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UNIVERSITY OF DELAWARE
NEWARK, DELAWARE
19711

OFFICE OF PERSONNEL & EMPLOYEE RELATIONS
SAFETY & RADIATION SAFETY
417 ACADEMY STREET
PHONE: 302-738-8475

February 9, 1983

License No. 07-01579-19
Docket No. 030-10925
Control No. 02864

Phillip C. Jerman
U. S. Nuclear Regulatory Commission
Nuclear Materials Section B
Division of Engineering and
Technical Programs
Region I
631 Park Avenue
King of Prussia, Pa. 19406

Dear Mr. Jerman:

This is in reference to your letter dated January 11, 1983 regarding the renewal of License No. 07-01579-19. The additional information requested is as follows:

1. The membership of the Radiation Safety Committee has been updated, re: Attachment #3, Revision 1 and Attachment #7, Revision 1. Our well logging amendment has been included in Attachment #12, Revision 1 and our decay-in-storage amendment in Attachment #13, Revision 1.

2. Re: Attachment #12, Revision 1, Organization of the Radiation Safety Committee.

3. Re: Attachment #12, Revision 1, Responsibilities of the Radiation Safety Committee.

4. Approximately 0 - 4 packages of radioactive material are received each week. These packages are given priority treatment.

   Packages containing radioactive materials are delivered by freight carriers and the U. S. Postal Service to Central Receiving, General Services Building, 222 South Chapel Street. Central Receiving personnel transfer packages via University vehicle, unopened, to the Safety Division, 417 Academy Street.

   Packages are accepted for delivery Monday - Friday, 0800 hrs. - 1630 hrs. Packages are not accepted for delivery after hours, holidays or weekends. Deliveries to the Safety Division occur at approximately 1000 hrs. and 1300 hrs. Packages received by Central Receiving between 1300 hrs. and 1630 hrs. are picked up by Safety Division personnel utilizing University vehicles after notification by Central Receiving.

Upon arriving at the Safety Division each package is surveyed for removable contamination and external surface radiation levels are measured with results of each test recorded. These tests are in accordance with 10CFR20.205. Packages are not routinely opened and contents inspected by Safety Division personnel.

If the package is not contaminated or does not demonstrate excessive external radiation levels (10CFR20.205), the final user is notified. The final user picks up the package at the Safety Division and transfers it to the restricted area. Packages are mainly hand carried at this point, although University vehicles or personal vehicles may be utilized. Packages are opened and the contents inspected by the final user once the package has reached the restricted area.

Records of all deliveries, tests, and surveys pursuant to 10CFR20.205 are maintained by the Radiation Safety Officer and are available for inspection.

5. Re: Attachment #12, Revision 1, Procedures for Opening Packages of Radioactive Material.

6. Re: Attachment #11, Revision 1, Security of High Activity Sources - Sealed and Unsealed; Attachment #13, Revision 1, Disposal via Decay-In-Storage; Attachment #12, Revision 1, Well-Logging.

7. Re: Attachment #12, Revision 1, Training.

8. Re: Attachment #12, Revision 1, Responsibilities of License Permit Supervisors.

9. Re: Attachment #12, Revision 1, Protective Rules for Controlling Contamination of Laboratory Facilities and Equipment.

10. Re: Attachment #11, Revision 1, Area Monitoring.

11. Re: Attachment #12, Revision 1, Definitions: Permit Supervisor, Authorized User, Trainee.

12. Re: Attachment #10, Revision 1, Thyroid Monitoring.

13. Re: Attachment #11, Revision 1, Air Sampling.

14. Re: Attachment #11, Revision 1, Security of High Activity Sources - Sealed and Unsealed.

Two (2) copies of the revised application are attached for your review.

Please contact me if additional information is required.

Sincerely,

Stuart W. Kline

Stuart W. Kline
Associate Director of Safety

SWK/Ch
Enclosures

FEB 10 1983

ATTACHMENT #1
REVISION 1
2/83

Item 1b.

Refer to Attachment #5, Revision 1.

A. Newark, Delaware Campus; Regional campus at Lewes, Georgetown, Wilmington, Dover and other properties owned or otherwise utilized by the University of Delaware.

B. Licensed material listed on Attachment #5, Revision 1, subitems A, B and C may also be used on-board ship at temporary job sites in U.S. coastal waters or at sea and on-board ship at temporary job sites in inland waters of the State of Delaware.

C. Licensed material listed on Attachment #5, Revision 1, subitem J may also be used at temporary job sites in the states of Delaware, New Jersey and Pennsylvania.

ATTACHMENT #2
2/83

Item 2.

Departments in the various colleges engaged in research and development and instruction of students as approved by the Radiation Safety Committee, including but not limited to:

Agricultural Engineering
Animal Science and Agricultural Biochemistry
Anthropology or Art
Chemistry
Chemical Engineering
Civil Engineering
Electrical Engineering
Entomology and Applied Ecology
Food and Nutrition
Geology
Institute for Energy Conversion
Institute for Neuroscience and Behavior
Life and Health Sciences
Marine Studies
Mechanical and Aerospace Engineering
Physics
Plant Science
Psychology

ATTACHMENT #3
REVISION 1
2/83

Item 4.

Individual users as authorized by the Radiation Safety Committee.

Members of the Radiation Safety Committee 1982-1983 are:

Robert C. Hodson, Ph.D., Chairman
Associate Professor, Life and Health Science

Conrad N. Trumbore, Ph.D., Vice Chairman
Associate Professor, Chemistry

Stuart W. Kline, M.S.
Associate Director of Safety/Radiation Safety Officer

Cheng-Ming Fou, Ph.D.
Associate Professor, Physics

Bruce C. Lutz, Ph.D.
Professor, Electrical Engineering

Paul H. Sammelwitz, Ph.D.
Associate Professor, Animal Science and Agricultural Biochemistry

Allen M. Thompson, Ph.D.
Associate Professor, Geology

Herman A. Smith, Director
Engineering and Construction

Milton H. Stetson, Ph.D.
Professor, Life and Health Science

Chin-Pao Huang, Ph.D.
Professor, Civil Engineering

Jonathan H. Sharp, Ph.D.
Associate Professor, Marine Studies

Robert D. Varrin, Ph.D.
University Research Coordinator
for L. Leon Campbell, Provost

Jean Marie Pagani, B.S.
Health Physics Technologist
Safety Division

ATTACHMENT #3
REVISION 1

When a member of the Radiation Safety Committee is unable to attend a Radiation Safety Committee meeting, the following alternates may attend in their place:

John C. Wriston, Ph. D. for Dr. Trumbore
Professor, Chemistry

Larry A. Cogburn, Ph. D. for Dr. Sammelwitz
Assistant Professor, Animal Science

Peter B. Leavens, Ph. D. for Dr. Thompson
Associate Professor, Geology

Charles P. Swann, Ph. D. for Dr. Fou
Professor, Bartol Research Foundation

Richard P. Walker for Mr. Smith
Engineering and Construction

Mary G. Tyler, Ph. D. for Dr. Sharp
Assistant Professor, Marine Studies

ATTACHMENT #4
REVISION 1
2/83

Item 5.

Ms. Jean Marie Pagani, Health Physics Technologist, is the authorized representative of the Radiation Safety Officer and can act in behalf of the Radiation Safety Officer during the Officer's absence. Any action taken during the Radiation Safety Officer's absence is subject to review by the Radiation Safety Committee and by the Radiation Safety Officer, upon return.

Training and experience of the Radiation Safety Officer and Health Physics Technologist are as follows:

Stuart W. Kline, M.S.

EDUCATION:

1978	M. S. Occupational and Environmental Health Wayne State University Detroit, Michigan
1973	B.S. Biology Wayne State University Detroit, Michigan

PROFESSIONAL EXPERIENCE:

7/1980 - Present	Associate Director of Safety/ Radiation Safety Officer University of Delaware Newark, Delaware
11/1978 - 7/1980	Health Physicist Radiation Control Service The University of Michigan Ann Arbor, Michigan
6/1978 - 11/1978	Director, Industrial Hygiene Services Swanson Environmental, Inc. Southfield, Michigan
3/1977 - 6/1978	Health Physicist (Senior) Health Physics - Radiation Control Wayne State University Detroit, Michigan
1/1973 - 2/1977	Health Physicist (Junior) Health Physics - Radiation Control Wayne State University Detroit, Michigan

ATTACHMENT #4
REVISION 1

RADIONUCLIDE EXPERIENCE:

1973 - Present — Health Physics related activities pursuant to Byproduct Material, Reactor, Special Nuclear Material, Medical, Specific Irradiator, and/or other licenses held by the University of Delaware, the University of Michigan and Wayne State University.

Nuclide	Amount
H-3	5 Ci unsealed
H-3	10 Ci plated targets
H-3	5 Ci chromatograph sources
C-14	20 mCi unsealed
Na-22, 24 Na-Be	100 mCi sealed & unsealed
P-32	100 mCi unsealed
S-35	100 mCi unsealed
Cl-36	10 mCi unsealed
Ca-45	10 mCi unsealed
Sc-46	25 mCi microspheres & unsealed
Cr-51	25 mCi microspheres
Fe-55, 59	1 mCi unsealed
Co-60	1000 + Ci Teletherapy
Co-60	1000 + Ci Irradiator
Co-60	100 mCi sealed source
Co-60	10 mCi unsealed
Ni-63	10 mCi unsealed
Ni-63	15 mCi chromatograph sources
Zn-65	10 mCi unsealed
Sr-85	25 mCi microspheres
Sr-90 Y-90	1 mCi unsealed
Sr-90 Y-90	100 mCi sealed sources & medical applicators
Mo99, Tc99M	2 Ci Tc Generator
Ag-110	1 mCi unsealed
Cd-109	10 mCi sealed source
Ge-68	100 mCi sealed source
As-74	1 mCi unsealed
Br-85	25 mCi unsealed/gas
Kr-85	10 mCi gas
Rb-86	10 mCi unsealed
In-111	10 mCi unsealed
Sn-119	10 mCi sealed
Sb-121	10 mCi sealed
I-123	10 mCi unsealed
I-125	50 mCi unsealed
I-125	100 mCi sealed

ATTACHMENT #4
REVISION 1

Nuclide	Amount
I-129	0.1 mCi sealed
I-131	200 mCi unsealed
Xe-133	100 mCi gas
Cs-137	1000 + Ci irradiator
Cs-137	100 mCi sealed source
Cs-137	10 mCi unsealed
Pm-147	1 + Ci light sources
Ir-192	1 Ci seeds
Au-198	10 mCi unsealed
Hg-203	10 mCi unsealed
Pb-210	1 mCi unsealed
Po-210	1 mCi unsealed
Ra-226	100 mCi sealed sources
Ra-Be	100 mCi sealed sources
Ce-141	25 mCi microspheres
Uranium enriched	Reactor related
Uranium depleted	1 + pound quantities
Am-241	1 mCi unsealed
Am-241	20 Ci sealed
Am-241	10 mCi plated
Am-Be	100 mCi sealed
Pu-Be	6 Ci sealed
Pu	1 uCi plated
Cm-244	1 mCi sealed
Cf-252	10 mCi sealed

Various quantities of short and long lived machine and reactor produced isotopes.

Jean Marie Pagani

EDUCATION:

March 15-19, 1982	Radiation Hazards and Controls Sponsored by Universities Occupational Safety and Health Educational Resource Centers
1977 - 1981	B.S. in Biology Villanova University Villanova, Pennsylvania

ATTACHMENT #4
REVISION 1

PROFESSIONAL EXPERIENCE:

11/1981 - present	Health Physics Technologist University of Delaware Newark, Delaware
8/1981 - 11/1981	Research Technician Wistar Institue Philadelphia, Pennsylvania

RADIONUCLIDE EXPERIENCE:

1981 - present

Health Physics related activities pursuant to Byproduct Material, specific irradiator and/or other licenses held by the University of Delaware. Research related activities pursuant to Byproduct Material, specific irradiator licenses held by Wistar Institue.

Nuclide	Amount
H-3	100 mCi unsealed
H-3	1 Ci sealed 1 plated sources
C-14	1 mCi unsealed
P-32	25 mCi unsealed
S-35	10 mCi unsealed
Ca-45	2 mCi unsealed
CO-60	100 + Ci Irradiator
Ni-63	15 mCi chromatograph sources
Cd-109	5 mCi sealed source
Rb-86	10 mCi unsealed
I-125	10 mCi unsealed
Cs-137	125 mCi sealed sources
Ra-226	10 mCi sealed sources
Ra-Be	1 mCi sealed sources
Uranium depleted	500 grams
Am-Be	100 mCi sealed sources
Pu-Be	6 Ci sealed sources
Pu	1 Ci plated

Various other isotopes in quantities < 1μCi used for instrument calibrations.

ATTACHMENT #5
REVISION #1
2/83

Item 6 (6A & 6B)

Byproduct, source, and/or special nuclear material	Chemical and/or physical form	Maximum amount to be possessed at any one time under this license
A. Any byproduct material with Atomic Numbers between 3-83, inclusive	A. Any	A. No single radioisotope to exceed 250 millicuries each, except as noted below. Total not to exceed 20 curies.
B. Hydrogen 3	B. Any	B. 10 curies
C. Carbon 14	C. Any	C. 5 curies
D. Americium 241	D. Any	D. 5 millicuries
E. Plutonium	E. Sealed sources, encapsulated as Pu-Be neutron source (Monsanto source No.M233, 16 grams) (NMEC source No.N800I18, 80 grams)	E. 96 grams
F. Polonium 210	F. Any	F. 5 millicuries
G. Polonium 208	G. Any	G. 5 millicuries
H. Americium 241	H. Sealed Sources	H. 20 millicuries
I. Americium 241	I. Americium/Bryllium Sealed sources (Part of Troxler 1255 Moisture Probe, 100 mCi) (Troxler AM-241/BE, SN 45-5085, 10mCi)	I. 110 millicuries
J. Cesium 137	J. Sealed Source (3M Model 4F6B)	J. 125 millicuries
K. Cesium 137	K. Sealed Source (USN Type 375, SN F171)	K. 100 millicuries

"OFFICIAL RECORD COPY"

ATTACHMENT #6
REVISION 1
2/83

Item 7.

SEALED SOURCES:

Americium-241 as Am-Be, 100 mCi sealed source (neutron) in a Troxler moisture depth gauge, Model 1255. Stored in Room 124 Worrilow Hall, equipment cage.

Plutonium as Pu-Be, Monsanto Research Corporation, Mound Lab., Miamisburg, Ohio, source No. M233, approximately 16 grams (1 Ci) of Pu, in secured storage container (15 gallon paraffin drum 15 inches diameter). Stored in Room 241 DuPont Hall.

Plutonium as Pu-Be. Nuclear Materials & Equipment Corp., Appollo, Pennsylvania, source No. N800I18, approximately 80 grams (5 Ci) of Pu, in secured neutron howitzer. Stored in Room 014 Sharp Laboratory.

Nickel-63, Antex Model-245, Serial No. 150, 15 millicurie gas chromatograph electron capture source as part of F & M Scientific Corp., Model 810 gas chromatograph. Stored in Room 118 Alison Hall.

Cadmium-109, Model 465, Serial D903, 0.73 millicurie sealed source, housed in 10 inch stainless steel tube or original shipping pig. Stored at 417 Academy, Safety Division.

Hydrogen-3, 670 millicurie gas chromatograph electron capture source, housed in Hewlett Packard Model 140, Serial No. 214, gas chromatograph. Stored in Room 250 Brown Laboratory.

Cesium-137, 91 millicurie, USN type 375, Serial No. F171, sealed source housed in J. L. Shepard and Associates Series 10 calibrator, Serial No. 598. Stored at 417 Academy, Safety Division.

Cesium-137, 1.02 millicurie sealed source stored in lead pig (no ID) in secured cabinet. Stored in Room 018 Sharp Laboratory.

Cobalt-60, 0.083 millicurie, Model B46 sealed source, stored in lead pig, in secured cabinet. Stored in Room 018 Sharp Laboratory.

Hydrogen-3, 130 millicuries, Model 2-2837, Serial No. 457, gas chromatograph electron capture source, stored in F & M Scientific Model 810 gas chromatograph. Stored in Room 160 Ag Hall.

Cobalt-60, 1.43 millicuries, Model R31-10, Serial No. 4168, stored in lead pig, secured in a safe. Stored in Room 281 DuPont Hall.

Nickel-63, 15 millicuries, Victoreen, Model 4015-12, Serial No. 158, gas chromatograph source, housed in Fisher-Victoreen Model 4414-11-105 gas chromatograph. Stored in Room 248 DuPont Hall.

ATTACHMENT #6
REVISION 1

Cesium-137, 118 millicuries well logging source, Nuclear Sources and Services Inc., Model 3M4F6B, Serial 1022, stored in original shipping container. Stored in Room 19 Penny Hall Annex.

Nickel-63, 10 millicurie Gas Chromatograph source, part no. 3300119, part of Perkin-Elmer gas chromatograph, SN 1927. Stored in Room 119 Cannon Laboratory.

Americum-241, 10 millicurie Am-Be neutron source, part of Troxler moisture density probe, type AM-241/Be, SN 45-5085. Stored in Room 124 Worrilow Hall, equipment cage.

ATTACHMENT #7
REVISION 1
2/83

Item 8. & Item 9.

A. ROBERT HODSON, Ph.D, Chairman 1982-83

Education:

1966	Ph.D. - Plant Physiology Cornell University
1961	M.S. - Plant Physiology Cornell University
1959	B.A. - Botany University of Minnesota

Professional Experience:

1976 - Present	Associate Professor - School Life & Health Sciences University of Delaware
1969 - 1976	Assistant Professor - Biological Sciences University of Delaware

Radionuclide Experience:
(Past 14 years - University of Delaware,
4 years - University of Minnesota,
4 years - Brandeis University)

Nuclide	Amount
^{14}C	10 mCi
^{3}H	10 mCi
^{35}S	25 mCi

B. Conrad N. Trumbore, Ph.D., Vice-Chairman 1982-1983

Education:

1955	Ph.D. Physical Chemistry Pennsylvania State University
1952	B.S. Chemistry Dickinson College Carlisle, Pennsylvania

ATTACHMENT #7
REVISION 1

B. CONRAD N. TRUMBORE, Ph.D., (Continued)

Professional Experience:

1960 - Present	Associate Professor - Chemistry University of Delaware
1967 - 1968	U.S.P.H.S. Special Fellowship Institute of Cancer Research Physics Department Sulton, England
1957 - 1960	Instructor - Chemistry University of Rochester Rochester, New York
1956 - 1957	Assistant Chemist - Chemistry Division Argonne National Lab (With Dr. E. J. Hart) and Lab Instructor (Heavy Elements Lab - 6 weeks) International School of Nuclear Science & Engineering
1955 - 1956	Fulbright Scholar Institute of Nuclear Research University of Amsterdam Holland

Radionuclide Experience:
(Supervisor N.R.C. License #07-01579-06 which covers Co-60 Gamma Irradiator and possession limit of 1100 Ci past 12 years)

Nuclide	Amount	Duration
I-131	50 mCi	4 years - Penn State & University of Rochester
Po-210	5 mCi	18 months - Argonne National Labs
Pu-239	10 mCi	3 months - Argonne National Labs
Co-60	1100 Ci	Past 12 years - University of Delaware
Cu-64	20 mCi	2 months

Tracer amounts of gamma and beta reference sealed sources.

ATTACHMENT #7
REVISION 1

C. CHENG-MENG FOU, Ph.D.

Education:

1965	Ph.D - Physics University of Pennsylvania Philadelphia, Pennsylvania
1961	Dipl. - Physics University of Munich Munich, Germany
1956	S.Sc. - Physics National Taiwan University

Professional Experience:

1972 - Present	Associate Professor - Physics University of Delaware
1968 - 1972	Assistant Professor - Physics University of Delaware

Radionuclide Experience:

Nuclide	Amount
Am-241	.005 mCi (sealed source)
Co-60	1.1 mCi (sealed source)
Cs-137	1.2 mCi (sealed source)
Na-22	0.1 mCi (sealed source)
Pu-Be	5.0 Ci (sealed source)

Van-deGraff Accelerator - protons, alpha, Li-ions, ^{12}C, ^{16}O to 30 MeV Range
16 years - University of Pennsylvania, 11 years - University of Delaware

D. BRUCE C. LUTZ, Ph.D.

Education:

1954	Ph.D - Physics John Hopkins University Baltimore, Maryland
1944	M.A. - Physics University of Western Ontario
1942	B.A. - Physics University of Western Ontario

ATTACHMENT #7
REVISION 1

D. BRUCE C. LUTZ, Ph.D. (Continued)

Professional Experience:

1962 - Present	Professor Electrical Engineering University of Delaware
1957 - 1962	Associate Professor Electrical Engineering University of Delaware
1947 - 1955	Instructor - Physics University of Delaware
1945 - 1947	Lecturer - Physics University of Manitoba
1944 - 1945	Instructor Lieutenant R.C.N.V.R.

Radionuclide Experience:
(Supervisor N.R.C. License R-043 for AGN-201 Reactor Facility at the University of Delaware 1958-1979. Senior Operators License SOP-313)

Nuclide	Amount	Duration
Uranium	3465 gm (19.26% Enriched) in reactor	20 years
Ra-Be	10 mCi (sealed source)	20 years
Pu-Be	96 gm (6 Ci) (sealed source)	15 years
Co-60	30 mCi (sealed source)	15 years
In-111	microcurie amounts reactor produced	15 years
Au-198	microcurie amounts reactor produced	15 years

ATTACHMENT #7
REVISION 1

E. PAUL SAMMELWITZ, Ph.D

Education:

1959	Ph.D - Physiology University of Illinois
1957	M.S. - Reproductive Physiology University of Illinois
1955	B.S. - Agricultural Sciences Cornell Illinois

Professional Experience:

1968 - Present	Associate Professor - Animal Science University of Delaware
1959 - 1968	Assistant Professor - Animal Science University of Delaware
1955 - 1959	Graduate Research Assistant (part-time) University of Illinois
1970 - 1971	Visiting Scientist Department of Physiology and Biophysics College of Veterinary Medicine Colorado State University

Radionuclide Experience:

Nuclide	Amount	Duration
H-3	microcurie to 1 millicurie amounts	12 years

F. ALLAN THOMPSON, Ph.D

Education:

1968	Ph.D. Sedimentology, Stratigraphy Brown University Providence, Rhode Island
1964	Sc.M. Experimental Mineralogy, Geochemistry Brown University Providence, Rhode Island

ATTACHMENT #7
REVISION 1

F. ALLAN THOMPSON, Ph.D (Continued)

1962	B.A. Geology Carleton College Northfield, Minnesota

Professional Experience:

1979 Summer	NASA Fellow Goddard Space Flight Center
1972 - Present	Associate Professor of Geology University of Delaware
1967 - 1972	Assistant Professor of Geology University of Delaware
1966 - 1967	Teaching Assistant Brown Univsersity
1964 - 1966	National Defense Education Act Fellow
1962 - 1964	Research Assistant Brown University
1972 - 1977 Summers	Geologist Delaware Geological Survey
1964 Summer	Field Assistant U.S. Geological Survey
1977	Consultant - Geology Justin & Courtney, Inc. Philadelphia, Pennsylvania
1961	Consultant Carleton College Northfield, Minnesota

Radionuclide Experience:

Dr. Thompson has not worked with radionuclides but has worked with a Norelco x-ray diffraction unit in mineral analysis since 1962 and has had x-ray spectrometric experience since 1963.

ATTACHMENT #7
REVISION 1

G. JONATHAN H. SHARP, Ph.D.

Education:

1972	Ph.D. - Oceanography Dalhousie University Halifax, N.S. Canada
1967	M.S. Biology - Biochemistry Lehigh University Bethlehem, Pennsylvania
1965	B.A. - Biology Lehigh University Bethlehem, Pennsylvania

Professional Experience:

1980 - Present	Associate Professor University of Delaware
1973 - 1980	Assistant Professor, Chemical Oceanography University of Delaware
1972 - 1973	Post-Doctoral Research Scripps Institution of Oceanography San Diego, California
1967 - 1971	Graduate Fellowship Dalhousie University
1965 - 1967	Research Assistant Lehigh University and Bermuda Biological Station

Other Experience:

1/74 - 2/74	Organization of American States Specialist in Marine Analytical Chemistry Institute del Mar (Callas, Peru)
1978 - 1981	Editoral Board, Limnology and Oceanography
1977 - 1983	Environmental Research Guidance Committee (Advisory Committee to Power Plant Siting Program of Department of Natural Resources, State of Maryland) Chairman Biological Sub Committee. Chairman full committee.
1979 - 1980	Oceanic Biology Advisory Panel Office of Naval Research

ATTACHMENT #7
REVISION 1

G. JONATHAN H. SHARP, Ph.D., (Continued)

Radionuclide Experience:
(Past 12 years)

Nuclide	Amount
H-3	1.0 mCi
C-14	5.0 mCi
P-33	5.0 mCi
Ge-68	1.0 mCi

H. MILTON STETSON, Ph.D.

Education:

1970	Ph.D. - Zoology University of Washington
1968	M.S. - Zoology University of Washington
1965	B.A. - Biology/Chemistry Central Connecticut State College

Professional Experience:

1981 - Present	Professor - School of Life & Health Sciences University of Delaware
1977 - 1981	Associate Professor School of Life & Health Sciences University of Delaware
1973 - 1977	Assistant Professor School of Life & Health Sciences University of Delaware
1971 - 1973	Post-Doctoral Follow, Zoology University of Texas

Radionuclide Experience:

Nuclide	Amount	Duration
P-32	1 mCi	5 years
H-3	1 Ci tritiations	3 years
I-125	10 mCi protien iodinations	10 years
I-135	.25 mCi RIA	10 years
H-3	1 mCi labeled cpds	10 years

ATTACHMENT #7
REVISION 1

I. CHIN-PAO HUANG, Ph.D.

Education:

1971	Ph.D. - Environmental Engineering Harvard University
1967	M.S. - Environmental Engineering Harvard University
1965	B.S. - Civil Engineering National Taiwan University

Professional Experience:

1980 - Present	Professor - Civil Engineering University of Delaware
1977 - 1980	Associate Professor - Civil Engineering University of Delaware
1974 - 1977	Assistant Professor - Civil Engineering University of Delaware
1971 - 1974	Assistant Professor - Civil Engineering Wayne State University

Radionuclide Experience:

Nuclide	Amount	Durations
P-32	1 mCi	3 years
Ca-45	1 mCi	3 years
Co-60	1 mCi	3 years
Ni-63	15 mCi	3 years
Cd-109	1 mCi	3 years
Pb-210	1 mCi	3 years
C-14	1 mCi	3 years
H-3	1 mCi	3 years

J. HERMAN A. SMITH

Mr. Herman Smith has no training or experience in the handling and use of radioisotopes. Mr. Smith is a member of the Radiation Safety Committee because as the Director of Engineering and Construction, he is responsible for the coordination of engineering controls which might be investigated by the Committee.

ATTACHMENT #7
REVISION 1

K. ROBERT D. VARRIN, Ph.D.

Dr. Robert Varrin is a member of the Radiation Safety Committee as the representative of the Office of the Provost and as a representative of management.

L. JOHN C. WRISTON, Ph.D. - Alternate for Dr. Trumbore

Education:

1953	Ph.D. - Biochemistry Columbia University
1948	B. S. - Chemistry University of Vermont

Professional Esperience:

1955 - Present	Professor - Chemistry University of Delaware

Radionuclide Experience:

Nuclide	Amount	Type of Use	Duration
H-3	100mCi	Labelling with Borohydride	30 years
H-3	.1mCi	Biochemical tracers	30 years
C-14	10mCi	Biochemical tracers	30 years
I-125	.1mCi	RIA	30 years

M. LARRY A. COGBURN, Pd.D. - Alternate for Dr. Sammelwitz

Education:

1978	Ph.D. University of Illinois
1974	M. S. North Carolina State University
1972	B. S. North Carolina State University

LARRY A. COGBURN Ph.D. - continued

Professional Experience:

1979 - Present	Assistant Professor - Animal Science University of Delaware
1979	Post-Doctoral Research Associate Mississippi State University

Radionuclide Experience:

Nuclide	Amount	Type of Use	Duration
I-125	10mCi	Protein iodinations, RIA	4 years
H-3	2mCi	Labelled tracers	4 years
H-3	2mCi	Autoradiography	4 years

N. PETER B. LEAVENS Ph.D. - Alternate for Dr. Thompson

Curriculum vitae not available at time of application preparation.

Dr. Leavens has not worked with radionuclides but has worked extensively with x-ray diffraction and x-ray spectrometric equipment over the last 20 years.

O. C. P. SWANN, Ph.D. - Alternate for Dr. Fou

Education:

1956	Ph.D. - Physics Temple University
1943	M. S. Harvard University
1941	B. S. Harvard University

Professional Experience:

1946 - Present	Professor - Bartol Research Foundation University of Delaware
1943 - 1946	Mechanical Engineer Westinghouse Electric

C. P. SWANN Ph.D. - continued

Radionuclide Experience:

Nuclide	Amount	Type of Use	Duration
Ra-Be	10mCi	Activation analysis	35 years
Pu-Be	5 Ci	Howitzer	10 years
Co-60	5mCi	Sealed Sources	35 years
Cs-137	5mCi	Sealed Sources	35 years
Ns-22	1mCi	Sealed Sources	35 years
Various Calibration Sources	100uCi	Calibrations	35 years
Various Isotopes	100uCi	Activated Samples	35 years

P. RICHARD P. WALKER - Alternate for Mr. Smith

Mr. Richard P. Walker has no training or experience in the handling and use of radioisotopes. Mr. Walker is a member of the Radiation Safety Committee because as Construction Superintendent, he is responsible for the coordination of engineering controls which might be investigated by the Committee.

Q. MARY C. TYLER, Ph. D. - Alternate for Dr. Sharp

Education:

1977	Ph. D. Johns Hopkins University
1972	A. B. Smith College

Professional Experience:

1980 - Present	Assistant Professor - Marine Studies University of Delaware
1980 - Present	Adjunct Associate Research Scientist Chesapeake Bay Institute Johns Hopkins University
1978 - 1980	Associate Research Scientist Chesapeake Bay Institute Johns Hopkins University
1977 - 1978	Assistant Research Scientist Chesapeake Bay Institute Johns Hopkins University
1973 - 1977	NIG Traineeship Johns Hopkins University

ATTACHMENT #7
REVISION 1

MARY G. TYLER, Ph.D. - continued

Radionuclide Experience:

Nuclide	Amount	Type of Use	Duration
C-14	1mCi	Marine Research	11 years
H-3	1mCi	Marine Research	11 years
P-32	1mCi	Marine Research	11 years

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2/83

Item 10.

Radiation Detection Instruments:

Safety Division

No. Available	Instruments
2	Victoreen-490 Survey Meter Range 0-200 mR/hr, 0-800,000 cpm
1	Victoreen-489-35 Probe 1.4 mg/cm^2 window alpha, beta, gamma
1	Victoreen-489-4 Probe 30 mg/cm^2 window beta, gamma
1	Victoreen-489-50 Probe NaI (Tl) 1X1" crystal gamma
5	Victoreen-6A Survey Meters (Civil Defense Type) Range 0-300 mR/hr
5	Victoreen-114/6993 Probes 30 mg/cm^2 window beta, gamma
1	Victoreen-440 Ion Chamber Survey Meter Range 0-300 mR/hr 3.0 mg/cm^2 window, alpha, beta, gamma
1	Victoreen-444 Ion Chamber Survey Meter Range 0-300 R/hr 3.0 mg/cm^2 window alpha, beta, gamma
1	Victoreen-2035 Ion Chamber Survey Meter Range 0.1 mR/hr - 1KR/hr 3.0 mg/cm^2 window beta, gamma
1	Jordan AGB-50-SR Ion Chamber Survey Meter Range 0-50 R/hr 3.0 mg/cm^2 window beta, gamma
1	Eberline-PAC-4G-3 Portable Gas Flow Proportional Counter Range 0-500,000 cpm
1	Eberline-AC-21 Probe 0.85 mg/cm^2 window alpha
1	Eberline-AC-21B Probe 0.85 mg/cm^2 window beta
1	Eberline-TP-1 Probe Windowless alpha, beta
1	Eberline-PNR-4 Portable REM Neutron Counter Range 0-5K mRem/hr with 9" diameter Cd Loaded Polyethylene Sphere BF3 Probe
2	Eberline-MS-2 Scaler Range $0-9.9 \times 10^5$ cpm

Safety Division (continued)

No. Available	Instruments
1	Eberline MS-3 Scaler Rate Meter Range 0.9.9x10^5 cpm
1	Eberline-FC-1 Gas Flow Proportional Detector Windowless with 0.9 mg/cm^2 and 0.1 mg/cm^2 insert windows, alpha beta
1	Eberline-FC-2 Gas Flow Proportional Detector Windowless with 0.9 mg/cm^2 and 0.1 mg/cm^2 insert windows alpha, beta
2	Eberline-HP-190 6-M Detectors 1.4 mg/cm^2 window alpha, beta, gamma
1	Harshaw-5SF4/1.5X (TSN-5) NaI (Tl) Scintillation Well Detector gamma
1	Eberline-LEG-1 Detector NaI (Tl) gamma
2	Wm. B. Johnson DGSP-2A NaI (Tl) Low Energy gamma
7	Victoreen CDV-715 Ion Chamber Survey Meter 0-500 R/hr
1	Wm. G. Johnson-PCS-1 Portable Counting System with GSM-5 Survey Meter Range 0-20 mR/hr, 0-50,000 cpm GP-90 Probe, 30 mg/cm^2 window beta, gamma GP-200 Probe, 1.4 mg/cm^2 window alpha, beta, gamma ASP-2A Probe alpha scintillation and DIG-1 Scaler (2) HP265 Probes, 1.4 mg/cm^2 window alpha, beta, gamma (pancake)
1	Beckman-LS-100C Liquid Scintillation System
1	Baird Atomic-443 Laboratory Monitor Rate Meter with Baird Atomic-941-233 Alarm Range 0-100,000 cpm
1	Baird Atomic-908-289 Probe, 1.4 mg/cm^2 window alpha, beta, gamma

Forty-five (45) additional survey and laboratory instruments are located throughout the University:

Chemical Engineering

3 - G. M. Survey Meters
1 - Liquid Scintillation Counter

Civil Engineering

1 - G. M. Survey Meter
1 - Liquid Scintillation Counter

ATTACHMENT #8
REVISION 1

Physics

1 - Neutron Counter - Portable
1 - Neutron Counter - Remote Area Monitor
2 - G. M. Survey Meters
1 - Gamma Remote Area Monitor
1 - Ionization Chamber
1 - Geli with MCA

Chemistry

4 - Liquid Scintillation Counters
2 - G.M. Survey Meters
1 - Gas Proportional Counter
1 - G. M. Rate Meter with Alarm

School of Life and Health Sciences

6 - Liquid Scintillation Counters
1 - Gamma Counter
7 - G. M. Survey Meters

Agriculture

1 - Liquid Scintillation Counter
1 - Gamma Counter
2 - G. M. Survey Meters
1 - G. M. Rate Meter

Marine Studies

1 - 3 X 3 NaI Well Counter - Gamma
1 - Alpha Spectrometer
2 - Liquid Scintillation Counters
2 - G. M. Survey Meters

Geology

1 - G. M. Survey Meter

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REVISION I
2/83

Item 11.

CALIBRATION OF INSTRUMENTS

Neutron Measuring Survey Instruments

n-Detection instruments will be calibrated at various distances in air against the 1 Ci Pu-Be neutron source #M233 which has a reported flux of 1.86×10^6 n/sec (1962). We will assume an average neutron energy for Pu-Be of 3.4 MeV (NBS publication 456 "Measurement for the Safe Use of Radiation," p. 89, 1976) and a conversion factor of approximately 28×10^6 n/cm^2 - 1 Rem (General Dynamics Health Physics Handbook, p. 163, 1963). The assumed radiation flux relation to source strength for point sources is $\Phi = S/(4\pi R^2)$ where Φ is n/cm^2/sec, s is n/sec and R is distance in cm. Relationship of $\Phi_1 = \Phi_2(R_2/R_1)^2$ is used. The source was given to the University by AEC, traceable to NBS is assumed. PuBe source has a tolerance distance in air of 22 inches giving 55 n/cm/sec which is equivalent to 0.3 Rem in 40 hours exposure.

Instruments will be adjusted to read $\pm$ 10% of the calculated values. A calibration chart will be maintained for instruments which cannot be adjusted to read $\pm$ 10% of the calculated values.

Other suitable standards and/or methods may be utilized at the discretion of the Radiation Safety Officer.

Alpha Measuring Survey Instruments

Alpha detection instruments and probes are calibrated against 4-Eberline Certified Pu-239 sources traceable to NBS within a 0.2% agreement. The sources are of 0.0003 uCi SN#7419, 0.0337 uCi SN#7420 and 0.3731 uCi SN#7421, giving disintegration rates of 690 $\pm$ 15, 6,700 $\pm$ 130, 74,700 $\pm$ 1,500, 827,400 $\pm$ 16,500 assuming 1.5% backscatter of alpha particles from the surface of the disk and 2π geometry in the source holder in which the source is recessed by 1 mm.

The instruments are calibrated on 2 scales compatible to sources with the probe at a distance of 1 mm from the surface of the source, instruments will be adjusted to read $\pm$ 10% of source values.

Other suitable standards and/or methods may be utilized at the discretion of the Radiation Safety Officer.

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Beta Measuring Survey Meters

Beta detection instruments and probes are calibrated against 4-Eberline Certified Tc-99 sources traceable to NBS within a 0.2% agreement. The sources are of 0.0002 uCi SN#7415, 0.0025 uCi SN#7416, 0.0256 uCi SN#7417 and 0.2289 uCi SN#139/71, giving disintegration rates of 550 $\pm$ 15, 5,650 $\pm$ 170, 56,820 $\pm$ 1710 and 507,500 $\pm$ 15,200 assuming 25% backscatter of beta particles from surface of the disk and 2 π geometry in the source holder in which the source is recessed by 1 mm.

The instruments are calibrated on 2 scales compatible to the source with the probe at a distance of 1 mm from surface of the source, instruments will be adjusted to read within $\pm$ 10% of source values.

A calibration chart will be maintained for instruments which cannot be adjusted to read $\pm$ 10% of the source values.

Other suitable standards and/or methods may be utilized at the discretion of the Raidation Safety Officer.

Gamma Measuring Survey Meters

Gamma detecting instruments and probes are calibrated against a 100 mCi CS-137 USN type 375, SN F171 source mounted in a JLS Series 10 Calibrator, SN 598 as is traceable to NBS, having an output of 100 mR/hr at 50 cm and a 20° beam port.

The instruments and probes are calibrated at distances in air along the center of the beam port which will give a 1/2 scale reading at 2 scale settings on the instrument.

A calibration chart will be maintained for instruments which cannot be adjusted to read $\pm$ 10% of the calculated values.

Other suitable standards and/or methods may be utilized at the discretion of the Radiation Safety Officer.

Calibration of survey instruments which are utilized for the purpose of making quantitative determinations of flux, exposure, dose, or activity for health physics purposes will occur twice yearly at approximately 6 month intervals, or directly following repair.

Survey instruments which are utilized for the purpose of making qualitative determinations in which the quantitative considerations are of little importance will not be routinely calibrated.

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The Radiation Safety Officer or Health Physics Technologist will calibrate the instruments.

An alternative to "in house" calibrations of instruments will be to use calibration services of the instrument manufacturer.

Laboratory Measuring Instruments

The Safety Division's Beckman LS-100C is calibrated for efficiency of detection using certified standards traceable to N.B.S. or by external standardization method.

Eberline MS-2 mini scaler - rate is meter is calibrated for efficiency using certified standards traceable to N.B.S. with the various detectors used. In gas flow proportional mode with FC-2 windowless detector a Pu-239 certified standard of = 0.005 uCi (Eberline S/N 7422) and a Sr-90 certified standard of = 0.005 uCi (Eberline S/N 7423) are used. The gamma scintillation detector (well type 5SF4/1.5XEIC-TSN-5) with single channel analysizer is calibrated with various gamma certified standards (NEN).

The measuring instruments are used for analyzing leak test smear sample, surface contamination smear samples, bioassay samples, air monitoring filter samples, etc.

Calibration of laboratory instruments which are utilized for the purpose of making quantitative determinations (leak test smear samples, surface contamination smear samples, bioassay samples, air monitoring filters samples, etc.) for health physics purposes will occur twice yearly at approximately 6 month intervals or more often as directed by the Radiation Safety Officer.

Laboratory instruments which are utilized for the purpose of making qualitative determination in which the quantitative considerations are of little importance will not be routinely calibrated.

The Radiation Safety Officer or Health Physics Technologist will calibrate instruments utilized by the Safety Division.

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Item 12.

External Monitoring

The Safety Division will provide personnel with beta/gamma film badges, neutron/gamma film badges, and/or TLD ring badges for the purpose of personnel monitoring pursuant to 10CFR20.202.

The decision to issue personnel monitoring equipment and the frequency of monitoring equipment issuance will be at the discretion of the Radiation Safety Officer, based upon the radiological health implications of the work being performed. Personnel monitoring equipment will generally be issued on a monthly basis.

The Safety Division also has on hand a number of R.A. Stephen and Co., Ltd. quartz fiber pocket dosimeters 0-200 mR range with a Bendix dosimeter charger model 906. Dosimeters are charged to 0 mR reading held in a shielded container for 1 week to check leakage and calibrated against a J.L. Shepard 100 mCi C-137 calibration source or a Nuclear Associates Calibrator model 06-201 as necessary. These dosimeters would only be used if film badges were not available or a one time experiment using gamma emitters (over 0.25 MeV) where an activity is present that a dose rate of greater than 2.5 mR/hr would occur.

Records and Reports

Permanent records of film badge exposures are maintained by the Safety Division.

In cases where an individual monitored for external exposure receives a monthly exposure equal to or exceeding 100 mRem, the Safety Division will notify the individual through a written Radiation Exposure Report. The individual fills out the information requested on the report and returns it to the Safety Division within 5 days of its receipt. The report information is necessary so that the exposure can be properly evaluated and recommendations to reduce or prevent recurrence of exposure can be made. External radiation exposure is kept as low as is reasonable achievable.

The Safety Division provides an individual, upon written request, a copy of his/her external occupational exposure at the University. Records of external exposure are forwarded to new employers upon written request of the individual.

Individuals who indicate that they have had previous occupational exposure which was recorded by personnel dosimeter at other institutions authorize release of such exposure from each of these institutions to the University of Delaware Safety Division.

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Internal Monitoring

Any individual authorized to use unsealed source of radioactive materials is subject to internal monitoring at the discretion of the Radiation Safety Committee.

Bioassays

Any individual handling 25 millicuries or more of any isotope, as an unsealed source (liquid, solid, or gas), excluding plated sources, shall notify the Safety Division at least 24 hours in advance of such usage and submit a urine specimen for bioassay. Within 72 hours after handling such amounts, the individual shall again submit a urine specimen for bioasssy.

A urine bioassay of all personnel in a laboratory will be required whenever a survey demonstrates beta activities greater than 10,000 dpm, or alpha activities greater than 2,000 dpm as removable contamination.

Urine bioassay requirements, more conservative than those above, may be issued at the discretion of the Radiation Safety Officer.

Urine specimens will be counted for activity against suitable standards and background samples utilizing liquid scintillation spectroscopy.

Urine specimens may, also, be counted for activity against suitable standards and background samples utilizing gas flow proportional counting techniques. This method involves evaporating an aliquot of urine on a planchette and counting.

Other methods of urinalysis may be utilized at the discretion of the Radiation Safety Officer.

Depending on the particular radionuclide, the physical and chemical form and mode of intake, individuals who are known or suspected to have accidently absorbed, inhaled, or ingested radioactive material, shall submit other specimens (e.g. fecal, nose wipes, breath, or blood) for bioassay in addition to or in lieu of urine samples.

Urine specimens and other biological specimens may be sent to a commercial firm for analysis at the discretion of the Radiation Safety Officer.

Thyroid Monitoring

Thyroid bioassays for Iodine-125 and Iodine-131 will be conducted in accordance with Regulatory Guide 8.20 utilizing the frequencies and methods described therein.

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Thyroid monitoring requirements more conservative than those in Regulatory Guide 8.20 may be ulitized at the discretion of the Radiation Safety Officer.

Instrument calibration will be carried out as described in Proceedings of the Ninth Midyear Topical Symposium of the Health Physics Society, pp. 255-261 "Calibration of a Detector System for the in Vivo Analysis of 125-Iodine", Douglas K. Garfield. An Eberline MS-2 mini scaler and Wm B. Johnson DGSP-2A low energy gamma probe will be utilized for thyroid monitoring. Other equipment may be utilized at the discretion of the Radiation Safety Officer.

Whole Body Counting

In case of real or suspected intake of gamma emitting nuclides, whole body counting may be required in addition to or in lieu of bioassays. The Safety Division will arrange for such counting.

Records and Reports

Permanent records of internal monitoring results are on file in the Safety Division.

The Safety Division will provide an individual, upon written request, a copy of his/her internal monitoring results. Records of internal monitoring will be forwarded to new employers upon written request of the individual.

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2/83

Item 13.

There are approximately 80 laboratories at the University of Delaware using byproduct material. A description of individual facilities is, therefore, not included. Many of the laboratories at the University of Delaware were not originally designed to be used for investigational or experimental work with radioactive materials. For most low to medium level tracer work, no special laboratory design is required over and above the usual chemical-type laboratory. The chief factors taken into consideration when a laboratory is surveyed for possible use as a radionuclide laboratory are that it contain an adequate hood system and adequate bench space made of suitable material for decontamination purposes. General information regarding laboratory description is provided.

Work Surfaces

Surfaces are generally constructed of materials that are non-porous and resistant to attack by solutions containing radioactive material. The ease of decontamination is the major consideration. Radioactive use areas are specified in each laboratory. Bench surfaces are covered with plastic backed absorbant paper.

Floors

Floors are generally constructed of vinyl plastic tile, asphalt tile or linoleum.

Hoods

A fume hood is used in laboratories for all operations where there is any chance of airborne radioactivity.

The Safety Division recommends that hoods have an airflow rate of at least 100 linear feet per minute at the size opening with which the hood will be utilized. This recommendation need not be maintained for hoods utilized for storage only. The Safety Division recommends that the inside surface of the hood be non-porous or lined with absorbant paper.

Hoods may be equipped with a filter housing for insertion of appropriate exhaust filters as necessary.

Glove Boxes

A glove box (or dry box) may be provided as necessary.

Remote Handling Equipment

The use of remote handling equipment is recommended by the Radiation Safety Committee or the Radiation Safety Officer to be consistent with good health physics practice.

Tongs, forceps, or other apparatus may be necessary depending upon the nuclide, activity, and sample matrix being utilized. Most experiments do not require the use of remote handling equipment.

Shielding

The Safety Division checks periodically that adequate shielding is used in operations with radionuclides. The total amount of shielding material that will be necessary will depend on the amount of activity and the type of radiation involved.

The Safety Division is consulted on all shielding problems encountered.

The following are efficient shielding materials for various types of radiation listed. The thickness necessary depends on energy radiation emitted.

Radiation Type	Shielding Material
Gamma Ray or X-Ray	Lead or Concrete
Beta Particles	Aluminum, Lucite or other Plastics of low Atomic Number
Neutron	Water, Paraffin or Barytes Concrete

Monitoring Instruments

Unless specifically exempted by the Radiation Safety Committee or the Radiation Safety Officer, laboratories have available an appropriate survey monitor.

Area Monitoring

Area monitoring of a laboratory facility by the Safety Division for removable contamination is carried out at least quarterly.

Area monitoring for external radiation is carried out by the Safety Division on an as need basis depending on the nuclide, amount, or whether sealed or unsealed sources are involved. Permit Supervisors are requested to conduct area monitoring in their own facilities on a routine basis to include a measurement of external exposure rates, contamination surveys at the end of each experiment, and maintenance of records of such surveys.

Waste Containers

Radioactive waste containers for facilities are provided or authorized by the Safety Division.

Sinks

Sinks where radioactive contaminated glassware is washed are designated by the Permit Supervisors. Intentional disposal of bulk radioactive material via the sewer system is not permitted by Permit Supervisors.

Storage Containers

Radioactive waste is stored in posted containers as outlined above. Fresh material is usually stored in the shipping containers in posted refrigerators or freezers. Material may also be stored in locked cabinets that are posted.

Security

Doors are locked to prevent unauthorized entry when the laboratory is left unattended. Material may also be secured in locked refrigerators or cabinets.

Postings

Laboratories are posted pursuant to 10CFR19 and 10CFR20.

Air Sampling

In cases where operations with radionuclides may produce airborne radioactivity, air monitoring is carried out by the Safety Division before initial use of the material in the project. Air monitoring is again carried out during the first use of the material. Review of the air monitoring results will determine need for further air monitoring or actions to be taken by the Radiation Safety Officer.

All operations with radionuclides which may produce airborne radioactivity are confined to a hood or glove box.

Other air sampling procedures and techniques will be developed consistent with operational needs.

The length of the sampling period will be a function of the MPC-air of the nuclide of interest and the sensitivity of the counting system.

Radioactivity concentrations in air are determined via liquid scintillation, gas proportional, sodium iodide, or other appropriate counting system depending upon the nuclide and the sample matrix.

Once concentrations of possible airborne radioactivity from a particular experimental procedure are determined, air monitoring is conducted on an "as needed" basis. The primary interest of the air sampling program is the determination of airborne concentrations of radioiodine in protein iodination laboratories.

The concentration of radioiodine in effluent air discharges and in worker areas will be periodically monitored pursuant to 10CFR20.106. Additional monitoring will be conducted whenever a new location for iodinations is established or whenever there is any other reason to suspect an increase in the amount of radioiodine released.

Radioiodine has been successfully monitored utilizing the following techniques:

In Stack: 0.8um membrane filter (37 mm) is placed in series with a jumbo charcoal tube (SKC). Air is drawn from the center of the stack, parallel to the direction of flow, at a rate of 1 liter per minute through filer and charcoal matrix, respectively. Samples are taken during the period of maximum expected release. Filter and charcoal are counted utilizing NaI well scintillation techniques and suitable standards (eff. ≈ 50%). The radioiodine concentration, calculated in uCi/cc of air release, is compared to the applicable MPC. Records of tests are maintained by the Radiation Safety Officer and are available for inspection.

Work Area: 0.8um membrane filter (37 mm) is placed in series with a jumbo charcoal tube (SKC). Air is drawn from the work area near the iodination at a rate of 1 liter per minute through filter and charcoal matrix, respectively. Samples are taken during the period of maximum expected concentration. Filter and charcoal are counted utilizing NaI well scintillation techniques and suitable standards (eff. ≈ 50%). The radioiodine concentrations, calculated in uCi/cc of air in restricted areas, is compared to the applicable MPC. Records of tests are maintained by the Radiaition Safety Officer and are available for inspection.

In addition, thyroid monitoring is conducted before and after most iodination procedures.

Security of High Activity Sources - Sealed or Unsealed

Doors are locked to prevent unauthorized entry when the laboratory or storage facility is left unattended. Material may also be secured in locked refrigerators or cabinets.

Sealed sources are usually housed in storage containers that can be locked to prevent unauthorized use with the storage container itself in locked cabinets, rooms or safe.

Sketches of the areas where higher than normal hazard is possible are attached and are as follows:

1. Safety Division, 417 Academy: Cs-137, 100mCi calibrator sealed source; Cd-109, 5mCi sealed source.

2. Room 014E, Sharp Laboratory: Pu-Be Howitzer, 5Ci sealed source.

3. Room 018A, Penny Hall Annex: Cs-137, 125mCi well logging sealed source.

4. Room 241, DuPont Hall: Pu-Be, 1Ci sealed source.

5. Room 281, DuPont Hall: Co-60, 10mCi sealed source.

6. Room 124, Worrilow Hall: Am-Be, 100mCi and 10mCi sealed sources as part of Troxler moisture density probes.

7. Room 043, Brown Laboratory: I-125 protein iodinations.

8. Room 017, McKinly Laboratory: I-125 protein iodinations.

9. Room 311, Worrilow Hall: I-125 protein iodinations.

10. Room 139, Brown Laboratory: H-3 labeling procedures utilizing borohydride.

11. Waste Storage, South Service Yard, General Services Building: waste storage.

12. Rooms 004-004A, Wolf Hall: Decay-in-storage, waste storage (for drawing see attachment 13).

Laboratory Classification

Laboratories are classified as Type A (high level), Type B (intermediate level), Type C (low level), and Type D (very low level) according to the type and level of material to be used and the type of usage. Laboratory classification guidelines are attached and are based on NBS Handbook 92, NCRP Report No. 30.

ATTACHMENT #11
REVISION 1

Table I

Radionuclide Classification (Unsealed Sources)

Class	Description	Example Radionuclide
I	Very High Hazard	*Pb-210+Bi-210(RaD+E), Po-210, *Ra-226, *Ra-228, Ac-227, Th-228, Th-230, Np-237, Pu-238, Pu-239, Pu-240, Pu-241, Pu-242, *Am-241, Cm-242
II	High Hazard	*Na-22, Ca-45, *Sc-46, *Co-60, Sr-90, *Ru-106, *Cs-137, I-125, *I-131, I-126 I-129, I-133, I-135, Ce-144, *Eu-154, *Ta-182, At-211, Ra-224, U-233
III	Moderate Hazard	*Na-24, Si-31, P-32, S-35, Cl-36, *K-42, Sc-47 *V-48, *Cr-51, *Mn-54, *Mn-56, Fe-55, *Fe-59, *Cu-64, *Zn-65, *Ga-72, *As-76, *Rb-86, Sr-89, Y-90, Y-91, *Zr-95, *Nb-95, *Mo-99, *Ru-103, Rh-105, Pd-103, Ag-105, Ag-111, *Cd-109, *Sn-113, *Te-127, *Te-129M, *Ba-140, *La-140, Pr-143, Pm-147, Sm-151, *Ho-166, *Tm-170, *Lu-177, *Re-183, *Ir-190, Ir-192, *Pt-192, *Pr-193, *Au-198, *Au-199, *Tl-200, *Tl-201, Tl-204, *Pb-203, Rn-220, *Rn-222, U-235
IV	Low Hazard	H-3, C-14, *Be-7, F-18, Ni-59, Ni-63, Zn-69, Ge-71, U-238, Nat. Thorium, Nat. Uranium, Noble Gases

* Emits gamma radiation in significant amounts.

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REVISION 1

Table II

Laboratory Classification for Hazard Class of Radionuclide

Radionuclide Hazard Class	A	B	C	D
I	> 1 mCi	100 µCi to 1 mCi	1 µCi to 100 µCi	< 1 µCi
II	> 10 mCi	1 mCi to 10 mCi	10 µCi to 1 mCi	< 10 µCi
III	> 100 mCi	10 mCi to 100 mCi	100 µCi to 10 mCi	< 100 µCi
IV	> 1000 mCi	100 mCi to 1000 mCi	1 mCi to 100 mCi	< 1 mCi

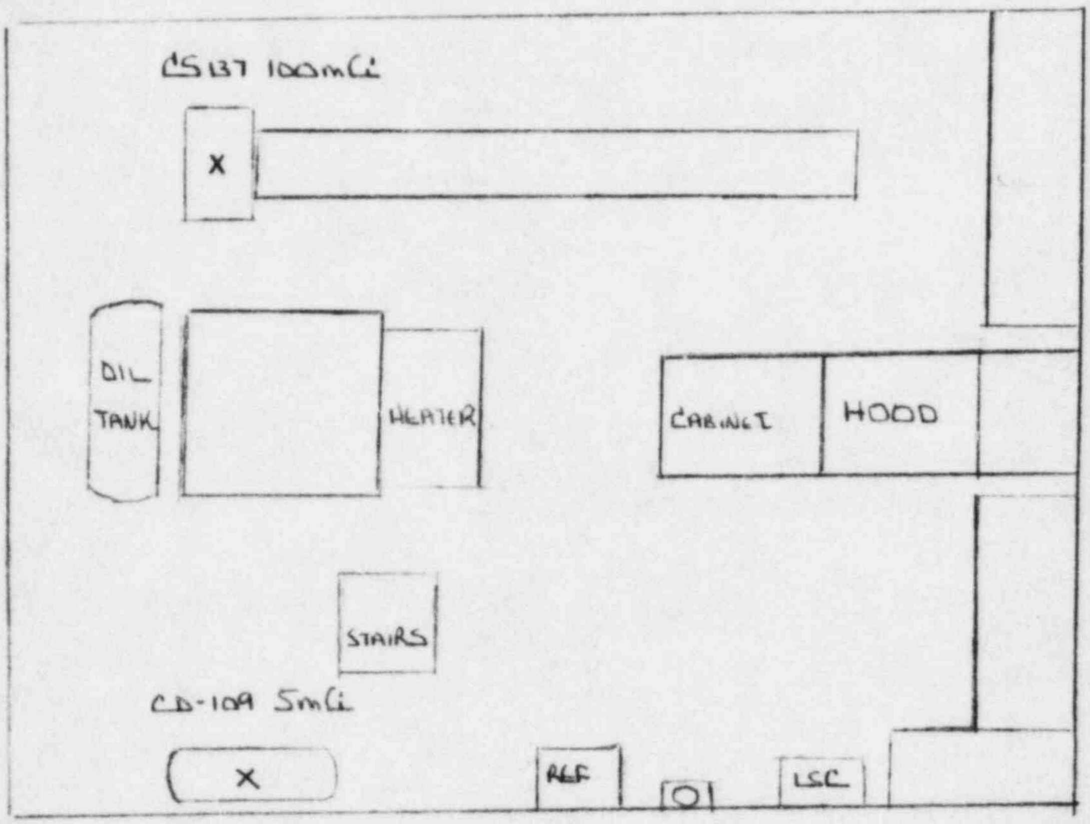
Table III

Modification Factors for Laboratory Classification (Table II)

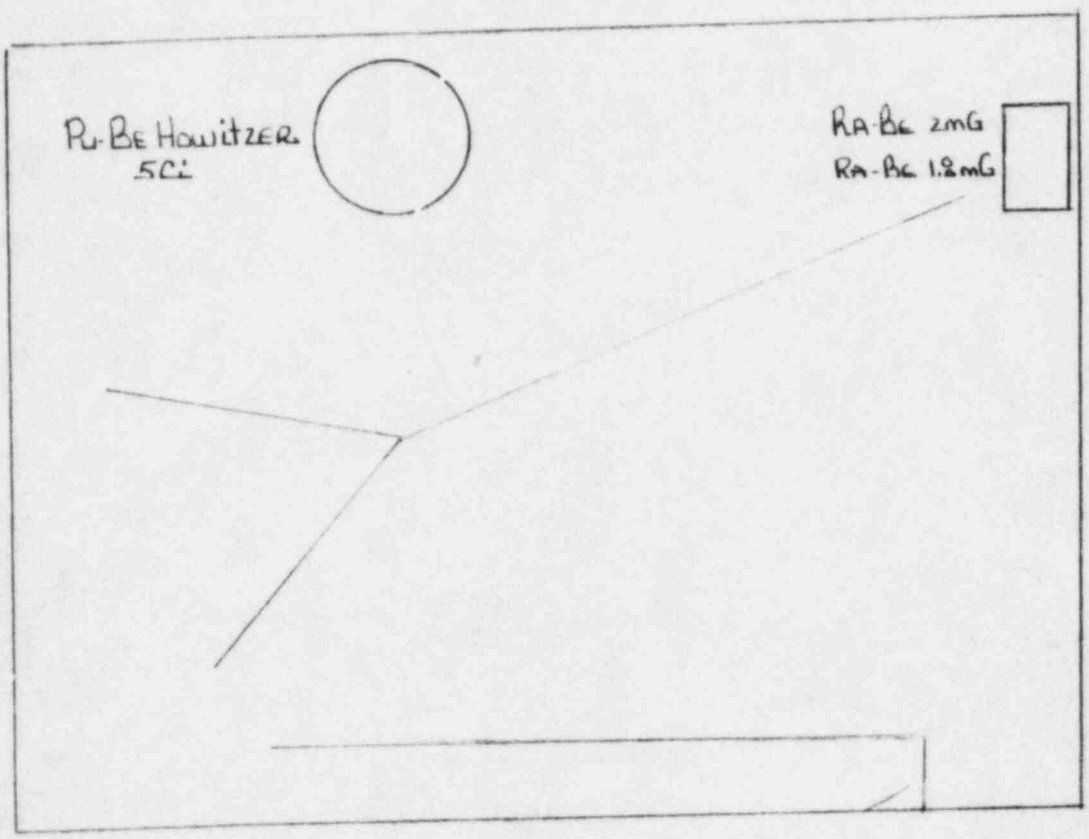
Use	Factor
Storage Only	X 100
Simple Wet Operation (e.g. preparing stock solutions)	X 10
Normal Chemical Operation (e.g. analysis)	X 1
Complex Chemical Operation with High Risk of Spill	X 0.1
Simple Dry Operations (e.g. work with volatile compounds)	X 0.1
Dry Dusty Operations (e.g. grinding)	X 0.01

ML10

SAFETY OFFICE
417 ACADEMY STREET
Cs-137 SEALED SOURCE 100 mCi
Cd-109 SEALED SOURCE 5 mCi

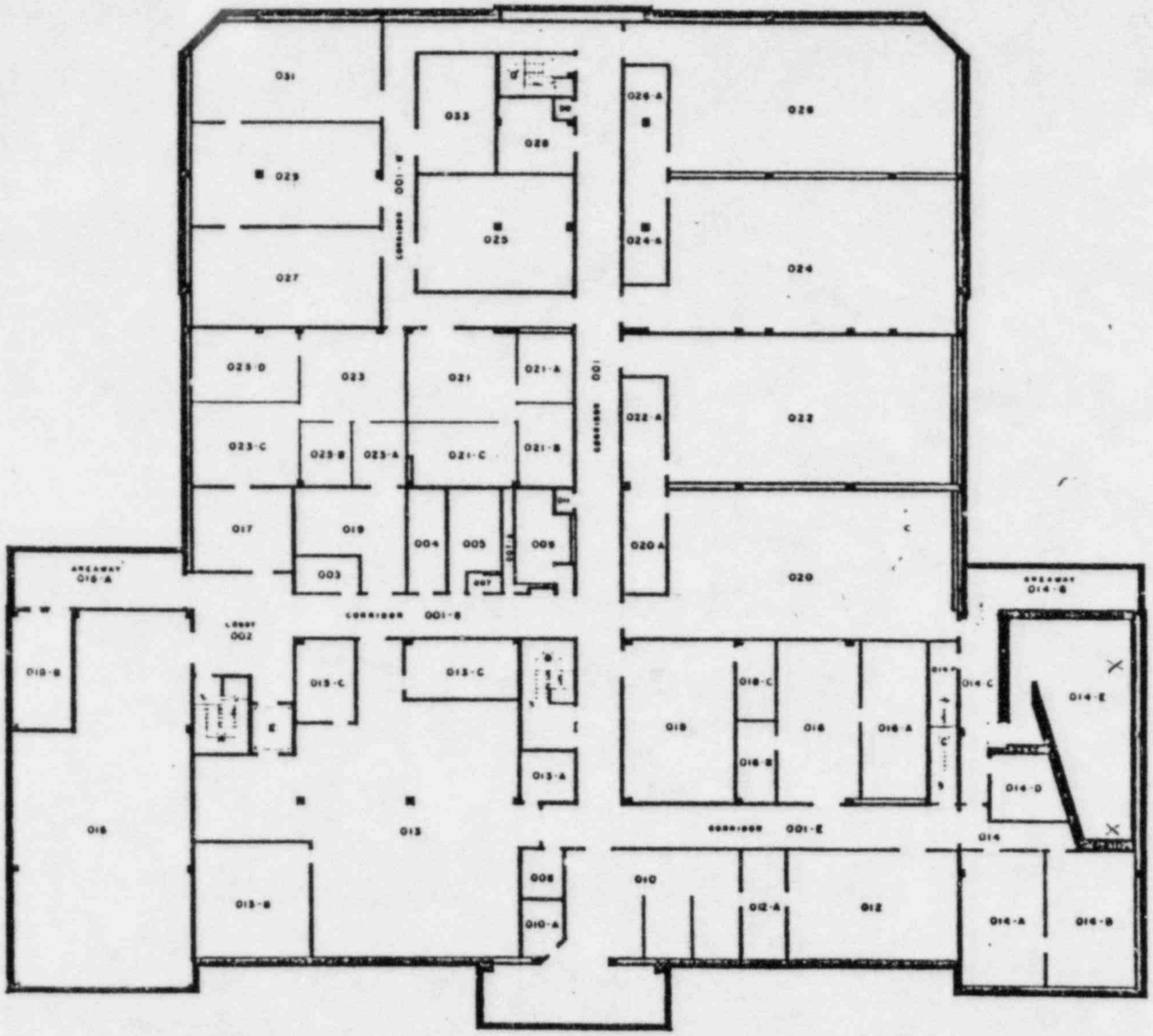


SHARP LABORATORY
ROOM 014-E
SEALED SOURCES:
Pu-Be Howitzer 5 Ci
Ra-Be 2 mG
Ra-Be 1.8 mG



SHARP LABORATORY
ROOM 014E

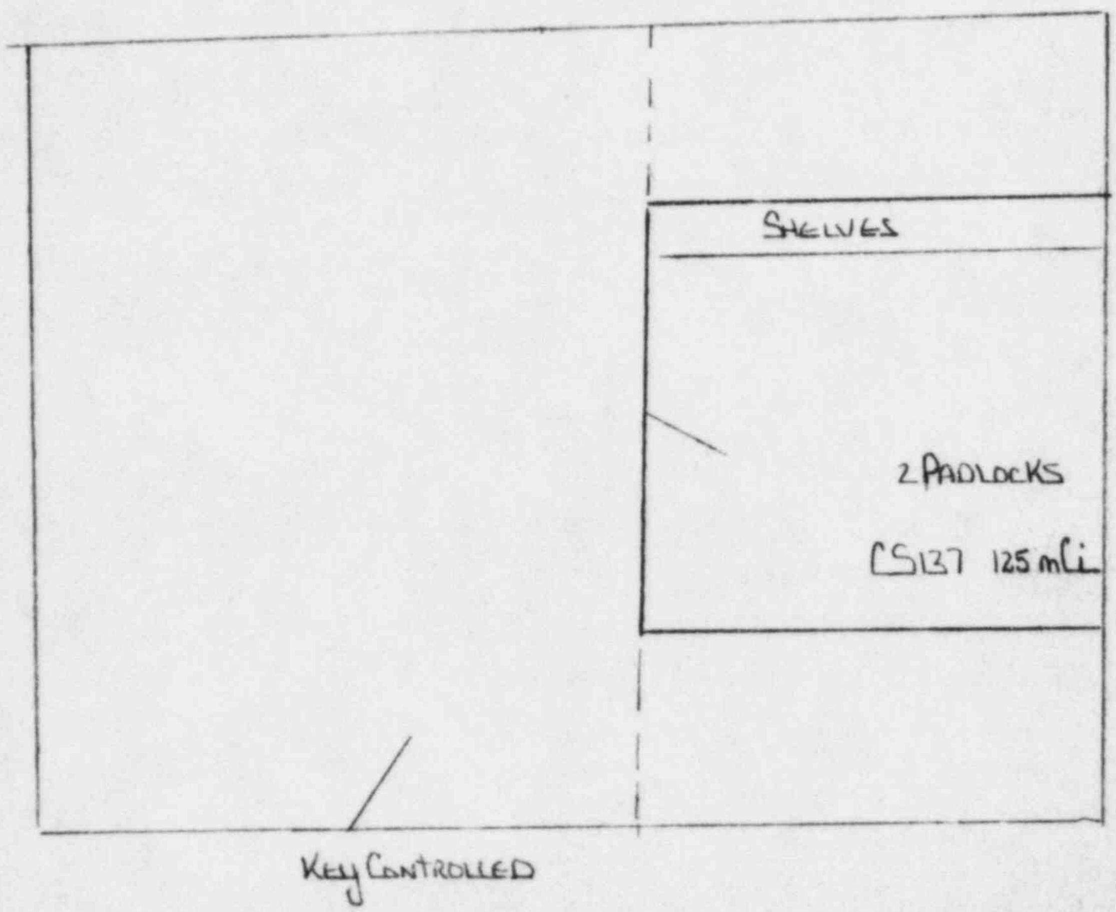
Sealed Sources:
Pu-Be Howitzer 5 Ci
Ra-Be 2 mGi
Ra-Be 1.8 mG



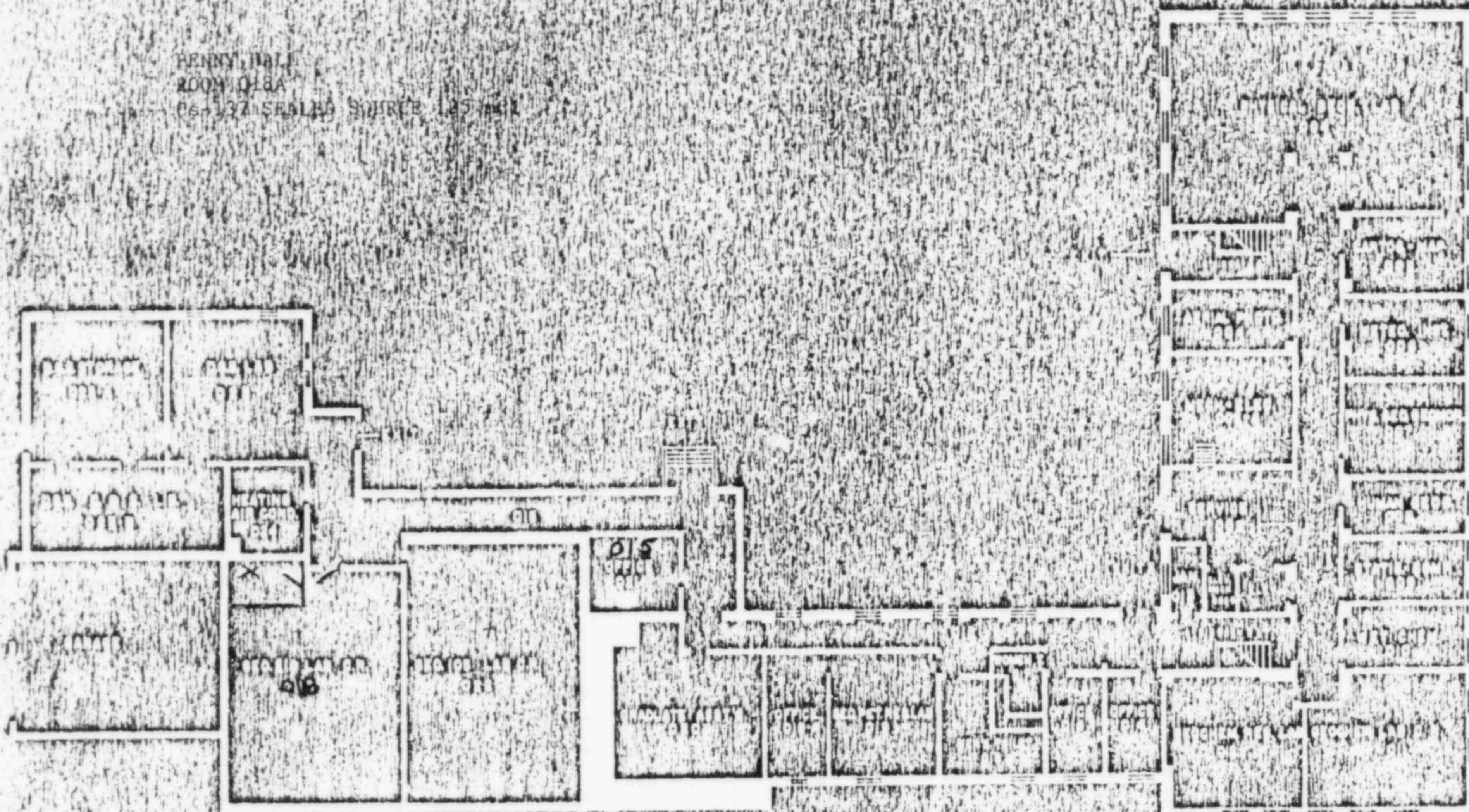
GROUND FLOOR PLAN

ATTACHMENT #11
REVISION 1

PENNY HALL
ROOM 018A
Cs-137 SEALED SOURCE 125 mCi



HENNY HALL
ROOM 018A
Cs-137 SEALED SOURCE 125 mCi

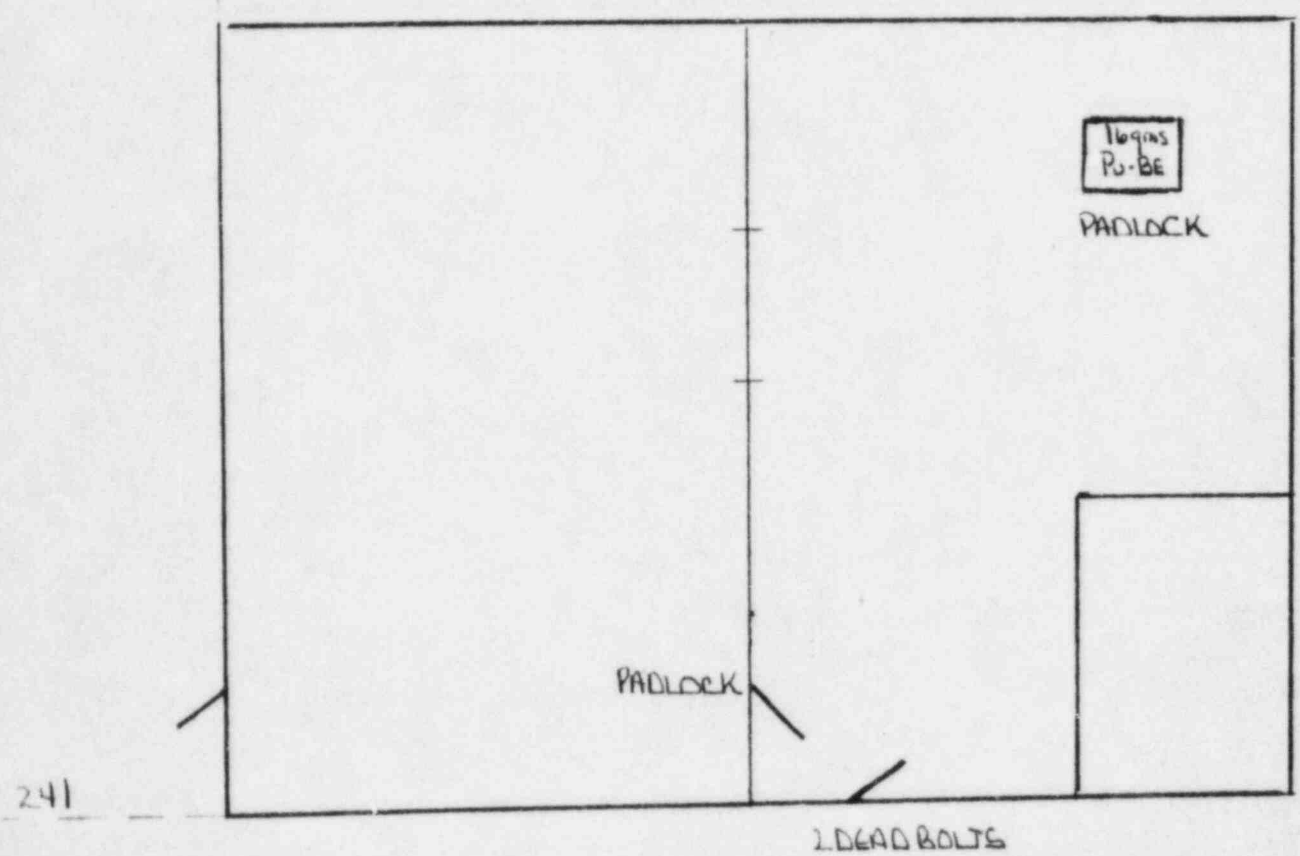


GROUND FLOOR PLAN

BIOCHEM BUILDING REMODELING
SCHEME 10

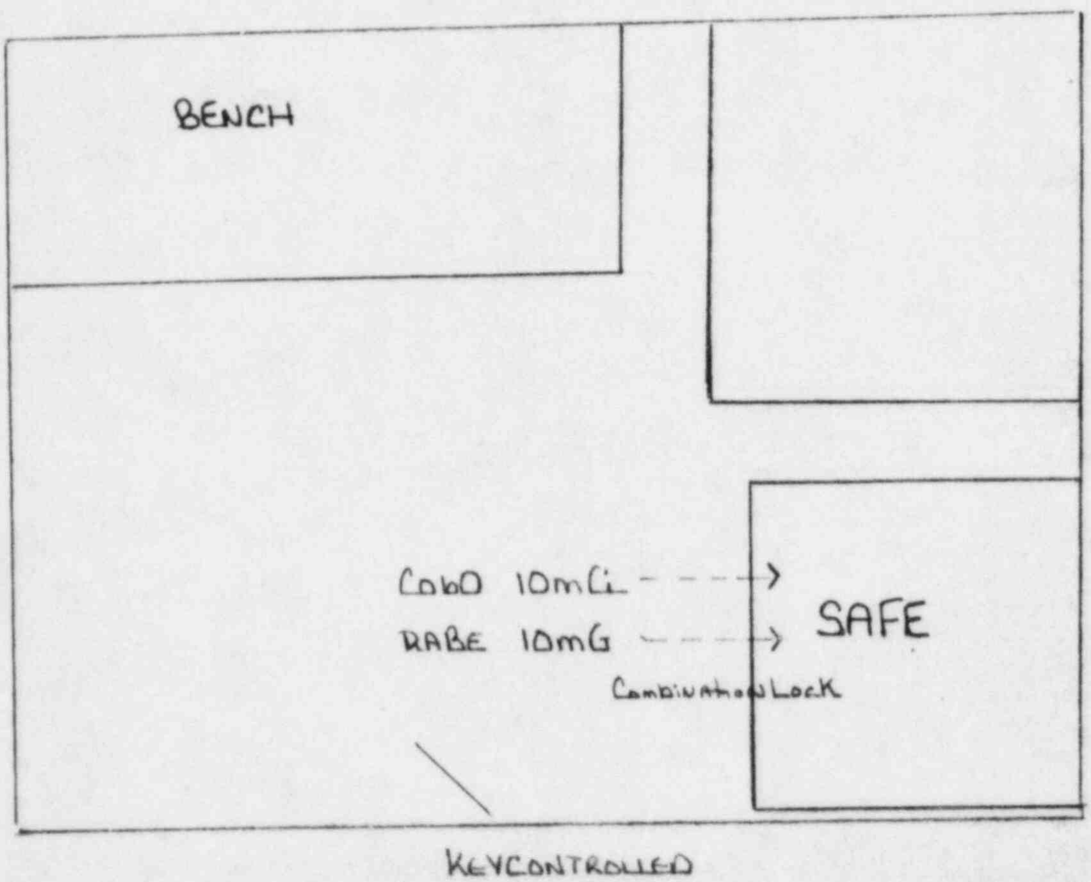
ATTACHMENT #11
REVISION 1

DUPONT HALL
ROOM 241
Pu-Be SEALED SOURCE 16 gms

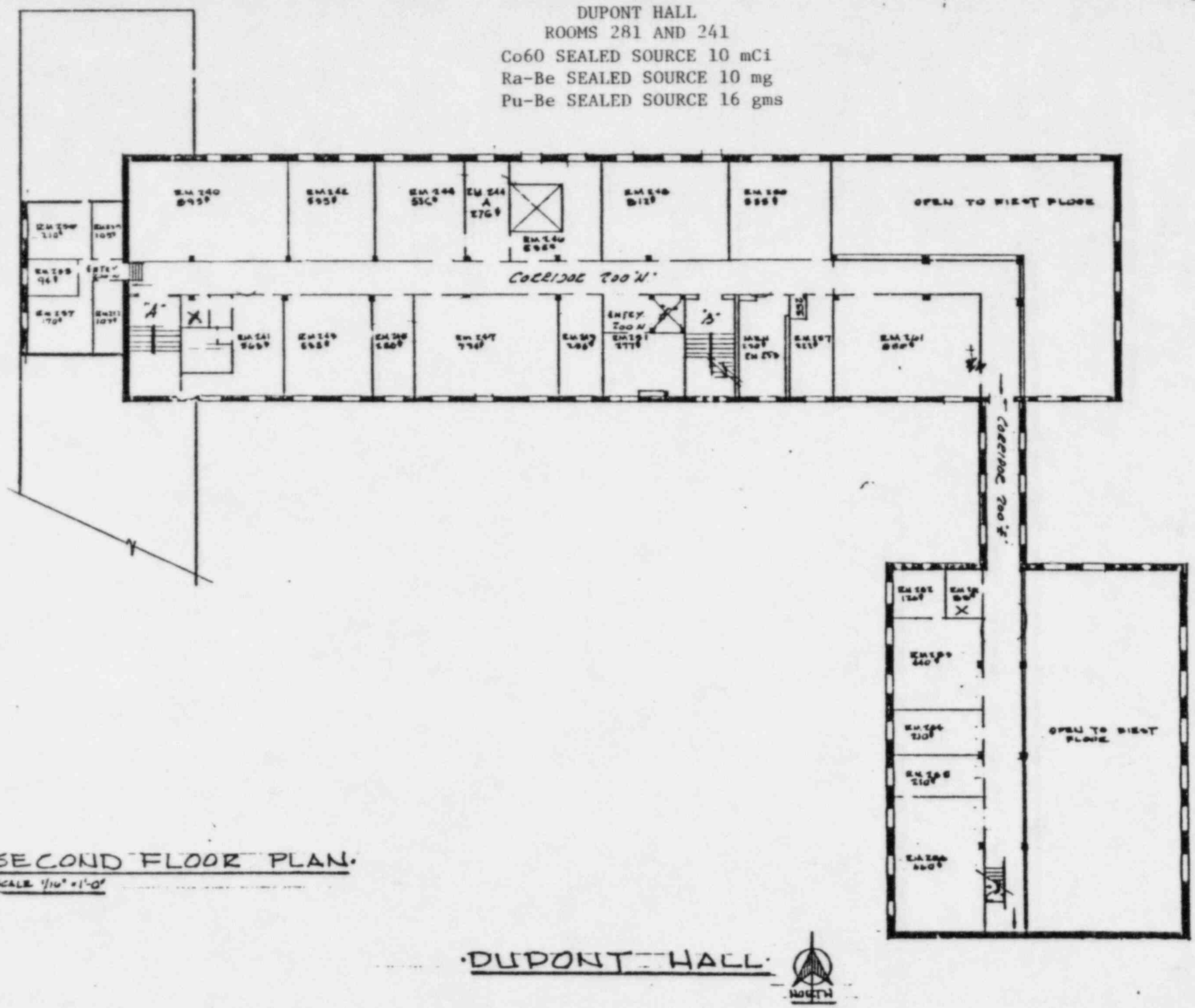


ATTACHMENT #11
REVISION 1

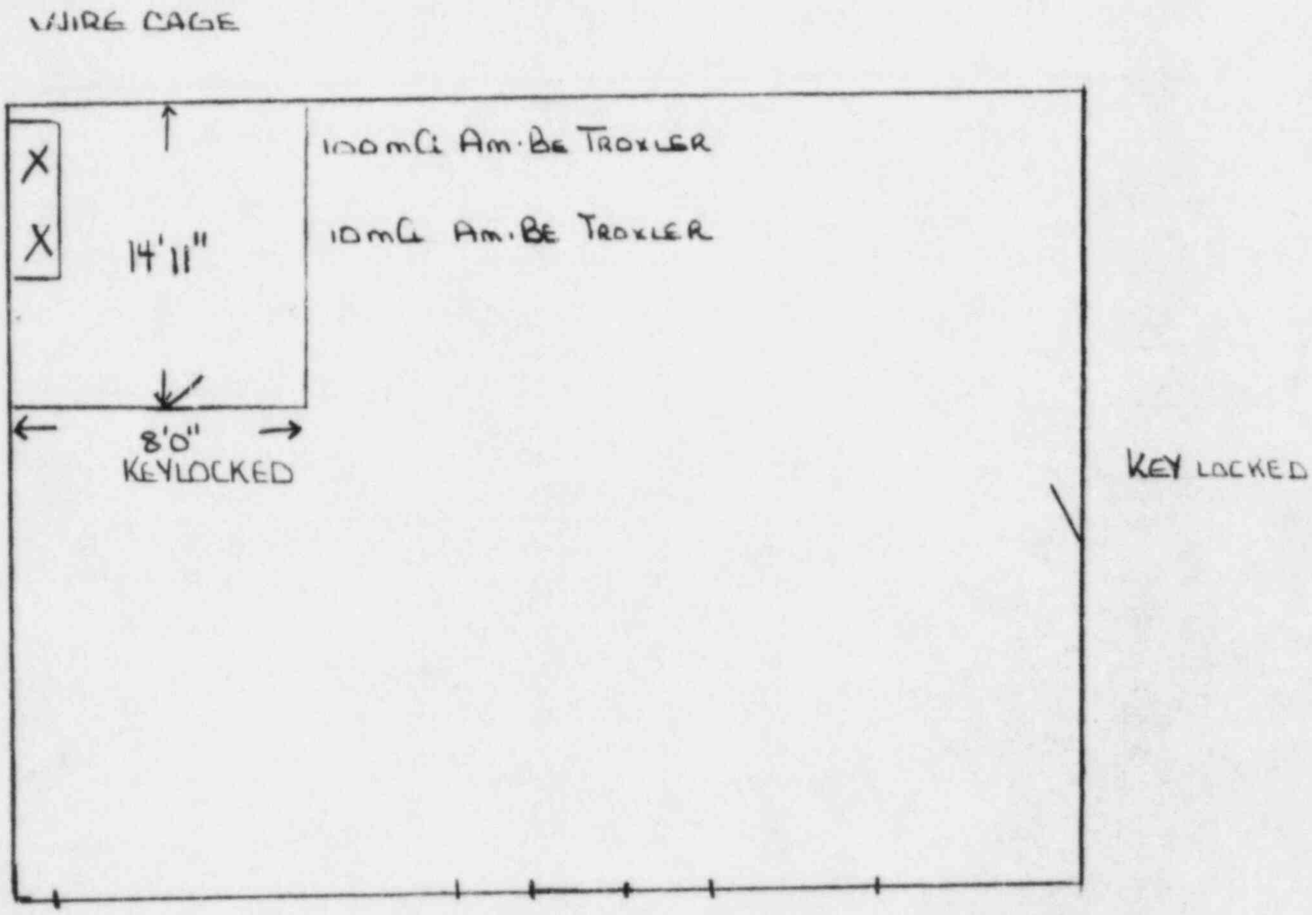
DUPONT HALL
ROOM 281
Co60 SEALED SOURCE 10 mCi
Ra-Be SEALED SOURCE 10 mg



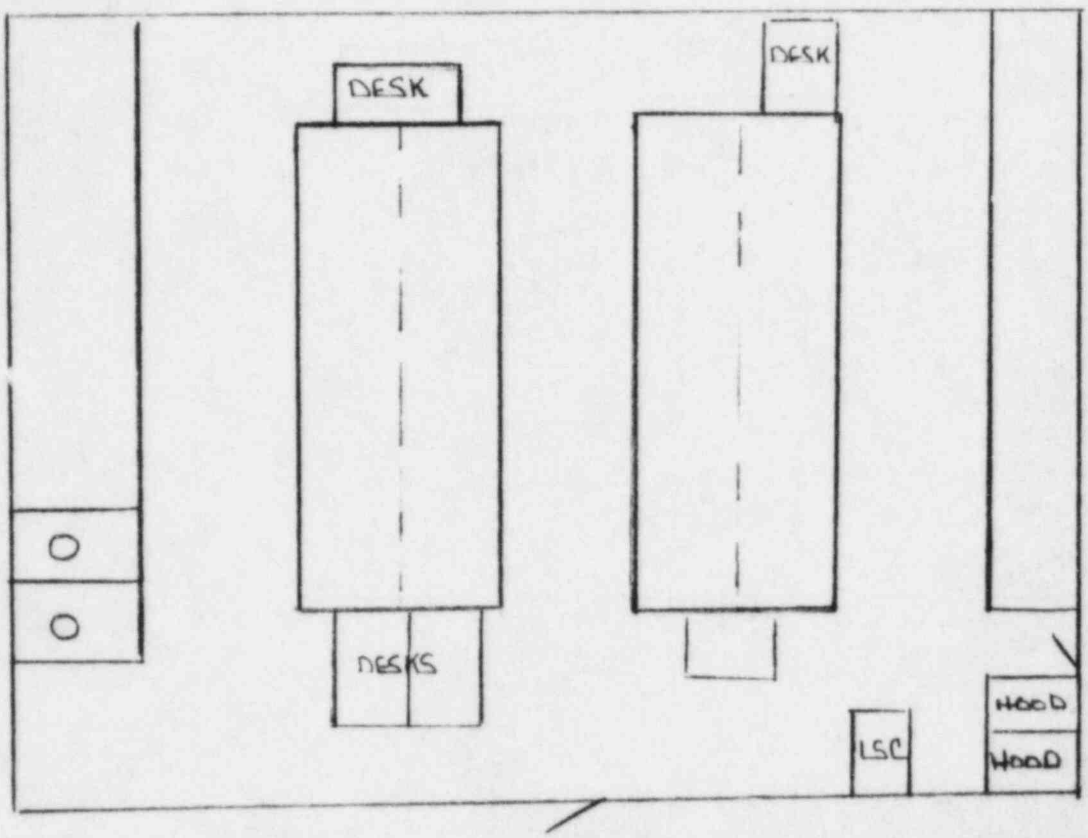
DUPONT HALL
ROOMS 281 AND 241
Co60 SEALED SOURCE 10 mCi
Ra-Be SEALED SOURCE 10 mg
Pu-Be SEALED SOURCE 16 gms

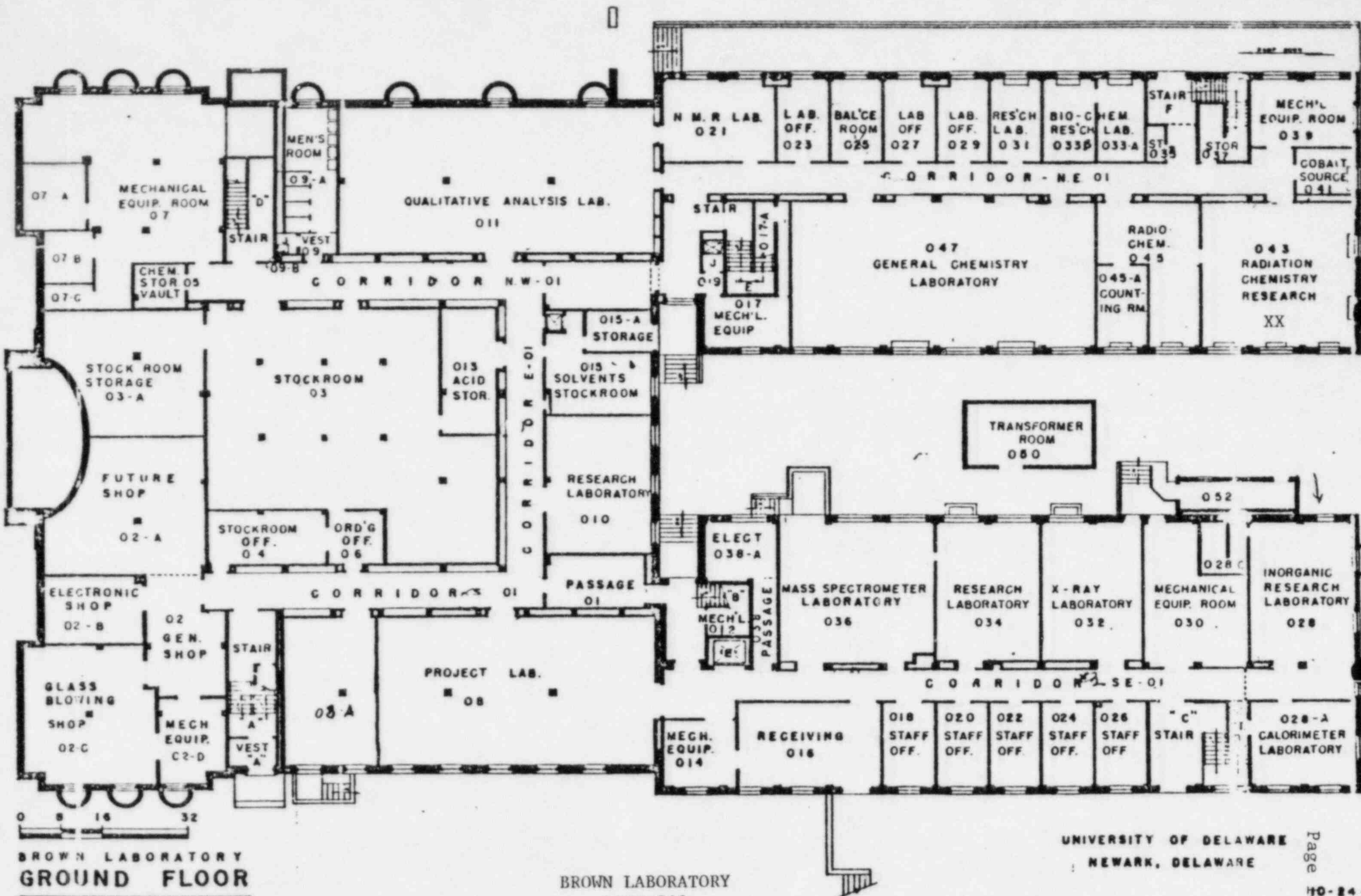


WORRILOW HALL
ROOM 124
SEALED SOURCES:
100 mCi Am-Be Troxler
10 mCi Am-Be Troxler



BROWN LABORATORY
ROOM 043
I^{125} PROTEIN IODINATION



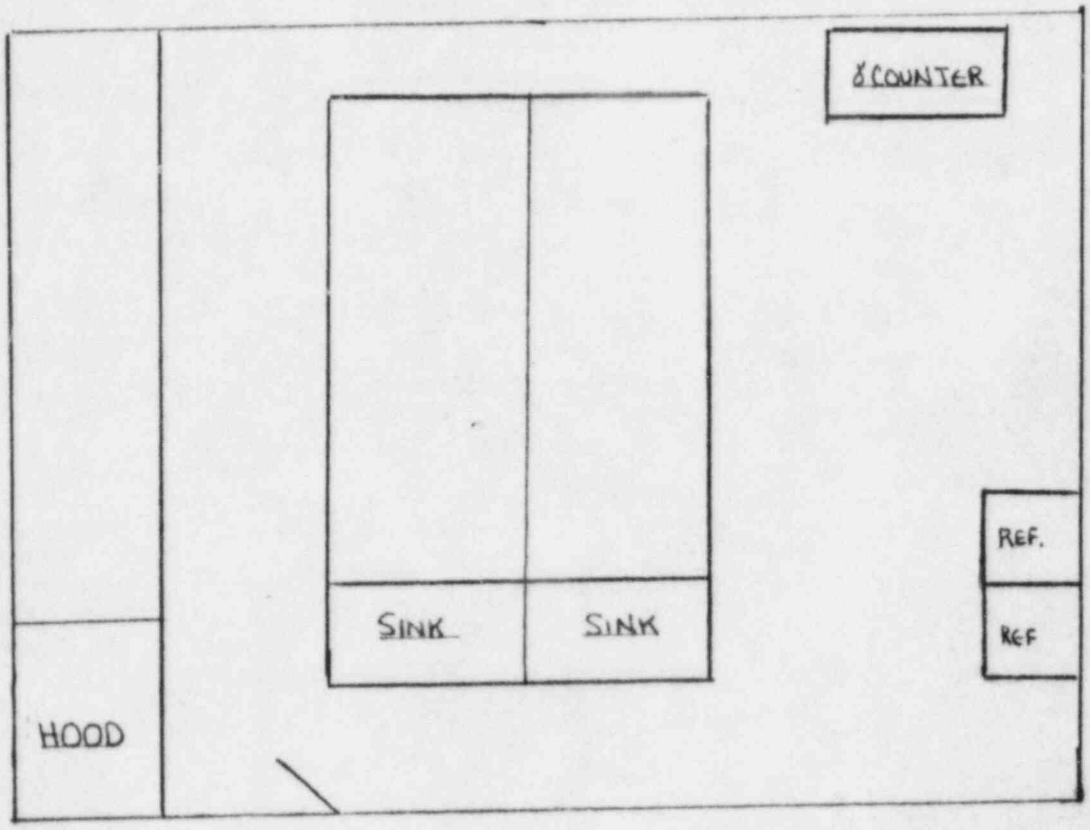


BROWN LABORATORY
ROOM 043
I^{125} PROTEIN IODINATION

28. |

ATTACHMENT #11
REVISION 1

MCKINLY LABORATORY
ROOM 017
I^{125} PROTEIN IODINATION



MCKINLY LABORATORY
ROOM 017
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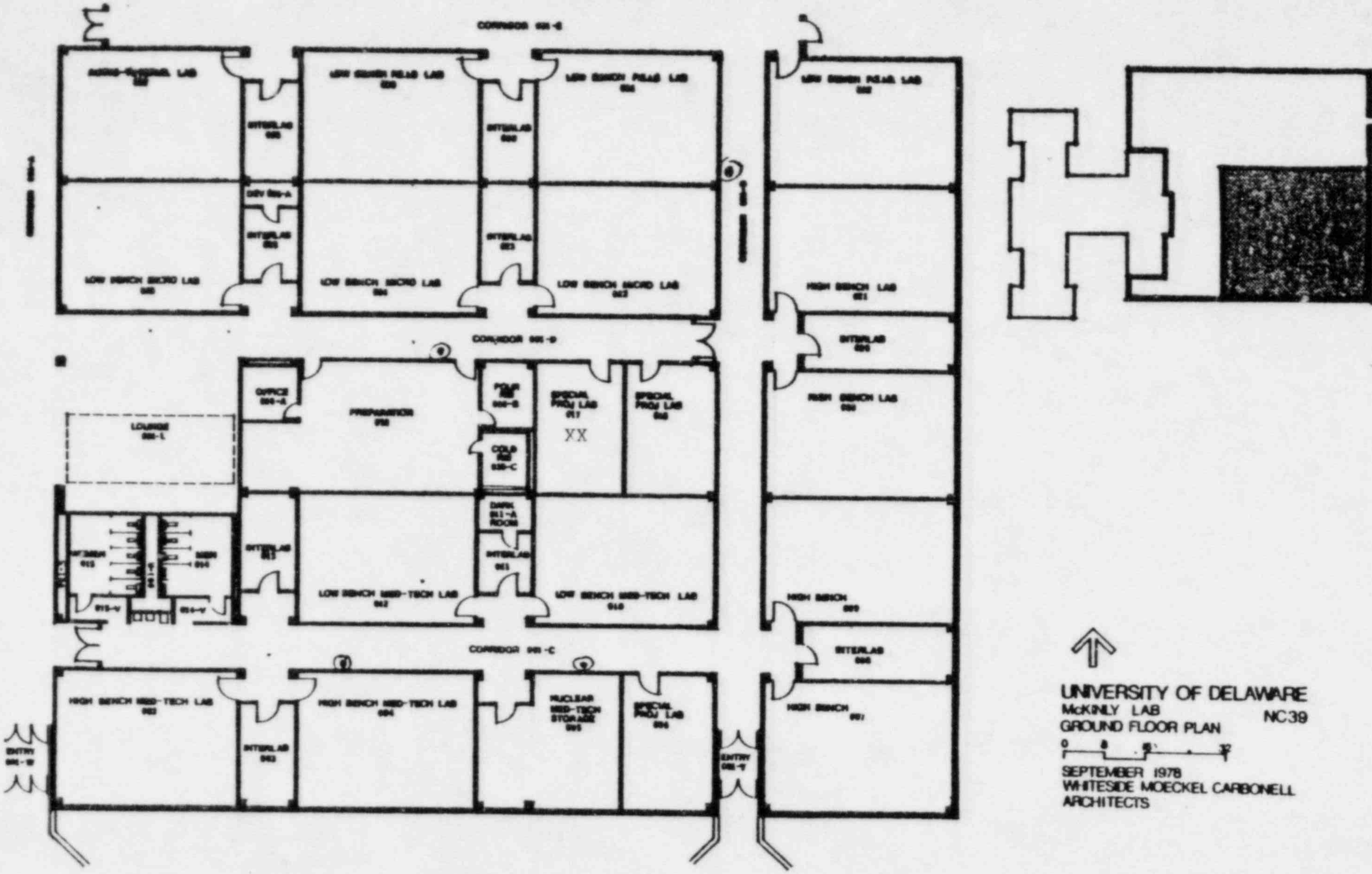
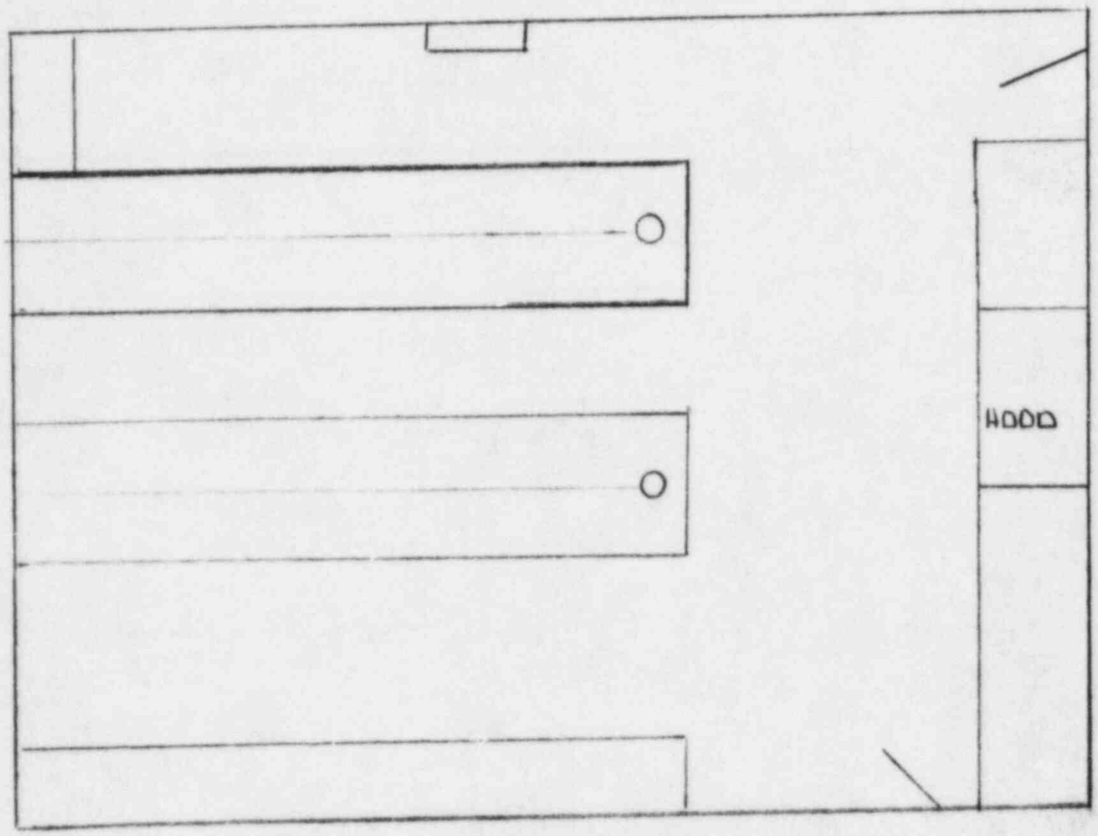
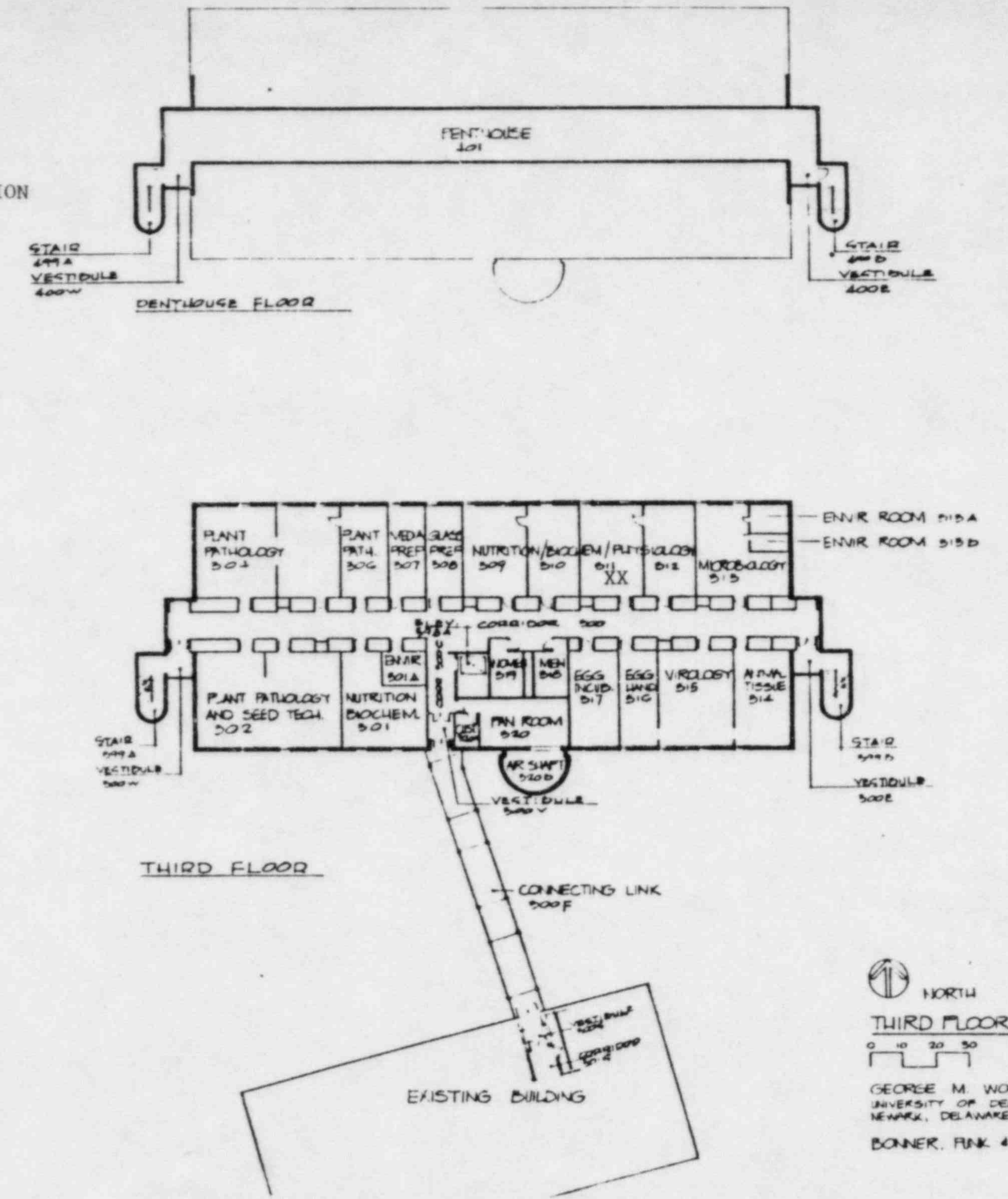


ATTACHMENT #11
REVISION 1

WORRILOW HALL
ROOM 311
I^{125} PROTEIN IODINATION



WORRILOW HALL
ROOM 311
I^{125} PROTEIN IODINATION



THIRD FLOOR & PENTHOUSE PLANS

0 10 20 30

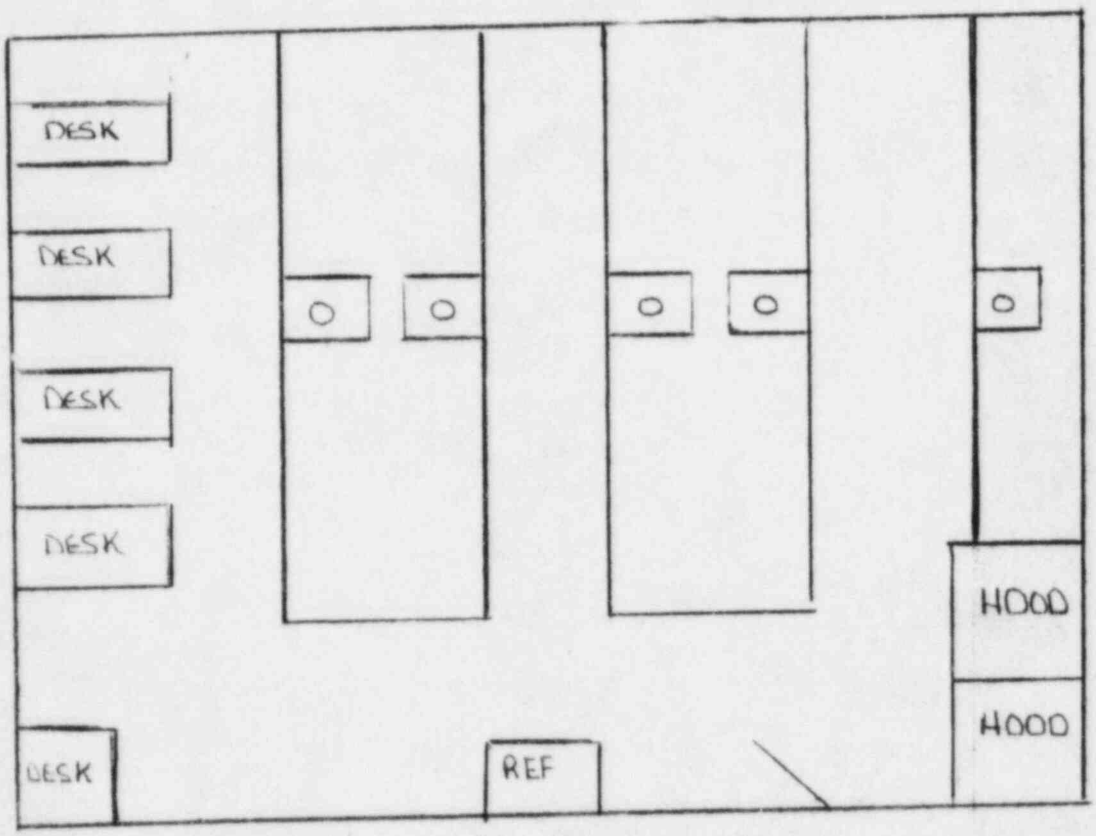
GEORGE M. WORRILOW HALL
UNIVERSITY OF DELAWARE
NEWARK, DELAWARE

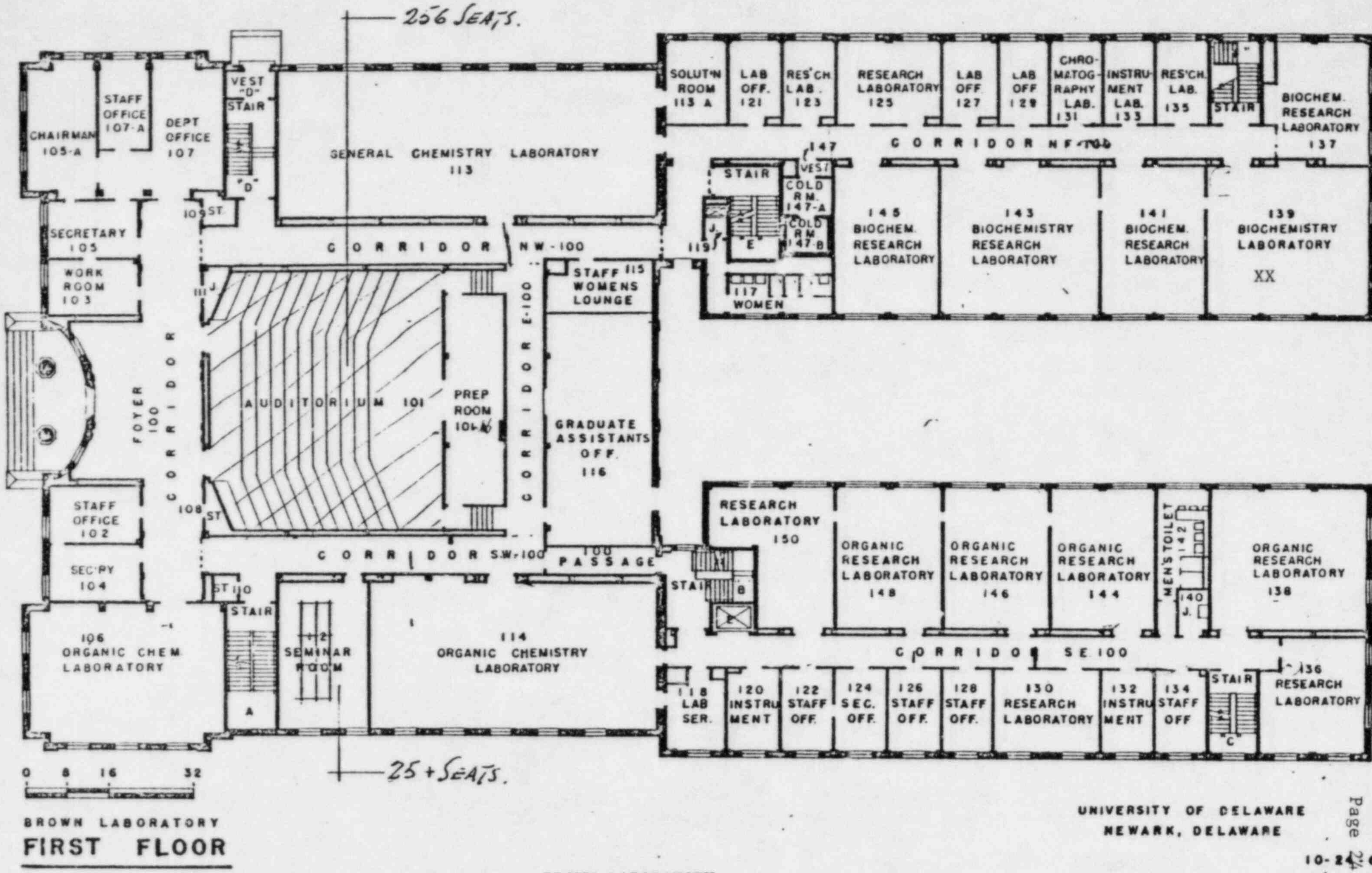
BONNER, FINK & ASSOCIATES, ARCHITECTS

"OFFICIAL RECORD COPY"

ATTACHMENT #11
REVISION 1

BROWN LABORATORY
ROOM 139
H^3 LABELING PROCEDURES UTILIZING BOROHYDRIDE

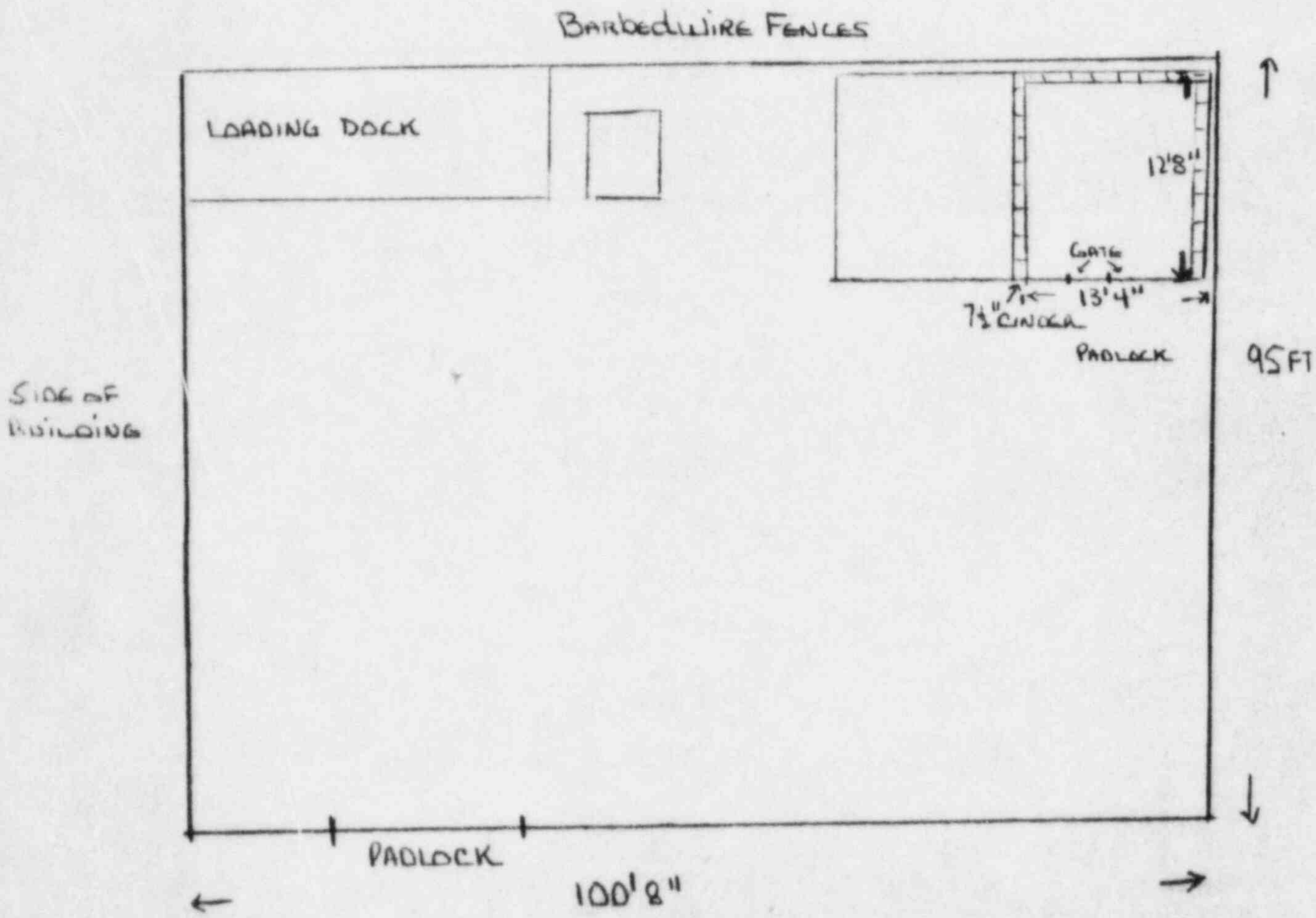




27.

BROWN LABORATORY
ROOM 139
H^3 LABELING PROCEDURES UTILIZING BOROHYDRIDE

WASTE STORAGE AREA
SOUTH SERVICE YARD
GENERAL SERVICES BUILDING



ATTACHMENT #12
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2/83

Item 14.

The University of Delaware has developed a Radiation Safety Manual which contains information regarding the University's internal radiation safety program. The University requires the flexibility to change its internal procedures from time to time. The manual is, therefore, not submitted under Item 14 of the application. The following are excerpts from the Radiation Safety Manual which exemplify the Radiation Safety Program and which may be considered part of the permanent structure:

THE RADIATION SAFETY COMMITTEE

PURPOSE OF THE RADIATION SAFETY COMMITTEE

The purpose of the Radiation Safety Committee of the University of Delaware is the promotion of the best practice safe handling and use of radioactive materials and radiation producing devices. Occupational radiation exposures to individuals and the environment are maintained as low as is reasonably achievable. The purview of the committee is the University campus, regional facilities, affiliated institutions, and University properties throughout the State of Delaware and University research vessels in national and international waters.

Federal and state government regulations for radionuclides are implemented by the committee in association with individual radionuclide users, department heads, and the administration of the University.

ORGANIZATION OF THE RADIATION SAFETY COMMITTEE

The Radiation Safety Committee is appointed by the Provost of the University.

Membership consist of faculty and professional staff experienced in handling radionuclides, the use of radiation producing devices, the practice of radiation protection, or those who have a desire to institute practices of safety in regard to radiation.

These members include the areas of Agriculture, Life and Health Sciences, Chemistry, Engineering, Human Resources, Marine Studies, Nursing, Physics, Safety and the Radiation Safety Officer who is the representative of the Administration.

The activities of the committee are directed by the chairperson; who is appointed by the Provost of the University upon recommendation of the committee.

The business of the committee is administered through the Safety Division which is directed by the Radiation Safety Officer. The Radiation Safety Officer is a full-time professional staff member from the Safety Division appointed to this position based on experience, education, and qualifications in the area of Radiation Safety and with the recommendation of the Radiation Safety Committee. The Radiation Safety Officer serves as Executive Secretary of the Radiation Safety Committee.

Meetings of the committee are called by the chairperson at his/her discretion, not less than once per quarter (calendar year) or on petition by any member of the committee.

A quorum of the committee to conduct business consist of at least three members plus the Radiation Safety Officer.

The Radiation Safety Officer and the chairperson conduct the interim business of the committee subject to the approval of the committee at the next scheduled meeting.

Proceedings of the Radiation Safety Committee are recorded as formal minutes that are distributed to the members and alternates and are subject to approval at the next meeting of the Committee. Agenda and minutes of the Radiation Safety Committee are maintained by the Radiation Safety Officer and are available for inspection. A record of each proposed and/or authorized use of radioactive material, safety evaluations, leak tests, surveys, bioassays, calibrations, inventory, waste disposal, etc. are maintained by the Radiation Safety Officer and are available for inspection.

RESPONSIBILITIES OF THE RADIATION SAFETY COMMITTEE

Assume the responsibility for radiation safety aspects for all University programs involving radioactive materials or radiation producing devices.

Review and grant permission for, or deny the use of radioactive materials or radiation producing devices within the University. Approval is necessary before a project involving these materials or devices can be initiated. A majority vote of the committee is required for approval.

Review and prescribe special conditions, requirements, and restrictions that may be necessary for safe handling of radioactive materials and radiation producing devices. These may include oral or written examination, additional training of personnel, physical examinations (e.g. blood test, urine test, etc.), upgrading of facility (hoods, ventilation, shielding, etc.), evaluation of airborne radioactivity, designation of areas of use within the laboratory, proper caution signs, proper disposal methods, proper handling procedures and procedures to be followed after spills or other radiation accidents.

Conduct an annual review of the University's radiation safety program. This review will determine if procedures and policies enacted by the Committee have been implemented and that resources have been adequately allocated. A record of such reviews will be maintained by the Radiation Safety Officer and will be available for inspection.

Serve as a liaison with the Delaware State Board of Health and the United States Nuclear Regulatory Commission in matters of registration, licensing and radiation safety.

Receive and review periodic and/or urgent reports from the Radiation Safety Officer regarding:

Results of area monitoring.

Personnel exposures as measured by suitable dosimeters.

Accidents in handling, storage or use of radionuclides.

Loss or theft of any amount of radionuclides.

Records of radionuclides procurement and disposal.

Recommend and/or initiate remedial action up to and including termination of permits, authorizations of personnel and confiscation of radioactive materials or radiation producing devices where safe procedures are not followed under an authorized project or where procedures are not in compliance with government regulations. Authorize resumption of operations, stopped by the Radiation Safety Officer when the operations are in compliance with the regulations.

Recommend modifications to operating and maintenance procedures, review and recommend in advance of construction of new buildings or alterations or remodeling of existing buildings, proper ventilation, flow rates and filtration as necessary on properly designed fume hoods, shielding, construction material, furniture and finishes for laboratories and rooms in which the use and storage of radioactive materials or radiation producing devices is contemplated. The Radiation Safety Officer shall carry out the Committee's responsibility in this area in order that the concept and philosophy of "as low as is reasonably achievable" (radiation exposure to personnel and environment) is carried out.

Keep department, chairpersons, permit supervisors, authorized users and other academic and administrative officers advised of changes in rules and recommendations of various government agencies concerned with radiation safety and the safe use of radioactive materials and radiation producing devices.

Keep a written record of action taken in approving or disapproving the use of radioactive materials and radiation producing devices and other transactions, communications, and reports involved in the work of the Committee.

Delegate to the Radiation Safety Officer the authority to review, grant, or deny temporary permits for use of radioactive materials and radiation producing devices during the interim between quarterly meetings. Such permits are subject to final approval or denial after review at a regularly scheduled committee meeting.

APPEAL OF COMMITTEE ACTIONS

Appeals to the actions taken by the Radiation Safety Committee should be directed to the Radiation Safety Committee.

THE RADIATION SAFETY OFFICER

AUTHORITY OF THE RADIATION SAFETY OFFICER

The Radiation Safety Officer derives his/her authority from the Office of the Provost. The Radiation Safety Officer is a member and the authorized representative of the Radiation Safety Committee regarding radiation protection and control within the University.

The Radiation Safety Officer, or his/her authorized representative, has the authority to stop all operations with radioactive materials or radiation producing devices where a potential hazard or violation of federal, state or University rules and regulations exist. Resumption of operations may take place only upon authorization from the Radiation Safety Committee.

The Radiation Safety Officer determines the applicable limits for maintaining occupational radiation exposures "as low as is reasonably achievable".

RESPONSIBILITIES OF THE RADIATION SAFETY OFFICER

The Radiation Safety Officer has the responsibility for ensuring adherence to all regulations issued by or subscribed to by the Radiation Safety Committee and will advise and assist the Radiation Safety Committee with regard to the current applicable regulations of the United States Nuclear Regulatory Commission, the United States Public Health Services, state and local agencies, and all similar codes and regulations.

Implement the organization, administration and management of the Radiation Safety Program of the University of Delaware.

Interpret regulations which govern the use of sources of ionizing radiation and disseminate information on radiation safety.

Develop and keep up-to-date a manual of Radiation Safety regualtions and procedures for the University of Delaware.

Supervise all radiation protection programs and develop and maintain these programs.

Coordinate the dosimetry service, maintain personnel exposure records, and give timely notification of exposures to supervisors as well as individuals exposed.

Review all requests for procurement of radionuclides to assure compliance with limitations for possession and use.

Procure, receive and arrange delivery and shipment of all radioactive materials coming to or leaving the University.

Maintain records of procurement and receipt of all radioactive materials including non-N.R.C. regulated radionuclides and radiation producing devices and machines.

Supervise the radioactive waste disposal program.

Instruct groups of employees and students on proper procedures for handling radioactive materials, radiation in restricted areas, health protection problems associated with exposure to such radioactive materials or radiations, exposure precautions, protective devices and applicable portions of the Commission's regulations.

Maintain radionuclide disposal records and records of disposal, transfer or shut down of any radiation producing equipment.

Conduct periodic radiation surveys and wipe tests in laboratories and storage areas.

Conduct alpha scintillation meter surveys when applicable (e.g. radium storage areas) and provide instrumentation for overseeing the decontamination of alpha-contaminated areas or equipment.

Conduct surveys on and register all radiation producing equipment.

Perform leak tests on sealed sources of radionuclides.

Maintain running inventory of radionuclides, sealed sources and materials not in current use.

Assume the responsibility for storage of sources and materials not in current use.

Assume the responsibility for calibration of monitoring and surveying equipment.

Verify and report to appropriate authorities any radiation incident which may have resulted in injury to, or contamination of, personnel or damage to property.

Note and take steps in order to correct nuclear and radiation safety problems.

Perform other duties related or similar to the type described above.

PROCUREMENT OF RADIOACTIVE MATERIAL

All radioactive materials for use at the University of Delaware (including regional campuses and other properties) are procured through the Safety Division. This includes so-called "license-exempt" quantities of radioactive materials.

Only persons authorized by the Radiation Safety Committee may procure radioactive materials.

AUTHORIZATION TO USE RADIOACTIVE MATERIALS

Approval or denial of an application to use radionuclides in research and development by the Radiation Safety Committee is based on:

Training in and experience with radionuclides of the applicant.

Proposed use of radionuclides in the project and precautions for the safe use of the radionuclides.

Type of radionuclide and amount to be used.

Adequacy of the facility and equipment for the projected use and compatability of the project to other uses of the laboratory.

Training and experience of others working on the project.

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PROJECT APPROVAL

The project for which radionuclides are requested are reviewed by the Radiation Safety Officer and the Radiation Safety Committee for feasibility based on the applicants experience with the radionuclides requested for the project and other information given in the project description. Permits to use radionuclides are granted for (1) year.

AMENDMENT(S) TO AUTHORIZED PERMITS

Amendments are granted on the same basis as the original application for authorization.

RENEWAL OF AUTHORIZATION

Renewals of authorization are reviewed and investigated on the same basis as original applications for authorization on a yearly basis.

TRAINING

Training will be provided to all personnel with access to restricted areas in accordance with 10CFR19, both upon initial employment or enrollment, and annually thereafter on a refresher basis. Training is geared to an employee's job classification and in relation to their work with or near radioactive material.

A nine (9) hour Radiation Safety Seminar Series is usually presented by the Radiation Safety Officer each August with an invitation extended to all users of radioactive material.

Handouts used by the Safety Division to meet some of the requirements of 10CFR19 are as follows (attached):

- Appendix to Regulatory Guide 8.13 - Prenatal Exposure
- Dosimeter Information
- Statement of Training and Experience
- Request for Personnel Dosimeter
- Radioisotope Authorized User Safe Laboratory Practices
- Radiation in Medicine and Industry
- Guidelines for Iodine 125 and 131

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DEFINITIONS: PERMIT SUPERVISOR, AUTHORIZED USER, TRAINEE

Permit Supervisor: the faculty or professional staff member who directs the research/teaching project and supervises the laboratory in which radionuclides are used. Generally, the minimum experience expected of a Permit Supervisor will be one year's research use of the radionuclide requested or experience with equivalent radionuclides supplemented by formal course work or on the job training covering the principles and practices of radiation protection, radioactivity measurements, standardization and monitoring techniques, mathematics and calculations involving radiation, and the biological effects of radiation.

Authorized User: the professional or technical staff person, graduate student or undergraduate student who works under the authority of the Permit Supervisor but does not require direct supervision. Generally, the minimum experience of an Authorized User will be three month's experience with the radionuclides requested or experience with equivalent radionuclides supplemented by formal course work or on the job training covering the principles and practices of radiation protection, radioactivity measurements, standardization and monitoring techniques, mathematics and calculations involving radiation, and the biological effects of radiation.

Trainee: a person working with radionuclides who does not meet the qualifications of an authorized user. A trainee must work in the continuous presence of the Permit Supervisor or Authorized User.

RESPONSIBILITY OF LICENSE PERMIT SUPERVISOR

Those persons who have been authorized by the Radiation Safety Committee as Permit Supervisors are responsible for the safe use of radionuclides and radiation sources by authorized users and trainees under their supervision. This includes training of new students and employees pursuant to 10CFR19.

Radioactive material utilized in undergraduate and graduate teaching laboratories will be under the supervision and in the physical presence of an instructor approved by the Radiation Safety Committee.

RESPONSIBILITIES OF AUTHORIZED USER(S) AND TRAINEE(S)

Each person who is authorized to use radionuclides has the responsibility to comply with the Federal, State, and University rules and regulations.

FACILITY APPROVAL

Radioactive materials are used only in those facilities which have been approved by the Radiation Safety Officer and the Radiation Safety Committee.

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LABORATORY CLASSIFICATION AND REQUIREMENTS

Laboratories are classified as Type A (high level), Type B (intermediate level), Type C (low level), and Type D (very low level) according to type and level of material to be used and type of usage.

MONITORING INSTRUMENTS

Unless specifically exempted by the Radiation Safety Committee or the Radiation Safety Officer, each Permit Supervisor using radioactive materials has available a monitoring instrument appropriate to the type and level of ionizing radiation used.

OTHER RADIATION SAFETY EQUIPMENT

The Radiation Safety Committee may require the use of other special equipment or devices that it may determine necessary to ensure the safe use of radionuclides in a given situation. This includes special shielding, handling tools or tongs, alarms and warning devices, sampling equipment and other such apparatus.

WASTE CONTAINERS

Radioactive waste containers for facilities are provided or authorized by the Safety Division.

POSTING OF AREAS AND LABELING REQUIREMENTS

Areas, rooms, and containers are posted pursuant to 10CFR20. Only signs of the design specified in 10CFR20 are used. The Safety Division supplies all signs required for posting in areas or rooms. All areas, rooms, or laboratories requiring posting shall be considered as Restricted Areas, as defined in 10CFR20.

EXCEPTIONS FROM POSTING REQUIREMENTS

A room or area is not required to be posted with a caution sign because of the presence of a sealed source provided the radiation level twelve (12) inches from the surface of the source container or housing does not exceed 2.5 mRem/hr.

Caution signs are not required to be posted at areas or rooms containing radioactive materials for periods less than 8 hours provided that such materials are constantly attended during such periods by an individual who shall take the precautions necessary to prevent the exposure of any individual to radiation or radioactive materials in excess of the limits established in this section and such areas or room is under the control of the permit supervisor.

PROTECTIVE RULES FOR CONTROLLING CONTAMINATION OF LABORATORY FACILITIES AND EQUIPMENT

Each user of radioactive material is provided with "Radioisotope Authorized User Safe Laboratory Practices" guidelines (attached) upon employment or enrollment and periodically thereafter. These rules should be posted in each facility.

Additional protective rules are as follows:

Contaminated equipment or equipment that has been used and is suspected of being contaminated, should be isolated in designated areas in the laboratory or in suitable storage spaces until it can be smear tested to determine the contamination level and shall be decontaminated as soon as possible. Contaminated equipment must bear the "Caution Radioactive Material" label.

One sink in each laboratory should be designated for washing contaminated glassware equipment, etc.

Tools, equipment, and apparatus when used in handling radioactive material, should be placed in non-porous metal trays or pans which are lined with plastic backed absorbant (disposable) paper. This paper should be surveyed and changed frequently.

Any working surface where radioactive materials are used should be covered with plastic backed absorbant paper (disposable) or polyethylene sheet and be appropriately labeled. This paper or polyethylene sheet should be surveyed and changed frequently.

Auxiliary containers, blotters, and covers should be used where danger of spills and contamination of personnel exist.

Care should be taken that equipment, not immediately necessary to the operations being performed, is not brought into the working area.

Equipment and tools shall be routinely surveyed following their use. No equipment shall be returned to stock unless it is known to be completely free of contamination inside and outside.

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Contamination shall not be allowed to remain on working surfaces unless appropriately shielded.

ALLOWABLE CONTAMINATION LEVELS

Contamination means amounts of beta - gamma activity greater than 220 dpm or alpha activity greater than 20 dpm as determined by survey of a filter paper smear on a surface of 100 cm^2.

SEALED SOURCES

PROTECTIVE RULES FOR PREVENTING EXPOSURE

Sealed sources shall not be handled directly by hand (exception: reference sources of very low activity; e.g. 0.1 uCi). The use of remote handling tools for sources of high activity is essential to minimize both whole body and hand exposure.

Permit Supervisors, Authorized Users, or Trainees should monitor themselves periodically during periods of work with a sealed source(s) to assure that the source rupture or leakage has not occured.

Under no circumstances is a user authorized to repair a ruptured or leaking source.

In case of devices containing sealed sources (e.g. gas chromatographs) the device and source shall be used only as recommended by the manufacturer. Sources may not be removed from such devices except in those cases where the devices are specifically designed for usage of the source outside the device. The Safety Division shall be notified if a source is to be removed from a device such as a gas chromatograph.

Repair of devices containing radioactive sources is normally not permitted when such repair involves those parts of the device containing the source. The Radiation Safety Officer should be consulted to determine the conditions under which minor repairs or corrections may be authorized.

SEALED SOURCE LEAK TESTING

Leak tests of sealed sources are performed by the Radiation Safety Officer or the Health Physics Technologist. Qualifications of the Radiation Safety Officer and the Health Physics Technologist are stated under Item 5, Attachment #4.

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Leak testing is carried out by smearing the surface of the source, or surfaces near the source where contamination is likely to accumulate, with absorbant material, such as a cotton swab, filter paper, or cloth. Remote handling devices are used where necessary.

Smears are counted on an Eberline FC-1 or FC-2 windowless gas flow proportional detector attached to an Eberline MS-2 mini scaler. A Beckman LS100C liquid scintillation counter may also be used. Other instruments may be utilized as the need arises.

When the proportional detector is utilized in the alpha mode, an Eberline Serial #7422 Pu-239 disk source of 0.0046 uCi ± 2% traceable to NBS serves as the calibration standard. In the beta mode, an Eberline Serial #7423 Sr-90 disk source of 0.005 uCi ± 2% traceable to NBS serves as the calibration standard.

When the liquid scintillation counter is utilized, an H-3 internal standard will serve as a calibration standard. The system's counting efficiency is better than 50% for low energy beta emitters.

Any instrument utilized for leak test analysis will be capable of detecting the presence of < 0.001 microcurie of radioactive material on a test sample.

Initial radiation surveys of sealed sources will be performed by the Safety Division. Specific requirements regarding the use of a particular sealed source will be established before the source is put into service.

University of Delaware personnel will not perform repair, maintenance or service operations on sealed sources. Such services will be conducted by the manufacturer or other authorized individual.

CAUTION SIGNS, LABELS AND TAGS FOR SEALED SOURCES

Sealed sources shall be appropriately identified.

Sealed sources mounted in devices or shields shall have on the shield or device a sign "Caution Radioactive Material". Also, the radionuclide, amount, and date assayed shall be included.

Sealed sources mounted in devices or shields should not have a radiation exposure of greater than 2.5 mR/hr. at 1 foot when in a shielded storage condition.

Sealed sources in devices or shields having an exposure rate greater than 2.5 mR/hr. at 1 foot must be provided with additional shielding or a "Caution Radiation Area" sign must be posted at the point where the exposure exceeds 2.5 mR/hr.

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PROCEDURES FOR OPENING PACKAGES OF RADIOACTIVE MATERIAL

Incoming packages of radioactive material are handled in the same fashion as any other container of radioactive material. Each user of radioactive material is provided with a "Radioisotope Authorized User Safe Laboratory Practices" guidelines (attached). Packages are to be handled in accordance with the cautions in the guidelines.

Shipping containers (cardboard boxes) may be placed in the cold trash if all shipping labels have been defaced.

TRANSFER OF RADIOACTIVE MATERIALS

OFF-CAMPUS TRANSFERS

Radioactive material is not shipped, carried or transferred to or from the University without approval of the Radiation Safety Officer. Approved shipments must be packaged and labeled in accordance with D.O.T., N.R.C. or U. S. Postal regulations, whichever are applicable.

Only persons authorized by the Radiation Safety Committee may transfer radioactive materials to or from the University with the approval of the Radiation Safety Officer. All transferred radioactive material coming to the University are shipped to or brought to the Safety Division for contamination check and inventory control before being stored or used at the University.

It is the responsibility of Department Chairpersons or the Radiation Safety Officer to inform newly hired faculty and professional staff members of these requirements.

ON-CAMPUS TRANSFERS

Radioactive materials are not transferred from one building, department or laboratory to another without the approval of the Radiation Safety Officer, since approval for the use of the materials is given only for the original working areas, amounts used and the project specified. Only persons authorized by the Radiation Safety Committee may transfer radioactive materials on campus.

All transfers approved between Permit Supervisors, laboratories, or from storage areas to working areas are done in such a manner as to minimize the probability of spillage or breakage. Double containers should be used, including suitable shielding, for such transfers.

GIFTS

No gifts of sealed sources, x-ray producing devices or other radiation emitting devices shall be accepted by any person at the University unless authorized by the Radiation Safety Officer.

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DISPOSAL OF RADIOACTIVE WASTE

GENERAL CONSIDERATIONS

Unless specifically authorized by the Radiation Safety Committee, no radioactive materials are disposed of directly into any sanitary sewer system.

No radioactive wastes may be placed into the cold trash baskets (non-radioactive waste).

Shipping containers (cardboard boxes) may be placed in the cold trash if all shipping labels have been removed and a survey of the container indicates no removable or embedded contamination.

All radioactive waste are collected in suitable containers provided or authorized by the Safety Division and held in the laboratory.

Any accidental releases of radioactive waste into the environment must be reported immediately to the Safety Division.

When unusual problems of disposal arise, the Safety Division is consulted to establish a satisfactory procedure.

USE OF ANIMALS IN RESEARCH WITH RADIOACTIVE MATERIALS

Normally, radioactive materials are administered only to animals owned by the University. Any administrations to animals not owned by the University is cleared with the Radiation Safety Officer and Director of Laboratory Animal Care.

All cages containing animals into which radioactive materials have been injected are marked with warning tape stating "Caution Radioactive Material".

All dead animals which have been injected with radioactive materials must be considered as radioactive waste. Feces and urine from animals injected with radioactive materials must be collected and considered as radioactuve waste. Dead animals or feces are placed in double plastic bags, urine shall be collected in plastic containers. All wastes so collected are marked with warning tape stating "Caution Radioactive Material" and the radionuclide, amount, and date.

The Permit Supervisor, Authorized User or Trainee is responsible for feeding, watering, cage cleaning and removal of urine and feces from cages which contain animals injected with radionuclides. They are also responsible for decontamination of the cages before returning the cages to the Director of Laboratory Animal Care.

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If an animal is sacrificed following the injection of radionuclides or shortly thereafter, the carcass should be double bagged, frozen, marked with warning tape stating "Caution Radioactive Materials", the radionuclide, amount, and date, and held for radioactive waste pick-up. If the animal is to remain alive, or is to be used in other succeeding experiments, the Permit Supervisor, in conjunction with the Director of Laboratory Animal Care and the Radiation Safety Officer, is responsible for tagging the animal in such a way as to insure that when the animal is sacrificed or dies it will be considered as radioactive waste and will be properly disposed of through the required channels. Animals may be tagged by ear notches or by other appropriate means. Tagging must be properly recorded so that when the animal dies the radionuclide used and amounts will be known.

Possible hazards resulting from air concentrations of radioactive materials arising from metabolism of the animal or from cage waste must be controlled with particular attention to airborne levels in Non-Restricted Areas. The Safety Division will carry out air sampling as necessary to determine concentrations of radionuclides in air. Filter traps or metabolism cages may be required to meet safety standards for airborne concentrations of radionuclides.

In cases where an animal caretaker may be necessary for care and feeding animals injected with radionuclides, the permit supervisor submits written instructions for animal care and hazards involved to the Director of Laboratory Animal Care and the Radiation Safety Officer for review. If the use of an animal caretaken is approved, the permit supervisor is responsible for advising the animal caretaker of the hazards (if any) which are involved.

The animals rooms have not been designed for research with radioactive materials. Animals cannot be returned to the normal population. They must be sacrificed.

The Permit Supervisor is responsible for notifying the Director of Laboratory Animal Care and the Radiation Safety Officer of any location in which animals injected with radioactive material are to be placed prior to placement of the animals.

REQUIREMENT FOR OTHER PERSONNEL (FREQUENTERS)

Definitions:

An "E" Frequenter is any University employee who is not a Permit Supervisor, Authorized User or Trainee, who may need to enter a radionuclide laboratory or may be involved with delivery of a package of radioactive material. (e.g. Security Guard, Campus Mail, or delivery personnel, plant operations personnel, etc.)

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An "S" Frequenter is any University graduate or undergraduate student or employee, who is not a Permit Supervisor, Authorized User or Trainee, but is engaged in research in a large lab where there is a radionuclide laboratory as defined by Section 3.6.1.

INSTRUCTION OF FREQUENTERS

All frequenters should attend a general seminar covering the subjects specified in 10CFR19, 20 or receive special instructions from the Safety Division. General seminars are to be held twice per year.

Frequenters required to enter a radionuclide laboratory in order to repair or maintain the facility, shall notify the Safety Division or the Permit Supervisor in order that an evaluation of possible contamination or radiation hazard associated with the problem to be corrected or the maintenance of the facility can be carried out before work proceeds in the laboratory.

RADIATION EMERGENCY PROCEDURES

Emergencies resulting from accidents in radionuclide laboratories may range from minor spills of radioactivity, involving relatively no personal hazard to major radiation incidents and spills, involving extreme hazards and possible bodily injury. Because of the numerous complicating factors which may arise and because of the wide range and variety of hazards, set rules of emergency procedure cannot be made to cover all possible situations.

In any emergency, however, the primary concern must always be the protection of personnel from radiation hazards. The secondary concern is the confinement of the contamination to the local area of the accident if possible.

The following procedures are regarded as recommendations except those with asterisks (*) which are required.

<u>REMEMBER ALWAYS TO STATE</u>: TYPE OF RADIATION EMERGENCY, YOUR NAME, WHERE EMERGENCY ASSISTANCE IS NEEDED WHEN CALLING THE RADIATION SAFETY OFFICER OR SECURITY, IF RADIATION SAFETY OFFICER CANNOT BE REACHED.

MINOR SPILLS IN UNPROTECTED AREAS INVOLVING NO RADIATION HAZARD TO PERSONNEL (IN ANY AMOUNT)

* Notify all other persons in the area immediately.

Permit only the minimum number of persons necessary to deal with the spill into the area.

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Confine the spill immediately.

Liquid Spills - Don protective gloves, drop absorbent paper on spill.

Dry Spills - Don protective gloves, drop absorbent paper on spill.

* Notify the RADIATION SAFETY OFFICER as soon as possible.

* Permit no one to resume work in the area until approval of the RADIATION SAFETY OFFICER is secured.

* REQUIRED ACTION

Water may be used except when chemical reaction with water would generate an air contaminant. Oil should then be used.

The RADIATION SAFETY OFFICER (or an assistant) may be reached directly by using the emergency call list posted in each radionuclide laboratory. Or, call the Campus Security Office number directly and they will locate assistance.

MAJOR SPILLS - INVOLVING RADIATION HAZARDS TO PERSONNEL

* Notify all other persons in area immediately of hazard.

* Request all persons not involved in the spill to vacate the room at once and notify the RADIATION SAFETY OFFICER immediately giving details of spill.

Make no immediate attempt to clean up the spill.

If spill is on skin, flush thoroughly with water. If the spill is on clothing, discard outer clothing at once.

Switch off all fans.

Vacate the room and prohibit entrance to contaminated area.

* Permit no person to work in area until the approval of the RADIATION SAFETY OFFICER is secured.

Under no circumstances should an untrained person attempt to examine or clean up the radioactive material.

ACCIDENTS - INVOLVING RADIOACTIVE DUSTS, MIST, FUMES, ORGANIC VAPORS AND GASES

* Notify all other persons to vacate the room immediately.

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Hold breath and close all windows and excape valves. Switch off air circulating devices if time permits.

Vacate the room.

* Notify the RADIATION SAFETY OFFICER at once.

Ascertain that all doors giving access to the room are closed and locked. If necessary, post guards to prvent accidental opening of doors.

* Do not re-enter the room until approval of the RADIATION SAFETY OFFICER is secured.

INJURIES TO PERSONNEL - INVOLVING RADIATION HAZARD

Wash minor wounds immediately (within 15 minutes if possible) under running water while spreading edges of gash. (Note: light tourniquet action to stop venous return but not to restrict asterial flow may be desirable to stimulate bleeding.)

Notify the RADIATION SAFETY OFFICER or Security for Special Medical Assistance.

* REQUIRED ACTION

The RADIATION SAFETY OFFICER (or an assistant) may be reached directly by using the emergency call list listed in each radionuclide laboratory. Or, call the Campus Security Officer number directly and they will locate assistance.

If spill is liquid and hands are protected, right the container.

Permit no person involved in a radiation injury to return to work without approval of the RADIATION SAFETY OFFICER.

OVER-EXPOSURE OR INGESTION

* Any person who suspects over-exposure to radiation from any source must report immediately, by phone or in person, to the RADIATION SAFETY OFFICER. (Any exposure in excess of 1.25 Rem whole body delivered in a period of 13 weeks or less is regarded as an over-exposure for purposes of these regulations.)

* Any person who swallows, injects, absorbs, or otherwise ingests radioactive materials (excluding normal environmental contaminants and excluding medical diagnosis or therapy) must report the intake immediately to the RADIATION SAFETY OFFICER or Security.

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FIRES - INVOLVING RADIOACTIVITY

* Pull fire alarm, notify Fire Department by public telephone or callbox, and notify Security by public telephone or direct call line.

* Notify RADIATION SAFETY OFFICER.

* Isolate the area and evacuate the building by shutting down all equipment in area if possible, and closing doors.

  Use portable fire extinguisher only to assist yourself and others to evacuate or to control or put out a small fire if radiation hazard is not immediately present.

CALL LIST FOR RADIATION EMERGENCIES

The following notice is posted in each area where radioactive materials or radiation devices are used or stored.

> "In case of accidents, spills, loss, theft or fire involving radioactive material, call the RADIATION SAFETY OFFICER FIRST. IF NO ANSWER, CALL SECURITY AND THEY WILL FIND ASSISTANCE FOR YOU.
>
> ALWAYS STATE: TYPE OF RADIATION EMERGENCY
> YOUR NAME
> WHERE RADIATION EMERGENCY HAPPENED

Radiation Safety Officer	Extension 8475
Health Physics Technologist	Extension 8475
Security	Extension 2222

* REQUIRED ACTION

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WELL LOGGING

PERMANENT STORAGE FACILITY

University of Delaware
Delaware Geological Survey
Room 18B Penny Hall Annex
Newark, Delaware 19711

JOB SITES

Field use at temporary job sites of the applicant in the states of Delaware, New Jersey and Pennsylvania

PERSONNEL

Licensed material shall be used by, or under the supervision of, individuals designated by the Radiation Safety Committee.

RADIATION PROTECTION OFFICER

Stuart W. Kline

MATERIALS

Cesium-137   125 millicuries

USE

Cesium-137, 125 millicuries, 3M Company, Model 3M 4F6B, serial number 1022 sealed source used in Neltronic Instrument Corporation, Houston, Texas - Gamma Density Logging Sonde. Source used for rock density determination in well logging operations.

RADIATION DETECTION INSTRUMENTS

William B. Johnson
End Window G.M. Survey Meter
0-20 mR/hr.
and as specified in renewal application dated August 20, 1980, license 07-01579-19, Control No. 02864
Instrument calibration is as specified in renewal application dated August 20, 1980, license 07-01579-19, Control No. 02864.

PERSONNEL MONITORING

Film badges, TLD rings supplied and interpreted by R. S. Landauer, Jr. & Co., Glenwood, Illinois.

FACILITIES AND EQUIPMENT

Sealed source is stored in room 18B, Penny Hall Annex when not in use. The shipping cask is chained and locked to the wall to ensure against unauthorized removal or unauthorized use as required by 10CFR20.207. The source is padlocked into the shipping cask. A sketch is attached.

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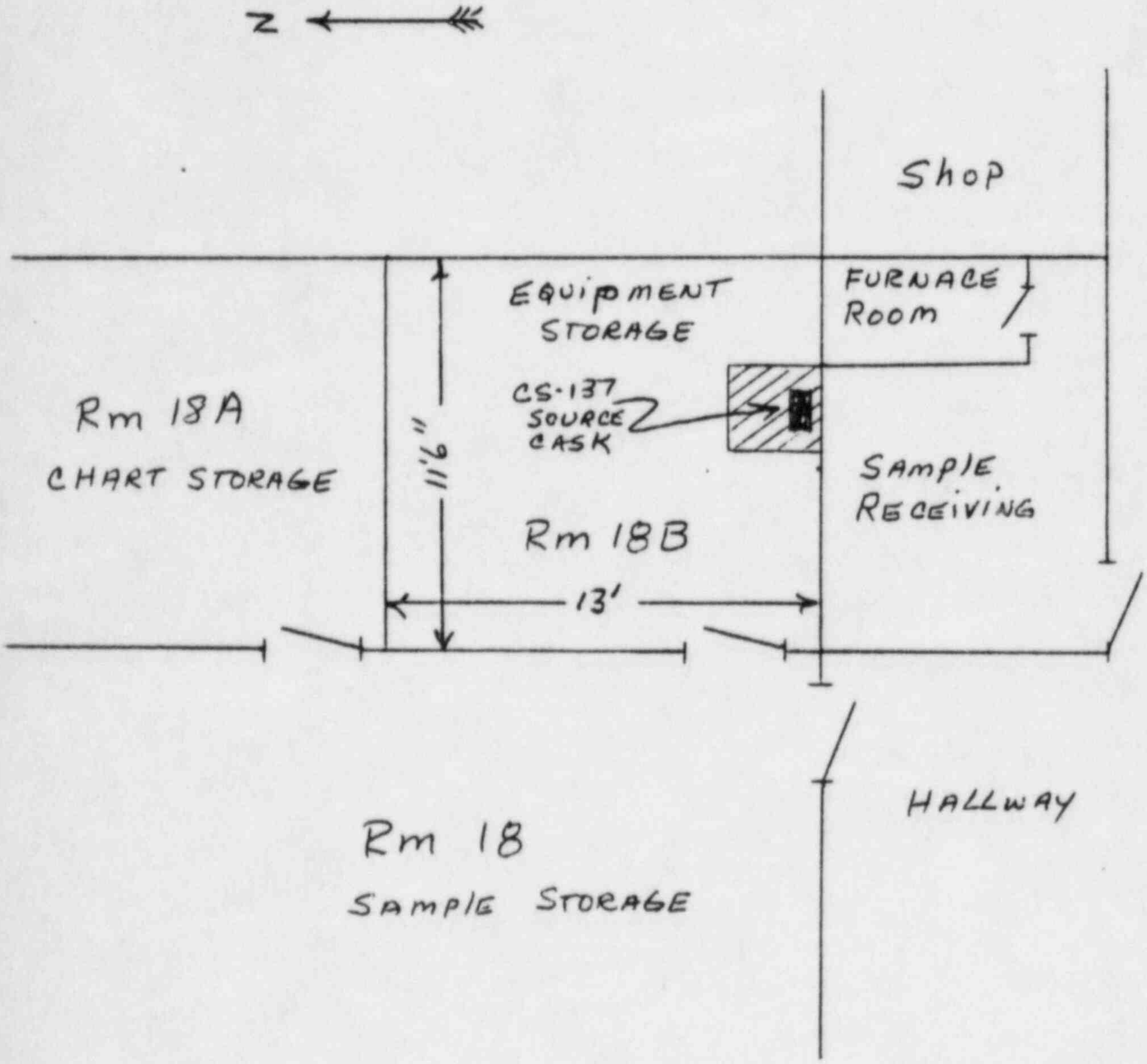
CS-137 Well Logging
Source Storage
Room 18B
Penny Hall Annex



ALL WALLS ARE 8" CINDER block.
RADIATION LEVELS:
AT SURFACE OF CASK 10 mR/hr
AT 1 METER FROM CASK <0.5 mR/hr