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CONFIRMATORY RADIOLOGICAL SURVEY OF THE NAVAL BIOSCIENCES LABORATORY U.S. NAVAL SUPPLY CENTER OAKLAND, CALIFORNIA

P. R. COTTEN

Radiological Site Assessment Program
Manpower Education, Research, and Training Division

FINAL REPORT
MAY 1988

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This draft report has not been given full review and patent clearance, and the dissemination of its information is only for official use. No release to the public shall be made without the approval of the Office of Information Services, Oak Ridge Associated Universities.

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INTRODUCTION AND SITE HISTORY

Since the early 1940's, the Naval Biosciences Laboratory (NBL), located at the U.S. Naval Supply Center in Oakland, California, was utilized by the University of California, Berkeley (UCB) School of Public Health as a biological research facility. Campus environmental health and safety records indicate that radioactive materials were used at NBL, beginning in the early 1960's under Atomic Energy Commission license number 4-650-1. Most research activities utilized low-energy beta emitting radionuclides such as H-3, C-14, P-32, S-25, and I-125; other radionuclides used included small quantities of Na-22, Cl-36, Cr-51, and Se-75. Records indicate that use of source material, special nuclear material, and fission product radionuclides was not authorized for these facilities. The facility is currently operated under the University of California Berkeley license 04-00650-07, issued by the Nuclear Regulatory Commission (NRC).

In September 1985, the U.S. Navy announced its intention to terminate NBL activities; final decommissioning was to be completed no later than September 30, 1987. Decontamination was performed by the University of Berkeley Environmental Health and Safety Department as individual research projects terminated. A final survey report prepared by UCB in September 1987, indicates that decontamination is complete, and that post-decontamination radiological conditions satisfy the NRC guidelines for release for unrestricted use.[1]

At the request of the Nuclear Regulatory Commission, Region V Office, the Radiological Site Assessment Program of Oak Ridge Associated Universities (ORAU) conducted a radiological survey in October, 1987 to confirm the status of the NBL Facility, relative to the NRC guidelines for release for unrestricted use.

SITE DESCRIPTION

The NBL facility is located within the boundaries of the U.S. Naval Supply Center along the San Francisco Bay Shores, in the city of Oakland (Figures 1 and 2). The facility is located near the Middle Harbor Road Entrance, (Gate 2), to the Center. The NBL consists of four buildings (Figure 3). Buildings 841 and 844 were the only sites used for research involving radioactive materials. Building 841 was the primary research center laboratory facility; Building 844 housed most of the administrative and workshop areas.

Buildings 841 and 844 are of wood frame construction. Building 841 has two stories (including an attic) with 4 wings interconnected to a central corridor. Only three wings, (C, D, E) of 841 contained laboratories used for radiological research (Figures 4 and 5). The smaller of the two buildings is 844 (Figure 6). It has one story (including an attic) and 5 wings interconnected to a central corridor. Only the C Wing of Building 844 contained laboratories used in radiological research.

SURVEY PROCEDURES

A confirmatory survey of Buildings 841 and 844 of the NBL was performed during the period of October 12-23, 1987, by the Radiological Site Assessment Program of Oak Ridge Associated Universities. The survey was conducted in accordance with a plan submitted to Region V of the NRC.[2] Methods and procedures utilized in the survey are presented in this section.

Objectives

The objectives of the survey were to confirm that the radiological condition of the NBL facility as described in the report prepared by the University of California Berkeley is accurate and adequate and to provide information and data for evaluation of the site status, relative to NRC guidelines for release for unrestricted use.

Procedures

Document Review

The licensee's termination survey report on the NBL was reviewed by ORAU. Data presented in the report were compared to the NRC established release guidelines.

Facility Survey

Gridding

An alpha numeric 2 m x 2 m reference grid system was established in rooms with known or probable radiological use history. The grid was established on the floor and lower walls (up to 2 m) on the first and second floors of Wings C, D, E and interconnecting wings in Building 841, and in C Wing of Building 844. The upper walls, ceilings, and miscellaneous surfaces were not gridded, but they were referenced to the floor and lower wall grids. Rooms with floor areas of less than 10 m^2 were not gridded; measurements and samples from these rooms were referenced to pertinent building features.

Surface Scans and Measurement of Total and Removable Contamination

Beta-gamma and gamma scans were performed on floors, using a beta gas-proportional floor monitor and NaI (Tl) gamma scintillation detectors with audible indicating scaler/ratemeters. Scans of surfaces not accessible to the floor monitor, i.e., walls, ceilings, and overhead areas such as ledges, beams, pipings, fixtures, and duct work were performed using portable "pancake" GM beta-gamma detectors. Locations with elevated direct radiation levels were to be noted for further investigations.

A minimum of 6 floor and lower wall grid blocks in each surveyed room was randomly selected for surface contamination measurements. Total measurements of beta-gamma contamination levels were systematically performed at the center and four equidistant points, midway between the center and block corners. Smears

for removable beta contamination were performed at the location in each grid block, where the highest direct reading was obtained. Total and removable contamination levels were also measured at random locations on the upper walls, ceilings, and miscellaneous overhead objects in the gridded rooms and on all surfaces in ungridded areas.

Paint Samples

Twenty-seven paint samples were collected from surfaces. No residual contamination was detected during the scans, but based on the previous use of low-energy beta emitters, samples were collected from selective laboratory areas in each wing.

Drain Samples

Liquid samples were collected from open drains in rooms E-101D and C-209 in Building 841. Residue was also collected from the elbow of a contaminated drain in Room DE-205 in Building 841 (Figure 5). Large area swipes were performed in open drains in Rooms E-227 and E-220 in Building 841 and in Room C-18 in Building 844. The swipes were scanned using the GM "pancake" probe to identify any removed activity.

Soil Sampling

One soil sample was collected from an excavated area beneath Room C-10 in Building 844.

Roof Scans and Samples

Beta-gamma and gamma scans were conducted on the roof of Building 841. All exhaust stacks, equipment, and structures on the roof were scanned. Two residue samples were collected from gutters on the east side of the building.

Sample Analysis and Interpretation of Results

Soil and gutter residue samples were analyzed by gamma spectroscopy, and the spectra were reviewed for identifiable photopeaks. Smears, liquids from drains and paint were analyzed for gross alpha and beta activity. Soil and selected paint, residue, and smear samples were also analyzed for H-3 and C-14. Additional information concerning major instrumentation, sampling equipment, and analytical procedures is provided in Appendices A and B. Results were compared with NRC guidelines, established for release of facilities for unrestricted use (Appendix C).

RESULTS

Document Review

A review of the termination survey report, submitted by the University of California Berkeley, indicates that procedures and instrumentation used were consistent with industry accepted practices. Measurement and sample data provided in the report were within the established NRC guidelines. No significant deficiencies or discrepancies were identified in this documentation.

Facility Survey

Surface scans

Up to 100% of the floors and lower walls were scanned in each of the rooms identified in Figures 4 to 6. Surface scans identified elevated direct radiation, associated with a drain line on the South wall of Room DE-205 in Building 841 (Figure 5). Further evaluations of this drain are discussed in the section of this report on Comparison of Results with Guidelines. No additional areas of elevated radiation were identified by the scans.

Surface Contamination Measurements

Over 1500 direct measurements and 750 smears were performed. Only five direct measurement locations indicated contamination levels above the detection sensitivities of the procedures. The maximum level measured was 1020 dpm/100 cm^2, in Room DE-205 of Building 841. The maximum beta-gamma removable measurement was 50 dpm/100 cm^2, also in room DE-205. Surface contamination measurement results are summarized in Table 1.

Thirty-four smears from rooms believed to have the highest potential for H-3 and C-14 contamination, based on site history, were analyzed for H-3 and C-14 content. Results indicated that all surface contamination levels were below the procedure detection limits of 20 dpm/100 cm^2, H-3 and 10 dpm/100 cm^2, C-14.

Radionuclide Concentrations in Paint

Results of gross-beta analyses on paint samples are presented in Table 2. Activity in paint ranged from 1.0 to 11.0 dpm/100 cm^2.

Five paint samples were also analyzed for H-3 and C-14. The results are presented in Table 3. Concentrations of H-3 and C-14 in these samples ranged from <430 dpm/100 cm^2 to <480 dpm/100 cm^2 and <340 dpm/100 cm^2 to <380 dpm/100 cm^2, respectively.

Radionuclide Contamination in Drains

Beta-gamma scans and measurements on large area swipes from dry drains did not identify the presence of residual contamination, except in Room DE-205 of Building 841. Liquid samples from two drains contained 95 and 110 pCi/l of gross beta activity (Table 4). A sample of residue from the contaminated drain in Room DE-205 contained 1975 pCi/g of gross beta activity (Table 4), and <180 pCi/g of H-3 and <140 pCi/g of C-14 (Table 3).

Radionuclide Concentrations in Soil

The gamma spectrum of the soil sample from beneath the floor did not indicate the presence of any radionuclides other than those of the naturally occurring potassium and the uranium and thorium decay series. Concentrations were in the range of typical baseline levels. No photopeaks associated with materials used at NBL were identified. Concentrations of H-3 and C-14 in this sample were below the detection sensitivities of 196 pCi/g and 152 pCi/g, respectively.

Roof Scans and Samples

Scans of the roof and equipment did not identify any areas of elevated direct radiation. Residue samples from the rain gutters did not contain gamma-emitting radionuclides other than those naturally occurring in soil. Additional analysis of one of these residue samples indicated levels of H-3 and C-14 were below detection sensitivities, i.e. <83 pCi/g, H-3 and <64 pCi/g, C-14.

COMPARISON OF RESULTS WITH GUIDELINES

NRC surface contamination guidelines for release of facilities for unrestricted use are presented in Appendix C. The radionuclides handled at NBL were beta-gamma emitters for which the guideline levels are as follows:

Total beta-gamma

5000 dpm/100 cm^2, average over 1 m^2 area
15000 dpm/100 cm^2, maximum in any 100 cm^2 area

Removable beta-gamma

1000 dpm/100 cm^2

All contamination measurements conducted by ORAU were within these guidelines.

Scans had identified a drain in Room DE-205, of Building 841, with elevated direct beta gamma measurements that suggested internal contamination. The presence of contamination was confirmed by a residue sample removed from this drain. This drain was brought to the attention of UCB representatives at the time of the survey. The elbow part of the drain was removed by UCB personnel during the ORAU survey, however contamination still remained within the drain line. After the ORAU survey was completed, University personnel removed the remaining drain line to its juncture with the sewer. Additional survey data, generated by the licensee following drain removal, indicated no residual contamination.[3] NRC inspectors from the Region V Office conducted sampling of the sewer line and provided results to ORAU.[4] This NRC information is presented in Table 5. A review of the UCB and NRC data indicates that the drain system now satisfies the guidelines for release.

Analyses of soil, gutter residue, liquid, and paint samples did not identify the presence of any radionuclides, known to have been handled at NBL under the AEC or NRC licenses.

SUMMARY

On October 12-23, 1987, Oak Ridge Associated Universities performed a confirmatory radiological survey of the NBL facility located at the U.S. Naval Supply Center in Oakland, California. The survey included surface beta-gamma, and gamma scans of the floors, and lower walls in Building 841 and Building 844. Direct measurements for total and removable contamination levels were performed in rooms designated as radioactive material use areas. In addition to these areas, some adjoining rooms and hallways were also surveyed. The survey also included the measurement of radionuclide concentrations in soil, paint, and drain residue samples. One area of elevated radiation in a drain line in Room DE-205 was identified. Additional remediation of the drain pipe in DE-205 was completed by the licensee, and the licensee and NRC conducted followup surveys which indicated that no significant contamination remained. The findings of the ORAU activities confirm that the close out survey performed by the licensee, accurately presents the radiological conditions of the NBL facility, relative to the NRC guidelines.

FIGURE 1: Map of Oakland Area, Indicating the Location of the U.S. Naval Supply Center

ONS3

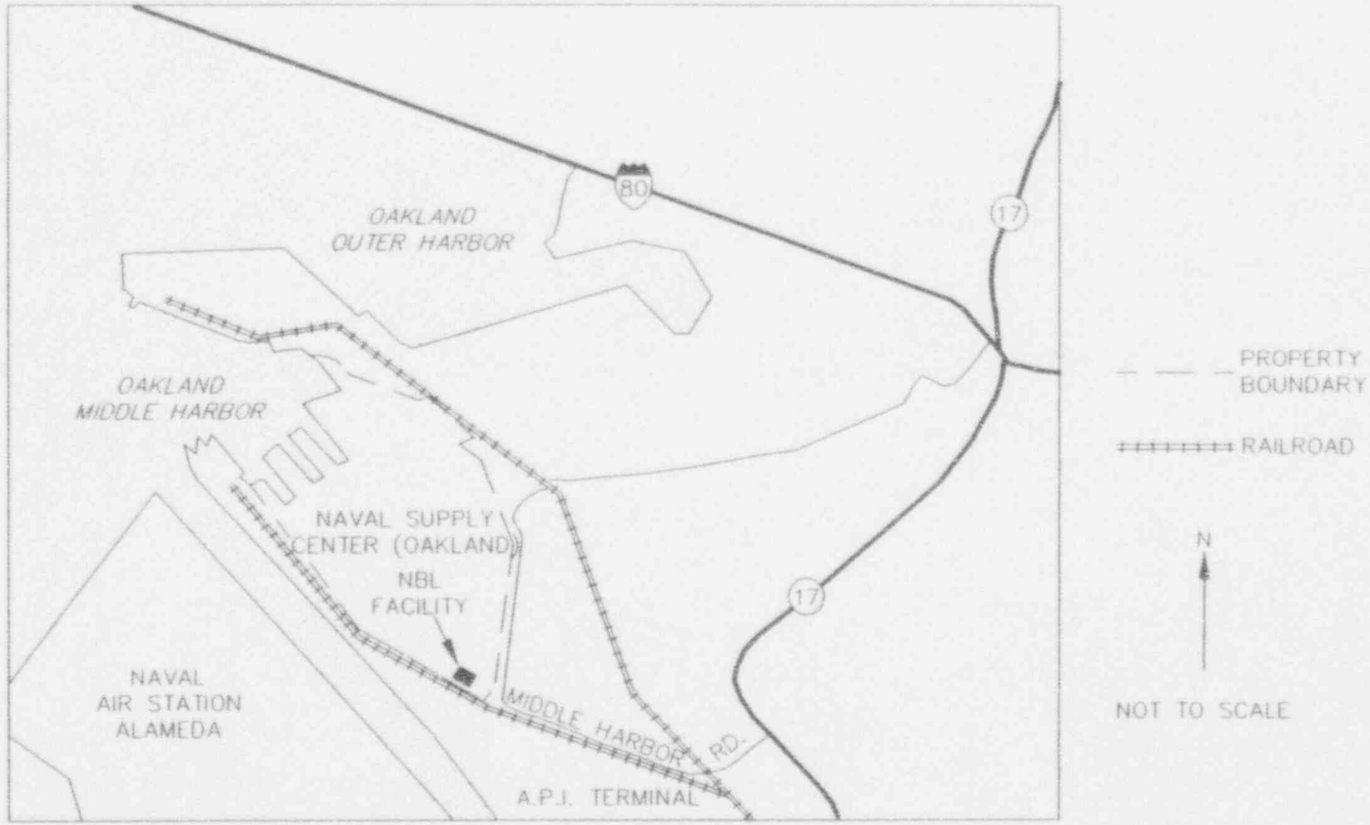

FIGURE 2: Layout of the U.S. Naval Supply Center Indicating Naval Biosciences Laboratory

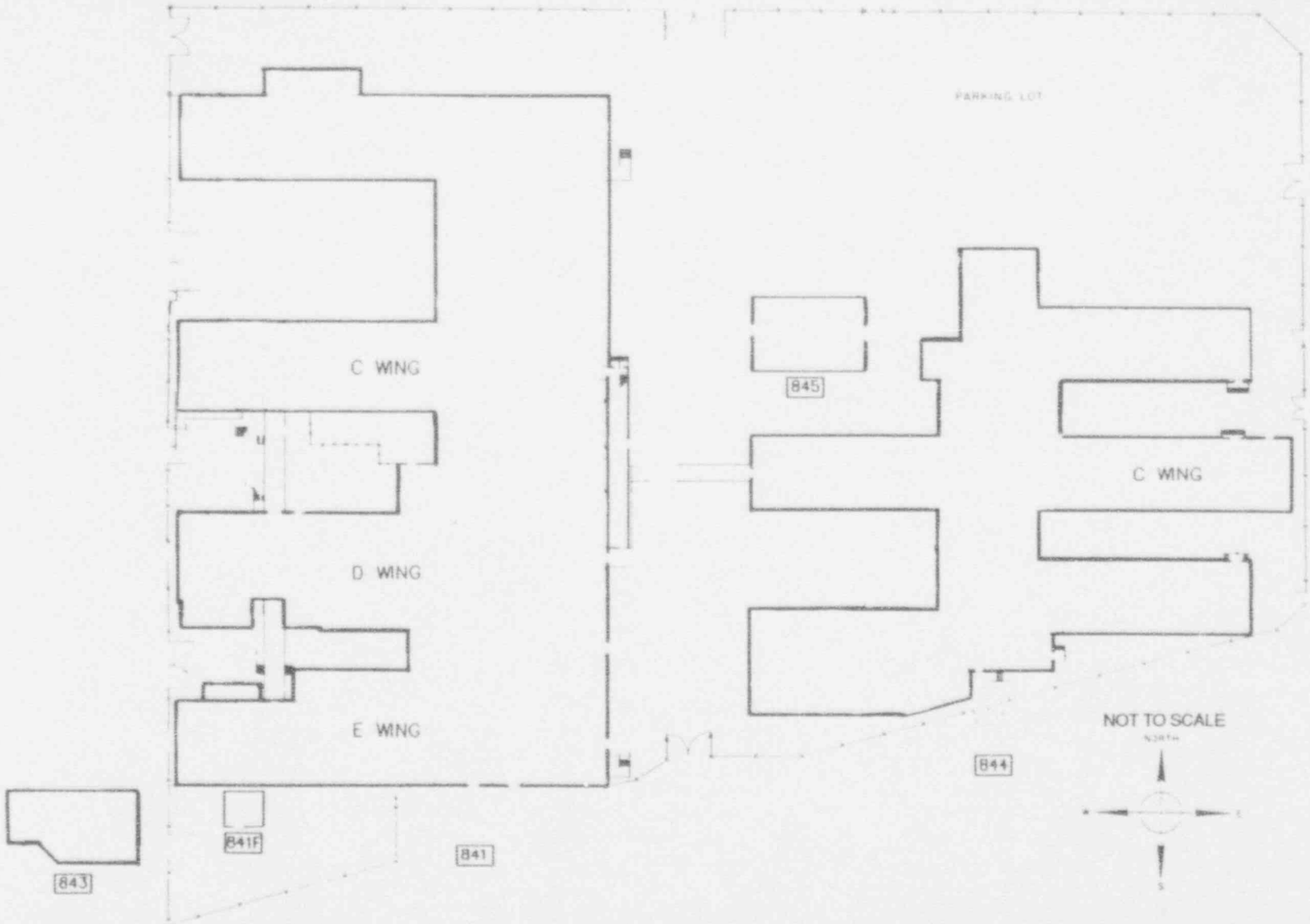

FIGURE 3: Plot Plan of the Naval Biosciences Laboratory Complex

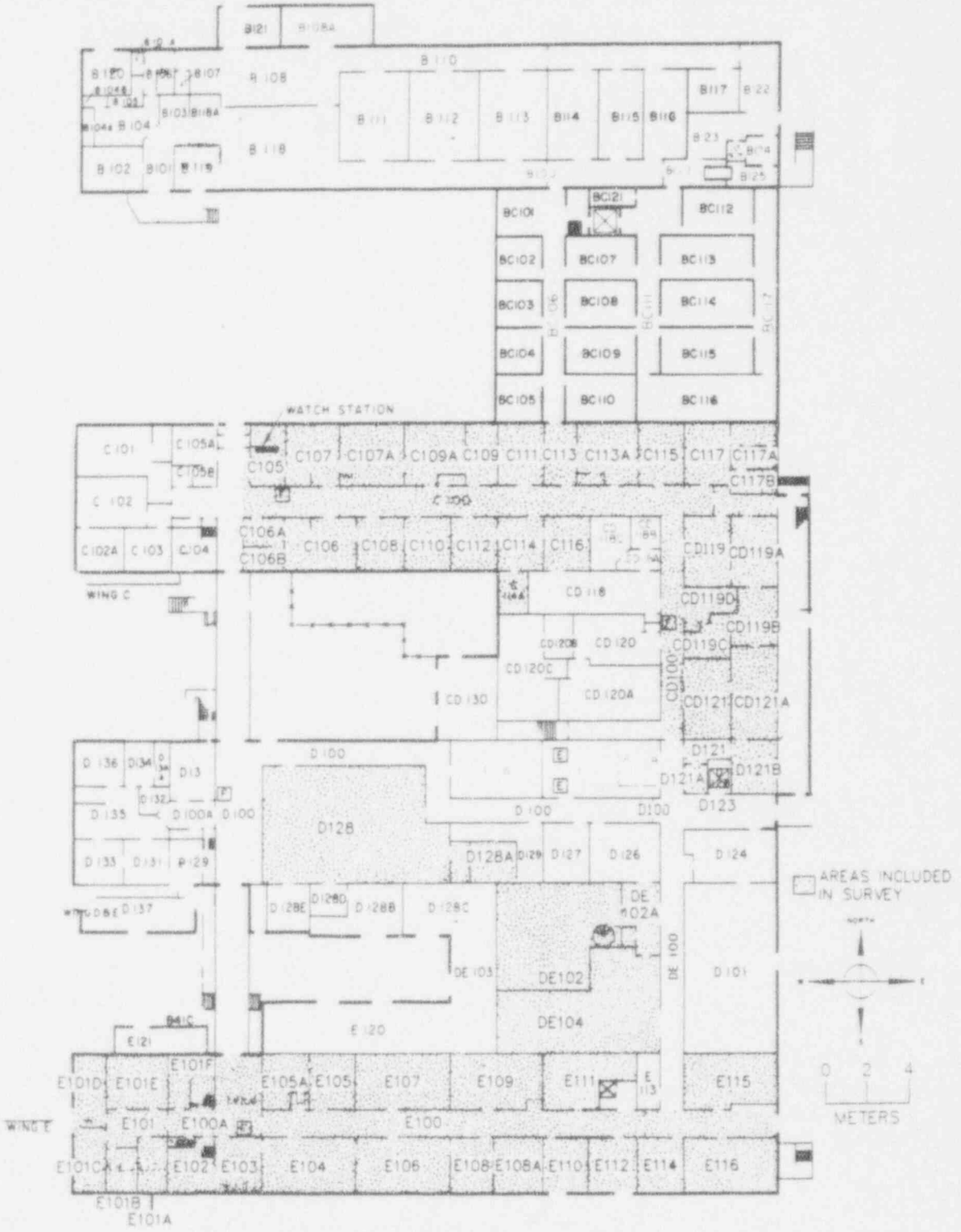

FIGURE 4: Areas Included in Confirmatory Survey
Building 841, 1st Floor

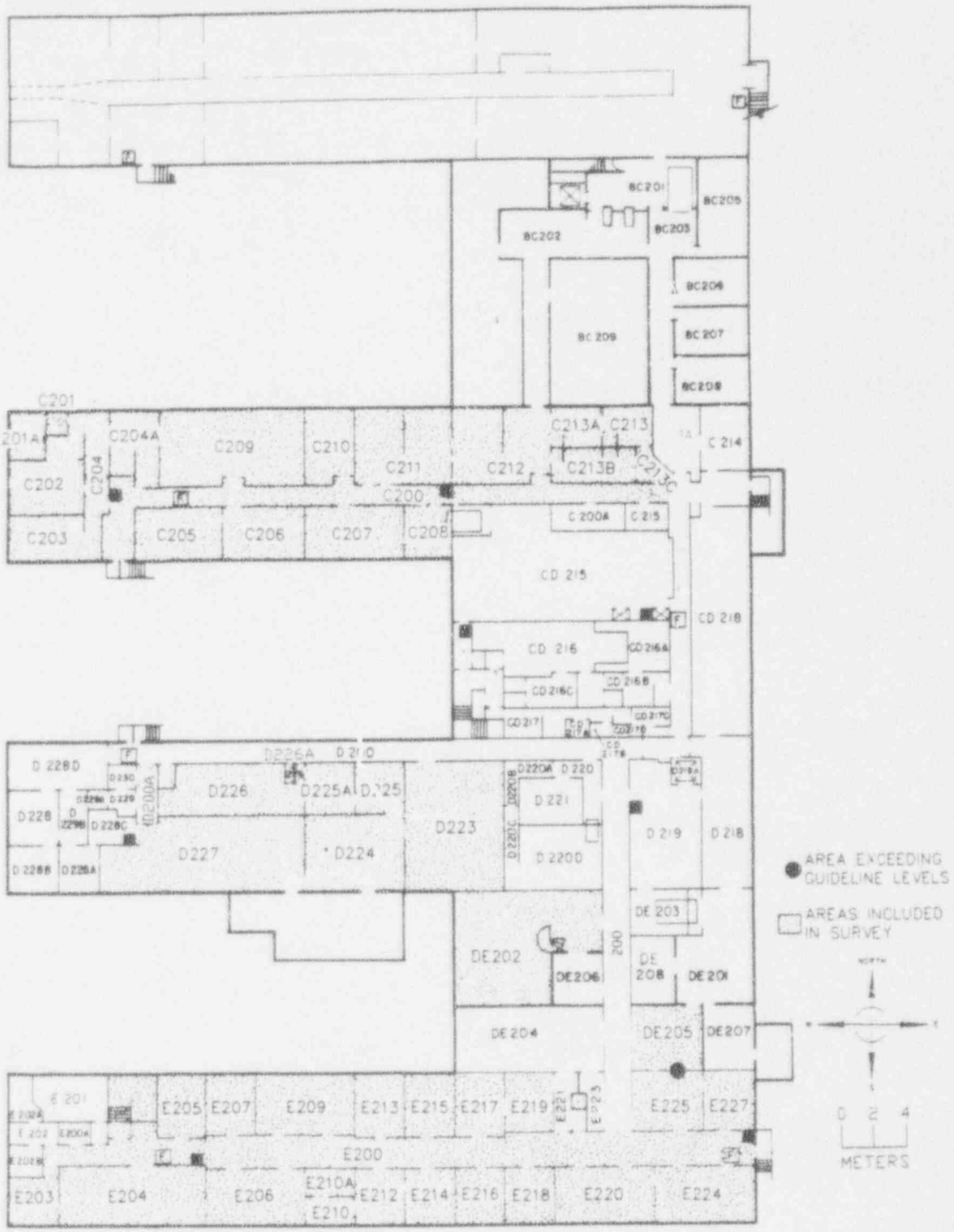

FIGURE 5: Areas Included in Confirmatory Survey, Building 841 2nd Floor

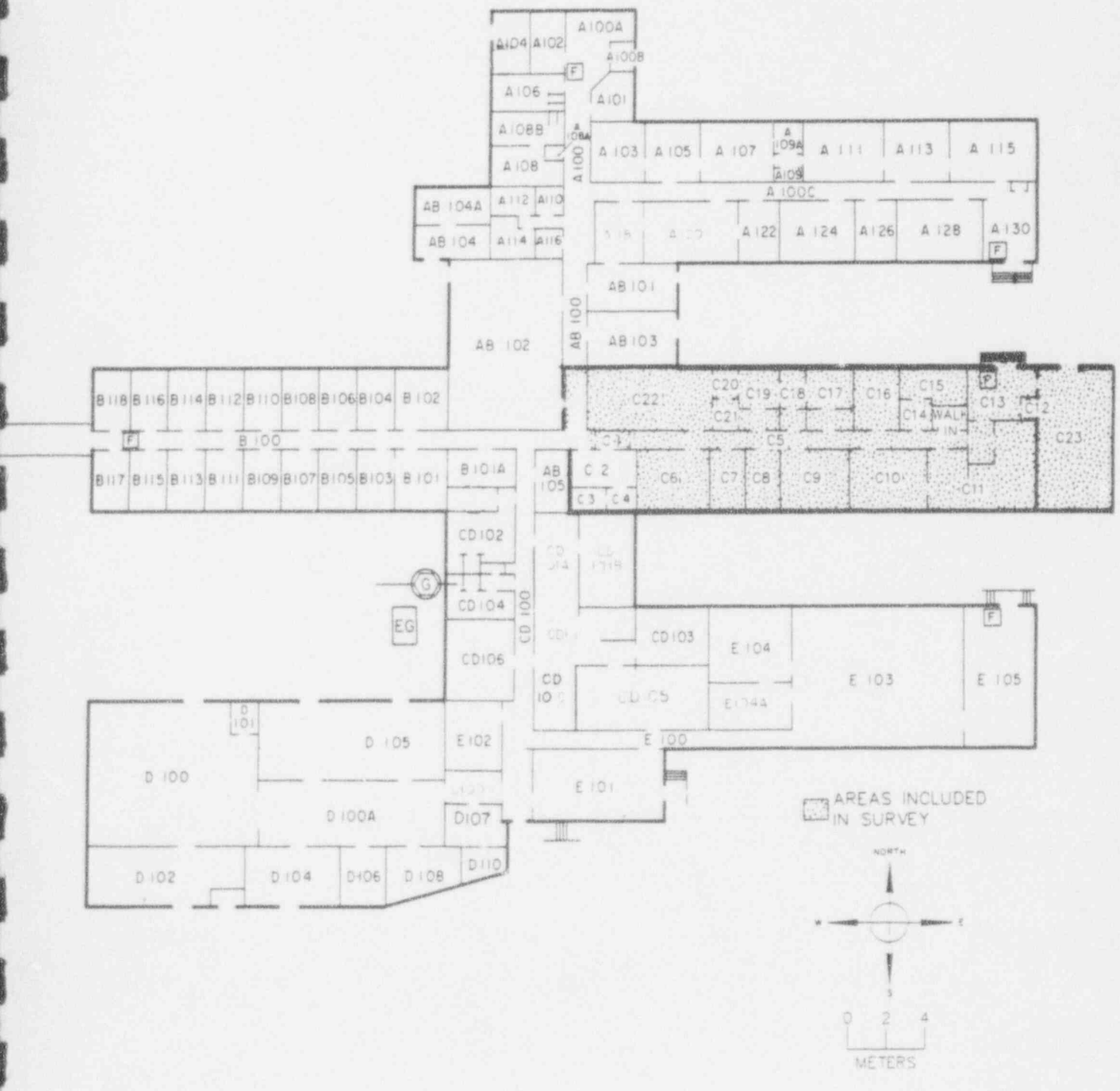

FIGURE 6: Areas Included in Confirmatory Survey, Building 844

TABLE I

SUMMARY OF SURFACE CONTAMINATION MEASUREMENTS
NAVAL BIOSCIENCES LABORATORY
OAKLAND, CALIFORNIA

Building	Area[a,b]	Surface	# of Grid Blocks or Locations Surveyed	Total Contamination Beta-Gamma (dpm/100 cm^2)		Removable Beta Contamination Range (dpm/100 cm^2)
				Highest Grid Block Average	Range of Measurements	
841 (1st Floor)	C-Wing (All Rooms)	Floors & Lower Walls[c/d]	23/108	<460	<460	<4-13
		Upper Walls & Ceiling[d]	62	N/A[e]	<460	<4-21
	D 128	Floors & Lower Walls[d]	16	N/A	<460	<4-44
		Upper Walls & Ceilings[d]	6	N/A	<460	<4
	D-Wing (All Other Rooms)	Floors & Lower Walls[d]	41	N/A	<460	<4- 6
		Upper Walls & Ceilings[d]	14	N/A	<460	<4
	E 109	Floors & Lower Walls[d]	5	N/A	<460-800	<4-10
		Upper Walls & Ceilings[d]	1	N/A	<460	<4
	E-Wing (All Other Rooms)	Floors & Lower Walls[d]	83	N/A	<460	<4- 9
		Upper Walls & Ceilings[d]	32	N/A	<460	<4- 9
841 (2nd Floor)	C 209	Floors & Lower Walls[c]	11	<460	<460-915	<4-10
		Upper Walls & Ceilings[d]	6	N/A	<460	<4
841 (2nd Floor)	C-Wing (All Other Rooms)	Floors & Lower Walls[c/d]	27/17	<460	<460	<4-14
		Upper Walls & Ceilings[d]	20	N/A	<460	<4- 9
	DE 205	Floors & Lower Walls[c]	4	<460	<460	<4-50
		Upper Walls & Ceilings[d]	3	N/A	<460-1020	<4- 7

TABLE 1 (continued)

SUMMARY OF SURFACE CONTAMINATION MEASUREMENTS
NAVAL BIOSCIENCES LABORATORY
OAKLAND, CALIFORNIA

Building	Area[a,b]	rface	# of Grid Blocks or Locations Surveyed	Total Contamination Beta-Gamma (dpm/100 cm^2) Highest Grid Block Average	Total Contamination Beta-Gamma (dpm/100 cm^2) Range of Measurements	Removable Beta Contamination Range (dpm/100 cm^2)
	D-Wing (All Other Rooms)	Floors & Lower Walls[c/d]	43/10	<460	<460-550	<4-10
		Upper Walls & Ceilings[d]	29	N/A	<460	<4-12
	E-Wing (All Rooms)	Floors & Lower Walls[c/d]	66/6	<460	<460	<4-9
		Upper Walls & Ceilings[d]	47	N/A	<460-640	<4-12
844	C-Wing (All Other Rooms)	Floors & Lower Walls[c/d]	22/23	<460	<460	<4-6
		Upper Walls & Ceilings[d]	20	N/A	<460	<4-9
	C 17	Floor[d]	1	N/A	570	8

[a]Refer to Figures 4 and 5.
[b]Refer to Figure 6.
[c]Five point measurements in grid blocks.
[d]Single-point measurements.
[e]N/A = not applicable.

TABLE 2

RESULTS OF GROSS BETA ANALYSIS OF PAINT SAMPLES
NAVAL BIOSCIENCES LABORATORY
OAKLAND, CALIFORNIA

Sample #	Building	Room #	Activity (dpm/100 cm^2)
006A	841[a]	E227	11
010A		DE205	7
011A		C119D	4
012A		C113A	3
013A		C107	4
014A		C116	3
015A		C209	3
016A		C202	3
017A		C204	2
018A		D223	3
019A		D225A	1
020A		D226	1
028A		E109	7
029A		E104	2
030A		D128	3
031A		DE102	2
001A	844[b]	C19	2
002A		C18	1
003A		C22	1
004A		C10	5
021A		C11	4
022A		C17	8
023A		C13	3
024A		C15	1
025A		C23	6
026A		C23 (N.Door)	2
027A		C15 (Floor)	9

[a]Refer to Figures 4 and 5.
[b]Refer to Figure 6.

TABLE 3

RESULTS OF TRITIUM AND CARBON-14 ANALYSES
ON MISCELLANEOUS SAMPLES
NAVAL BIOSCIENCES LABORATORY
OAKLAND, CALIFORNIA

Sample #	Location[a]	Sample Type	Concentration/activity H-3	C-14
001A	Bldg. 844 Rm C-10	Soil	<196 pCi/g	<152 pCi/g
003A	Bldg. 844 Rm C-22	Paint	<480 dpm/100 cm^2	<370 dpm/100 cm^2
027A	Bldg. 844 Rm C-15	Paint	<430 dpm/100 cm^2	<340 dpm/100 cm^2
010A	Bldg. 841 Rm DE-205	Paint	<480 dpm/100 cm^2	<380 dpm/100 cm^2
015A	Bldg. 841 Rm C-209	Paint	<430 dpm/100 cm^2	<370 dpm/100 cm^2
018A	Bldg. 841 Rm D-223	Paint	<480 dpm/100 cm^2	<370 dpm/100 cm^2
009A	Bldg. 841 Rm DE-205	Residue	<180 pCi/g	<140 pCi/g
034A	Bldg. 841 Roof	Residue	< 83 pCi/g	< 64 pCi/g

[a]Refer to Figures 4 and 6.

TABLE 4

RESULTS OF GROSS BETA ANALYSIS OF DRAIN SAMPLES
NAVAL BIOSCIENCES LABORATORY
OAKLAND, CALIFORNIA

Sample #	Location[a]	Sample Type	Concentration/activity
032A	E-101D	Liquid	95 ± 50 pCi/l[c]
033A	C-209	Liquid	110 ± 50 pCi/l
009A[b]	D[illegible]-205	Residue	1975 ± 6 pCi/g

[a]Refer to Figures 4 and 5.
[b]Sample collected before drain line was removed.
[c]Uncertainties are 2σ based only on counting statistics; additional uncertainties of ± 6 to 10% have not been propagated into these data.

TABLE 5

RADIONUCLIDE CONCENTRATIONS IN SAMPLES COLLECTED BY THE NRC
NAVAL BIOSCIENCES LABORATORY
OAKLAND, CALIFORNIA

Sample #[a]	Radionuclide Concentration (pCi/sample)	
	Cs-137	Gross Beta
A (sewer)	-1.4 ± 1.3[b]	4.6 ± 0.6
B (sewer)	1.3 ± 1.2	1.6 ± 0.2

[a]Each sample was <2 g of wet solids with approximately 2 ml of liquid.
[b]Estimated random uncertainty reported is one standard deviation. Small negative and other results less than or equal to 2σ are interpreted by RESL as including "zero" or as not detected. For results greater than 2σ but less than or equal to 3σ, detection is questionable. Results greater than 3σ indicate detection.

REFERENCES

(1) "Termination Survey of the Naval Biosciences Laboratory," University of California Berkeley, Office of Environmental Health and Safety, NRC license 04-00650-07, Docket 03000577, September 24, 1987.

(2) "Proposed Confirmatory Radiological Survey Plan Naval Biosciences Laboratory, U.S. Naval Supply Center Oakland, California," Oak Ridge Associated Universities, September 28, 1987.

(3) "Final Clearance of Naval Biosciences Lab," University of California Berkeley, Office of Environmental Health and Safety, November 25, 1987.

(4) "Sewer Sampling and Analysis Naval Biosciences Lab," University of California Berkeley, Office of Environmental Health and Safety, November 20, 1987.

APPENDIX A

MAJOR SAMPLING AND ANALYTICAL EQUIPMENT

APPENDIX A

MAJOR SAMPLING AND ANALYTICAL EQUIPMENT

The display or description of a specific product is not to be construed as an endorsement of that product or its manufacturer by the authors or their employer.

A. Direct Radiation Measurements

Eberline "RASCAL"
Portable Ratemeter-Scaler
Model PRS-1
(Eberline, Santa Fe, NM)

Eberline PRM-6
Portable Ratemeter
(Eberline, Sante Fe, NM)

Ludlum Floor Monitor
Model 239-1
(Ludlum, Sweetwater, TX)

Eberline GM Pancake Probe
Model HP-260
(Eberline, Sante Fe, NM)

Eberline Scintillation Detector
Model PG-2
(Eberline, Sante Fe, NM)

Victoreen NaI Scintillation Detector
Model 489-55
(Victoreen, Cleveland, OH)

Ludlum Ratemeter - Scaler
Model 220
(Ludlum, Sweetwater, TN)

B. Laboratory Analyses

Automatic low-background Alpha-Beta Counter
Model LB5110-2080
(Tennelec, Inc., Oak Ridge, TN)

High-Purity Germanium Detector
Model GMX-23195-S, 23% efficiency
(EG&G ORTEC, Oak Ridge, TN)

Used in conjunction with:
Lead Shield, G-16
(Gamma Products Inc., Palos Hills, IL)

Multichannel Analyzer
ND-66/ND-680 System
(Nuclear Data Inc., Schaumburg, IL)

Liquid Scintillation Counter
Model Tri-Carb 300
(Packard Instruments Company, Downers Grove, IL)

Sample Oxidizer
Oxi-one Combustor
(Radiomatic, Tampa, FL)

APPENDIX B

MEASUREMENT AND ANALYTICAL PROCEDURES

APPENDIX B

Measurement and Analytical Procedures

Surface Scans

Surface scans in the facility were performed by passing the probes slowly over the surface. The distance between the probes and the surface was maintained at a minimum - nominally about 1 cm. Identification of elevated levels was based on increases in the audible signal from the indicating instrument. Beta scans of large surface areas on the floor of the facility were performed using a gas-proportional floor monitor, with a 600 cm^2 sensitive area. The instrument was slowly moved in a systematic pattern to cover 100% of the accessible area. Combinations of detectors and instrument for the scans were:

Beta-Gamma - Pancake GM probe with PRS-1 scaler/ratemeter.
Gamma - NaI scintillation detector (3.2 cm x 3.8 cm crystal) with PRM-6 ratemeter.
Beta - Gas proportional floor monitor with Ludlum Model 2220 scaler/ratemeter.

Beta-gamma Surface Contamination Measurements

Measurements of total beta-gamma radiation levels were performed using Eberline Model PRS-1 portable scaler/ratemeters with Model HP-260 thin-window "pancake" GM probes. Count rates (cpm) were converted to disintegration rates (dpm/100 cm^2) by dividing the net rate by the 4π efficiency and correcting for the active area of the detector. The effective window area for the GM detectors was 15 cm^2. The average background count rate was approximately 30 cpm for the GM detectors.

Removable Contamination Measurements

Gross Beta

Smear samples were collected using numbered filter paper disks, 47 mm in diameter. Smears were placed in labeled envelopes with the location and other pertinent information recorded. The smears were counted on a low-background gas proportional counter at the Oak Ridge laboratory. Large area drain swipes, used to collect activity from the inner surfaces of drains and pipes, were scanned for the presence of contamination using a beta-gamma GM "pancake" probe

Tritium and Carbon 14

Selected smears were cut into small pieces and direct counted in a Packard Tri-carb 300 Liquid Scintillation Counter.

Soil and Gutter Residue Sample Analysis

Soil and gutter residue samples were dried, mixed, and a portion sealed in 0.5 liter Marinelli beaker. The quantity placed in the beaker was chosen to reproduce the calibrated counting geometry and ranged from 600 to 800 g of soil. Net soil weights were determined and the sample counted using an intrinsic germanium detector coupled to a Nuclear Data Model ND-680 pulse height analyzer system. Background and Compton stripping, peak search, peak identification, and concentration calculations were performed using the computer capabilities inherent in the analyzer system. The spectrum was scanned for identifiable photopeaks, which could be attributed to NBL operations.

Miscellaneous Sample Analysis

Aliquots of liquid samples from drains were evaporated to dryness and counted in a low-background proportional counter.

Soil and residue samples were oxidized at high temperature in a Radiomatic Oxi-one Combustor to separate the H-3 and C-14 components, which were then placed into a liquid scintillation solution and counted in a Packard LS Counter.

Samples of paint scrappings, representing approximately 100 cm^2 of surface area were dried, pulverized, and counted for beta contamination, using the low-background proportional counter. The samples were then oxidized at high temperature to separate the H-3 and C-14 components; analysis was performed by liquid scintillation counting.

Uncertainties and Detection Limits

The uncertainties associated with the analytical data presented in the tables of this report, represent the 95% confidence levels for that data. These uncertainties were calculated based on both the gross sample count levels and the associated background count levels. When the net sample count was less than the 95% statistical deviation of the background count, the sample concentration was reported as less than the detection limits of the procedure. Because of variations in background levels and Compton contributions from other radionuclides in samples, the detection limits differ from sample to sample and instrument to instrument. Additional uncertainties of $\pm$ 6 to 10%, associated with sampling and laboratory procedures, have not been propagated into the data presented in this report.

Calibration and Quality Assurance

Laboratory and field survey procedures are documented in manuals developed specifically for the Oak Ridge Associated Universities' Radiological Site Assessment Program.

With the exception of the measurements conducted with portable gamma scintillation survey meters, instruments were calibrated with NBS-traceable standards. The calibration procedures for the portable gamma instruments are performed by comparison with an NBS calibrated pressurized ionization chamber.

Quality control procedures on all instruments included daily background and check-source measurements to confirm equipment operation within acceptable statistical fluctuations. The ORAU laboratory participates in the EPA and EML Quality Assurance Programs.

APPENDIX C

GUIDELINES FOR DECONTAMINATION OF FACILITIES AND EQUIPMENT PRIOR TO RELEASE FOR UNRESTRICTED USE OR TERMINATION OF LICENSES FOR BYPRODUCT, SOURCE OR SPECIAL NUCLEAR MATERIAL

GUIDELINES FOR DECONTAMINATION OF FACILITIES AND EQUIPMENT PRIOR TO RELEASE FOR UNRESTRICTED USE OR TERMINATION OF LICENSES FOR BYPRODUCT, SOURCE, OR SPECIAL NUCLEAR MATERIAL

U.S. Nuclear Regulatory Commission
Divison of Fuel Cycle & Material Safety
Washington, D.C. 20555

July 1982

The instructions in this guide, in conjunction with Table 1, specify the radionuclides and radiation exposure rate limits which should be used in decontamination and survey of surfaces or premises and equipment prior to abandonment or release for unrestricted use. The limits in Table 1 do not apply to premises, equipment, or scrap containing induced radioactivity for which the radiological considerations pertinent to their use may be different. The release of such facilities or items from regulatory control is considered on a case-by-case basis.

1. The licensee shall make a reasonable effort to eliminate residual contamination.

2. Radioactivity on equipment or surfaces shall not be covered by paint, plating, or other covering material unless contamination levels, as determined by a survey and documented, are below the limits specified in Table 1 prior to the application of the covering. A reasonable effort must be made to minimize the contamination prior to use of any covering.

3. The radioactivity on the interior surfaces of pipes, drain lines, or ductwork shall be determined by making measurements at all traps, and other appropriate access points, provided that contamination at these locations is likely to be representative of contamination on the interior of the pipes, drain lines, or ductwork. Surfaces or premises, equipment, or scrap which are likely to be contaminated but are of such size, construction, or location as to make the surface inaccessible for purposes of measurement shall be presumed to be contaminated in excess of the limits.

4. Upon request, the Commission may authorize a licensee to relinquish possession or control of premises, equipment, or scrap having surfaces contaminated with materials in excess of the limits specified. This may include, but would not be limited to, special circumstances such as razing of buildings, transfer of premises to another organization continuing work with radioactive materials, or conversion of facilities to a long-term storage or standby status. Such requests must:

   a. Provide detailed, specific information describing the premises, equipment or scrap, radioactive contaminants, and the nature, extent, and degree of residual surface contamination.

   b. Provide a detailed health and safety analysis which reflects that the residual amounts of materials on surface areas, together with other considerations such as prospective use of the premises, equipment or scrap, are unlikely to result in an unreasonable risk to the health and safety of the public.

5. Prior to release of premises for unrestricted use, the licensee shall make a comprehensive radiation survey which establishes that contamination is within the limits specified in Table 1. A copy of

the survey report shall be filed with the Division of Fuel Cycle and Material Safety, USNRC, Washington, D.C. 20555, and also the Administrator of the NRC Regional Office having jurisdiction. The report should be filed at least 30 days prior to the planned date of abandonment. The survey report shall:

a. Identify the premises.

b. Show that reasonable effort has been made to eliminate residual contamination.

c. Describe the scope of the survey and general procedures followed.

d. State the findings of the survey in units specified in the instruction.

Following review of the report, the NRC will consider visiting the facilities to confirm the survey.

TABLE 1

ACCEPTABLE SURFACE CONTAMINATION LEVELS

Nuclides[a]	Average[b,c,f]	Maximum[b,d,f]	Removable[b,e,f]
U-nat, U-235, U-238, and associated decay products	5,000 dpm α/100 cm^2	15,000 dpm α/100 cm^2	1,000 dpm α/100 cm^2
Transuranics, Ra-226, Ra-228, Th-230, Th-228, Pa-231, Ac-227, I-125, I-129	100 dpm/100 cm^2	300 dpm/100 cm^2	20 dpm/100 cm^2
Th-nat, Th-232, Sr-90, Ra-223 Ra-224, U-232, I-126, I-131, I-133	1000 dpm/100 cm^2	3000 dpm/100 cm^2	200 dpm/100 cm^2
Beta-gamma emitters (nuclides with decay modes other than alpha emission or spontaneous fission) except Sr-90 and others noted above.	5000 dpm $\beta\gamma$/100 cm^2	15,000 dpm $\beta\gamma$/100 cm^2	1000 dpm $\beta\gamma$/100 cm^2

[a] Where surface contamination by both alpha- and beta-gamma-emitting nuclides exists, the limits established for alpha- and beta-gamma-emitting nuclides should apply independently.

[b] As used in this table, dpm (disintegrations per minute) means the rate of emission by radioactive material as determined by correcting the counts per minute observed by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.

[c] Measurements of average contaminant should not be averaged over more than 1 square meter. For objects of less surface area, the average should be derived for each such object.

[d] the maximum contamination level applies to an area of not more than 100 cm^2.

[e] The amount of removable radioactive material per 100 cm^2 of surface area should be determined by wiping that area with dry filter or soft absorbent paper, applying moderate pressure, and assessing the amount of radioactive material on the wipe with an appropriate instrument of known efficiency. When removable contamination on objects of less surface area is determined, the pertinent levels should be reduced proportionally and the entire surface should be wiped.

[f] The average and maximum radiation levels associated with surface contamination resulting from beta-gamma emitters should not exceed 0.2 mrad/h at 1 cm and 1.0 mrad/h at 1 cm, respectively, measured through not more than 7 milligrams per square centimeter of total absorber.