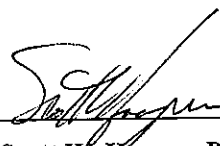


# **Final Status Survey Report for Radioactive Materials Decommissioning**


**Merck & Co., Inc. Stonewall Site**

**Elkton, VA**

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19-Sept-2002  
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**Approved by the Site Radiation Safety Committee: September 19, 2002**

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## Final Status Survey Report for Decommissioning Merck & Co., Inc. Stonewall Site, Elkton, VA

### Executive Summary

Radiological surveys of the Merck & Co., Inc. Stonewall site at Elkton Virginia demonstrate that the radiological conditions at the site meet U.S. Nuclear Regulatory Commission and Commonwealth of Virginia guidelines for future use without radiological controls. It is therefore recommended that the site petition the U.S. Nuclear Regulatory Commission and the Commonwealth of Virginia for termination of the site's specific radioactive materials licenses and declaration of a decommissioned status.

### 1. Background

Merck & Co., Inc. has operated a pharmaceutical manufacturing facility at 2778 South Eastside Highway, Elkton, Virginia since 1941. Use of radiolabeled compounds on site has been allowed under licenses granted by the United States Nuclear Regulatory Commission and the Commonwealth of Virginia Bureau of Radiological Health. NRC licensed materials were used for research purposes and were formerly (prior to 1993) used in the manufacture of a radiolabeled diagnostic agent. Virginia licensed materials were used in the manufacture of the radiolabeled diagnostic agent since 1993. The site no longer wishes to use radiolabeled compounds and is therefore seeking permission from the NRC and the Bureau of Radiological Health to decommission the site and to terminate the site specific radioactive materials licenses. The Merck & Co., Inc. Elkton, VA site (also known as the Stonewall site) will continue its non-radioactive materials operations at the current site.

In order to prepare the site for decommissioning, an outside agent, Physics Associates of Roanoke, VA was hired to 1.) contact the NRC and Bureau of Radiological Health to develop agreed upon decommissioning survey plans, 2.) conduct the site surveys, and 3.) prepare a report in support of decommissioning the site. The data contained within this report was collected by Physics Associates for Merck & Co., Inc..

### 2. Site Description

#### 2.1 Type and Location of Facility

The manufacturing facilities of the Merck & Co., Inc. Stonewall site at Elkton, Virginia are used to produce pharmaceutical agents and finished pharmaceutical products for human, animal and agricultural use. The manufacturing complex is comprised of approximately 78 significant buildings clustered on a land area of approximately 147 acres. The South Fork of the Shenandoah River bounds the manufacturing area to the north (Figure 1). These manufacturing facilities are contained within a restricted, fenced-in perimeter.

#### 2.2 Ownership

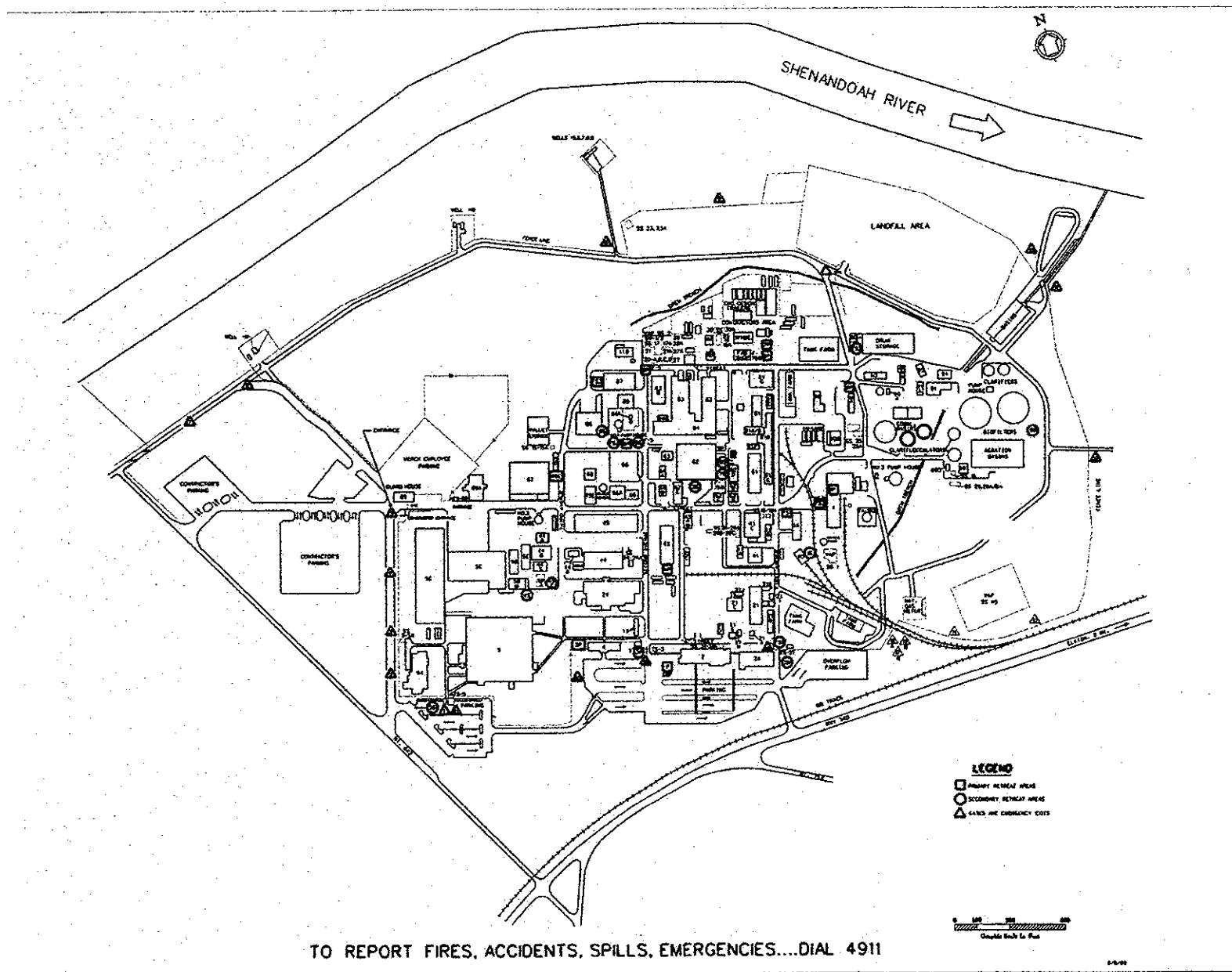
The Merck & Co., Inc. Elkton, Virginia manufacturing facilities are wholly owned by Merck & Co., Inc., a publicly-traded entity and member of the Dow Jones Industrials list. In addition to the grounds occupied by the manufacturing facility, Merck & Co., Inc. owns approximately 1300 acres surrounding the plant site.

#### 2.3 Facility Description

##### 2.3.1 Buildings

Radioactive materials were confined to sub-portions of 7 buildings within the facility. NRC licensed

Figure 1: Map of Manufacturing and Support Areas of the Merck & Co., Inc. Plant at Elkton, Virginia



materials were used or stored in Buildings 24, 65 (prior to 1993), 80A, 84 (prior to 1993), 84A (prior to 1993) 92, and T.O. (Technical Operations) Shed. Virginia Bureau of Radiological Health licensed materials were used or stored within Buildings 65, 80A, 84, 84A and T.O. Shed.

Within each of these buildings, the areas where radioactive materials were stored or used had additional containment features (e.g. impervious flooring, containment within an impervious vessel, presence of absorbent spill kits, etc.) to minimize the possibility of migration of materials in the event of a major spill. No major spills are known to have occurred.

### 2.3.2 Grounds

The remaining buildings on site house manufacturing and manufacturing support facilities including sanitary and industrial waste treatment facilities. The grounds are trenched such that chemical spills would be contained and directed to the industrial waste treatment system. Surface run-off is directed through lined surface ditches to a monitored run-off collection system and is mixed with industrial waste system effluent prior to discharge to the South Fork of the Shenandoah River. Only trace amounts (pCi to µCi levels) of water soluble radioactive materials are known to have been sent to the site wastewater treatment system. Calculations are on hand demonstrating that had a catastrophic release occurred of all of the radioactive materials allowable under the site's licenses, the plant effluent would have still been well below the limits given in 10 CFR 20 Appendix B and the Virginia disposal regulations.

The radioactive materials used at this site were in a form and quantity making it virtually impossible that any significant amount of airborne contamination could have occurred.

## 3. Operating History

### 3.1 Licensing and Operations

Use of radiolabeled materials has been authorized by U.S. Nuclear Regulatory Commission Byproduct Materials License #45-033302-01 and the Commonwealth of Virginia's Radioactive Materials License #VA-100-01. C-14, S-35, and P-32 were used for research purposes. Cobalt 57 and Co-60 were used in the manufacture of a radiolabeled diagnostic agent. The locations of use and quantities of materials used are listed in section 3.2 of this report.

### 3.2 Processes Performed

The following table lists radionuclide use in each of the buildings.

**Table 1.**

<b>Building Number</b>	<b>Radionuclides Used</b>	<b>Purpose</b>
24 (Biochemistry Lab)	C-14, S-35, P-32	Research
65 (Quality Control Lab)	Co-57, Co-60	Manufacturing
80A	C-14, Co-57, P-32, S-35 (prior to 1994)	Research and Manufacturing
84 (Production Labs)	Co-57, Co-60	Manufacturing
84A	Co-57, Co-60	Manufacturing
T.O. Shed	C-14, S-35, P-32, Co-57, Co-60	Waste Holding Prior to Disposal
92	C-14, Co-57	Research and Manufacturing

The total quantities of each licensed radionuclide ever used at the facility are estimated at:

**Table 2.**

<b>Radionuclide</b>	<b>Activity</b>	<b>Half-Life</b>
Co-57	10.5 Ci	271 days
Co-60	440 mCi (all prior to 1993)	5.26 years
C-14	3 mCi	5738 years
H-3	None	12.3 years
S-35	10 mCi (all prior to 1994)	87 days
P-32	None since 1993 (> 100 half-lives)	14.3 days

### 3.3 Waste Disposal Practices

Waste in all forms is collected and stored in the T.O. Shed prior to transfer to a commercial waste broker for disposal. As of this date, all radioactive waste on site has been sent for disposal.

## 4. Decommissioning Activities

### 4.1 Objectives

The objective of these studies was to demonstrate that the radiological conditions at the Merck & Co., Inc. site satisfy the NRC and Commonwealth of Virginia guidelines and that the plant site can, therefore, be released from licensing restrictions for future use without radiological controls.

### 4.2 Results of Previous Surveys

Quarterly surveys of the use locations listed in Table 1 and as detailed in the NRC and Virginia licensing applications have not had a survey result above the action level (typically 200 dpm by scintillation counting or 0.2 to 2.5 mR/hr by survey instrument) for over 3 years.

### 4.3 Decontamination Surveys

In preparation for the final decommissioning surveys by Physics Associates of Roanoke, Virginia, equipment that had contact with Co-57 or Co-60 was surveyed with a G.M. survey meter and contaminated equipment was staged for disposal in the Building 84A-Shed as noted in section 3.3 of this report. Equipment and supplies that appeared to be uncontaminated were left in the respective labs for the final survey. Equipment and supplies in contact with C-14 or S-35 were minimal and were also sent for disposal. This waste from the decontamination surveys has been taken away for disposal by a licensed commercial radioactive waste disposal company.

## 5. Final Survey Procedures

### 5.1 Sampling Parameters

Plan views of all labs in which radioactive materials have been used were provided to Physics Associates. Areas of use and survey points which have been accepted over the years by the NRC and the Virginia Bureau of Radiological Health were noted on the drawings. All of the listed survey points, additional floor survey points in a 1 meter grid, and, where accessible, walls at 1 meter above the floor and one meter between survey points were included in the sampling plan. Copies of these maps are attached as appendices IV – X. In addition to these survey points, the entire working surface of bench or counter tops were assessed with a survey meter.

These sampling plans had been previously discussed with the relevant agencies and agreed to by phone (letters from Dr. Lee Anthony of Physics Associates to Dr. Scott Hooper of Merck & Co., Inc. dated 12/3/01 for discussion with NRC; 12/6/01 for discussion with the Virginia Bureau of Radiological Health).

## **5.2 Background / Baseline Levels Identified**

As the amounts of radioactive materials used on site were small and no significant sources of radioactivity exist within the area, background levels were determined in the open air and were found to be consistent with background radiation levels found throughout the western portion of Virginia.

## **5.3 Major Contaminants Identified**

No major contaminants were found. No locations were found to be above action levels for unrestricted use as listed in Table N-1 of the NRC Regulatory Guide 10.8, except for several locations in the Building 84 lab which were initially above the limit for Co-57. These locations were decontaminated until they were below the Table N-1 designated limits. No locations now exceed the action limits for unrestricted use given in NRC Regulatory Guide 10.8, Table N-1.

## **5.4 Guidelines Established**

The action limits listed in Table N-1 of the NRC Reg. Guide 10.8 were used as the limits for allowable residual radioactivity.

## **5.5 Equipment, Instruments and Procedures Selected**

Calibrated survey instruments were used to sweep areas potentially contaminated with gamma emitters. The most sensitive survey meter for gamma counting was a Ludlum Model 3 Sodium-Iodide survey meter. Wipe surveys were conducted with an Atom Lab 950 Sodium Iodide Gamma Ray Spectrometer (for gamma emitters) and a Beckman Model 5000 TD Liquid Scintillation Counter (for beta and gamma emitters). Scintillation counting results using the Beckman 5000 TD counter were considered the definitive result for beta emitter presence. Both wipe survey instruments were calibrated on site with NIST-traceable sources.

Wipe sampling used standard wipe-test methods. Commercially available dry wipes were used for conducting gamma-emitter wipe tests and methanol-moistened lab tissues were used to perform wipe tests for beta-emitters. In each case a minimum of 100 cm<sup>2</sup> was wiped to conduct the test. Typically the area wiped significantly exceeded 100 cm<sup>2</sup>.

There was no requirement for special deviations from standard surveying techniques.

## **5.6 Procedures Followed**

No special statistical sampling methods were required. Sampling and survey points were as noted in section 5.1 of this report. All meters and counters were calibrated and checked with NIST-traceable sources. All survey, wipe test, and decontamination activities were carried out using standard methods.

## **5.7 Surveying Organization**

Surveys were conducted by Dr. Lee Anthony, Ph.D. and Mr. James Nunn of Physics Associates, Roanoke, Virginia. Dr. Anthony is a Certified Health Physicist, a Certified Medical Physicist, and a Certified Radiologic Physicist.



## 6. Final Survey Findings

### 6.0.1 Survey Results for Beta-Emitters (Carbon-14, Phosphorus-32 or Sulfur-35).

Samples were wipe samples counted on a Beckman 5000 TD Liquid Scintillation counter monitoring all channels. Values given in the tables are the raw data counts per minute (cpm). Scintillation counter efficiency was 96% for C<sup>14</sup> and 48% for H<sup>3</sup>. Assuming tritium counting efficiency as a worst case, the maximum number of dpm detected at any of the beta-emitter locations was 99.2 [Calculation for location 24-10 Doorknob: (108.4 cpm detected - 60.8 cpm background) \* 1/0.48= 99.2 dpm]. This value is well below a 200 dpm / 100 cm<sup>2</sup> wipe test limit.

#### Building: 24

Wipe Location	Background (cpm) <sup>b</sup>	Activity (cpm) <sup>b</sup>	Condition <sup>a</sup>
24-1 Door Handles	60.8	62.2	Satisfactory
24-2 Sink	60.8	66.2	Satisfactory
24-3 Refrig. Door & Handle	60.8	65.7	Satisfactory
24-4 Benchtop	60.8	63.8	Satisfactory
24-5 Hood	60.8	65.2	Satisfactory
24-6 Floor	60.8	66.9	Satisfactory
24-7 Doorknobs	60.8	63.0	Satisfactory
24-8 Doorknobs	60.8	64.6	Satisfactory
24-9 Sink	60.8	63.3	Satisfactory
24-10 Doorknob	60.8	108.4	Satisfactory
24-11 Floor	60.8	64.5	Satisfactory
24-12 Floor	60.8	64.0	Satisfactory

<sup>a</sup> Condition refers to whether the activity is less than the action level recorded in Table N-1 of the NRC Reg. Guide 10.8. Satisfactory = less than the action level in Table N-1.

#### Building: 80A

Wipe Location	Background (cpm) <sup>b</sup>	Activity (cpm) <sup>b</sup>	Condition <sup>a</sup>
80A-1 Doorknobs	64.5	65.0	Satisfactory
80A-2 Doorknobs Room B	64.5	62.6	Satisfactory
80A-3 Floor	64.5	63.1	Satisfactory
80A-4 S. Benchtop	64.5	61.3	Satisfactory
80A-5 W. Benchtop	64.5	67.6	Satisfactory
80A-6 Scintillation Counter	64.5	58.3	Satisfactory
80A-7 Dry Waste Container	64.5	65.4	Satisfactory
80A-8 Refrigerator	64.5	62.7	Satisfactory
80A-9 Sink	64.5	60.6	Satisfactory
80A-10 Floor	64.5	59.6	Satisfactory
80A-11 Doorknobs	64.5	60.5	Satisfactory
80A-12 Doorknob	64.5	65.8	Satisfactory
80A-13 Floor	64.5	60.8	Satisfactory
80A-14 Floor	64.5	65.4	Satisfactory
80A-15 Countertop	64.5	60.5	Satisfactory
80A-16 Countertop	64.5	61.6	Satisfactory
80A-17 Doorknob	64.5	63.2	Satisfactory

<sup>a</sup> Condition refers to whether the activity is less than the action level recorded in Table N-1 of the NRC Reg. Guide 10.8. Satisfactory = less than the action level in Table N-1.

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**Building: T.O. Shed**

Wipe Location	Background (cpm) <sup>b</sup>	Activity (cpm) <sup>b</sup>	Condition <sup>a</sup>
Wall 1 and Door	50.0	62.7	Satisfactory
Wall 2	50.0	71.2	Satisfactory
Wall 3	50.0	58.4	Satisfactory
Floor	50.0	43.5	Satisfactory

<sup>a</sup> Condition refers to whether the activity is less than the action level recorded in Table N-1 of the NRC Reg. Guide 10.8. Satisfactory = less than the action level in Table N-1. Wipe samples performed by Merck & Co., Inc. personnel.

**Building: 92**

Wipe Location	Background (cpm) <sup>b</sup>	Activity (cpm) <sup>b</sup>	Condition <sup>a</sup>
92-1 Doorknobs	64.5	65.3	Satisfactory
92-2 Doorknobs Room A	64.5	65.7	Satisfactory
92-3 Benchtop	64.5	65.8	Satisfactory
92-4 Floor	64.5	69.3	Satisfactory
92-5 Floor	64.5	66.2	Satisfactory
92-6 Hood	64.5	60.3	Satisfactory
92-7 Hood	64.5	62.9	Satisfactory
92-8 Respiriometer Area	64.5	58.2	Satisfactory
92-9 Floor	64.5	62.1	Satisfactory
92-10 Doorknobs	64.5	66.6	Satisfactory
92-11 Floor	64.5	61.7	Satisfactory
92-12 Benchtop	64.5	61.1	Satisfactory
92-13	64.5	62.5	Satisfactory
92-14	64.5	62.0	Satisfactory
92-15	64.5	64.0	Satisfactory
92-16	64.5	59.9	Satisfactory
92-17	64.5	67.4	Satisfactory
92-18	64.5	59.2	Satisfactory
92-19	64.5	66.6	Satisfactory

<sup>a</sup> Condition refers to whether the activity is less than the action level recorded in Table N-1 of the NRC Reg. Guide 10.8. Satisfactory = less than the action level in Table N-1.

**6.0.2 Survey Results for Gamma-Emitters (Cobalt-57 or Cobalt-60).**

Samples were wipe samples counted on an Atom Lab 950 Sodium Iodide Gamma Ray Spectrometer, cobalt-57 and cobalt-60 channels.

**Building: T.O. Shed**

Wipe Location	LLD <sup>a</sup> (dpm)	Background (dpm)	Activity (dpm – Bkgnd dpm)		Condition <sup>b</sup>
			Co-57	Co-60	
Wall 1 and Door	43	331	174	-9	Satisfactory
Wall 2	43	331	-16	-23	Satisfactory
Wall 3	43	331	611	-37	Satisfactory
Floor	43	331	78	17	Satisfactory

<sup>a</sup> LLD = Lower Limit of Detection as determined by the instrument.

<sup>b</sup> Condition refers to whether the activity is less than the action level recorded in Table N-1 of the NRC Reg. Guide 10.8. Satisfactory = less than the action levels in Table N-1.

**Building: 84 Production Room 1**

Wipe Location	LLD <sup>a</sup> (dpm)	Background (dpm)	Activity (dpm – Bkgnd dpm)		Condition <sup>b</sup>
			Co-57	Co-60	
FL-1	43	331	1430	38	Satisfactory <sup>c</sup>
FL-2	43	331	133	10	Satisfactory <sup>c</sup>
FL-3	43	331	1784	10	Satisfactory <sup>c</sup>
FL-4	43	331	461	10	Satisfactory <sup>c</sup>
FL-5	43	331	720	17	Satisfactory
FL-6	43	331	1525	-50	Satisfactory
Autoclave	43	331	1784	58	Satisfactory
F-11 Cabinet	43	331	474	-64	Satisfactory
W-1	43	331	310	126	Satisfactory
W-2	43	331	174	140	Satisfactory
2A	43	331	147	-84	Satisfactory <sup>c</sup>
1A	43	331	133	-112	Satisfactory <sup>c</sup>
5A	43	331	911	17	Satisfactory
3A Tray	43	331	Disposed as Waste		Disposed as Waste
8 Floor Mat	43	331	Disposed as Waste		Disposed as Waste
7 Waste Container	43	331	Disposed as Waste		Disposed as Waste
6 Floor Mat	43	331	Disposed as Waste		Disposed as Waste
1	43	331	351	-16	Satisfactory <sup>c</sup>
2 & Top of Autoclave	43	331	201	-71	Satisfactory <sup>c</sup>
3 (Upper)	43	331	174	51	Satisfactory <sup>c</sup>
3 (Lower)	43	331	447	-37	Satisfactory
5	43	331	133	113	Satisfactory
W-3	43	331	229	-37	Satisfactory
W-4	43	331	201	58	Satisfactory
W-5	43	331	215	113	Satisfactory
W-6	43	331	420	72	Satisfactory
W-7	43	331	215	-23	Satisfactory
W-8	43	331	201	-64	Satisfactory
W-9	43	331	106	-105	Satisfactory
W-10	43	331	65	72	Satisfactory
W-11	43	331	338	72	Satisfactory
10 Hood	43	331	1061	-30	Satisfactory <sup>c</sup>
13 Hood	43	331	1689	78	Satisfactory <sup>c</sup>
23 Door	43	331	229	31	Satisfactory

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**(Bldg. 84 Production Room 1 Continued)**

Cart	43	331	-30	-98	Satisfactory <sup>c</sup>
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<sup>a</sup> LLD = Lower Limit of Detection as determined by the instrument.

<sup>b</sup> Condition refers to whether the activity is less than the action level recorded in Table N-1 of the NRC Reg. Guide 10.8. Satisfactory = less than the action levels in Table N-1.

<sup>c</sup> Satisfactory<sup>c</sup> indicates that the location was initially found to exceed the action level in Table N-1, but was decontaminated to the activity level listed.

**Building: 84 Production Room 2**

Wipe Location	LLD <sup>a</sup> (dpm)	Background (dpm)	Activity (dpm - Bkgnd dpm)		Condition <sup>b</sup>
			Co-57	Co-60	
13	41	266	867	75	Satisfactory
16	41	266	1126	20	Satisfactory
16R	41	266	225	48	Satisfactory
16L	41	266	1194	61	Satisfactory
13L	41	266	1986	20	Satisfactory
13/16	36	194	215	78	Satisfactory <sup>c</sup>
13/16 (Top Left Drawer)	41	266	471	102	Satisfactory
13/16 (Top Rt. Drawer)	41	266	1494	-6	Satisfactory
13/16 (2nd Drawer)	41	266	225	48	Satisfactory
13/16 (3rd Drawer)	41	266	130	75	Satisfactory
13/16 (4th Drawer)	41	266	607	839 <sup>c</sup>	Satisfactory <sup>c</sup>
13/16 (P-Trap Vicinity)	36	194	270	-16	Satisfactory <sup>c</sup>
Inside Flammable Cart	36	194	65	-30	Satisfactory <sup>c</sup>
Outside Flammable Cart	36	194	92	92	Satisfactory <sup>c</sup>
15/14 Rt. Lower Drawer	41	266	7	102	Satisfactory
15/14 Lt. Lower Drawer	41	266	143	-60	Satisfactory
15/14 Drawer #1 Top	41	266	-19	102	Satisfactory
15 Drawer #2 Top	41	266	198	-101	Satisfactory
13/16 Right Cabinet and Left Door	41	266	20	130	Satisfactory
13/16 Back Trap on Top of Counter	41	266	-60	34	Satisfactory
15/14 OC-4	41	266	730	-60	Satisfactory
15/14 OC-3	41	266	1453	116	Satisfactory
15/14 OC-2	41	266	266	-6	Satisfactory
15/14 OC-1	41	266	171	20	Satisfactory
15/14 C8	41	266	212	20	Satisfactory
15/14 C7	41	266	171	-6	Satisfactory
15/14 C6	36	194	256	-57	Satisfactory <sup>c</sup>
15/14 Cab C-5	41	266	20	-6	Satisfactory
15/14 Cab C-4	41	266	130	61	Satisfactory
15/14 Cab C-3	41	266	389	7	Satisfactory
15/14 D8	41	266	293	20	Satisfactory
15/14 D7	41	266	34	-60	Satisfactory
15/14 D6	41	266	75	20	Satisfactory
15/14 D5	41	266	198	-88	Satisfactory
15/14 Drawer 4	41	266	785	116	Satisfactory
15/14 Drawer 3	ND	50.0 <sup>d</sup>	19.6 <sup>d</sup>	19.6 <sup>d</sup>	Satisfactory <sup>c,d</sup>
15/14 ½ Counter Top	36	194	160	10	Satisfactory <sup>c</sup>
15/14 ½ Counter Top	36	194	-2	-30	Satisfactory <sup>c</sup>
15/14 High Cnter Top	41	266	362	225 <sup>c</sup>	Satisfactory <sup>c</sup>
15/14 Floor	41	266	212	89	Satisfactory

<b>(Bldg. 84 Production Room 2 Continued)</b>					
13/16 Front Trap on top of Counter	41	266	89	89	Satisfactory
13/16 Right Cabinet and Right Door	41	266	157	102	Satisfactory
18	41	266	1754	307 <sup>e</sup>	Satisfactory <sup>c</sup>
17	36	266	420	24	Satisfactory <sup>c</sup>
White Refrig.	36	194	133	-16	Satisfactory <sup>c</sup>
Meter Cabinet	41	194	648	61	Satisfactory
White Cart Trays	41	266	Disposed as Waste		Disposed as Waste
20	41	266	321	7	Satisfactory
22I	41	266	1044	75	Satisfactory
22h	41	266	676	-33	Satisfactory
22g	41	266	1058	143	Satisfactory
22f	41	266	853	-6	Satisfactory
22e	41	266	225	48	Satisfactory
22d	41	266	676	143	Satisfactory
22c	41	266	1412	7	Satisfactory
22b	41	266	1822	130	Satisfactory
22a	41	266	525	-19	Satisfactory

<sup>a</sup> LLD = Lower Limit of Detection as determined by the instrument. An LLD was not determined (noted as ND) for the 1 instance of scintillation counting.

<sup>b</sup> Condition refers to whether the activity is less than the action level recorded in Table N-1 of the NRC Reg. Guide 10.8. Satisfactory = less than the action levels in Table N-1.

<sup>c</sup> Satisfactory<sup>c</sup> indicates that the location was initially found to exceed the action level in Table N-1, but was decontaminated to the activity level listed.

<sup>d</sup> Post-decontamination, the site was re-sampled by Merck & Co., Inc. personnel by wipe sampling and scintillation counting, counting all channels. Values given are cpm and (cpm - background cpm) for the background and activities, respectively. Scintillation counter efficiency was 96% for C<sup>14</sup> and 48% for H<sup>3</sup>. Assuming tritium counting efficiency as a worst case, the number of dpm lifted would be 40.8. This value is well below a 200 dpm / 100 cm<sup>2</sup> limit.

<sup>e</sup> Locations for which the number of Co-60 dpm detected appears to exceed the Table N-1 values. As detailed in Appendix III, the area wiped significantly exceeded 100 sq. centimeters so the actual dpm/100 cm<sup>2</sup> values are below the Table N-1 action levels.

**Building: 84A**

Wipe Location	LLD <sup>a</sup> (dpm)	Background (dpm)	Activity (dpm - Bkgnd dpm)		Condition <sup>b</sup>
			Co-57	Co-60	
Small Storage Room	45	331	38	-91	Satisfactory
Wall 2	45	331	38	-9	Satisfactory
Wall 1 Near Hose	45	331	78	31	Satisfactory
Shelves	45	331	188	-64	Satisfactory
Refrigerator	45	331	-30	3	Satisfactory
Floor 1	45	331	119	-118	Satisfactory
Floor 2	45	331	-2	85	Satisfactory
Floor 3	45	331	10	72	Satisfactory
Floor 4	45	331	-2	72	Satisfactory
Floor 5	45	331	92	85	Satisfactory
L1 Inside	45	331	-57	3	Satisfactory
L2 Inside	45	331	-16	31	Satisfactory
L3 Inside	45	331	65	72	Satisfactory
L4 Inside	45	331	38	3	Satisfactory
L5 Inside	45	331	-16	58	Satisfactory
L6 Inside	45	331	201	-50	Satisfactory
Counter Top	45	331	65	99	Satisfactory
L6 Outside	45	331	-2	72	Satisfactory

Final Status Survey Report for Decommissioning  
 Merck & Co., Inc. Stonewall Site, Elkton, VA

**(Building 84A Continued)**

L5 Outside	45	331	-43	99	Satisfactory
L4 Outside	45	331	10	44	Satisfactory
L3 Outside	45	331	-30	140	Satisfactory
L2 Outside	45	331	-2	-77	Satisfactory
L1 Outside	45	331	51	3	Satisfactory

<sup>a</sup> LLD = Lower Limit of Detection as determined by the instrument.

<sup>b</sup> Condition refers to whether the activity is less than the action level recorded in Table N-1 of the NRC Reg. Guide 10.8. Satisfactory = less than the action levels in Table N-1.

**Building: 65**

Wipe Location	LLD <sup>a</sup> (dpm)	Background (dpm)	Activity (dpm – Bkgnd dpm)		Condition <sup>b</sup>
			Co-57	Co-60	
1 - Lower Hood	38	242	31	78	Satisfactory
1A – Upper Hood	38	242	3	24	Satisfactory
2	38	242	72	51	Satisfactory
3	38	242	113	51	Satisfactory
4	38	242	3	78	Satisfactory
5	38	242	3	-2	Satisfactory
6	38	242	17	51	Satisfactory
7	38	242	-9	51	Satisfactory
8	38	242	31	-2	Satisfactory
9	38	242	181	10	Satisfactory
9A	40	242	194	65	Satisfactory
10	40	242	17	65	Satisfactory
11	40	242	31	-30	Satisfactory
12	40	242	58	106	Satisfactory
13	40	242	17	38	Satisfactory
14	40	242	3	-71	Satisfactory
14A	40	242	140	65	Satisfactory
15	40	242	58	-16	Satisfactory
15A	40	242	72	24	Satisfactory
16	40	242	3	-57	Satisfactory
17	40	242	-37	160	Satisfactory
18	40	242	113	106	Satisfactory
19	40	242	-9	119	Satisfactory
19A	40	242	-50	10	Satisfactory
20	40	242	126	-71	Satisfactory
21	40	242	-9	78	Satisfactory
22	40	242	-23	24	Satisfactory
22A	40	242	72	92	Satisfactory
23	40	242	72	24	Satisfactory
23A	40	242	113	10	Satisfactory
24	40	242	3	-2	Satisfactory
25	40	242	99	106	Satisfactory
26	40	242	85	-57	Satisfactory

<sup>a</sup> LLD = Lower Limit of Detection as determined by the instrument.

<sup>b</sup> Condition refers to whether the activity is less than the action level recorded in Table N-1 of the NRC Reg. Guide 10.8. Satisfactory = less than the action levels in Table N-1.

### **6.1 Techniques for Reducing / Evaluating Data**

No special techniques were required for reducing or evaluating the data.

### **6.2 Statistical Evaluation**

No statistical methods were required for evaluating the results.

## **7. Comparison of Findings with Guideline Values and Conditions**

The majority of all sampled locations were below the action limits for unrestricted use in NRC Regulatory Guide 10.8 Table N-1 and required no further action. Some of the locations in the Building 84 labs were above the limit for Co-57. In each of these cases, the location was either decontaminated or the contaminated piece of equipment was disposed of as radioactive waste. None of the sites surveyed remain above the limits for unrestricted use given in Regulatory Guide 10.8 Table N-1.

Copies of letters from Dr. Lee Anthony to Merck & Co., Inc. describing the status of the site are appended as Appendices I and II. These letters concur with the assessment that no locations on site are above the limits described in Regulatory Guide 10.8, Table N-1.

## **8. Summary**

Surveys of the Merck & Co., Inc. Stonewall Plant at Elkton, Virginia indicate that decommissioning and decontamination activities at the site have been effective in removing residual activity. The survey data indicate that the site meets NRC and Virginia limits for release to unrestricted use.

## Appendix I Copy of Letter from Physics Associates to Merck Dated 12/24/01

MEDICAL PHYSICS  
SHIELDING RECOMMENDATIONS

RADIATION PHYSICS  
EMERGENCY CONSULTATION



### PHYSICS ASSOCIATES

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Certified Medical Physicist  
Certified Radiologic Physicist

Robert C. Hudson, M.S.  
Kay A. Saul, B.S.  
Lee S. Anthony, Jr., B.S.;M.A.

December 24, 2001

Dr. Scott Hooper, Radiation Safety Officer  
Stonewall Plant  
Merck, Inc.  
P.O. Box 7  
Elkton, Virginia 22827-0007

Dear Dr. Hooper,

This document represents an interim report on the radiological decommissioning activities at your facility.

#### History

Your facility has carried out operations with radioactive materials for many years, as authorized by U.S. Nuclear Regulatory Commission Byproduct Materials License #45-033302-01, and the Commonwealth of Virginia's Radioactive Materials License #VA-100-01.

The most recent inspections of your facility were carried out on 1/25/99, by Orsya Masure Bailey of the U.S.N.R.C.; and on 3/31/99 by Ryan Paris of the Virginia Bureau of Radiological Health. No discrepancies were noted during these inspections.

#### Radiological Characterization of the Site:

By far, the majority of the licensed material used at this site has been Co-57, which is regulated by Virginia; approximately 96% of the total activity.

Small amounts of other nuclides have been used on the site over the years. We now list the building numbers and radionuclides which have been used in them:



Dr. Scott Hooper  
 Merck, Inc.  
 Page 2 of 3

<u>Building Number</u>	<u>Radionuclides Used</u>
24 (Biochemistry Lab)	H-3, C-14, S-35, and P-32
65 (Quality Control Lab)	Co-57 and Co-60
80 A	C-14, Co-57, P-32; and S-35 prior to 1994
84 (Production Lab)	Co-57, Co-60
84A	Co-57, Co-60
T.O. Shed (Shed used as a holding facility for waste prior to disposal)	H-3, C-14, S-35, P-32, Co-51, and Co-60
92	C-14, Co-57

The total quantity of each licensed radionuclide ever used at the facility is estimated at:

<u>Radionuclide</u>	<u>Activity</u>	<u>Half-Life</u>
Co-57	10.5 Ci	271 days
Co-60	440 mCi prior to 1993	5.26 years
C-14	3 mCi	5738 years
H-3	None	12.3 years
S-35	10 mCi prior to 1994	87 days
P-32	None since prior to 1993 (> 100 Half-lives)	14.3 days

**Equipment Used for the Survey:**

A list is attached of the survey instruments available for the surveys. Copies of calibration certificates are attached for those survey meters used in the survey.

In addition to the survey meters, a Physics Associates Atom Lab 950 Sodium Iodide gamma ray spectrometer and a Merck Beckman Model 5000 TD Liquid Scintillation Counter were used, and were calibrated on site with NIST-traceable sources.

It was found that the most sensitive survey meter for gamma counting was the Merck Model 3 Ludlum Sodium-Iodide Survey Meter. Although the Bicon Surveyor 2000 meters with thin-window PGM probes were also used, the definitive detection devices for beta emitters were the wipes which were counted with the Beckman Liquid Scintillation Counter. The Atom Lab 950 NaI gamma-ray spectrometer was used for counting the gamma wipes. Values listed under Co-57 and Co-60 windows were used to document whether or not the wipes were below the action levels given in Table N-1 of USNRC Reg. Guide 10.8.

Dr. Scott Hooper  
Merck, Inc.  
Page 3 of 4

**Methodology:**

Merck has provided plan views of all labs in which licensed materials have been used. Areas of use within individual labs have been highlighted.

Survey points which have been accepted over the years by the N.R.C. and Virginia B.R.H. are noted on these drawings.

All of these points have been surveyed with an appropriate survey meter, and by wipe tests. The survey chronology describes the specific survey meter used in a specific lab.

In addition to these defined survey points, the survey meter was used to cover the entire working surface; bench-top or counter-top.

Additional survey points were established on floors, approximating a one-meter grid.

Walls were not generally available, being covered by laboratory furniture such as benches. However, the one room which had the highest usage of licensed material (Building 84's Fermentation Lab) did have three accessible walls. Survey points were defined on these walls, approximately one meter above the floor, and approximately one meter between survey points.

**Findings:**

Survey points are identified on each room plan view.

Survey meter readings were "Background" unless otherwise noted.

Wipe test results have been printed for all survey points. Results which were greater than action levels in Table N-1 of NRC Reg. Guide 10.8 have been highlighted (Co-57 window).

Decontamination has been performed at all such points, and post-decontamination survey results are printed. All post-decontamination results are below Table N-1 action levels.

Dr. Scott Hooper  
Merck, Inc.  
Page 4 of 4

Liquid scintillation counting results indicate that all survey points located in labs where C-14, H-3, S-35, or P-32 were used, are at background activity and below Table N-1 action levels.

A number of pieces of laboratory apparatus have been identified as having residual Co-57 contamination, and these have been taken to the T.O. shed for disposal by an appropriately licensed RadWaste firm, or decontamination by Merck personnel.

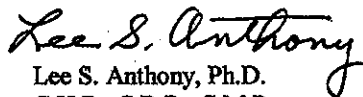
**Other Observations:**

The total quantity of licensed Radioactive Materials used at Merck's Stonewall Plant in Elkton, Virginia has been small. (Previous calculations have been made to show that if all the Co-57 used at the plant had been disposed to the sanitary sewer, the plant would have been within 10 CFR 20 Appendix B and Virginia disposal levels).

**Conclusions:**

1. There are no survey points which are at or above action levels of Table N-1, NRC Reg. Guide 10.8.
2. All radioactive waste has been removed to the T.O. shed for disposal or decontamination.
3. After pick-up of the RadWaste from the T.O. Shed, the shed will be surveyed again. At that time, Physics Associates and Merck will declare the site to be decommissioned, and will ask the U.S.N.R.C. and Virginia B.R.H. to provide a letter of concurrence.  
At that time, Merck will surrender its N.R.C. and State RAM licenses.

Sincerely,



Lee S. Anthony, Ph.D.  
C.H.P.; C.R.P.; C.M.P.

LSA/kas

**Appendix II: Copy of Letter From Physics Associates to Merck Dated 4/29/02**

**MEDICAL PHYSICS  
SHIELDING RECOMMENDATIONS**

**RADIATION PHYSICS  
EMERGENCY CONSULTATION**



**PHYSICS ASSOCIATES**

Lee S. Anthony, Ph.D.  
Certified Health Physicist  
Certified Medical Physicist  
Certified Radiologic Physicist  
29 April, 2002

**5346 Peters Creek Road  
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Tel: (540) 563-0165  
Fax: (540) 563-0082**

Robert C. Hudson, M.S.  
Kay A. Saul, B.S.  
Lee S. Anthony, Jr., B.S.;M.A.  
James P. Nunn, B.S.

Scott W. Hooper, Ph.D.  
Radiation Safety Officer  
Merck & Company, Inc.  
P.O. Box 759  
Elkton, VA 22827

Dear Dr. Hooper,

Our activities on this date have completed the necessary health physics surveys, which will enable the decommissioning of your Stonewall Plant licensed radioactive material program.

Today, we performed GM and scintillations surveys of Building 84-A (large shed) and the nearby small shed both contained within the fenced area.

Several items were noted during today's survey:

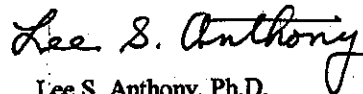
1. Residual Co-57 contamination was noted on the interior wall of the small shed. This contamination was within the limits specified by USNRC Reg. Guide 10.8 Appendix N Table N-1 for release for unrestricted use.
2. A small (roughly 10cm x 30cm) area was found to be contaminated above background levels (< 3 mR/hr) in Building 84-A. It would appear that spill which may have occurred many years ago, and was probably painted over, has sealed this material in the concrete floor immediately below locker No. 1. We have placed "Radioactive Material" warning tape around this area. Whenever this building is demolished, we would recommend that the radiation safety

officer work with the demolition personnel, who should wear respiratory protection and anticontamination suit for the operation.

3. One sample tray was found which had a very small amount of Co-60 in one well of the tray. This measured approx. 0.3 mR/hr. We recommend that this tray be appropriately disposed of.

Otherwise, our testing of this date, when combined with the previous testing of 17-20 December, 2001 indicate that you are ready for the final decommissioning.

Sincerely,



Lee S. Anthony, Ph.D.  
C.H.P., C.R.P., C.M.P.

**\*\*Note: The concrete slab section and Co-60 contaminated wooden rack referred to in this letter were transferred to a licensed disposal company on 7/19/02.**

### Appendix III: Copy of Letter From Physics Associates to Merck Dated 9/11/02

MEDICAL PHYSICS  
SHIELDING RECOMMENDATIONS

RADIATION PHYSICS  
EMERGENCY CONSULTATION



## PHYSICS ASSOCIATES

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Scott Hooper, Ph.D.  
Radiation Safety Officer  
Merck & Company  
P.O. Box 7  
Highway 340 South  
Elkton, Va. 22827-0007

Dear Dr. Hooper,

As per our conversation this morning I am writing you this letter to clear up concerns about some of the wipe tests that were taken during the decommissioning of your facility. The wipes that are in question were taken in building 84, M&P Room and exceeded the limit of 200 dpm/100cm<sup>2</sup> for <sup>60</sup>Co.

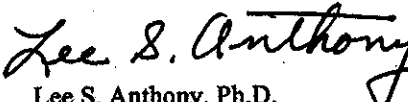
- Location 18 (hood): This wipe was taken over half the bottom area of the hood and was much larger than 100cm<sup>2</sup>. We would estimate the area of half the floor of the hood to be of the order of 1 meter x 1 meters = 10000 cm<sup>2</sup>. Therefore the activity collected on the wipe multiplied by a factor of 100/10000 would yield an activity of approximately 3 dpm/100cm<sup>2</sup> for <sup>60</sup>Co, which is much less than the 200 dpm/100cm<sup>2</sup> required for unrestricted use.
- Location 84-15/14 High Counter top: This wipe represents the raised counter top in the media prep area labeled as 14 and 15 on the room diagram. The wipe represents the entire counter top and not an area of 100cm<sup>2</sup>. This counter has approximate dimensions of 30 cm x 2 meters yielding an area of 6000 cm<sup>2</sup>. Multiplying the activity collected on the wipe by a factor of 100/6000 would yield an activity of approximately 4 dpm/100cm<sup>2</sup> for <sup>60</sup>Co, which is much less than the 200 dpm/100cm<sup>2</sup> required for unrestricted use.
- Location 84-13/16 4<sup>th</sup> drawer: This the 4<sup>th</sup> drawer in the shelf that is located in the media prep room below the counter top labeled 13. The entire bottom area of the drawer was wiped and not the customary 100 cm<sup>2</sup>. I would estimate the drawer to have dimensions of 1.5 meters x 0.5 meters, which yields an area of 7500 cm<sup>2</sup>. Multiplying the activity collected on the wipe by

a factor of 100/7500 would yield an approximate activity of 12 dpm/100cm<sup>2</sup> for <sup>60</sup>Co which is much less than the 200 dpm/100cm<sup>2</sup> required for unrestricted use.

Attached to this letter please find diagrams of buildings 24(biochem lab), building 80A, and building 92 with detailed diagrams of where wipes were taken for liquid scintillation to detect the presence of beta (e<sup>-</sup>) emitting radionuclides.

If you should need any more clarification of the data that was obtained during our time spent at Merck & Company please feel free to call either James or myself any time.

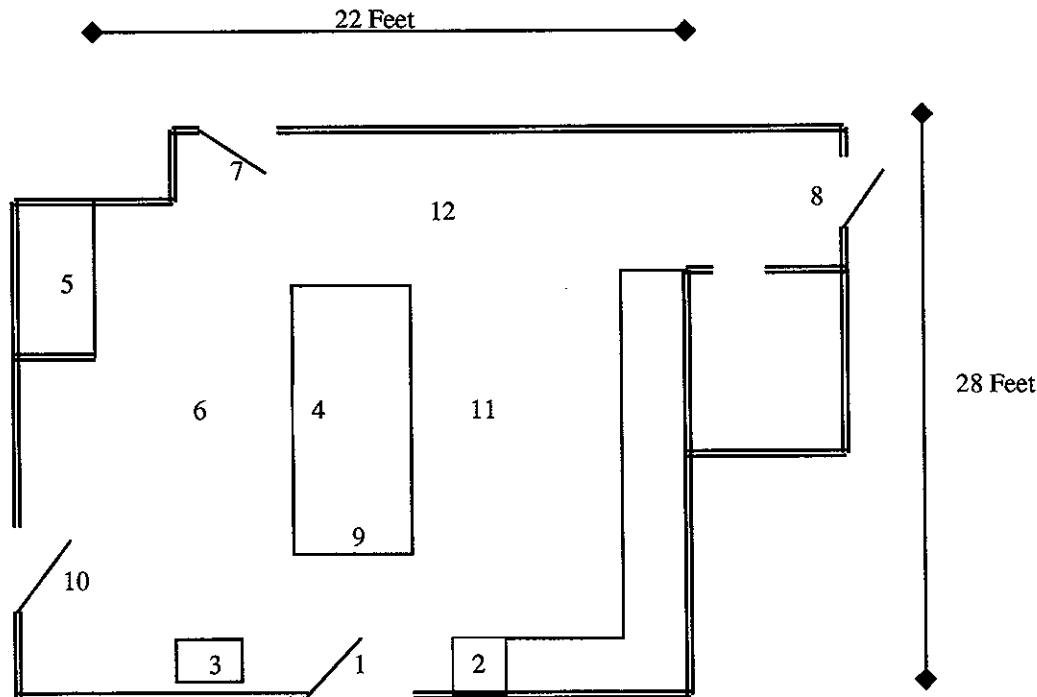
Sincerely,



Lee S. Anthony, Ph.D.  
C.H.P., C.R.P., C.M.P.

**Appendix IV.**

**Building 24 Biochemistry Lab (C-14, P-32)**



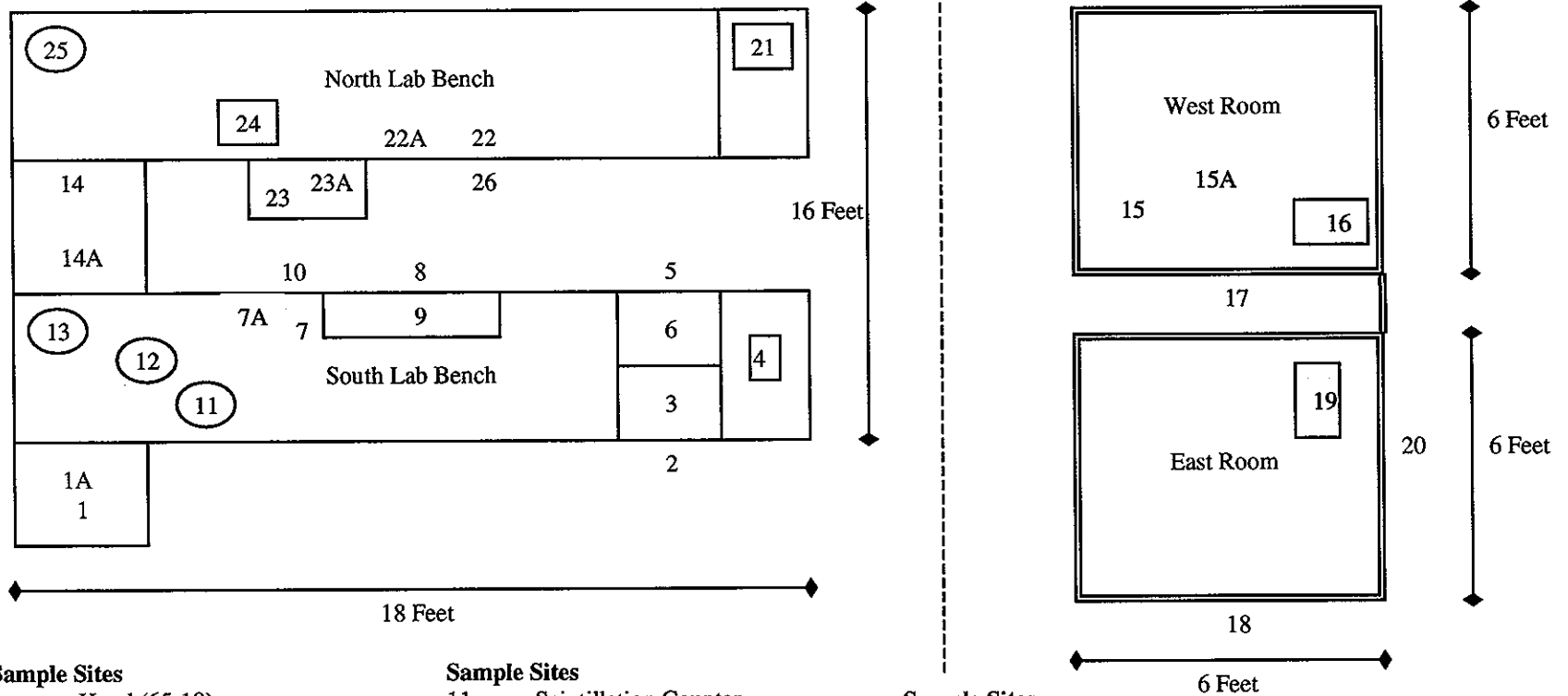
Sampling Sites	
24-1	Door handle, Inside and Outside
24-2	Sink
24-3	Refrigerator Door & Handle
24-4	Benchtop of Island
24-5	Hood
24-6	Floor
24-7	Doorknob, Inside and Outside
24-8	Doorknob, Inside and Outside
24-9	Sink
24-10	Doorknob, Inside and Outside
24-11	Floor
24-12	Floor

Locations of radioactive materials use highlighted in yellow.



Appendix V.

Building 65 Labs (Co-57, Co-60)



Sample Sites

- 1 Hood (65-18)
- 1A Wipe Test Hood #1
- 2 Outside Ice Box #1
- 3 Inside Ice Box #1
- 4 Sink #1
- 5 Outside Ice Box #2
- 6 Inside Ice Box #2
- 7 Bench #2
- 7A Wipe Test Bench #2
- 8 Outside Cabinet
- 9 Inside Cabinet
- 10 Floor #1

Sample Sites

- 11 Scintillation Counter
- 12 Inside Centrifuge
- 13 Sink #2
- 14 Hood 65-19
- 14A Wipe Test Hood #2
- 15 Bench #8
- 15A Wipe Test Bench #8
- 16 Inside UV
- 17 Floor #2
- 18 Outside Door
- 19 Storage Area
- 20 Outside Wall

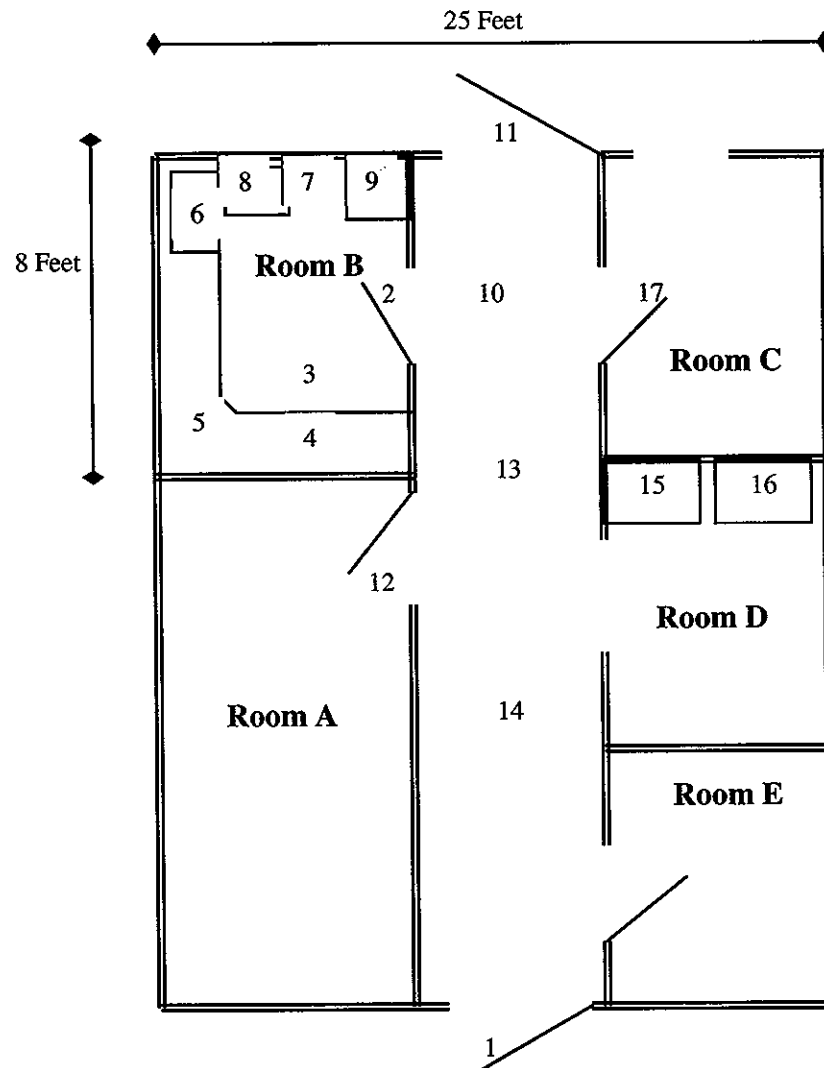
Sample Sites

- 21 Sink #3
- 22 Bench #3
- 22A Wipe Test Bench #3
- 23 Laminar Flow Hood
- 23A Wipe Test Laminar Hood
- 24 Incubator
- 25 Autoclave
- 26 Floor #3

Locations where radioactive materials were used are marked in yellow.

**Appendix VI.**

**Building 80A (C-14, Co-57 --- P-32 prior to 1996)**



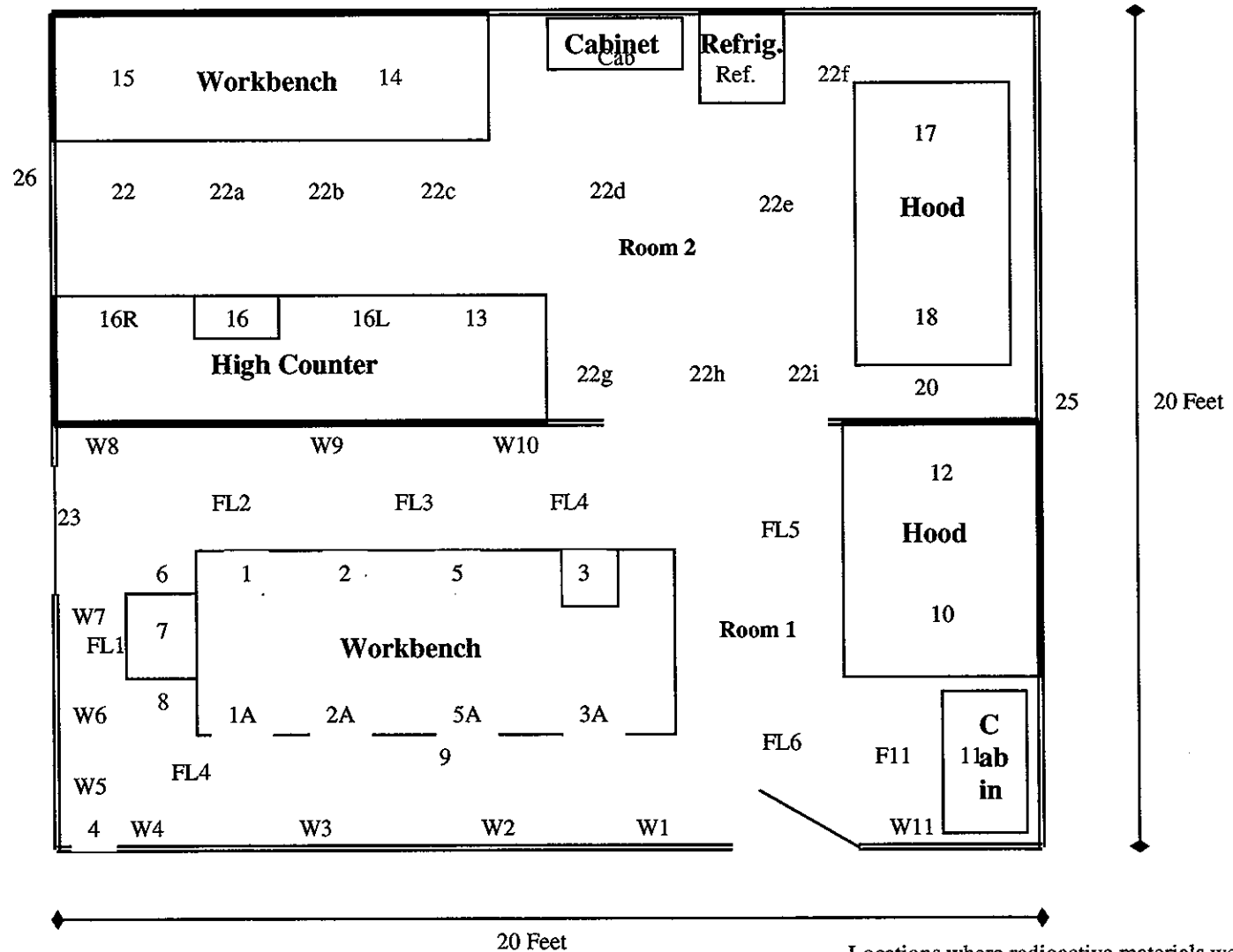
**Sampling Sites**

- 1 Doorknobs, Main Entrance
- 2 Doorknobs, Room B
- 3 Floor, Room B
- 4 South Benchtop, Room B
- 5 West Benchtop, Room B
- 6 Surface of Scintillation Counter
- 7 Surface of Dry Waste Container
- 8 Top of Refrigerator
- 9 Sink, Near Drain
- 10 Floor of Hallway
- 11 Doorknobs to Main Lab
- 12 Doorknobs
- 13 Floor
- 14 Floor
- 15 Refrigerator Door and Handles
- 16 Refrigerator Door and Handles
- 17 Doorknobs

**Notes:**  
 Locations of radioactive materials use highlighted in yellow.  
 No use of materials in rooms D or E ever.  
 No use of materials (P-32) in A or C since 1996.

**Appendix VII.**

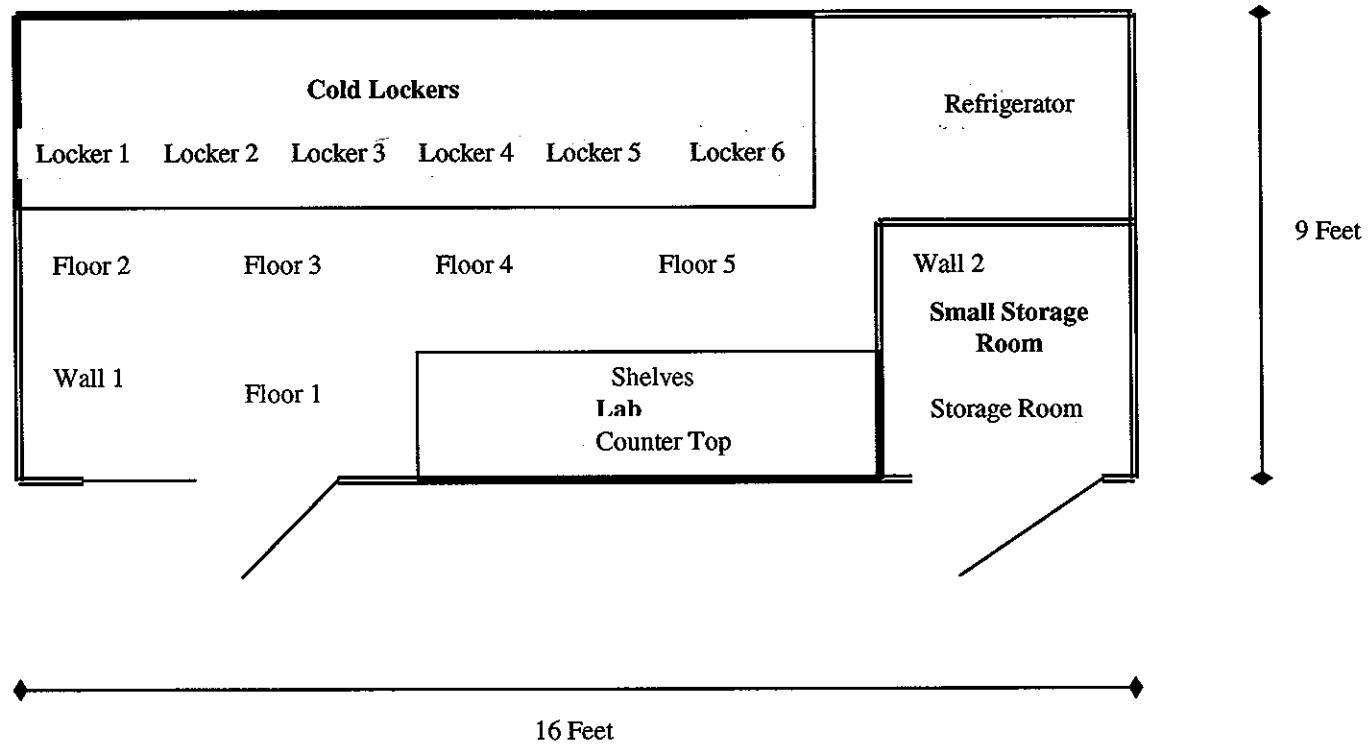
**Building 84 Production Labs (Co-57, Co-60)**



Locations where radioactive materials were used  
 are marked in yellow.

**Appendix VIII.**

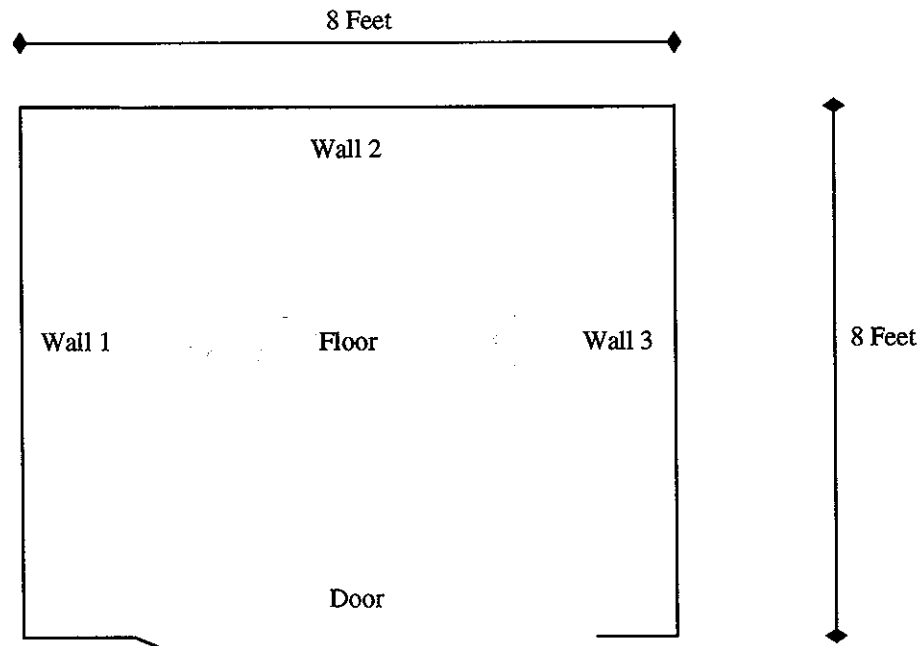
**Building 84A (Co-57, Co-60)**



Locations of radioactive materials use highlighted in yellow.

**Appendix IX.**

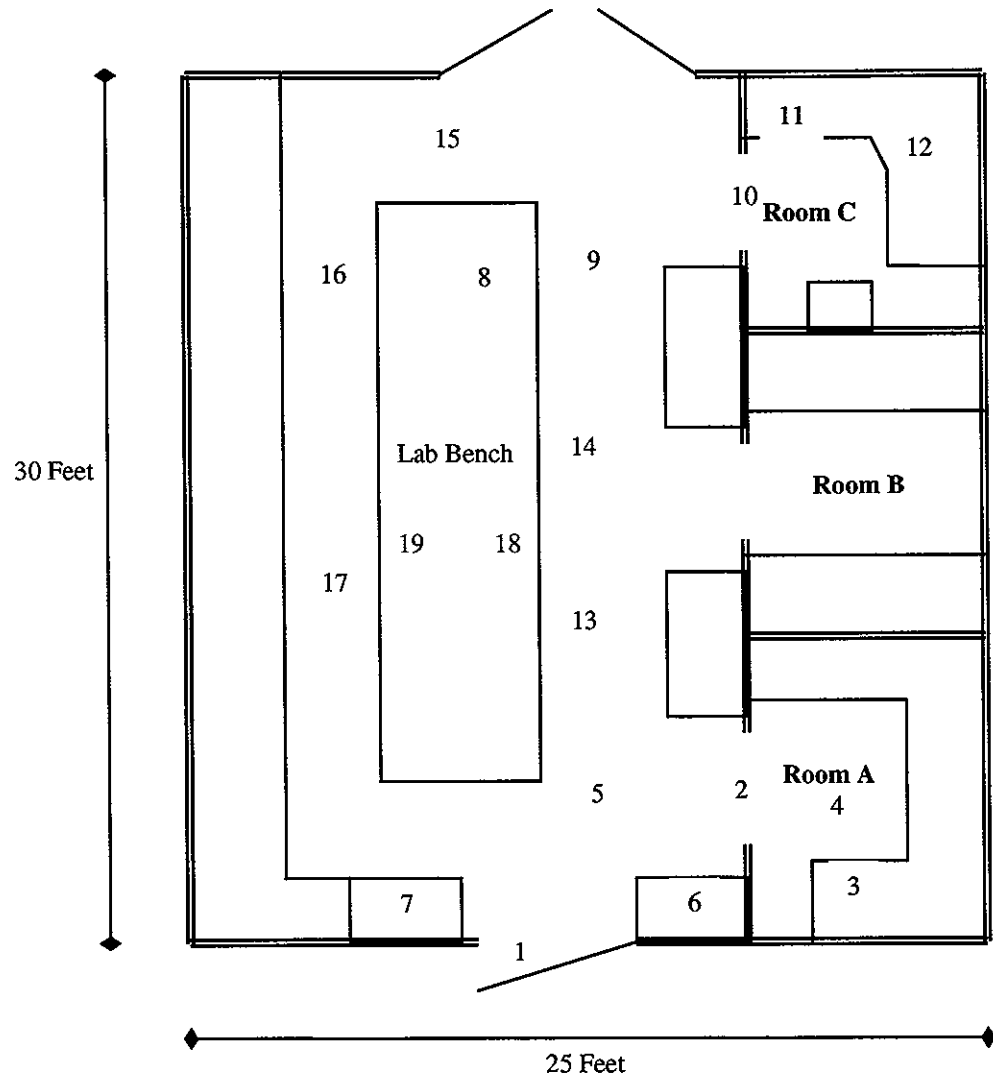
**T.O. Shed (C-14, Co-57, Co-60, P-32 before 1996)**



Locations of radioactive materials use highlighted in yellow.

**Appendix X.**

**Building 92 (C-14, Co-57)**



**Sample Sites**

- 1 Doorknobs, Main Entrance
  - 2 Doorknobs, Room A
  - 3 Benchtop, Room A
  - 4 Floor, Room A
  - 5 Floor Near Hoods
  - 6 Hood, Center of Work Area
  - 7 Hood, Center of Work Area
  - 8 Work Area
  - 9 Floor
  - 10 Doorknobs, Room C
  - 11 Floor, Room C
  - 12 Benchtop, Room C
  - 13-17 Floor Area Around Benchtop
  - 18-19 Benchtop Areas
- Locations of radioactive materials use highlighted in yellow.