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**Radiological Characterization
Survey Results for Gaskill Hall,
Miami University,
Oxford, Ohio
(OXO015)**

K. R. Kleinhans
M. E. Murray
R. F. Carrier

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HEALTH SCIENCES RESEARCH DIVISION

**Environmental Restoration and Waste Management Non-Defense Programs
(Activity No. EX 20 20 010)**

**Radiological Characterization Survey Results for
Gaskill Hall, Miami University,
Oxford, Ohio (OXO015)**

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Date of publication — April 1996

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U. S. DEPARTMENT OF ENERGY
under contract DE-AC05-96OR22464**

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ACKNOWLEDGMENTS

This project was sponsored by the Office of Environmental Restoration, U.S. Department of Energy, under contract DE-AC05-96OR22464 with Lockheed Martin Energy Research Corp. The authors wish to acknowledge the essential contributions of J. F. Allred, G. H. Cofer, R. C. Gosslee, R. A. Mathis, S. P. McKenzie, D. D. McKinney, V. P. Patania, D. E. Rice, R. E. Rodriguez, D. A. Roberts, D. A. Rose, P. F. Tiner, and W. Winton of the Measurement Applications and Development Group, Health Sciences Research Division, Oak Ridge National Laboratory, for their participation in collecting, reporting, and analyzing the data for this effort. The surveying assistance of A. C. Butler and the graphics skills of J. M. Lovegrove of Midwest Technical, Inc., are also gratefully acknowledged.

ABSTRACT

Between October 1952 and February 1957, National Lead of Ohio (NLO), a primary contractor for the Atomic Energy Commission (AEC), subcontracted certain uranium machining operations to Alba Craft Laboratory, Incorporated, located at 10-14 West Rose Avenue, Oxford, Ohio. In 1992, personnel from Oak Ridge National Laboratory (ORNL) confirmed the presence of residual radioactive materials from the AEC-related operations in and around the facility in amounts exceeding the applicable Department of Energy (DOE) guidelines. Although the amount of uranium found on the property posed little health hazard if left undisturbed, the levels were sufficient to require remediation to bring radiological conditions into compliance with current guidelines, thus ensuring that the public and the environment are protected.

Because it was suspected that uranium may have been used in the past in the immediate vicinity of Alba Craft in a Miami University building (Gaskill Hall), a team from ORNL performed a radiological characterization survey of that structure in January 1994. The survey was conducted at the request of DOE as a precautionary measure to ensure that no radioactive residuals were present at levels exceeding guidelines.

The survey included the determination of directly measured radiation levels and the collection of smear samples to detect possible removable alpha and beta-gamma activity levels, and comparison of these data to the guidelines.

Results of the survey showed that all measurements were below the applicable guideline limits set by DOE.

**Results of the Radiological Characterization Survey of Gaskill Hall,
Miami University, Oxford, Ohio*
(OXO015)**

INTRODUCTION

Alba Craft Laboratory, Incorporated, Oxford, Ohio, was a subcontractor to National Lead of Ohio (NLO), a primary contractor for the Atomic Energy Commission (AEC). Between October 1952 and February 1957, the company provided a variety of machine shop services for NLO involving normal uranium metal. Early work included general machining and developmental machining of uranium slugs for the Savannah River Plant in Aiken, South Carolina. Final operations involved the hollow drilling and turning of uranium to produce uranium slugs for the Savannah River and Hanford, Washington, reactors on a large-scale basis. NLO also used the Alba Craft facilities in 1954, supplying its own operators and material for machining. The total quantity of uranium machined by Alba Craft is estimated at several hundred tons; the quantity machined by NLO during 1954 is unknown.¹

As a result of these and similar activities at AEC-contracted sites, equipment, buildings, and land at some of the sites became contaminated with low levels of radioactive residuals. At contract termination, sites used by contractors were decontaminated in accordance with the standards and survey methods in use at that time. Since the original assessments, radiological criteria and guidelines for the release of such sites for unrestricted use have become more stringent. As a result, the Formerly Utilized Sites Remedial Action Program (FUSRAP) was established in 1974 to identify these formerly used sites and to reevaluate their radiological status.² The radiological survey detailed in this report was performed under the FUSRAP program.

The Alba Craft site had been previously investigated to determine the extent of on-site contamination.³ As a follow-up to earlier investigations, and as a precaution to ensure that residual radioactive materials did not exceed current U.S. Department of Energy (DOE) guidelines, DOE requested a radiological survey of the former laboratory and vicinity properties.

In July and September 1992, a radiological characterization survey was conducted at the former Alba Craft Site property, 10-14 West Rose Avenue, Oxford, Ohio, by personnel from Oak Ridge National Laboratory (ORNL) at the request of DOE. Results of that survey are presented in *Results of the Radiological Survey at the Former Alba Craft Laboratory Site Properties, Oxford, Ohio (OXO001)*, ORNL/RASA-92/14 (March 1993).⁴ Following the survey of the Alba Craft site, and because of the possibility that contamination may have migrated off-site, several vicinity property owners granted permission for Oak Ridge National Laboratory (ORNL) personnel to survey their properties for DOE. ORNL employees surveyed vicinity properties in August, September, and December 1993.

*The survey was performed by members of the Measurement Applications and Development Group, Health Sciences Research Division, Oak Ridge National Laboratory under DOE contract DE-AC05-96OR22464 with Lockheed Martin Energy Research Corp.

During the investigation of the site and the surrounding properties, it was reported that the owner/operator of the former Alba Craft Laboratory, a professor at Miami University in Oxford, may have performed uranium machining development work in a Miami University building (Gaskill Hall). Because of concern that Gaskill Hall may also have become contaminated, a radiological survey of portions of the interior of that building was performed in January 1994. The results of that survey are presented in this report.

The Gaskill Hall building contained various types of offices and laboratories. Because information indicated that only certain specific areas within the building may have been involved in uranium work, the survey was confined to those locations and to several specific offices.

Figure 1 shows the relative location of the City of Oxford in southwestern Ohio. Figure 2 is a diagram indicating the approximate location of the former Alba Craft Laboratory site in Oxford. Figure 3 shows the general location of the Gaskill Hall building.

SCOPE OF THE SURVEY

For the purposes of this report, the three general areas surveyed have been labeled the "Process Control Laboratory," (Figs. 4 and 5) the "Interior Design Studio," (Figs. 6-9) and the "Paper Science Laboratory" (Fig. 10). Two offices in the basement formerly occupied by graduate students during the time of concern and occupied by Miami University professors during the time of the survey were also assessed (Figs. 11 and 12).

The indoor survey included:

- A gamma scan near the surface over all accessible areas.
- Determination of beta-gamma activity levels on surfaces.
- Collection and analysis of smears to determine removable alpha and beta-gamma activity levels.

SURVEY METHODS

Descriptions of the typical survey methods and instrumentation providing guidance for this survey are given in *Procedures Manual for the ORNL Radiological Survey Activities (RSA) Program*, ORNL/TM-8600, April 1987, and in *Measurement Applications and Development Group Guidelines*, ORNL-6782, January 1995.^{5,6}

Using a portable NaI gamma scintillation meter, gamma radiation levels were determined near the surface over 100% of accessible areas. 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

$\mu\text{R/h}$. Using a Geiger-Mueller pancake detector, beta-gamma radiation levels were measured in counts per minute (cpm) over all accessible hard surfaces and then converted to mrad/h and disintegrations per minute over 100 cm^2 (dpm/ 100 cm^2) for comparison with guideline values. Using an ORNL alpha survey meter connected to a zinc sulfide probe, selected surfaces were checked for the presence of total (fixed) alpha activity levels. Removable alpha and beta-gamma activity levels were assessed by gross counting of smear samples that had been collected by wiping selected surfaces and/or gamma spectrometry analysis.

Large, Open floor areas were scanned for beta-gamma measurements using a Ludlum 2221 meter with a Ludlum 23-1F floor monitor. Elevated areas were then measured using the above portable instrumentation. The same portable instrumentation was used on space-restricted areas.

SURVEY RESULTS

Typical background radiation levels for the Oxford, Ohio, area are presented in Table 1. Current DOE guidelines for sites included within FUSRAP are summarized in Table 2. These data are provided for comparison with the survey results presented in this report. All radiation levels are reported in gross $\mu\text{R/h}$, dpm/ 100 cm^2 , and mrad/h ; i.e., background concentrations have not been subtracted.

RADIATION MEASUREMENTS

Gamma Measurements

Figs. 13, 14, and 15 are diagrams showing the layouts and locations of samples for the three general surveyed interiors.

Gamma exposure rates near floor and window sill surfaces in the Paper Science and Engineering Laboratory ranged from 9 to $21\text{ }\mu\text{R/h}$ with the maximum readings found on the walls and in the block wall corners of the room. Concentrations of naturally occurring radionuclides in construction materials such as concrete block are often slightly elevated above typical values. Overhead, gamma levels were $10\text{ }\mu\text{R/h}$. These results are well below the DOE guideline of $20\text{ }\mu\text{R/h}$ above normal background (Table 2).

Gamma radiation levels throughout the Process Control Laboratory were 8 to $16\text{ }\mu\text{R/h}$. In the Interior Design Studio and the adjoining rooms (100, 102-105, 107, and 108) measurements ranged from 6 to $12\text{ }\mu\text{R/h}$, averaging $8\text{ }\mu\text{R/h}$. All values are comparable to those typically found in the Oxford area (Table 1).

Surface Activity Measurements

Beta-gamma activity levels in the Paper Science and Engineering Laboratory ranged from 2,100 to 3,400 dpm/100 cm², averaging 2,600 dpm/100 cm². Beta-gamma dose rates ranged from 0.04 to 0.06 mrad/h, averaging 0.04 mrad/h.

Average beta-gamma activity levels in the Process Control Laboratory were 2,600 dpm/100 cm², ranging from 2,100 to 3,400 dpm/100 cm². Dose rates were 0.04 to 0.06 mrad/h, averaging 0.04 mrad/h.

No gamma, beta-gamma, or alpha anomalies were found in any of these areas, nor in the Interior Design Studio. All directly measured alpha and beta-gamma activity levels were the same as or less than background. All results were below the applicable guidelines (Table 2).

SMEAR ANALYSES

Table 3 lists the results of analysis of smear samples collected to assess the possible presence of transferable alpha and beta-gamma activity levels. Locations of smears collected from floor level surfaces are indicated on Figs. 13, 14, and 15. All results are below the minimum detectable activity (MDA)* levels for the instrumentation.

SIGNIFICANCE OF FINDINGS

Results of the radiological survey of areas within Gaskill Hall possibly having been involved with uranium work showed that all radiation levels and radiation measurements are below the applicable guideline limits set by DOE. The only anomaly located within the surveyed areas at Gaskill Hall was an aircraft oil pressure gauge that was marked with radium paint.** This gauge was discovered while performing a gamma scan of the Process Control Laboratory (Figs. 4 and 5), which identified an anomaly near the cabinet in which the gauge was found.

*The instrument-specific minimum detectable activities (MDAs) for removable alpha and beta-gamma radiation levels are 10 and 200 dpm/100 cm², respectively.

**It was a common practice from 1915 through the 1970s to use a zinc sulphide radium mixture as a luminous paint to mark military instruments and watches so that they would "glow in the dark."

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Fig. 1. Diagram showing the general location of Oxford, Ohio.

Fig. 2. Diagram showing the general location of the Alba Craft site, Oxford, Ohio.

ORNL-PHOTO 95-5629

Fig. 3. Diagram showing the general location of Gaskill Hall, Miami University, Oxford, Ohio.

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Fig. 4. Photograph of part of the Process Control Laboratory.

ORNL-PHOTO 9880-95

Fig. 5. Photograph showing part of the Process Control Laboratory.

ORNL-PHOTO 9881-95

Fig. 6. Photograph taken in the Interior Design Studio.

ORNL-PHOTO 9882-95

Fig. 7. Photograph taken in the Interior Design Studio.

ORNL-PHOTO 9883-95

Fig. 8. Photograph showing part of the Interior Design Studio.

ORNL-PHOTO 9884-95

Fig. 9. Photograph showing part of the Interior Design Studio.

ORNL-PHOTO 9885-95

Fig. 10. Photograph taken in the Paper Science Laboratory.

ORNL-PHOTO 9886-95

Fig. 11. Photograph taken in one of the basement offices.

ORNL-PHOTO 9887-95

Fig. 12. Photograph taken in one of the basement offices.

Fig. 13. Diagram showing the layout of the Paper Science Laboratory and locations of smear samples.

Fig. 14. Diagram showing the layout of the Interior Design Studio and locations of smear samples.

ORNL-DWG 95-5606

Fig. 15. Diagram showing the layout of the Process Control Laboratory and locations of smear samples.

Table 1. Background radiation levels and concentrations of selected radionuclides in soil samples taken near Oxford, Ohio

Type of radiation measurement or sample	Radiation level or radionuclide concentration	
	Range	Average
Gamma exposure rate at 1 m above ground surface ($\mu\text{R/h}$) ^a	6 – 9	8
Concentration of radionuclides in soil (pCi/g dry wt) ^b		
²³⁸ U	0.86 – 2.2	1.3
²²⁶ Ra	1.0 – 2.5	1.9
²³² Th	0.71 – 0.99	0.89

^aResults of measurements taken at three locations near Oxford, Ohio.

^bResults of analysis of soil samples obtained from three locations near Oxford, Ohio.

Source: T. E. Myrick, B. A. Berven, and F. F. Haywood, *State Background Measurements Taken During 1975-1979*, ORNL/TM-7343, November, 1981.

**Table 2. Applicable guidelines for protection against radiation
(Limits for uncontrolled areas)**

Mode of exposure	Exposure conditions	Guideline value
Gamma radiation	Indoor gamma level (above background)	20 μ R/h ^a
Total residual surface contamination ^b	²³⁸ U, ²³⁵ U, U-natural (alpha emitters) or Beta-gamma emitters ^c	
	Fixed and removable	15,000 dpm/100 cm ²
	Average	5,000 dpm/100 cm ²
	Removable	1,000 dpm/100 cm ²
	Maximum dose rate in any 100-cm ² area	1.0 mrad/h

^aThe 20 μ R/h shall comply with the basic dose limit (100 mrem/yr) when an appropriate-use scenario is considered.

^bDOE 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.

^cBeta-gamma emitters (radionuclides with decay modes other than alpha emission or spontaneous fission) except ⁹⁰Sr, ²²⁸Ra, ²²³Ra, ²²⁷Ac, ¹³³I, ¹²⁶I, ¹²⁵I.

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 FUSRAP and Remote SFMP Sites*, Rev. 2, March 1987; and U. S. Department of Energy *Radiological Control Manual*, DOE N5480.6 (DOE/EH-256T), June 1992.

**Table 3. Results of analysis of smear samples collected from surfaces
in Gaskill Hall, Miami University, Oxford, Ohio**

Sample ID	Location ^a	Location detail	Removable contamination	
			Alpha (dpm/100 cm ²) ^b	Beta-gamma (dpm/100 cm ²) ^c
T1	Process Control Laboratory	Tiled floor	<MDA	<MDA
T2	Process Control Laboratory	Tiled floor	<MDA	<MDA
T3	Process Control Laboratory	Tiled floor	<MDA	<MDA
T4	Process Control Laboratory	Unpainted brick window sill	<MDA	<MDA
T5	Equipment Room	Surface beneath removed tiles	<MDA	<MDA
T7	Paper Science Laboratory	Overhead electric service	<MDA	<MDA
T8	Paper Science Laboratory	Floor	<MDA	<MDA
T9	Paper Science Laboratory	Overhead electric service	<MDA	<MDA
T10	Paper Science Laboratory	Floor	<MDA	<MDA
T11	Interior Design Studio	Floor	<MDA	<MDA
T12	Interior Design Studio	Floor	<MDA	<MDA
T13	Interior Design Studio	Floor	<MDA	<MDA
T14	Interior Design Studio	Floor	<MDA	<MDA
T15	Interior Design Studio	Floor	<MDA	<MDA
T16	Interior Design Studio	Floor	<MDA	<MDA
T17	Room 5	Floor drain	<MDA	<MDA
T18	Room 7	Floor	<MDA	<MDA

^aWith the exception of those taken in Rooms 5 and 7 of the basement, locations of smears are shown on Figs. 13 through 15.

^bThe instrument-specific minimum detectable activity for removable alpha activity levels is 10 dpm/100 cm².

^cThe instrument-specific minimum detectable activity for beta-gamma activity levels is 200 dpm/100 cm².

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