in Table 1 (p. 8). Typical background radiation levels for the Beverly, Massachusetts, area are presented in Table 2 (p. 9). These data are provided for comparison with the survey results presented in this section. All direct 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, debris, and other samples.

SURFACE RADIATION MEASUREMENTS

A general gamma scan was conducted on this property where exposure rates at the ground surface ranged from 8 to 11 $\mu\text{R}/\text{h}$. Rocks and granite were prevalent over much of the property. Results of gamma measurements are shown on Fig. 3 (p. 7). A maximum value of 24 $\mu\text{R}/\text{h}$ was measured on contact with the northwest corner of the concrete/granite wall of the patio at the rear of the house. A sediment sample was taken here where water runoff had collected. These values are slightly higher than the typical background measurements in the Beverly area of 6 to 9 $\mu\text{R}/\text{h}$, (Table 2); however, concrete and granite contain slightly greater concentrations of naturally occurring radionuclides than soil and contribute to a higher gamma measurement.

SOIL SAMPLES

Soil sample locations are shown in Fig. 3, and results of analyses are listed in Table 3 (p. 10). Rock and granite were encountered in the soil, prohibiting subsurface sampling in some cases. Maximum concentrations of ^{226}Ra and ^{232}Th in surface soil (0-15 cm), including the sediment sample, were 1.7 and 1.4 pCi/g, respectively. In subsurface soil, the maximum value was 1.1 pCi/g for both ^{226}Ra and ^{232}Th . These values are comparable to the typical background levels in the Beverly area (Table 2), and well below DOE guidelines (Table 1). Maximum ^{238}U concentrations in surface and subsurface soil were 5.7 to 5.1 pCi/g, respectively, in systematic samples and measured 4.1 pCi/g in the sediment sample. Uranium-238 concentrations were slightly above typical background soil concentrations in the Beverly area, but well below guidelines of 35 to 40 pCi/g that have been applied at other FUSRAP sites.

SIGNIFICANCE OF FINDINGS

The results of the radiological survey at 5 Porter Street, Beverly, Massachusetts, demonstrated no radioactive concentrations or radiation measurements above established DOE guidelines.

REFERENCES

1. U.S. Department of Energy, *A Background Report for the Formerly Utilized Manhattan Engineer District/Atomic Energy Commission Sites Program*, DOE/EV-0097, September 1980.
2. W. D. Cottrell and R. F. Carrier, *Results of the Radiological Survey at the Ventron Site, Beverly, Massachusetts*, ORNL/TM-10053, Martin Marietta Energy Systems, Inc., Oak Ridge Natl. Lab., May 1988.
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*, ORNL/TM-8600, Martin Marietta Energy Systems, Inc., Oak Ridge Natl. Lab., April 1987.

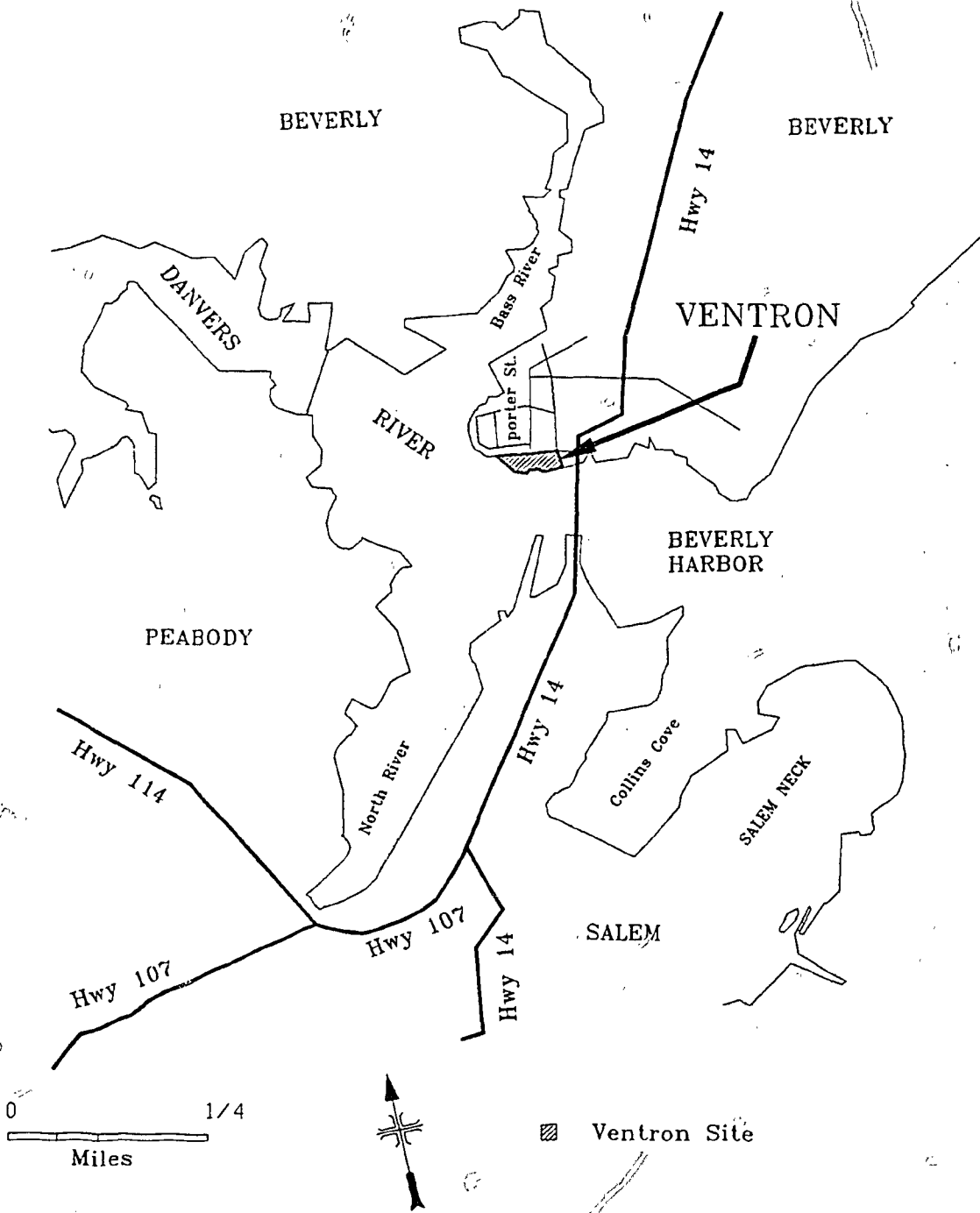


Fig. 1. Diagram showing general location of the former Ventron site.

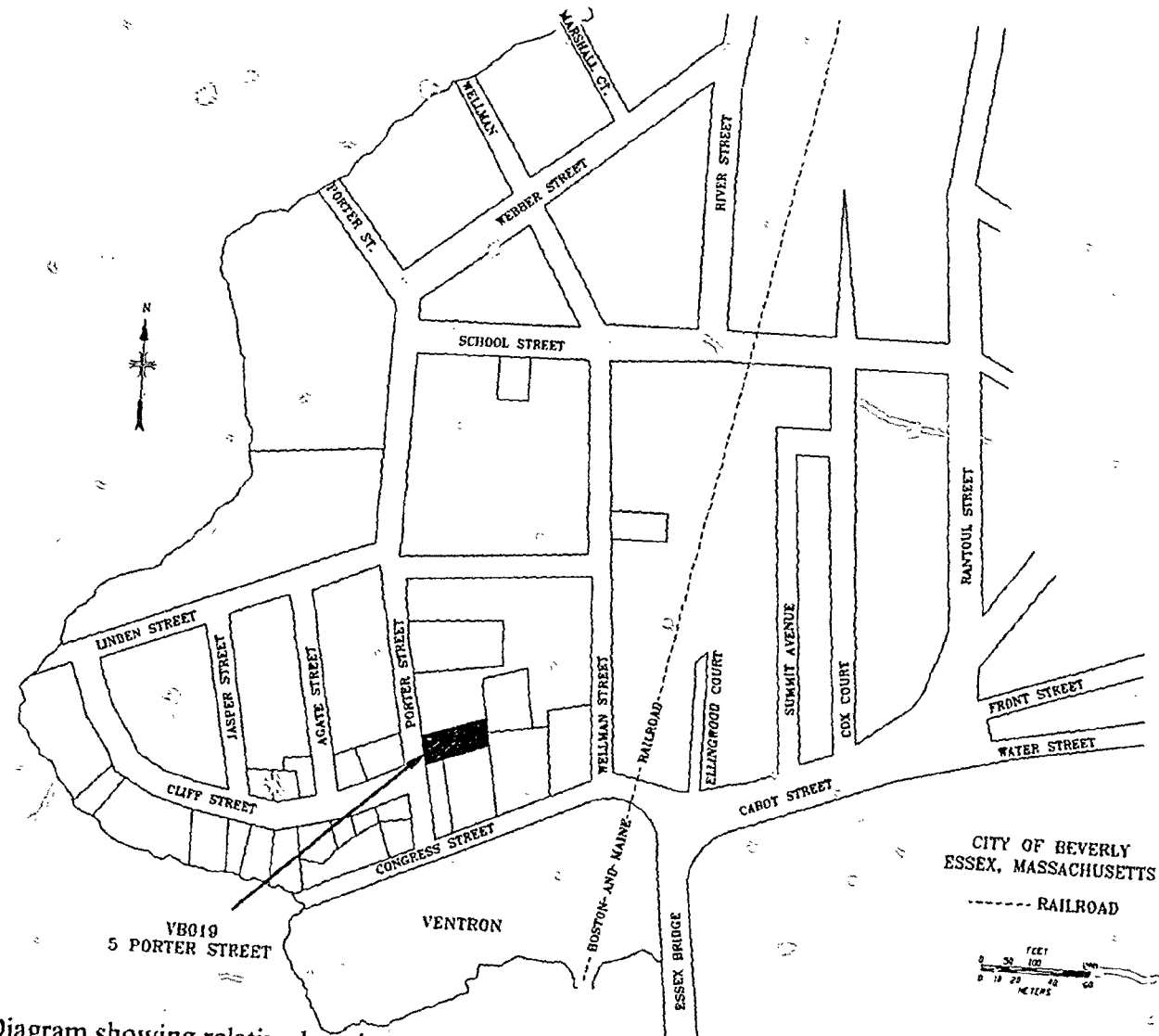


Fig. 2. Diagram showing relative location of 5 Porter Street, Beverly, Massachusetts, to the former Ventron site.

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 $\mu\text{R}/\text{h}^a$
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 > 15 cm below the surface
Derived concentrations	²³⁸ U	Site specific ^b
Guideline for non-homogeneous contamination (used in addition to the 100-m ² guideline) ^c	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

^aThe 20 $\mu\text{R}/\text{h}$ shall comply with the basic dose limit (100 mrem/yr) when an appropriate-use scenario is considered.

^bDOE 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.

^cDOE 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, 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 2. Background radiation levels and concentrations of selected radionuclides in soil in the Beverly, Massachusetts, area

Type of radiation measurement or sample	Radiation level or radionuclide concentration	
	Range	Average
Gamma exposure rate at ground surface ($\mu\text{R/h}$) ^a	6-9	7
Concentration of radionuclides in soil (pCi/g) ^a		
²²⁶ Ra	0.70-0.94	0.84
²³² Th	0.76-0.94	0.84
²³⁸ U	0.69-1.05	0.89

^aValues obtained from three locations in the Beverly area.

Table 3. Concentrations of radionuclides in soil samples from 5 Porter Street, Beverly, Massachusetts

Sample number ^a	Depth (cm)	Radionuclide concentration (pCi/g) ^b		
		²²⁶ Ra	²³² Th	²³⁸ U
<i>Systematic samples^c</i>				
S1A	0-15	1.3 ± 0.04	1.2 ± 0.1	5.0 ± 0.1
S1B	15-30	0.86 ± 0.02	1.0 ± 0.04	1.4 ± 0.7
S2	0-8	1.7 ± 0.02	1.4 ± 0.03	2.9 ± 0.6
S3A	0-15	0.89 ± 0.04	0.86 ± 0.06	4.2 ± 0.9
S3B	15-23	0.87 ± 0.02	0.99 ± 0.03	3.9 ± 0.6
S4A	0-15	0.73 ± 0.03	0.82 ± 0.05	4.0 ± 1
S4B	15-30	0.88 ± 0.02	0.96 ± 0.03	2.7 ± 0.5
S5A	0-15	1.0 ± 0.04	0.98 ± 0.06	5.7 ± 1
S5B	15-30	1.1 ± 0.03	1.1 ± 0.04	5.1 ± 1
S6A	0-15	0.93 ± 0.02	0.92 ± 0.03	3.4 ± 0.6
S6B	15-30	0.96 ± 0.02	0.97 ± 0.03	3.8 ± 0.6
<i>Sediment sample^d</i>				
E1	0-15	0.88 ± 0.02	1.2 ± 0.04	4.1 ± 0.7

^aLocations of soil samples are shown on Fig. 3.

^bIndicated counting error is at the 95% confidence level ($\pm 2\sigma$).

^cSystematic samples are taken at locations irrespective of gamma exposure rates.

^dSediment sample was taken from NW corner of the patio.

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