INSPECTION REPORT NO. 78-02

Attached
[ ] Appendix A
[ ] Appendix B
[ ] Appendix C
[ ] Memo

President + Fellows of Harvard College
Harvard University
Cambridge, Mass. 02138

Licensee contact: Robert Johnson Telephone no. 8-830-5011 (617-495-2061)

License no. 20-00297-53, ~~-58~~ (SUB-978) SNM-71 Last amendment and date: 31, 12-1-77 Or, ~~5-11-78~~ 6-22-78

Category: F1A, and Priority: III, as of last amendment.

Inspection date(s): 11/14-15/78 Type of inspection: Special-unannounced

SUMMARY OF FINDINGS AND ACTION

[✓] No noncompliance, ~~view 591 issued~~ ROL
[ ] Noncompliance, Appendix A
[ ] Action on previous noncompliance, Appendix B
[ ] Noncompliance, 591 issued
[ ] Regional action Hq action
[ ] Supplemental info, Appendix C

RECOMMENDATIONS

See basis in Appendix C or attached memo.

[ ] Change Category to: ____ [ ] Change Priority to: ____
[✓] Next inspection date: 2-80

PERSONS CONTACTED

R.H. Johnson
Frank Osborne
Paul Zybert
Charles Lohmiller
Jacob Shapiro, Ph.D.
Warren E.C. Wacker, Ph.D. Dir. Rad. Health Service
Ed Lenhoff, Biology Dept. supervisor of isotopes

Inspector: Laurence T. Friedman 11-27-78

Approved: [signature] 11/27/78

INSPECTION PLAN AND REPORT NUMBER 78-02

Plan approved: _____ Date: _____

Licensee: Harvard University License no: 20-297-53, SNM-71

Inspection Items	Scheduled for inspection	Post-inspection status	Module no.	766 Time Info
Management meeting - Entrance and Exit Interviews [REQUIRED]	✓		307038	1
Initial Management Meeting				
Program requirements, MC 2850 [REQUIRED]	✓		77710B	7
Licensee Event Followup			927008	
Followup on Inspector-identified problems			927018	
Followup on Noncompliance and Deviations	Letter 4-19-78		927028	1
IE Bulletin/Immediate Action Letter Followup			927038	
Followup on Headquarters Requests			927048	
Followup on Regional Requests			927058	
Independent Inspection Effort [REQUIRED]	✓		92706B	2
Inspector Dispatched to Site			937008	
Followup on Significant Event Occurring During Inspection			937018	

INSPECTION REPORT NUMBER _____ Page 3 of ___

777103 - Industrial-Academic

AREAS INSPECTED AND FINDINGS

Licensee: _____ License no: _____ Amendment no: _____

INSPECTION ITEMS	CRITERIA	FINDING
1. Organization	Lic Cond ____	C
Management organization.		
Radiation protection organization.		
NOTES & REMARKS:		
2. Licensee internal audits	Lic Cond ____	C
Scope and frequency.		
Management controls.		
NOTES & REMARKS: internal inspections excellent. New system for posting internal license conditions + possession limits in each lab.		
3. Training and instructions to employees	Lic C	C
Training program, scope and frequency, retraining.	Lic Cond ____	
Required tests administered; scores satisfactory.		
Instructions to workers.	19.12	
NOTES & REMARKS: rigorous course twice a year		
4. Radiation protection procedures		C
Operating & emergency procedures implemented.	Lic Cond ____	
Security.	20.207	
NOTES & REMARKS:		

INSPECTION REPORT NUMBER ___ _____ Page 4 of ___

777108 - Industrial-Academic

AREAS INSPECTED AND FINDINGS

Licensee: _____ License no: _____ Amendment no: _____

INSPECTION ITEM	CRITERIA	FINDING
5. Materials, facilities and instruments		C
Authorized uses and quantities.	Lic Cond ____	
Restricted areas, posting requirements.	20.203	
Survey instruments & dosimeters; operable, properly calibrated.	Lic Cond ____	

NOTES & REMARKS: all SNM except Pu-Be source stored as waste; instrument calibration procedures adequate. Steps suggested to reduce dose to calibrator

6. Receipt and transfer of materials		C
Procedures implemented, adequate.	20.205, 71.51	
Transfer of byproduct material.	30.41	
Labeling and packaging.	71.5, 49CFR 170-189	
Records of receipt, transfer, storage, survey, and monitoring	30.51	

NOTES & REMARKS:

7. Personnel protection - external		C
Personnel monitoring control; minimize exposures, control of accumulated dose.	20.101, 20.102, 20.202	
Surveys conducted, adequate.	20.201	
Records of monitoring, surveys, disposals.	20.401, Lic Cond ____	
Levels in unrestricted areas.	20.1, 20.105	

NOTES & REMARKS:

8. Personnel protection - internal		n/a
Airborne concentrations in restricted areas.	20.103	
Exposure of minors.	20.104	
Posting of airborne radioactivity areas.	20.203	
Survey, monitoring requirements; records.	20.201, 20.401	
Leak tests of sealed sources.	Lic Cond ____	

NOTES & REMARKS:

777103 - Industrial-Academic

AREAS INSPECTED AND FINDINGS

Licensee: _____ License no: _____ Amendment no: _____

INSPECTION ITEM	CRITERIA	FINDING
9. Effluent control, waste disposal		C
Release of effluents.	20.106	
Waste disposal.	20.301, 20.303, 20.304, 20.305	
Procedures, records.	20.401, Lic Cond ____	

NOTES & REMARKS: waste collection + disposal procedures covered in detail. methods good.

10. Shipping, shipping incidents		n/i
Procedures for pickup, receipt, monitoring of packages.	20.205(b) & (c)	
Transportation of licensed material.	71.5	
Incidents, reports, corrective actions.	49CFR 170-189	

NOTES & REMARKS:

11. Notifications and reports		C
To individuals.	19.13	
Overexposures, excessive levels & concentrations, incidents.	20.403, 20.405	
Personnel exposures and monitoring, termination reports.	20.407, 20.408	
Theft or loss of licensed material.	20.402	

NOTES & REMARKS:

12. Posting of notices		C
Part 20, license & documents, procedures, notice of violations.	19.11(a)	
NRC-3.	19.11(c)	

NOTES & REMARKS:

INSPECTION REPORT NUMBER _____ Page 5 of ___

777103 - Industrial-Academic

AREAS INSPECTED AND FINDINGS

Licensee: _____ License no: _____ Amendment no: _____

INSPECTION ITEM	CRITERIA	FINDING
13. Environmental monitoring program Implementation of program, scope and frequency as required. Records maintained, reviewed by management. NOTES & REMARKS:	Lic Cond ____	C
14. Emergency preparedness Procedures available for incidents and accidents. Training for personnel; coordination with supporting groups and agencies. NOTES & REMARKS:	Lic Cond ____	N/I
15. Other license conditions NOTES & REMARKS:	Lic	C
16. Confirmatory measurements Licensee's surveys verified on sampling basis. NOTES & REMARKS: levels around Pu-Be source ~ 0.8 mR/hr at 1 foot	20.105, 20.201	C
17. Independent inspection effort NOTES & REMARKS:		C

INSPECTION REPORT NUMBER _____ Page ___ of ___

APPENDIX A - DOCUMENTATION OF NONCOMPLIANCE

Licensee: _____ License no: _____

Reference	Basis for noncompliance
Report item _____ 10 CFR _____ Lic Cond _____ Type n/c _____	
Report item _____ 10 CFR _____ Lic Cond _____ Type n/c _____	
Report item _____ 10 CFR _____ Lic Cond _____ Type n/c _____	
Report item _____ 10 CFR _____ Lic Cond _____ Type n/c _____	
Report item _____ 10 CFR _____ Lic Cond _____ Type n/c _____	

INSPECTION REPORT NUMBER 1-02 Page ___ of ___

APPENDIX B - LICENSEE ACTION ON PREVIOUS INSPECTION FINDINGS

Licensee: Harvard University License no: 20-00297-53

Identification and summary of action taken	Status
Report no: 78-01 Type n/c: I Describe: food with unsealed licensed mat'l Action taken: being checked for rigorously by Health Physics inspectors	OPEN (CLOSED)
Report no: 78-01 Type n/c: I Describe: failure to wash + survey before leaving lab Action taken: same as above	OPEN (CLOSED)
Report no: 78-01 Type n/c: I Describe: waste stored w/ waste next to radiation area Action taken: waste storage behind plexiglass shielding	OPEN (CLOSED)
Report no: ___ Type n/c: ___ Describe: ___ Action taken:	OPEN CLOSED
Report no: ___ Type n/c: ___ Describe: ___ Action taken:	OPEN CLOSED

APPENDIX C - SUPPLEMENTARY INFO

...ated noncompliance	[ ]
...nce, conditions, etc	[ ]
...e of Catagory or Priority	

Harvard

^{32}P use, bldg. C-2

animal burial + incineration, disposal in general disposal in general, collection of waste from other int. storage of collected waste, control instrument calibration

Primate center

SNM license

(1) MASS Pike to 2nd exit past Rte 128

(2) ~~After~~ toll booths take (L) fork onto Rt 9 west

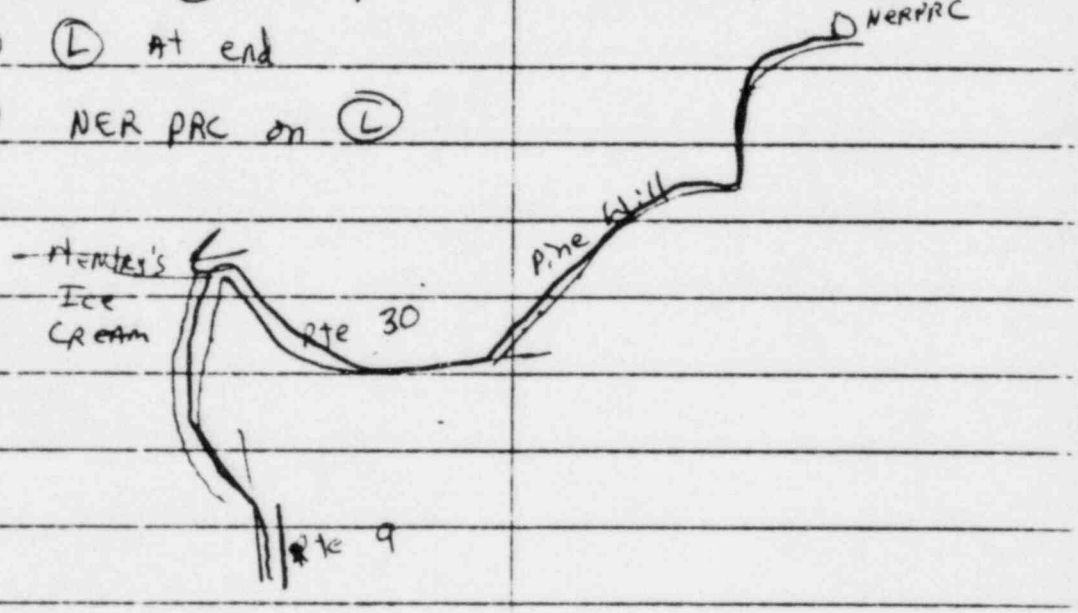
(3) take (L) exit just past "Bay Colony gas station

(4) go to bottom of hill & take 135° (R) Pine Hill

(5) Turn (L) onto Pine Hill Drive

(6) (L) at end

(7) NERPRC on (L)



Ed Lenhoff, Biology Dept., supervisor of isotopes
Chemistry loading dock
0.8 mR/hr outside Pu-Be source at 1 ft. (R.F. Gempel)
Bldg 1 Rm behind Rm. B22, Medical Center

Pu-Be source used 1-2 x/yr. all other material
stored as waste

HARVARD UNIVERSITY
UNIVERSITY HEALTH SERVICES

75 Mt. Auburn Street
Cambridge, Massachusetts 02138

February 23, 1979

Division of Fuel Cycle and Material Safety
Office of Nuclear Material and Safeguards
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Gentlemen:

Enclosed are two copies of an application for the straight renewal of the Harvard broad specific license, 20-00297-53(C79), for the use of byproduct material at Harvard University.

I have tried to present a complete application covering the supplemental information required by the Licensing Division. If any pertinent information has been inadvertently omitted, please advise me and I will send it to you.

Please send any correspondence directly to me as material addressed to, "President and Fellows of Harvard College" manages to find its way all around the University before ending up in this office.

Sincerely,

Robert U. Johnson
Assistant
Radiation Safety Officer

RUJ:dp

98882

~~1p.~~

1p.

M-120

4

FORM NRC-313 I (1-79) 10 CFR 30 — U.S. NUCLEAR REGULATORY COMMISSION

APPLICATION FOR BYPRODUCT MATERIAL LICENSE
INDUSTRIAL

See attached instructions for details.

Completed applications are filed in duplicate with the Division of Fuel Cycle and Material Safety, Office of Nuclear Material Safety, and Safeguards, U.S. Nuclear Regulatory Commission, Washington, DC 20555 or applications may be filed in person at the Commission's office at 1717 H Street, NW, Washington, D. C. or 7915 Eastern Avenue, Silver Spring, Maryland.

1. APPLICATION FOR: *(Check and/or complete as appropriate)*

	a. NEW LICENSE
	b. AMENDMENT TO LICENSE NUMBER
X	c. RENEWAL OF LICENSE NUMBER 20-0297-53

2. APPLICANT'S NAME *(Institution, firm, person, etc.)*
President & Fellow of Harvard College

TELEPHONE NUMBER: AREA CODE – NUMBER EXTENSION
617-495-2061

3. NAME OF PERSON TO BE CONTACTED REGARDING THIS APPLICATION
Mr. Robert U. Johnson

TELEPHONE NUMBER: AREA CODE – NUMBER EXTENSION
617-495-2061

4. APPLICANT'S MAILING ADDRESS *(Include Zip Code)*
Department of Environmental Health & Safety
Harvard University Health Services
75 Mt. Auburn Street
Cambridge, Mass. 02138

5. STREET ADDRESS WHERE LICENSED MATERIAL WILL BE USED *(Include Zip Code)*
See Appendix #1

(IF MORE SPACE IS NEEDED FOR ANY ITEM, USE ADDITIONAL PROPERLY KEYED PAGES.)

6. INDIVIDUAL(S) WHO WILL USE OR DIRECTLY SUPERVISE THE USE OF LICENSED MATERIAL
(See Items 16 and 17 for required training and experience of each individual named below)

	FULL NAME	TITLE
a.	Individuals approved by the Radioisotope Committee, Dr. Jacob Shapiro, Ph.D., Radiation Protection Officer	
b.		
c.		

7. RADIATION PROTECTION OFFICER
Jacob Shapiro, Ph.D.

Attach a resume of person's training and experience as outlined in Items 16 and 17 and describe his responsibilities under Item 15.
See Appendix #2

8. LICENSED MATERIAL

LINE NO.	A ELEMENT AND MASS NUMBER	B CHEMICAL AND/OR PHYSICAL FORM	C NAME OF MANUFACTURER AND MODEL NUMBER *(If Sealed Source)*	D MAXIMUM NUMBER OF MILLICURIES AND/OR SEALED SOURCES AND MAXIMUM ACTIVITY PER SOURCE WHICH WILL BE POSSESSED AT ANY ONE TIME
(1)	Any Byproduct Material between Atomic #3-83	Any		10 Ci each *
(2)	60-Co 3H	Any Any		20 Ci * 300 Ci *
(3)	210Po 228Th	Any Any		1 Ci * 0.1 Ci *
(4)	241Am 252Cf	Any Any	(ORNL Pt foil, & SRO Type ALC or SALC 5.6 mCi*	1.0 Ci *

DESCRIBE USE OF LICENSED MATERIAL
E

(1) Research and Development and educational use as defined in 30.4(c) of Title 10, Part 30, "Rules of General Applicability to Licensing of Byproduct Material.

(2) Tracer Studies in animals

(3) * Total possession limit for all byproduct

(4) material in Subitems A and B shall not exceed 350 Curies.

ORNL

FORM NRC-313 I (1-79)

5 1906 36 11
77 pp.

9. STORAGE OF SEALED SOURCES

LINE NO.	CONTAINER AND/OR DEVICE IN WHICH EACH SEALED SOURCE WILL BE STORED OR USED. A.	NAME OF MANUFACTURER B.	MODEL NUMBER C.
(1)	See Appendix #6		
(2)			
(3)			
(4)			

10. RADIATION DETECTION INSTRUMENTS

LINE NO.	TYPE OF INSTRUMENT A	MANUFACTURER'S NAME B	MODEL NUMBER C	NUMBER AVAILABLE D	RADIATION DETECTED (alpha, beta, gamma, neutron) E	SENSITIVITY RANGE (milliroentgens/hour or counts/minute) F
(1)		See Appendix #3				
(2)						
(3)						
(4)						

11. CALIBRATION OF INSTRUMENTS LISTED IN ITEM 10

☐ a. CALIBRATED BY SERVICE COMPANY

NAME, ADDRESS, AND FREQUENCY

☒ b. CALIBRATED BY APPLICANT

Attach a separate sheet describing method, frequency and standards used for calibrating instruments.

See Appendix #4

12. PERSONNEL MONITORING DEVICES

TYPE (Check and/or complete as appropriate.) A	SUPPLIER (Service Company) B	EXCHANGE FREQUENCY C
☒ (1) FILM BADGE	Harvard University	☒ MONTHLY
☒ (2) THERMOLUMINESCENCE DOSIMETER (TLD) (Finger Rings)	See Appendix #7	☐ QUARTERLY
☐ (3) OTHER (Specify): Pocket Dosimeters (as required)		☒ OTHER (Specify): More frequently if situation requires it.

13. FACILITIES AND EQUIPMENT (Check were appropriate and attach annotated sketch(es) and description(s).

☒ a. LABORATORY FACILITIES, PLANT FACILITIES, FUME HOODS (Include filtration, if any), ETC.

☒ b. STORAGE FACILITIES, CONTAINERS, SPECIAL SHIELDING (fixed and/or temporary), ETC.

☒ c. REMOTE HANDLING TOOLS OR EQUIPMENT, ETC.

☒ d. RESPIRATORY PROTECTIVE EQUIPMENT, ETC.

See Appendix #5

14. WASTE DISPOSAL

a. NAME OF COMMERCIAL WASTE DISPOSAL SERVICE EMPLOYED

Currently Interex Corp., 3 Strathmore Road, Natick, Mass. 01760

b. IF COMMERCIAL WASTE DISPOSAL SERVICE IS NOT EMPLOYED, SUBMIT A DETAILED DESCRIPTION OF METHODS WHICH WILL BE USED FOR DISPOSING OF RADIOACTIVE WASTES AND ESTIMATES OF THE TYPE AND AMOUNT OF ACTIVITY INVOLVED. IF THE APPLICATION IS FOR SEALED SOURCES AND DEVICES AND THEY WILL BE RETURNED TO THE MANUFACTURER, SO STATE

Also disposal by sewerage, incineration and burial. See Appendix # 8

INFORMATION REQUIRED FOR ITEMS 15, 16 AND 17

Describe in detail the information required for Items 15, 16 and 17. Begin each item on a separate page and key to the application as follows:

15. RADIATION PROTECTION PROGRAM. Describe the radiation protection program as appropriate for the material to be used including the duties and responsibilities of the Radiation Protection Officer, control measures, bioassay procedures *(if needed)*, day-to-day general safety instruction to be followed, etc. If the application is for sealed source's also submit leak testing procedures, or if leak testing will be performed using a leak test kit, specify manufacturer and model number of the leak test kit.

16. FORMAL TRAINING IN RADIATION SAFETY. Attach a resume for each individual named in Items 6 and 7. Describe individual's formal training in the following areas where applicable. Include the name of person or institution providing the training, duration of training, when training was received, etc.

    a. Principles and practices of radiation protection.

    b. Radioactivity measurement standardization and monitoring techniques and instruments.

    c. Mathematics and calculations basic to the use and measurement of radioactivity.

    d. Biological effects of radiation.

17. EXPERIENCE. Attach a resume for each individual named in Items 6 and 7. Describe individual's work experience with radiation, including where experience was obtained. Work experience or on-the-job training should be commensurate with the proposed use. Include list of radioisotopes and maximum activity of each used.

18. CERTIFICATE

(This item must be completed by applicant)

The applicant and any official executing this certificate on behalf of the applicant named in Item 2, certify that this application is prepared in conformity with Title 10, Code of Federal Regulations, Part 30, and that all information contained herein, including any supplements attached hereto, is true and correct to the best of our knowledge and belief.

WARNING.–18 U.S.C., Section 1001; Act of June 25, 1948; 62 Stat. 749; makes it a criminal offense to make a willfully false statement or representation to any department or agency of the United States as to any matter within its jurisdiction.

a. LICENSE FEE REQUIRED *(See Section 170.31, 10 CFR 170)* **EXEMPT**	b. CERTIFYING OFFICIAL *(Signature)* Lawrence Wachter
	c. NAME *(Type or print)*
(1) LICENSE FEE CATEGORY:	d. TITLE
(2) LICENSE FEE ENCLOSED: $	e. DATE 9/8/82

FORM NRC-313 I (1-79)

(5) Street addresses at which byproduct material will be used.

Cambridge, Mass.

Harvard University

Boston, Mass.

Harvard Medical School, 25 Shattuck Street
Harvard School of Public Health, 665 Huntington Avenue
Harvard School of Dental Medicine, 188 Longwood Avenue
Harvard Laboratory for Human Reproduction and
Reproductive Biology, 45 Shattuck Street
Seeley G. Mudd Building, 250 Longwood Avenue
Angell Memorial Building, 180 Longwood Avenue

Harvard teaching hospitals, used for research activities under the administrative control of Harvard University for staff members possessing Harvard appointments and Harvard grants.

Boston City Hospital

Boston Hospital for Women (Longwood Avenue and Pond Avenue, Brookline)

Beth Israel Hospital

Children's Hospital Medical Center

Forsyth Dental Infirmary

Mass. General Hospital

Peter Bent Brigham Hospital

Mass. Mental Health Center, 74 Fenwood Road

Shields Warren Radiation Lab., 50 Binney Street

Lemuel Shattuck Hospital, Jamaica Plain, Mass.

Harvard University Animal Primate Research Center, Southboro, Mass. Regional

Robert Breck Brigham Hospital, 125 Parker Hill Avenue, Roxbury, Mass.

Central Clinic Laboratory of the Howard Community Health Plan,
63 Rogers Street, Cambridge

Harvard Forest, Petersham, Mass.

APPENDIX # 2

Radiation Safety Committee

A list of the current members of the Radiation Safety Committee is attached for your information. There have been serveral changes since the previous renewal and the Committee has been expanded to take advantage of the expertise within the University. The Isotope Committee has added Dr. Ronald D. Hunt, Animal Research Center, Southboro, Dr. Kenneth Kase, Radiation Therapy, Sidney Farber Cancer Institute, Dr. John Little, Physiology Department of the School of Public Health, and Prof. Robert Pound of the Physics Department. Dr. William Preston and Dr. Bernard Trum have retired from the Committee. The Committee meets quarterly with the responsibilities, duties, and authority outlined in sections 3.2 and 3.3 of the Radiation Safety Manual, page 3. The responsibility of the Radiation Protection Officer is specified in section 3.4, page 4 of the Radiation Safety Manual. All applications received for use of radioactive materials are investigated by the Assistant Radiation Safety Officer which includes an interview with the applicant. The information gathered follows the outline on page 5, section 3.5 of the R.S.M. and a completed form (see attached form) is posted in the laboratory as well as copies filed at the R.S.O., Purchasing Department, and one returned to the user for the files. The interviewer inspects the facilities and equipment, and documents the training and experience of the applicant and all other associated personnel. No one is allowed to work with radioactive materials without having had formal training and a condition is appended to all authorizations requiring notification of any changes in personnel be sent to the Radiation Safety Officer. The investigation report is submitted to the radiation safety officer and duplicate copies sent to members of the Committee for their review and comments. This report may contain special conditions and requirements to be met by the applicant. Unless any adverse comments are received, authorization number is assigned which is in effect for two years at which time a renewal application must be completed by the user for continuation of his project. All applications including new authorizations, amendments, and renewals are reviewed at the Committee Meeting. (Any adverse comments are resolved within the Committee) A minimum of four members must be present for business to be enacted.

All authorized user are required to submit an annual inventory of each radionuclide in his possession, usually as of April 1st. These inventory results are compared to the amounts permitted on the authorization and if there is an excess, the user is notified that he must either dispose of the excess amount or amend the authorization. However, each purchase of one mCi or more must be cleared through the radiation safety office which allows a pre-purchase review to be made of the order. The Purchasing Department will not process any order of 1 mCi or more without specific approval and they also maintain a copy of each authorization. In addition all Purchase Orders are sent to the Assistant Radiation Safety Officer for review and any subsequent action required.

The Radiation Protection Officer acts as recording secretary at each meeting and minutes are maintained with each member receiving a copy.

LICENSED RADIOISOTOPES LABORATORY
monitored by
Environmental Health and Safety, Harvard University Health Services
Tel: (617) 495-2061

Responsible Users _____ Office Phone _____

_____ Office Phone _____

Department _____ Building _____

RADIONUCLIDES, CHEMICAL AND PHYSICAL FORM, POSSESSION LIMITS

NATURE OF WORK WITH RADIONUCLIDES AND MAXIMUM QUANTITIES INVOLVED

LOCATIONS FOR USE

LOCATIONS FOR STORAGE

WASTE STORAGE AND DISPOSAL METHODS AND LOCATIONS

MONITORING INSTRUMENTATION AND LOCATION

RECORDS ON FILE

SUPPORT PERSONNEL

Special conditions and information important in source, exposure, and contamination control, including work with biohazards and carcinogens. (These supplement controls in Radiation Safety Manual and supplementary notices).

PLEASE POST

DATE:

Authorization No._____
Expiration Date_____
(above to be completed by EH&S)

HARVARD UNIVERSITY
APPLICATION FOR AUTHORIZATION TO USE RADIOISOTOPES

Instructions: Send orginal and two signed copies to Environmental Health and Safety, 75 Mt. Auburn Street, Cambridge, MA 02138. Upon approval, one copy will be returned to the applicant.

1. Name_____ 3. Department_____

2. Position_____ 4. Address &_____
Extension_____

5. Locations where radioactive materials will be used_____

_____

_____

6. Radioisotopes, Chemical and Physical form and maximum amount that you will possess at any one time.

7. Purpose for which radioactive material will be used. (Use extra sheets if necessary).

_____ _____
Date Signature of Applicant

_____ _____

If this is your first application for authorization, submit a signed statement giving your training and experience in the use of radioisotopes, including (A) training in protection, dosimetry, and biological effects; (B) experience with specific radionuclides, including largest amounts of sealed and unsealed activities handled, places, dates, and type of work.

****

THIS SECTION TO BE COMPLETED BY ENVIRONMENTAL HEALTH AND SAFETY

Investigated for Radioisotope Committee_____
Name Date

This application is approved subject to the conditions listed on the reverse side and provided that the use, storage and disposal of the radioactive material shall be in conformity with (A) the provisions of the Code of the Federal Regulations Title 10, Part 20, "Standards for Protection Against Radiation Hazards of Radioactive Materials", and (B) the regulations for the use of radioisotopes at Harvard University issued by Environmental Health and Safety.

_____ _____
Date For the Radioisotope Committee

THE RADIATION SAFETY OFFICE (RSO)

AUTHORITY

The Radiation Safety Office, RSO, is directed by the Radiation Protection Officer, who appoints the Radiation Safety Officer(s). The Radiation Safety Officer(s) conduct(s) the duties of the RSO with the full authority of the RSO.

The Radiation Safety Office, RSO, derives its authority from the Executive Committee of the University. The RSO is the authorized representative of the Isotopes Committee regarding measures to implement radiation protection and control within the University.

The RSO has the authority to stop all operations with radioactive materials where a hazard or violation exists. Resumption of operations may take place only upon authorization from the Isotopes Committee or the RSO.

FUNCTION

The duties of the Radiation Safety Office are to:

1. Provide consulting services on all aspects of radiation protection.

2. Maintain radiation exposures at the lowest possible level by the supervision or operation of an effective and appropriate radiation protection and control program.

3. Develop and maintain a procedure for keeping the personnel exposure and contamination records.

4. Educate personnel in the proper procedures to be used and the equipment necessary for the safe use of radioisotopes.

5. Provide assurance that the waste disposal program and the records associated with waste disposal are appropriate in accordance with regulations.

6. Supervise periodic leak testing of sealed radioactive sources.

7. Supervise a continuous program of area and environmental radiation hazard analysis.

8. Insure maintenance of records of radioisotope procurement, distribution, and disposal within the Hospital.

9. Conduct an annual inventory of radioisotopes.

10. Supervise the maintenance and operation, when required, of a capability for handling radiation emergencies.

CURRICULUM VITAE

Kenneth R. Kase

Address: 9 Longfellow Road
Wayland, MA 01778

Born: July 13, 1938, Oak Park, IL

Education:
1961 B.S. Physics, Georgia Institute of Technology, Atlanta, GA
1963 M.S. Bioradiology, University of California, Berkeley, CA
1975 Ph.D. Biophysics, Stanford University, Stanford, CA

Professional Experience:

1975 -	Assistant Professor of Radiation Therapy and Chief, Dosimetry and Radiation Safety Section, Division of Physics and Engineering, Joint Center for Radiation Therapy, Harvard Medical School, Boston, MA
1973 - 1975	Pre-Doctoral Fellow. NIH Grant 5T01 CA 05008-17, Department of Radiology, Stanford Medical School, Stanford, CA
1969 - 1973	Health Physicist, Stanford Linear Accelerator Center Stanford, CA
1967 - 1969	Head, Radiation Safety Section, Hazards Control Department, Lawrence Radiation Laboratory Livermore, CA
1963 - 1967	Health Physicist, Hazards Control Department Lawrence Radiation Laboratory, Livermore, CA

Professional Society Activities:

Member:
American Association of Physicists in Medicine
1976 - Continuing Education Committee
1978 - Radiation Protection Committee

Health Physics Society
1971 - 1974 } Panel of Examiners, American Board of
1978 - } Health Physics (Vice-Chairman, 1974)
1977 - Editor, Health Physics Journal
1978 - Program Committee
1978 Elda Anderson Award

Radiation Research Society

Certified, American Board of Health Physics

Advisory Board: Program in Radiological Health Physics and Radiological Sciences and Protection, University of Lowell, Lowell, MA

PUBLICATIONS

1. Sondhaus, C.A., Wallace, R.W., Lyman, J.T., Kase, K.R., and Steward, P.G.: Proceedings of the International Atomic Energy Agency Symposium on the Biological Effects of Neutron Irradiation, Upton, NY (1963), CONF-205, Physical parameters in exposure of large animals to high-energy protons.

2. Kathren, R.L., Knezevich, M.L., Kase, K.R., et al.: Health Physics 11:481 (1965), Loss of water experiment at the Livermore Pool-Type Reactor.

3. Kase, K.R.: Health Physics 13:869 (1967), Radioactive gas production at a 100-MeV electron linac facility.

4. Kase, K.R. and Rich, B.L.: Proceedings of the Second International Conference on Accelerator Dosimetry and Experience, Stanford, (1969), CONF 691101, The LRL Livermore Accelerator Safety Program.

5. Kase, K.R., et al.: "Project Gasbuggy Operational Experiences," in Health Physics Operational Monitoring, C.A. Willis, and J.S. Handloser, ed. Gordon and Breach, Science Publishers, New York (1972).

6. Kase, K.R. and Domen, S.R.: Nucl. Inst. Meth. 118: 469 (1974), Calorimetric and ionization measurements of stopping power in carbon for 19.5 GeV electrons.

7. Kase, K.R., Nelson, W.R., and Keller, L.: Health Physics 27: 243 (1974), Radiation measurements in secondary electron beam and comparison with calculations.

8. Nelson, W.R. and Kase, K.R.: Nucl. Inst. Meth. 120: 401 (1974), Muon shielding around high-energy accelerators -- Part I, Theory.

9. Nelson, W.R., Kase, K.R., and Svensson, G.K.: Nucl. Inst. Meth. 120: 413 (1974), Muon shielding around high-energy accelerators -- Part II, Experimental investiation.

10. Kase, K.R. and Hahn, G.M.: Nature 255: 228 (1975), Differential heat response of normal and transformed human cells in tissue culture.

11. Kase, K.R. and Hahn, G.M.: European J. Cancer 12: 481 (1976), Comparison of some response to hyperthermia by normal human diploid cells and neoplastic cells from the same origin.

12. Kase, K.R., Bjarngard, B.E., Maddox, B.J., and Svensson, G.K.: Proceedings of the Symposium on Measurements for the Safe Use of Radiation, March 1-4, 1976, Washington, DC Dose Control in Radiation Therapy.

13. Kase, K.R., Balter, S., Bjarngard, B.E.: Strahlentherapie (in press), Observations regarding the X-ray beams from the Philips RT-305 therapy machine.

14. Cobb, P.D., Kase, K.R., Bjarngard, B.E.: Health Physics 34:661 (1978) Radiation exposure of nursing personnel to brachytherapy patients.

15. Kase, K.R. and Nelson, W.R.: Concepts of Radiation Dosimetry, Pergamon Press, Elmsford, NY (1978).

16. Kase, K.R. and Bjarngard, B.E.: Radiology (in press), Dose to patients from bremsstrahlung in rotational electron therapy.

Robert V. Pound

Date of Birth: May 16, 1919, Ontario, Canada

Marital Status: Married

Degrees: 1941: B.A. University of Buffalo

1950: A.M. (honorary) Harvard University

Positions, Fellowships, and Professional Honors:

1941-42: Research Physicist, Submarine Signal Co., Boston

1942-46: Staff member, Radiation Laboratory, Massachusetts Institute of Technology

1945-48: Jr. Fellow, Society of Fellows, Harvard University

1948-50: Assistant Professor of Physics, Harvard University

1950-56: Associate Professor of Physics, Harvard University

1956-68: Professor of Physics, Harvard University

1968---: Mallickrodt Professor of Physics, Harvard University

1968-72: Chairman, Department of Physics, Harvard University

1975---; Director of the Physics Laboratories, Harvard University

1951: Fulbright Scholar, Oxford University

1958: Fulbright Lecturer, University of Paris

1957-58: Guggenheim Fellow

1972-73: Guggenheim Fellow

1973: Visiting Professor, College de France, Paris

Fellow of American Physical Society and American Academy of Arts and Sciences
Member, National Academy of Science
Associé Etranger, Académie des Sciences (Paris)
B.J. Thompson Memorial Award, IRE 1948
Eddington Medal, Royal Astronomical Society, 1965
125th Anniversary Award, SUNY at Buffalo 1971

R.V. Pound

Supplementary biographical information:

Government Studies and Committees:

Lincoln Summer Study (USAF) 1952

Consultant Lamplight Study 1953-4

Nobska Study (NAS-NRC for USN) 1956

Atlantis Study (USN) 1959

Project Sorrento (ONR, USN) 1959

Ocean Surveillance (NAS-NRC for USN) 1966

Advisory Committee, AFOSR for Physical Sciences, 1958-65

Commissioner, Commission on College Physics 1964-68

Member, Scientific Advisory Committees, United Technologies Corp., 1963 on.

Consultant NASA, 1975-78

Trustee, Assoc. Univ., Inc., 1976-

Trained by AEC, 1954, to receive byproduct materials - #20-297-4 prior to Harvard holding institutional license. Isotopes included ^{60}Co, ^{181}Hf, ^{137}Cs, ^{133}Ba, ^{3}H, ^{57}Co, ^{119}Sn, ^{67}Ga and the products of various reactor irradiations.

VIII. Biographical Note on Principal Investigator

Robert V. Pound made his first professional contributions to science and technology as a member of the Radiation Laboratory at MIT during World War II. He became known for introducing a technique of "broad banding," exemplified by the broad-band stub, for the design of microwave mixers, and for the development of devices based on the Magic-Tee, including the stabilization of microwave oscillators (Pound stabilizer). In the closing days of that laboratory, while engaged in writing for the Radiation Laboratory Series, the "moonlight" collaboration with E. M. Purcell and H. C. Torrey began, which resulted in the first detection of nuclear magnetism via resonant absorption in December 1945. He had been at that time elected a member of Harvard's Society of Fellows, but was on leave, pending the completion of activities at MIT.

During the next few years important contributions to the study of NMR were made. These included the fundamental theory of relaxation and linewidth (BPP) in 1947, the discovery and study of electric quadrupole interactions in crystals (1947 onward), the development of the stable and low noise version of the marginal oscillator (Pound Box). He first suggested the importance of alignment of nuclei as distinct from polarization, as an application of the electric quadrupole interaction in crystals (Pound Method of Nuclear Alignment). A collaboration with A. Abragam in 1952-53 led to a considerable advance in the understanding of the effects of fields in perturbing directional correlations. Perhaps his most widely known work is the measurement of the gravitational red-shift via the Mössbauer effect (1959-65). Two steps made in his laboratory

that were necessary to make that possible were the discovery and reduc
practice, in unbroadened form, of the resonance of Fe^{57} and the recogni
experimental confirmation of the effect of temperature on the γ-ray freq
relativistic time dilation. Another first was the observation of the ef
hydrostatic compression on γ-ray frequency.

Considerable work has continued in the area of nuclear magnetism, mu
of it in recent years relating to the development of polarized targets. A
recent experiment used such a target at the CEA to seek a violation of time
reversal symmetry in inelastic e-p scattering. The move into the study of
at high fields and low temperatures was an offshoot of the interest in polar
targets.

From 1963-1972 he served as Chairman of the Department of Physics at
Harvard. From 1975 he undertook the duties of Director of the Physics Labor-
atories. Since 1976, he has been a member of the Board of Trustees of Associate
Universities Inc. which oversees the Bookhaven National Laboratory and the
National Radio Astronomy Observatory where he serves on the panels on Astron-
omy and on Applied Sciences.

RESUME
of
EDUCATIONAL BACKGROUND
and
PROFESSIONAL EXPERIENCE

PERSONAL DATA

Name	GEOFFREY P. POLLITT
Marital Status	Unmarried (wife deceased) - three children
Nationality	British
Born	England, 2 June 1918
Health	Excellent
Religion	Church of England
Emigrated	To the United States, June 1961

EDUCATIONAL BACKGROUND

UNIVERSITY — Cambridge University, Trinity College, England 1936 to 1939

Subjects — Chemistry, Botany, Physiology, Biochemistry (Majors); Agriculture (1st year Diploma Course)

Awards — Honors in Part I Natural Sciences Tripos

Degrees — Bachelor of Arts (Honors) 1939
Master of Arts 1962

PUBLIC SCHOOL — St. Peter's College, Radley, Oxford, England 1931 to 1935. School Certificate 'A' awarded by Oxford and Cambridge Schools Examination Board. Passed with credits in all subjects taken - Latin, English, Mathematics, Physics & Chemistry - 1935.

MILITARY BACKGROUND

March 1939	Commissioned 2nd Lieutenant in Shropshire Yeomanry.
August 1941	Appointed to rank of Captain.
May 1942	Qualified as Flying Instructor, Royal Air Force.
June 1942	Appointed Flying Instructor No. 43 Officers Training Unit, R.A.F.
June 1943	Appointed Chief Ground Instructor No. 43 Officers Training Unit, R.A.F., Salisbury, England, (rank of Major).

January 1944	Appointed Commanding Officer 653 Air Observation Post Squadron, R.A.F. with rank of Major.
June 1944	Served overseas on active flying duties and operations in France, Belgium, Holland & Germany commanding 653 Air O.P. Squadron, R.A.F. until February 1945.
February 1945	Appointed General Staff Officer 1 to the Directorate of Operational Requirement at Air Ministry, London, with rank of Lieutenant Colonel.
May 1946	Demobilized with honorary rank of Lieutenant Colonel.

PROFESSIONAL EXPERIENCE

1946 to 1961	Managing Director of Makaianga Estate (Pvt) Ltd. - a private Company owning 2900 acres of ranch land in Rhodesia. Livestock and crop porduction including cattle, pigs, hybrid maize, market garden crops under irrigation, alfalfa (artificially dehydrated and milled for stock feeds), foundation grass seed production. Lettuce seed production for export to the United Kingdom. The Company employed two or more managers and 50 laborers.
1948 to 1961	Director of Aranbira Estates Ltd. - a public Company owning 2500 acres of ranch land and producing 180,000 lbs. of tobacco annually, together with maize and other crops. The Company employs two managers and 130 laborers.
1955 to 1960	Resident Director of The Tobacco Company of Rhodesia and S. Africa Ltd. - a London Company owning 13,000 acres of ranch land in Rhodesia and specializing in timber and tobacco production. I was responsible to the London Board for the entire operations of the Company in Rhodesia. Five managers and 320 laborers were employed by the Company. President - Mr. W.E.A. Robinson
1959 to 1961	Director of Marsham Court (Pvt) Ltd. This Company owns residential property in Salisbury, S. Rhodesia. Offered Chairmanship of the Company in 1960 but declined due to pressure of other interests. Chairman - Mr. G. Wimshurst.
1962 to 1964	Senior Research Assistant, Department of Cytology, Dartmouth Medical School, Hanover, N.H.
1963 to date	Administrative Aide, Department of Cytology, Dartmouth Medical School, Hanover, N.H.
1964 to date	Research Associate, Department of Cytology, Dartmouth Medical School, Hanover, N.H.
1965 to date	Director, Biological Laboratories, Harvard University

RESEARCH INTERESTS

Controlled artificial cultivation and seed production of Haemanthus katherinae to extend production period of endosperm cells for experimental cytology. Time-lapse photography of mitosis.

Research administration.

SOCIAL AND OTHER ACTIVITIES

Councillor of The Concession Road Council, Salisbury, Rhodesia, 1959.

Manager of the Federation of Rhodesia & Nyasaland Sailing Team, 1960 Olympic Games, Italy.

Commodore of Mazoe Sailing Club in Rhodesia for three years.

Travelled in France, Holland, Italy, Spain and Africa.

Sailing, flying, beekeeping and harpsichord making.

REFERENCES

Professor R. P. Levine, The Biological Laboratories, Harvard University Cambridge, Massachusetts 02138.

Professor J. R. Raper, The Biological Laboratories, Harvard University, Cambridge, Massachusetts 02138.

Professor James D. Watson, The Biological Laboratories, Harvard University, Cambridge, Massachusetts 02138.

Professor Keith R. Porter, Chairman, Department of Molecular, Cellular and Developmental Biology, University of Colorado, Boulder, Colorado 80302.

Professor Kenneth W. Cooper, Department of Biology, University of California, Riverside, California 92502.

Professor Shinya Inoué, Department of Biology, University of Pennsylvania, Philadephia, Pennsylvania.

Lord Acton, President Amalgamated Paper Packaging (Rhodesia) Ltd., c/o Makalanga Estate, P.O. Mazoe, Rhodesia.

Mr. W. E. A. Robinson, Past President, Tobacco Company of Rhodesia and S. Africa Ltd. 44, Lowndes Sq., London, S.W. 1., England.

NEW ENGLAND REGIONAL PRIMATE RESEARCH CENTER

HARVARD MEDICAL SCHOOL

Memorandum

To: Radioisotope Committee

From: Dr. Ronald D. Hunt

Date: November 10, 1967

The following information is provided relative to my training and experience with radioisotopes:

1. Summers of 1957 and 1958, employed by Atomic Energy Commission at U.C.L.A. to process tissues collected from animals exposed to fallout from atomic tests in Nevada.

2. Short course at Walter Reed Army Medical Center in 1959 on radiation biology. Included emphasis on protection and dosimetry.

3. From 1960-1963 I worked with isotopes at the Medical Research Laboratory at Fitzsimmons General Hospital under supervision of the chief of their radioisotope laboratory. This included use of Iodine-131, Tritium, Carbon-14, Zinc-65. The largest amount used by any of these isotopes was 1000 microcuries.

4. For the past two years I have worked with Dr. D. M. Hegsted at the Harvard School of Public Health using Calcium-47 as $CaCl_2$. Use to date has never exceeded 70 microcuries /per experiment.

5. I have a published chapter on Microautoradiography and its applications.

RDH/alw

Curriculum Vitae

RONALD DUNCAN HUNT

BORN:	October 9, 1935, Los Angeles, California
1953-54	Los Angeles City College
1954-55	University of California, Los Angeles
1957	B.S. University of California, Davis
1959	D.V.M. University of California, Davis
1959-60	Staff Member, Armed Forces Institute of Pathology
1960-63	Assistant Chief, Pathology Division, U.S. Army Medical Research and Nutrition Laboratory, Fitzsimmons General Hospital, Denver, Colorado
1963-64	Research Fellow in Pathology, Harvard Medical School
1964-69	Research Associate in Pathology, Harvard Medical School
1963-72	Pathologist-in-charge, Animal Research Center, Harvard Medical School
1964-	Lecturer in Nutritional Pathology, Massachusetts Institute of Technology
1965-76	Chairman, Division of Comparative Pathology, New England Regional Primate Research Center, Harvard Medical School
1966-75	Affiliate Pathologist, Angell Memorial Animal Hospital
1969-72	Principal Associate in Pathology, Harvard Medical School
1972-77	Associate Director, Animal Research Center, Harvard Medical School
1972-77	Associate Professor of Comparative Pathology, New England Regional Primate Research Center, Harvard Medical School
1976-	Director, New England Regional Primate Research Center, Harvard Medical School
1977	Professor of Comparative Pathology, New England Regional Primate Research Center, Harvard Medical School

MEMBERSHIPS

American College of Veterinary Pathologists
New York Academy of Sciences
International Academy of Pathology
American Veterinary Medical Association
American Society for Experimental Pathology
American Association for Laboratory Animal Science
New England Society of Pathologists
American Society of Primatologists
International Primatological Society
Phi Zeta (Honorary Society)
Phi Kappa Phi (Honorary Society)
Comparative Pathology Colloquy
Massachusetts Society of Pathologists
International Society for Comparative Leukemia Research

Curriculum Vitae

RONALD DUNCAN HUNT

SPECIALTY BOARD:	1964-	Diplomate, American College of Veterinary Pathologists
MILITARY SERVICE:	1959-61	First Lieutenant, Veterinary Corps, U.S. Army
	1961-63	Captain, Veterinary Corps, U.S. Army

APPOINTMENTS, AWARDS

1967, 1969, 1973	Co-author of "Most Outstanding Paper Published in Laboratory Animal Science"
1968, 1975	President, New England Branch, American Association for Laboratory Animal Science
1969-	Associate Editor, Laboratory Animal Science
1970-73	Member, Council on Accreditation of American Association for Accreditation of Laboratory Animal Care
1974-77	Member, National Research Council, Subcommittee on Laboratory Animal Nutrient Requirements
1975-76	Chairman Scientific Programs, American Association for Laboratory Animal Science
1975	Member, Commission on Continuing Education, American Society of Clinical Pathologists
1977-	Member, Editorial Board, Journal of Medical Primatology
1978-80	Member Editorial Board, American Journal of Veterinary Research
1979-82	Honorary Trustee, Charles Louis Davis D.V.M. Foundation

PUBLICATIONS

1. Thompson, S.W., Huseby, R.A., Fox, M.A., Davis, C.L. and Hunt, R.D.: Spontaneous Tumors in the Sprague-Dawley Rat. J. Nat. Cancer Inst. 27: 1037-1057, 1961.

2. Thompson, S.W., Hunt, R.D., Fox, M.A., and Davis, C.L.: Perivascular Nodules of Lymphoid Cells in the Lungs of Normal Guinea Pigs. Amer. J. Path. 40: 507-517, 1962.

3. Leveille, G. A., Sauberlich, H.E., and Hunt, R.D.: Effect of Dietary Lithocholic Acid on Liver Size of the Chick. Poultry Science 41: 1991-1992, 1962.

4. Leveille, G.A., Sauberlich, H.E., and Hunt, R.D.: Dietary Bile Acids and Lipid Metabolism. I. Influence on Lipids and Liver Size of Chicks. Proc. Soc. Exp. Biol. and Med. 114: 334-337, 1963.

5. Hunt, R.D., Leveille, G.A., and Sauberlich, H.E.: Dietary Bile Acids and Lipid Metabolism. II. The Ductular Cell Reaction Induced by Lithocholic Acid. Proc. Soc. Exp. Biol. and Med. 113: 139-142, 1963.

6. Hunt, R.D.: Dacryoadenitis in the Sprague-Dawley Rat. Amer. J. Vet. Res. 24: 638-641, 1963.

7. Hunt, R.D., Ferrell, J.F., Thompson, S.W., and Walton, G.: A Histochemical Comparison of the Inclusion Bodies of Canine Distemper and Infectious Canine Hepatitis. Amer. J. Vet. Res. 24: 1248-1255, 1963.

8. Thompson, S.W., and Hunt, R.D: Spontaneous Tumors in the Sprague-Dawley Rat. Incidence Rates of Some Types of Neoplasms as Determined by Serial Section Versus Single Section Technics. Annals N.Y. Acad. Sci. 108:832-845, 1963.

9. Leveille, G.A., Hunt, R.D., and Sauberlich, H.E.: Influence of Dietary Lithocholic Acid on Plasma and Liver Lipids and Liver Size of Growing Chicks. Fed. Proc. 22: 490, 1963.

10. Hunt, R.D.: Aberrant Thyroid Tissue in the Mouse. Science 141: 1054-1055, 1963.

11. Tanzer, M.L., and Hunt, R.D.: Osteoclasts, Organization in Chick Embryo Bone. Science 141: 1270-1272, 1963.

12. Tanzer, M.L., and Hunt, R.D.: Experimental Lathyrism. An Autoradiographic Study. J. Cell. Biol. 22: 623-631, 1964.

13. Ferrell, J.F., Hunt, R.D., and Nims, R.M.: Cervical Ganglioneuroma in a Dog. J. Amer. Vet. Med. Assoc. 144: 508-512, 1964.

14. Hunt, R.D., Leveille, G.A., and Sauberlich, H.E.: Dietary Bile Acids and Lipid Metabolism. III. Effects of Lithocholic Acid in Mammalian Species. Proc. Soc. Exp. Biol. and Med. 115: 277-280, 1964.

15. Leveille, G.A., Hunt, R.D., and Sauberlich, H.E.: Dietary Bile Acids and Lipid Metabolism. IV. Dietary Level of Lithocholic Acid for Chicks. Proc. Soc. Exp. Biol. and Med. 115: 569-572, 1964.

16. Leveille, G.A., Hunt, R.D., and Sauberlich, H.E.: Dietary Bile Acids and Lipid Metabolism. V. Reversibility of the Effects of Lithocholic Acid in Chicks. Proc. Soc. Exp. Biol. and Med. 115: 573-574, 1964.

17. Leveille, G.A., Hunt, R.D., and Sauberlich, H.E.: Dietary Bile Acids and Lipid Metabolism. VI. Protective Effect of Cholic Acid in Lithocholic Acid Fed Chicks. Proc. Soc. Exp. Biol. and Med. 116: 92-94, 1964.

18. Thompson, S.W., Hunt, R.D., Ferrell, J.F., Jenkins, E.D. and Monsen, H.: Histopathology of Mice Fed Irradiated Foods. (U.S.A. Med. Res. and Nutr. Lab. Report, 1963, pp. 1-68). J. Nutrition 87: 274-284, 1965.

19. Sasaki, H., Schaffner, F., Thompson, S.W., and Hunt, R.D.: Toxicity Testing of Fat Emulsions. II. Ultrastructural Changes in the Liver Following Administration of a New Intravenous Fat Emulsion (Intralipid). Amer. J. Clin. Nutr. 16: 37-42, 1965.

20. Thompson, S.W., Jones, L.D., Ferrell, J.F., Hunt, R.D. Meng, H.C., Kuyama, T., Sasaki, H., Schaffner, F. Singleton, W.S., and Cohn, I.: Testing of Fat Emulsions for Toxicity. III. Toxicity Studies with New Fat Emulsions and Emulsion Components. J. Clin. Nutrition 16: 43-61, 1965.

21. Hunt, R.D.: Proliferation of Bile Ductules (The Ductular Cell Reaction) Induced by Lithocholic Acid. Fed. Proc. 24: 431, 1965.

22. Hunt, R.D.: Animal Research Center and New England Regional Primate Research Center at Harvard University. The Vet. (Mass.) 11: 11-12, 1965.

23. Hunt, R.D.: Histochemical Methods for the Demonstration of Enzymes. Chapter 10 In: Selected Histochemical and Histopathological Technics by S.W. Thompson, pp. 1243-1255. Thomas, Springfield, Ill. 1966.

24. Hunt, R.D.: Microautoradiography. Chapter 14 ibid. 1966.

25. Hunt, R.D., and Melendez, L.V.: Spontaneous Herpes-T Infection in the Owl Monkey (Aotus trivirgatus). Path Vet. 3: 1-26, 1966.

26. Melendez, L.V., Hunt, R.D., Garcia, F.G., and Trum, B.F.: A Latent Herpes-T Infection in Saimiri sciureus (Squirrel monkey). In: Recent Developments in Comparative Medicine pp.393-397. Academic Press. 1966.

27. Garcia, F.G., and Hunt, R.D.: The Hematogram of the Squirrel Monkey (Saimiri sciureus). Lab. Anim. Care 16: 50-51, 1966.

28. Hunt, R.D., Garcia, F.G., and Hegsted, D.M.: Vitamin D Requirement of New World Primates. Fed. Proc. 25: 1966, p.545.

29. Melendez, L.V., Hunt, R.D., and King, N.W.: A Latent Nuclear Inclusion Agent Isolated from Sand Rats (Psammomys obesus) Fed. Proc. 25: 1966.

30. Melendez, L.V., and Hunt, R.D.: Current Views on Herpes-T Infection in South American Monkeys. Proceedings 5th Pan American Congress of Vet. Med. and Zootechnique. 2: 930-936. 1966.

31. Hunt, R.D., Garcia, F.G., and Hegsted, D.M.: Vitamin D Deficiency in New World Monkeys. Lab. Primate Newsletter 5: 12-13, 1966.

32. Melendez, L.F., Hunt, R.D., King, N.W., Garcia, F.G., Like, A.A., and Miki, E.: A Herpes Virus from Sand Rats (Psammomys obesus). Lab. Anim. Care 17: 302-309, 1967.

33. Hunt, R.D., King, N.W., and Melendez, L.V.: Cytomegalic Inclusion Disease in Sand Rats (Psammomys obesus): Histopathologic Evidence. Amer. J. Vet. Res. 28: 1190-1193, 1967.

*34 Hunt, R.D., Garcia, F.G., and Hegsted, D.M.: A Comparison of Vitamin D_2 and D_3 in New World Primates. I. Production and Regression of Osteodystrophia Fibrosa. Lab. Anim. Care 17: 222-234, 1967.

35. Daniel, M.D., King, N.W., Hunt, R.D., and Melendez, L.V.: Herpes -T Virus Isolation from a Natural Disease in Squirrel Monkeys (Saimiri sciureus). Fed, Proc. 26: 421, 1967.

36. King, N.W., Hunt, R.D., Daniel, M.D., and Melendez, L.V.: Overt Herpes -T Infection in the Squirrel Monkey (Saimiri sciureus). Lab. Anim. Care 17: 413-423, 1967.

37. Hunt, R.D., Garcia, F.G., Hegsted, D.M., and Kaplinsky, N.: Vitamin D_2 and D_3 in New World Primates: Influence on Calcium Absorption. Science 157: 943-945, 1967.

38. Hunt, R.D., and Chalifoux, L.: The Hemogram of the Tree Shrew (Tupaia glis). Folia Primatologica 7: 34-36, 1967.

39. Plank, S.J., Hunt, R.D., and Cohen, A.S.: Amyloidosis in Guinea Pigs Immunized with Sperm and Adjuvant. Nature 214: 1368-1369, 1967.

40. Daniel, M.D., Karpas, A., Melendez, L.V., King, N.W., and Hunt, R.D.: Isolation of Herpes -T Virus from a Spontaneous Disease in Squirrel Monkeys (Saimiri sciureus). Arch. Ges. Virusforsch. 22: 324-331, 1967.

* Recipient of the American Association for Laboratory Animal Science Research Award for the most outstanding paper published in Laboratory Animal Care in 1967.

41. Melendez, L.V., Daniel, M.D., Hunt, R.D., and Garcia, F.G.: An Apparently New Herpesvirus from Primate Kidney Cultures of the Squirrel Monkey (Saimiri sciureus). Lab. Anim. Care 18: 374-381, 1968.

42. Melendez, L.V., Hunt,R.D., Daniel,M.D.,and Garcia, F.G.: Natural Herpes simplex Infection in Owl Monkeys (Aotus trivirgatus). Fed. Proc. 27: 664., 1968.

43. Melendez, L.V.,Espana, C., Hunt,R.D., Daniel, M.D. and Garcia, F.G.: Natural Herpes simplex Infection in Owl Monkey (Aotus trivirgatus). Lab. Anim. Care 19: 38-45, 1969.

44. Hunt, R.D., Garcia, F.G., and Hegsted, D.M.: Hypervitaminosis D in New World Monkeys. Amer. J. Clin. Nutr. 22: 358-366, 1969.

45. Hunt, R.D., and Melendez, L.V.: Herpes Virus Infections of Non-Human Primates: A Review. Lab. Anim. Care 19: 221-234, 1969.

**46 Melendez, L.V., Daniel, M.D., Garcia, F.G., Fraser, C.E.O. Hunt, R.D., and King, N.W.: Herpes saimiri I. Further Characterization Studies of a New Virus from the Squirrel Monkey. Lab. Anim. Care 19: 372-377, 1969.

**47 Melendez, L.V., Hunt, R.D., Daniel,M.D., Garcia, F.G. and Fraser, C.E.O.: Herpes saimiri II. Experimentally Induced Malignant Lymphoma in Primates. Lab. Anim. Care 19: 378-386, 1969.

48. Hunt, R.D., Calligure, T.J., and Chalifoux, Laura: Variation of Serum Alkaline Phosphatase in Squirrel Monkeys (Saimiri sciureus). Fed. Proc. 28: 805. 1969.

49. Melendez, L.V., Daniel, M.D., Hunt, R.D., and Garcia, F.G.: Herpes saimiri, A Virus that Produces A Disease Resembling Reticulum Cell Sarcoma in Nonhuman Primates. Lab. Primate Newsletter 8: 1-2, 1969.

** Recipient of the American Association for Laboratory Animal Science Research Award for the most outstanding paper(s) published in Laboratory Animal Care in 1969.

Curriculum Vitae

October, 1976

Name: LITTLE, John Bertram

Birth: 5 October 1929, Boston, Massachusetts

Education: A.B. (Physics) Harvard University, 1951

M.D. Boston University, 1955

Positions Held:

Intern (medicine) Johns Hopkins Hospital, Baltimore Maryland	1955-56
Assistant Radiologist, U.S. Army Hospital, Fort Hood, Texas	1956-57
Chief of Radiology, U.S. Army Hospital, Landes de Bussac (Bordeaux), France	1957-58
Resident in Radiology, Massachusetts General Hospital, Boston, Massachusetts	1958-60
Chief Resident in Radiology, Massachusetts General Hospital, Boston, Massachusetts	1960-61
Clinical Assistant in Radiology, Massachusetts General Hospital, Boston, Massachusetts	1961-65
Research Fellow in Physiology, Harvard School of Public Health, Boston, Massachusetts	1962-63
Instructor in Physiology (Radiobiology), Harvard School of Public Health, Boston, Massachusetts	1963-65
Consultant in Radiology, Massachusetts General Hospital, Boston, Massachusetts	1965-
Assistant Professor of Radiobiology, Harvard School of Public Health, Boston, Massachusetts	1965-69
Lecturer on Radiology, Harvard Medical School, Boston, Massachusetts	1969-
Associate Professor of Radiobiology, Harvard School of Public Health, Boston, Massachusetts	1969-75
Professor of Radiobiology, Harvard School of Public Health, Boston, Massachusetts	1975-

Professional Memberships:

American Boards of Radiology and Nuclear Medicine (Certified, 1961)
American Association for Cancer Research
American Physiological Society
Health Physics Society
Radiation Research Society

Bibliography

John B. Little

1. Little, J. B. X-ray seminars of the Massachusetts General Hospital -

   Large Solitary pulmonary nodule. J.A.M.A. 180: 234-235, 1962.

   Pain and abdominal mass following appendectomy. J.A.M.A. 180: 544-545,1962.

   Disseminated malignant disease. J.A.M.A. 180: 248-249, 1962.

   Destructive bone lesion following injury. J.A.M.A. 181: 248-249, 1962.

   Partial obstructions of large and small bowel. J.A.M.A. 181: 627-629, 1962.

   Congenital urinary-tract disease. J.A.M.A. 181: 1067-1069, 1962.

   Acute cardiovascular disease. J.A.M.A. 182: 289-291, 1962.

   Generalized collagen-vascular disease. J.A.M.A. 182: 1110-1113, 1962.

2. Maruyama, Y. and J. B. Little. Roentgen manifestations of traumatic pulmonary fat embolism. Radiology, 79: 945-952, 1962.

3. Wang, C. C., J. B. Little and M. D. Schulz. Cancer of the nasopharynx: Clinical and radiotherapeutic considerations. Cancer, 15: 921-926, 1962.

4. Little, J.B., J. P. Lavender and R. W. DeSanctis. The narrow infundibulum in pulmonary valvular stenosis: Its preoperative diagnosis by angiocardiography. Circulation, 28: 182-189, 1963.

5. Little, J. B., M. D. Schulz and C. C. Wang. Results of radiation therapy for cancer of the nasopharynx: Long-term follow-up on 113 adequately treated patients. A.M.A. Arch. Otolaryngology, 77: 621-624, 1963.

6. Little, J. B. and E. P. Radford, Jr. Bio-assay for antidiuretic activity in blood of undisturbed rats. J. Appl. Physiol.,19: 179-186, 1964.

7. Little, J. B. and E. P. Radford, Jr. Effects of ionizing radiation and their importance in anesthesiology. Anesthesiology, 25: 479-489, 1964.

8. Little, J. B. and E. P. Radford, Jr. Circulating antidiuretic hormone in rats: Effects of dietary electrolytes and protein. Am. J. Physiol., 207: 821-825, 1964.

9. Radford, E. P., Jr., V. R. Hunt and J. B. Little. Polonium-210 in cigarette smoke. Science, 146: 86-87, 1964.

10. Little, J. B. and R. S. Chang. Radiation resistance in lipovirus-altered human cells. Science, 148: 1746-1747, 1965.

Ronald E. Vanelli

Personal	Born	July 5, 1919, Quincy, Massachusetts
	Married	1953
	Children:	Mark, 1957; Jill, 1960

Education

Quincy Public Schools

Harvard University, A.B. 1941; M.A. 1950; Ph.D. 1950
(Synthetic Organic Chemistry)

Service

Post Graduate School, U.S. Naval Academy, Fall, 1941

Line Officer in Destroyer, December 1941 - February 1946

Employment

DuPont, July 1950 - June 1951

Harvard University, 1951 -
- Lecturer on Chemistry, 1951 - 1974
- Senior Lecturer on Chemistry, 1974 -
- Director, Chemical Laboratories, 1951 - 1979
- Director, Science Center, 1972 -

APPENDIX # 3

RADIATION DETECTION INSTRUMENTS

Survey Instruments

33 Eberline E-120 GM survey meters 0-50mr/hr

9 Nuclear Chicago 2612 GM survey meters 0-20mr/hr

11 Nuclear Chicago 2650 GM survey meters 0-100mr/hr

6 Victoreen Thyac III GM survey meters 0-200mr/hr

2 Victoreen Model 493 GM survey meters 0-50mr/hr

5 Picker Lab Monitor GM survey meters, Model 642081 0-30K cpm

1 Baird-Atomic 420 GM survey meter 0-100mr/hr

1 Baird-Atomic 540 GM survey meter 0-50mr/hr

1 Technical Associates PUG-1 GM survey meter 0-50K cpm

55 Mini-Instrument Ltd. Type 5.10 GM survey meters 0-100k cps

1 Nuclear Chicago QT6 Ionization chamber 0-250mr/hr

4 Tracerlab SU1H Ionization chambers 0-150mr/hr

4 Tracerlab SU3L Ionization chambers

3 Tracerlab SU5A Ionization chambers

3 Ludlum Model 2 Survey meters with gamma-scintillator probe Model 44-3 0-50,000 cpm

Liquid Scintillation Counters

9 Packard Model 3375

3 Packard Model 3385

6 Packard Model 3255

7 Packard Model 3330

18 Packard Tri-Carb Liquid Scintillation Counters

4 Beckman Model 3313P

5 Beckman Model LS345

3 Beckman Model LS 255

4 Beckman Model LS 250

4 Beckman Model LS 230

1 Beckman Model LS 8100

4 Beckman Model LS 233

7 Searle Analytic Mark III Model 6880

3 Searle Analytic Model 1185

7 Searle Analytic Model 1190

7 Nuclear Chicago Mark I

1 Nuclear Chicago Unilux I

17 Nuclear Chicago, (no model number)

1 Nuclear Chicago Isocap

1 Picker Model 220

Gamma Counters

6 Packard Model 578

3 Packard Model 5260

9 Packard Gamma Counters (no model number)

3 Beckman Gamma 300

2 Beckman Gamma 4000

a. For contamination

GM Counter	1.4 mg/cm^2 end window GM tube detects alpha particles above 1.9 MEV beta, gamma. Picker Cliniscaler #600-150 with precision discriminator. - 0-10^6 cpm
Liquid Scintillation Spectrometer	Packard Tri-Carb with 3 channels #3310-0-10^5 cpm

b. Low level GM survey instruments

Picker Labmonitor 600-081
End window geiger tube 1.4 mg/cm^2 for alpha, beta, gamma
Ranges (5) 300-30,000 c/m
Contains battery pack for portable use in field.

c. Neutron survey instrument

Fairport Instruments Inc.
Model 420 Fast Neutron Dosimeter (tissue equivalent)
Detector proton recoul proportional counter
Ranges 0-25, 0-250, 0-2500 mrem/hr.

d. Tritium monitor

Texam Nuclear Instrument Co.
Model 9160 "sniffer" tritium monitor
Range 100 uc T/m^3 air to 100,000 uc T/m^3 air

e. Air sampling equipment

The Staplex Company
Model TF-1a Hi-Vol Air Sampler
Flow rate 20 CFM with TFA #41 filter of 4 inches diameter.

f. 8 Eberline E-120 GM survey meters with thin end window probe and audible speaker 0-50 mr/hr - 1.4 mg/cm^2

1 Victoreen Thyac with thin end window probes and audible speaker 0-20^{0}mr/hr. - 1.4 mg/cm^2
2 Victoreen 440 survey meters - ionization chambers - 0-300 mr/hr. - 3.0 mg/cm Mylar
1 Victoreen 440RF survey meter - ionization chambers - 0-300 mr/hr. - 5 mg/cm^2 Acrylic
1 Eberline PAC 4G with alpha probe model Ac-21 and tritium probe model - .85 mg/cm^2 0-5k cpm
1 Nuclear Measurements PCCIO-A Ser.673 Proportional Counter Converter (with windowless flow counter)

1 Baird Atomic Scintillation Detector Model 810 using 2" thick NaI(Ti) Well Crystal - 0-10^6 cpm
1 Nuclear Chicago Model 2592 Exposure Ratemeter (cutie pie) with Model 2593 Ion chamber- 0-1000 mr/hr. - 0-10.
2 Victoreen Radector 111 0- 1KR/hr, 20 mg/cm^2 #2025

1 Rad-Gun Model AgB-10KG-5R - 0-10R/hr
1 Ludlum Model 1 with low energy thin NaI Scintillation detector.

G. Victoreen Model 570 Condenser r-meter with 1r, 2.5r, 10r, 100r, chambers.

H. Victoreen Model 687D, Minometer II - Charger-Reader with indirect reading Chambers 0-40mR and 0-200mR.

I. Harshaw Automatic Intergrating Picoammeter Model 2000B with Theroluminescence detector models 2000C and 2000P - 0-1MR.

J. Ludlum 2206 Scaler-Ratemeter with Anderson-Braun moderator and Nancy Wood detectors.

K. Canberra Multichannel Analyzer - Series 30 with 3" X 3" NaI crystal detector - Range 1024 channels; 10^6-1 counts/channel.

Appendix # 4 - METHOD, FREQUENCY AND STANDARD USED IN CALIBRATING INSTRUMENTS LISTED.

I. Calibration of Instruments

Laboratory equipment used for contamination or bioassay measurements is checked daily with a reference source when in use.

Survey Instruments are checked monthly with cross comparison to a calibrated instrument or a small check source. The instruments are calibrated with a standard source of ^{60}Co, radium, or ^{137}Cs semi-annually. The instruments used for the surveys in the laboratories by the safety staff are calibrated monthly and prior to each survey where exact dose measurements are required. They are also spot-checked prior to every field survey.

The calibration is carried out in a special facility by the radiation protection staff. The standards available for instrumentation calibration are:

II. Beta Standards for GM counter

Beta reference sources from New England Nuclear Co. including ^{14}C, ^{60}Co, ^{204}Tl, ^{210}Bi, and ^{234}Pa.

III. Gamma Standards for Scintillation Counter

Gamma reference sources to include ^{137}Cs, ^{60}Co, ^{57}Co, and ^{22}Na from NENUC

IV. Gamma Standards for Iodine Surveys and Thyroid Scans ^{125}I and ^{131}I simulated standards, including ^{125}I NES 211S and ^{131}I NES 214

V. Standards for Liquid Scintillation Counter

Standard Source Set with Packard Tri-Carb including ^{14}C, ^{3}H, and ^{36}Cl

R-Meter for X and Gamma Fields

Victoreen Instrument Co. Model 570 Condenser R-Meter with chambers from 0.025 R to 100 R including low and medium energy chambers (7).

VI. Gamma Sources for Instrument Calibration

Radium	50 mg, 3 mg, 10 mg, and two less than 1 mg.
^{60}Co	3 mCi, 15 mCi, 100 mCi, and 250 mCi.
^{137}Cs	5 mCi, 25 mCi.

VII. The Laboratory survey meters of authorized users are calibrated on a semi-annual basis with the measurements taken at a minimum of 2 points on each scale. These calibrations are carried out at the Harvard University Health Services calibration facility. The calibration procedure is as follows:

1. Instrument checked for contamination of detector.
2. Mechanical zero is checked and adjusted if necessary (meter turned off).
3. Batteries checked and replaced or charged, if necessary.

VII. - Con't.

4. Response checked for isotropism (side or end window) and direction of calibration specified, where appropriate.
5. Reproducibility checked by repeating measurements three times. Both source and detector are moved and repositioned each time.

Calibrations made of low dose levels with both sources and detector suspended on ring stands which are moved as far as possible from surrounding walls, floor, and other scattering surfaces. Distances are measured from center of source to center of detector with tape measure.

Calibrations of high dose levels made with source positioned on specially constructed table. The detector is positioned on supports at pre-measured distances.

A variety of sources are available including 226Ra (standardized by comparison to NBS standards), sources of 0.177 mCi, 1 mCi and 50 mCi, 137Cs, 241Am.

The calculations are basically checked with a Victoreen R-meter and and the dose rates are calculated using the equation:

$$\frac{\Gamma_A}{r^2}$$

The calibration curve is plotted and the intermediate points taken from this curve.

Appendix # 5

FACILITIES AND EQUIPMENT

Diagram #1 depicts the radioisotope laboratory at the Holyoke Center under the supervision of the radiation safety office, including a brief description of the facilities. This facility is open to all University personnel who may have need of the shielded cave, calibration facilities, laboratory, hood, or shielded storage area. A diagram is also included of the EH&S laboratory facilities where the low level procdures are carried out to include bioassay preparations, survey wipe test preparation, and other radioactive work.

The University facilities may be divided into the Cambridge and Medical Areas. These are described as follows:

Cambridge Area

1. Biological Laboratories - A three cornered building of five floors for use of radioactive materials including a "hot laboratory" which has a shielded hood, lead shielding for storage of stock solutions, and a glove box for iodinations which is attached to the hood and a continuous air sampler. (see diagram #2)

2. Chemistry Department - includes Conant Laboratory which has several laboratories for the use of radioactivity including approved hoods, stainless steel sinks, and non-porous benches. Also the Gibbs and Mallinckrodt Buildings, which are older buildings for use of low-level work.

3. Physics and Applied Physics Building including Jefferson, Lyman and Cruft used by the Physics Department for research purposes including shielded areas for sealed sources. The Gordon McKay Building and Engineering Building have laboratories also for low level materials. A new Science Center has been recently opened and has facilities for the storage and use of sealed sources as well as low level prepatory rooms for student demonstrations.

Medical Area

1. Medical School Complex consists of nine buildings, of which several have been remodeled for all research and teaching purposes. These have four laboratories which have been equipped with continuous air samplers for radioiodinations, stainless steel remote control hoods, and non-absorbent benches. Two radioactive storage areas are housed here for the receipt, storage, and disposal of radioactive waste and have space for over 50 thirty gallon barrels. A freezer has just been installed in one of them which has a fenced-in locked area. These are located at opposite ends of the quadrangle for the convenience of the users who may deposit their waste at specified times with radiation staff personnel who log in and package the waste. Every laboratory must be approved for use of radioactive materials as part of the review of the application for an authorization.

2. Also part of this complex is the School of Dental Medicine which has several approved research laboratories.

3. The Laboratory for Human Reproduction and Reproductive Biology was constructed 5-6 years ago and has modern hoods, benches, sinks, and an approved radioiodination laboratory with a continuous air sampler. The L.H.R.R.B. has one area designated as an animal facility with storage space for animal carcasses.

4. A new Seeley Mudd Building of five stories in height has been recently opened and has three approved laboratories for radioiodinations equipped with continuous air samplers. These all have modern facilities.

5. The School of Public Health formerly had a "hot lab." but it has partially been dismantled for other purposes but is still used for radioactive materials. There are two approved areas for radioiodinations with continuous air samplers and a large animal research facility. The Industrial Hygiene and Radiological Sciences laboratories are here with appropriate facilities.

6. The Angel Memorial Building has been acquired for animal studies and is equipped with operating tables, animal housing facilities, and storage for animal carcasses. There are also research laboratories which have been remodeled for the use of radioactive materials.

7. The Shields Warren Radiation Laboratory has modern facilities including animal facilities for animal use of radioisotopes, an iodination laboratory with a continuous air sampler and nuclear medicine research laboratories with appropriate hoods, lead shielding, and storage areas. A cesium irradiator (separate license) is also housed here.

Many special facilities are available throughout the complex for receipt, storage, handling, and disposal of radioactive materials. A special freezer is located in the School of Public Health for the storage and disposal of animal carcasses and two hold-up tanks are in the former "hot lab." for short-lived material, if necessary.

Iodination facilities are equipped in general with continuous air samplers unless the use is sporadic in which case the iodinations are monitored for the release of airborne effluents on an individual basis. Where the situation warrants it, special charcoal filters have been installed in the ducts and if the releases are still higher than desired, specially built lucite boxes are used which are connected to charcoal traps that remove the gaseous radioiodine prior to its reaching the ducts. (Please see attachment # 1)

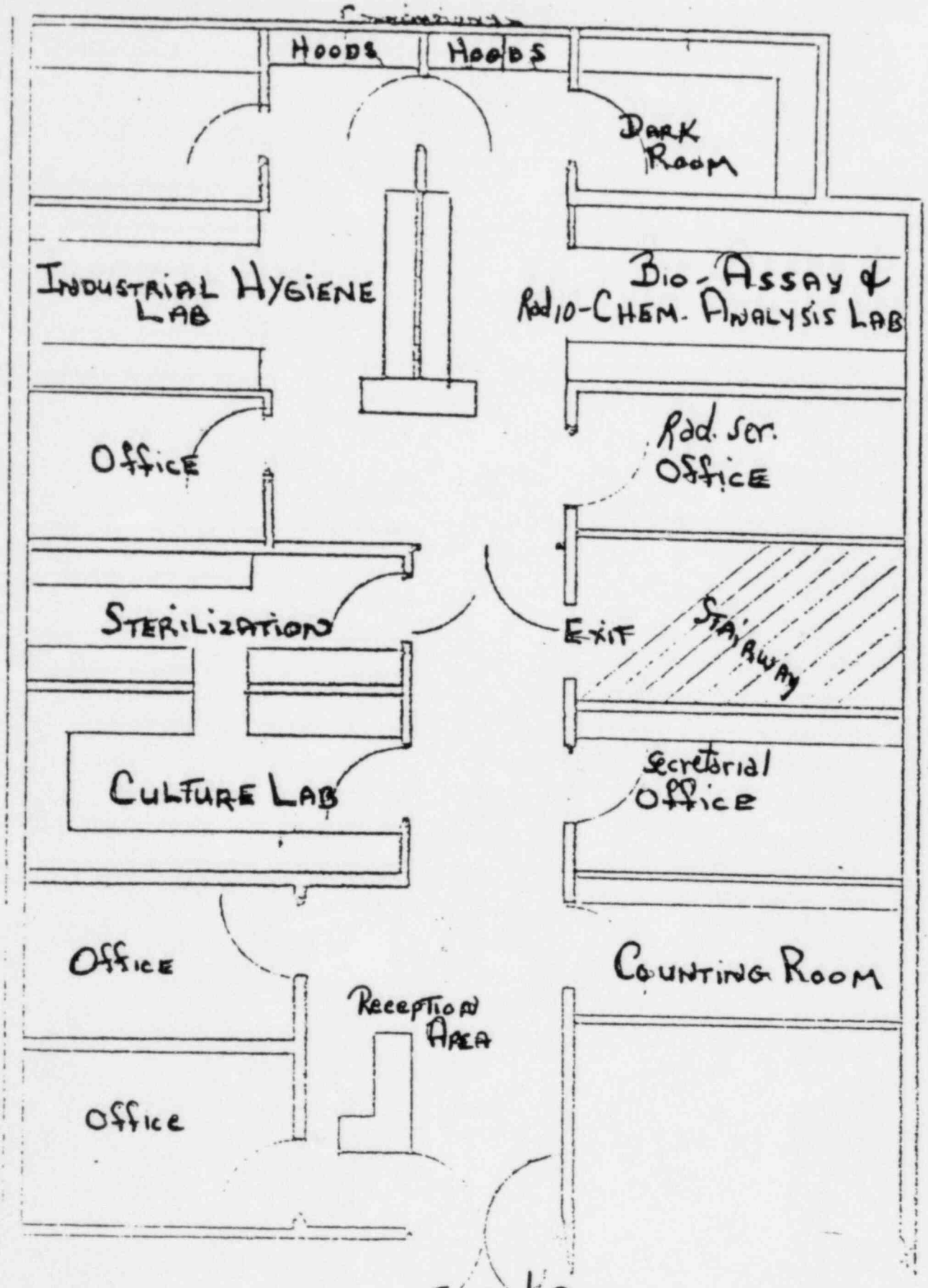
NUCLEAR REGULATORY COMMISSION
APPLICATION FOR BYPRODUCT MATERIAL LICENSE
APPENDIX # 5

Facilities and Equipment

Laboratory facilities include a radioisotope laboratory and a conventional chemical laboratory for bioassays. A darkroom is also located in the conventional laboratory area.

The radioisotope laboratory has the following equipment:

1. Cave box containing a pair of remote handling tongs; 1.5 inches of lead shielding, lead glass viewing window. Air from cave box is exhausted through an absolute filter.
2. Fume hood. Air from fume hood is exhausted through absolute filter and flow rate checked by Environmental Health and Safety.
3. Hold-up tank. Stainless steel.
   Liquids can be held for decay in this tank and monitored before release to the sewer system.
4. Source storage room. Contains four storage pits, each 12" in diameter, three feet deep with Pb covers 4 inches thick.
   Also metal cabinets for storage of source.
5. Remote handling tools including multipurpose type with four different jaw attachments. Tools for special remote operations fabricated as needed.
6. Gamma alarm area monitor. Nuclear Measurements Corp., Model GA-2.
7. GM counter for contamination and personnel surveys.
8. Copious supply of lead bricks.



E.H.&S.

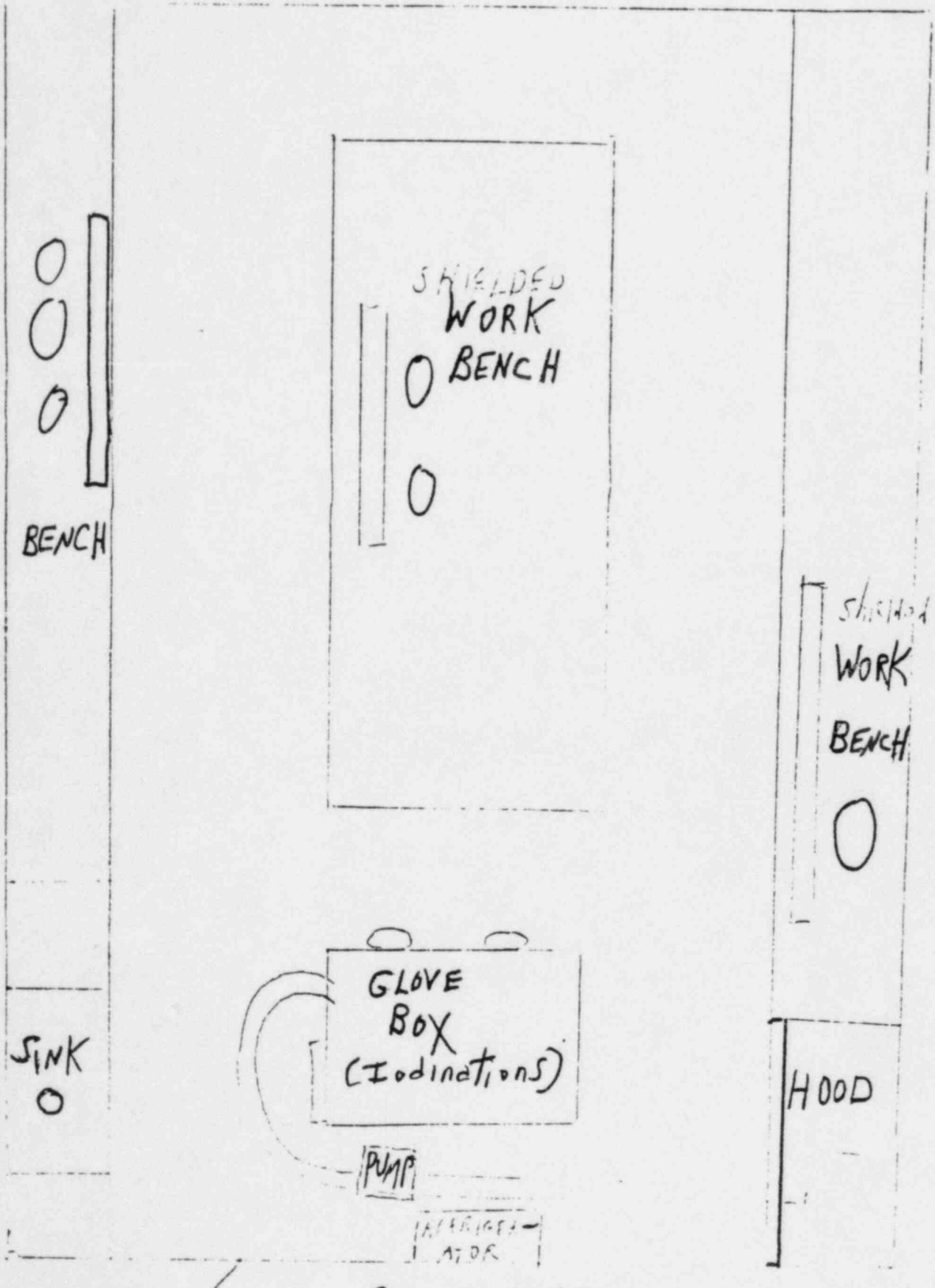
Offices and Conventional Chemical Laboratories

1 = 1 foot

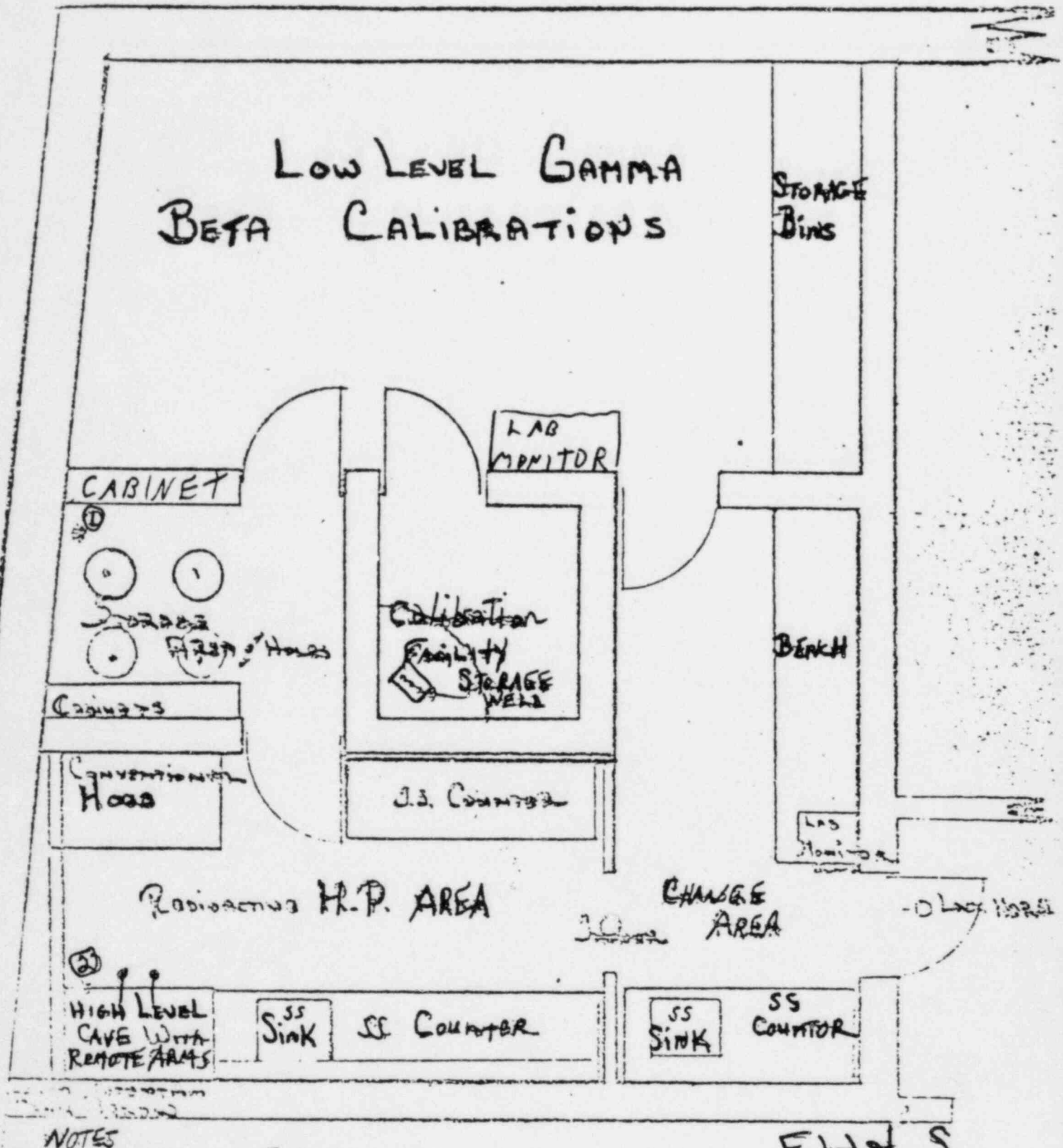
1962

4th floor

BIOLOGICAL LABS



ROOM 540



NOTES

① STORAGE HOLES 5 FEET IN DEPTH WITH LEAD 4" COVERS

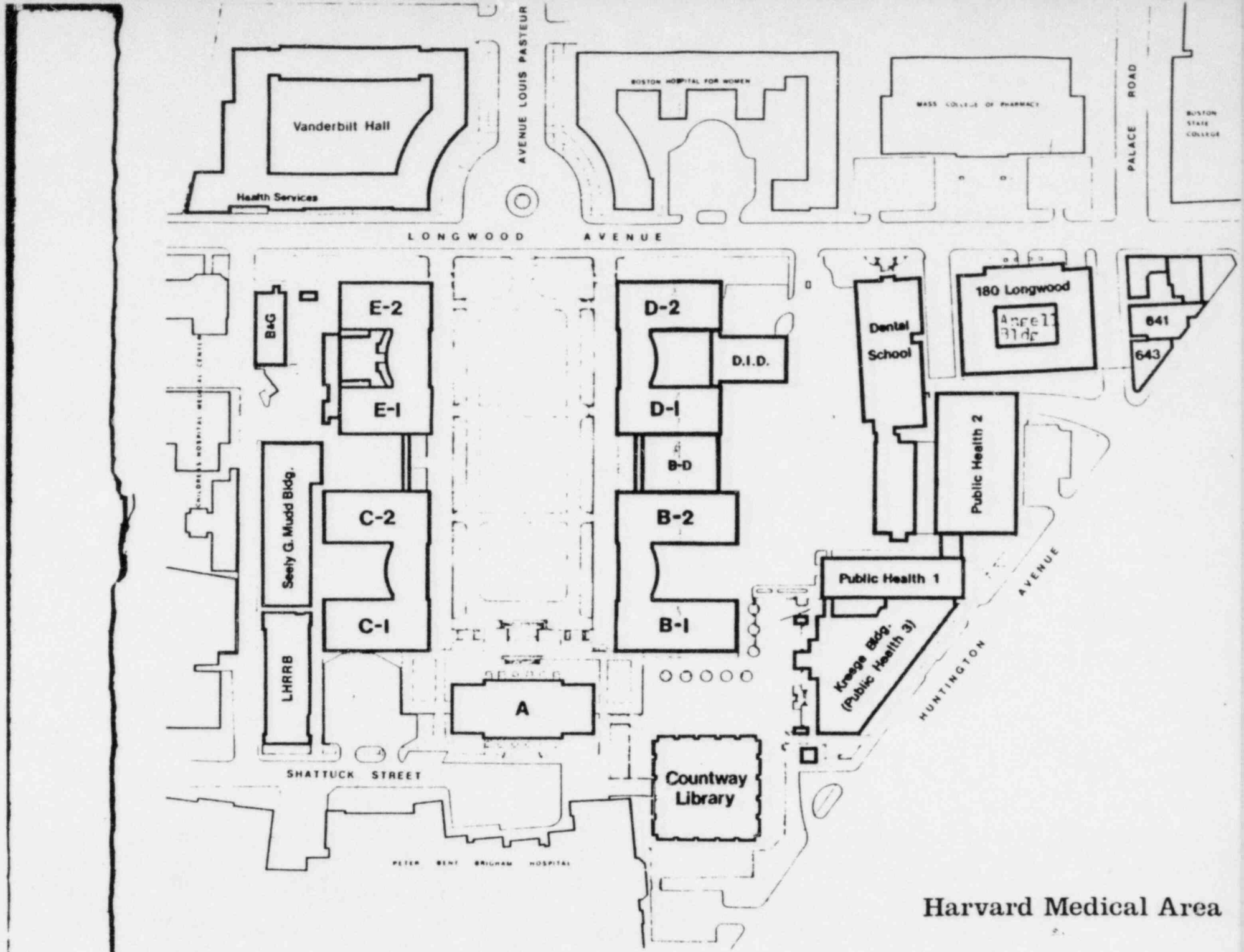
② HIGH LEVEL CAVE SHIELDED WITH 1.5 INCHES LEAD

HIGH LEVEL RADIOACTIVITY LABORATORY AREA

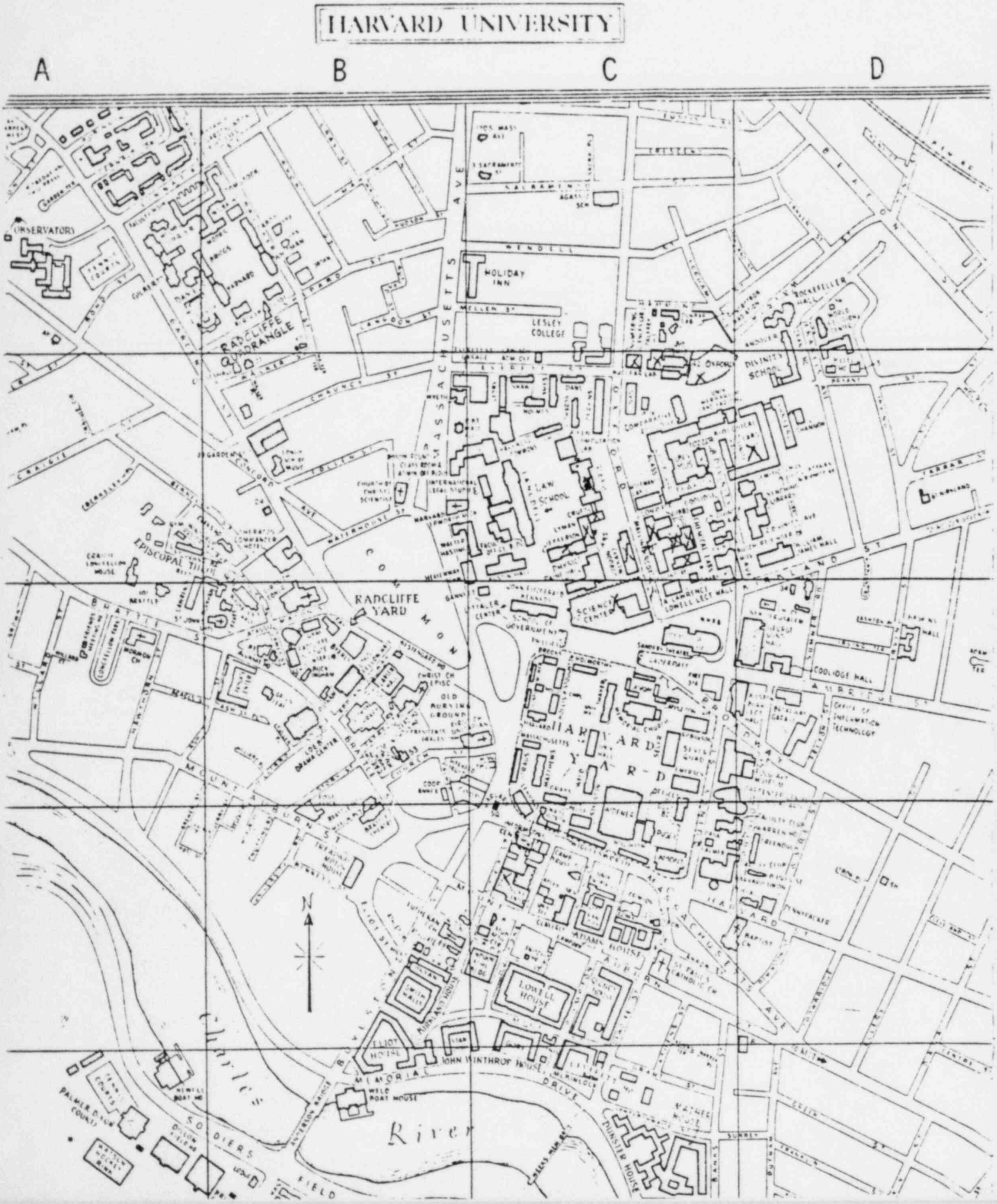
98HR2

Scale: ½" = 1 foot

SUB-BASEMENT



Harvard Medical Area


HARVARD UNIVERSITY
A
B
C
D
HOLIDAY INN
LESLEY COLLEGE
RADCLIFFE QUADRANGLE
RADCLIFFE YARD
EPISCOPAL THEOL SCH
DIVINITY SCHOOL
SCIENCE CENTER
COOLIDGE HALL
HARVARD YARD
LOWELL HOUSE
ELIOT HOUSE
JOHN WINTHROP HOUSE
WEEKS BOAT HOUSE
SOLDIERS FIELD
River
MASSACHUSETTS AVE
MEMORIAL DRIVE
N

APPENDIX # 6

STORAGE OF SEALED SOURCES

ISOTOPE	AMOUNT	CONTAINER/DEVICE	MANUAFACTURER	MODEL/SERIAL #(S/N)
210Po	1.45 uCi	Lead Box	N/A	S/N A668
55Fe	0.86 mCi	Lead Box	Isotopes Products Labs.	A-2 capsule
109Cd	0.27 mCi	Lead Box	Isotopes Products	A-2 Capsule
55Fe	1 mCi	Lead Box	N/A	S/N A488
60Co	<10 uCi	Lead Box	N/A	N/A
244Cm	0.092 mCi	Lead Box	N/A	S/N B769
55Fe	0.59 mCi	Lead Box	N/A	S/N B-770
244Cm	0.094 mCi	Lead Box	N/A	A996
133Ba	100 uCi	Lead pig	N/A	N/A
60Co*	1.5 mCi	Lead Pig	N/A	N/A
241/Am/Be	3 mCi	Lead Pig in lead box	N/A	S/N AMN-33073
90Sr	3.3 mCi	Lead Pig in safe	N/A	N/A
60Co*	<1.6 mCi	Lead Pig	N/A	N/A
137Cs	3.9 mCi	Lead Pig	Tracer Lab.	N/A
60Co	716 mCi	irradiator	Technical Operations	Model 402
60Co*	0.66 mCi	Lead pig	Nuclear Chicago	S/N A27
60Co*	0.150 mCi	Lead pig	N/A	N/A
90Sr*	10 mCi	Lead pig	Victoreen	Model 540B
241Am/Be	0.029 gms.	Polyethylene Can	Monsanto	N/A
137Cs*	34.4 mCi	Lead Pig	N/A	N/A
90Sr*	217 mCi	Lead pig in lead box	3M	Model 601B
90Sr*	217 mCi	Lead pig in lead box	3M	Model 601B
241/Am/Be	10 mCi	Borated polyethylene	N/A	N/A
137Cs	10X0.01 mCi	Cabinet (shielded can)	N/A	N/A
241Am	100 mCi	Lead Pig	NEN	Model A-198
3H*	500 mCi	Tin can	Amersham	Model TRC3
55Fe*	12.7 mCi	Lead Pig	NEN	S/N 240917
241Am*	0.250 mCi	Cabinet	N/A	N/A
241Am/Be	$8.3X10^3$ m/sec	Lead Pig	Monsanto	N/A
252Cf	0.200 mCi	Polyethylene shielded can	Savannah River Lab.	University Source
60Co*	0.095 mCi	Lead Pig	Tracer Lab.	Model R-31
90Sr*	4X200 mCi	Lead Pig in Lead Box	N/A	N/A
60Co*	0.182 mCi	Lead Pig	N/A	S/N 529
90Sr*	50 mCi	Applicator in wooden box	Technical Operations	Model M1
90Sr*	6.6 mCi	cabinet	Research Specialties	Model 600-3
90Sr*	13 mCi	cabinet	Jarrel - Ash Chromatograph	Model 26-752
90Sr*	13 mCi	cabinet	" "	Model 26-252
90Sr*	6.31 mCi	cabinet	Research Specialties	Model 600-3
60Co*	81.4 mCi	well	N/A	N/A
60Co	2 mCi	Lead Pig	AECL	N/A
60Co	54.4 mCi	Lead Pig	N/A	N/A
60Co*	21 mCi	Lead Pig	N/A	N/A
3H*	55 mCi	cabinet	Chromatograph source	N/A
137Cs	15 mCi	Iron pig in lead box	N/A	N/A
241Am/Be	$3X10^5$ m/sec	well	N/A	N/A

60Co	144 uCi	Lead pig	N/A	Rod #7
60Co	60 uCi	Lead pig	N/A	Rod #8
60Co	1 mCi	Lead pig	N/A	Rod #9
60Co	22 uCi	Lead pig	N/A	Rod #11
60Co	10 mCi	Lead pig	Amersham	N/A
137Cs	5.7 mCi	Lead pig	N/A	Rod #1
137Cs	2.5 mCi	Lead pig	N/A	Rod #2
137Cs	0.787 mCi	Lead pig	N/A	Rod #3
60Co	1 mCi	Lead pig	N/A	Rod #17
90Sr	6.6 mCi	Chromatograph	Research Specialties	N/A
63Ni	15 mCi	Chromatograph	Hewlett-Packard	Model 5710A
63Ni	15 mCi	Chromatograph	Shimad Zu	GC-GAM
137Cs*	658 mCi	well	N/A	N/A
60Co	106 mCi	well	N/A	N/A

Those sources marked with an asterisk have been in dead storage for at least ten years. It is requested that such sources be exempted from the semi-annual leak test requirement. Should they ever be used they will be leak tested immediately upon retrieval from dead storage prior to use and at six month invervals, or prior to return to dead storage.

Appendix # 7

FILM BADGES, DOSIMETERS, AND BIO-ASSAY PROCEDURES

Each user of radioactive materials (other than tritium) is issued a film badge containing a Kodak Type 2 film which is routinely changed monthly unless more frequent change periods are required based on the radionuclide, quantity used, and conditions of use. A back film is also issued in the film badge to those whose exposures could possibly exceed 25% of the permissible level and are changed quarterly. This film is also a check on the monthly films and is a safety factor in the event that the monthly film is either lost or destroyed. Those using weak beta emitters may request modified film which has a small circular section of the white wrapper cut out of the end which fits into the open window of the badge. These films are used to detect contamination or exposures which would indicate that a problem exists within the laboratory rather than being used to quantitatively determine the specific dose measurements. The primary utilization of any monitoring system is the control and subsequent investigation of any problems that may occur within the laboratories. While the exposures are evaluated and recorded, the use of films to determine the source of exposures, contamination, (a contaminated film would tend to indicate contaminated clothing, hands, etc.) and as a means of control is fundamental. Supplementing the whole body films are wrist badges and TLD finger rings for those handling significant levels of radioactive materials as determined by the radiation safety office. These films are processed by Environmental Health and Safety as are the finger rings which are evaluated using a Harshaw 2000 TLD reader.

Beta-gamma and neutron pencil dosimeters are available for work in high radiation levels although such levels are rare within a University environment.

Kodak Type I neutron track films are used to evaluate the dose from neutron sources and are processed and evaluated at Harvard.

Thyroid scans are required for all those handling 0.1 mCi 125I or 131I within one month of any iodination unless the personnel air monitor indicates the potential of an uptake at which time the safety office requires a scan within 14 days of the iodination. In general, the safety requirements follow Regulatory Guide 8.20 regarding the frequency for thyroid scans except that those handling small quantities of iodinated material or kits are required to be scanned at a frequency determined by the radiation safety office. (See attached safety bulletin) Scintillation detectors are set up both in the medical school area and at the University Holyoke Center. Investigations are conducted for those whose uptake may exceed 20% of the permissible uptake.

Urine samples are collected and assayed for those handling tritium with mandatory samples for those handling 0.1 Ci as tritiated water or 10 mCi as an organic compound. This is interpreted to require samples for those opening containers with the above quantities even though the activity withdrawn may be a smaller amount. Urine samples may be required at the discretion of the radiation safety office in the event of a spill or an unusual circumstance. The users are instructed to handle mCi levels in an approved hood in order to minimize the chance of any ingestion or inhalation.

HARVARD UNIVERSITY
HEALTH SERVICES

ENVIRONMENTAL HEALTH AND SAFETY

RADIATION PROTECTION BULLETIN

OCCURRENCES OF THYROID EXPOSURES TO RADIOACTIVE IODINE AMONG LABORATORY WORKERS REQUIRES INCREASED CONTROL AND MONITORING PROCEDURES

Laboratory personnel working with radioactive iodine are accumulating levels of radioiodine in their thyroids which are high enough to require reporting to the Nuclear Regulatory Commission.

All necessary control measures to prevent these exposures must be instituted.

Operations which have been identified to date as involving significant releases of radioiodine to the air and radioactive contamination include opening vials containing high level high specific activity solutions; labelling proteins to high specific activity; and freezing and subsequently thawing NaI solutions.

The following measures are hereby required for iodinations. Substitute measures which provide equivalent protection may be used if cleared through the Radiation Protection Office.

1. IODINATIONS MUST BE PERFORMED IN A GLOVE BOX; OR IN A COMPLETELY CLOSED SYSTEM IN A HOOD; OR IN A HOOD USING A TRAPPING SYSTEM EQUIVALENT IN CONTROL TO A CLOSED SYSTEM. (Closed system control can be obtained by ordering and processing all solutions in vials with rubber septum closures and transferring all solutions through the septums with syringes.)

2. HOODS MUST HAVE A MINIMUM LINEAR FLOW RATE OF 100 FT/MIN.

3. ALL PERSONNEL MUST WEAR GLOVES WHILE HANDLING RADIOACTIVE IODINE.

4. NO EATING, DRINKING, OR SMOKING ARE ALLOWED IN ANY LABORATORY USING RADIOIODINE.

5. PERSONNEL AIR MONITOR MUST BE WORN FOR IODINATIONS WITH ONE OR MORE MILLICURIES.

6. ALL RADIOACTIVE WASTE MUST BE DOUBLE-BAGGED.

7. ALL ACCIDENTS AND SPILLS MUST BE REPORTED TO ENVIRONMENTAL HEALTH AND SAFETY (495-2061).

8. HANDS, CLOTHING, AND LABORATORY SURFACES MUST BE SURVEYED FOLLOWING WORK WITH RADIOIODINE AND THE RESULTS OF THE SURVEYS MUST BE RECORDED.

9. ALL PERSONNEL PERFORMING IODINATIONS WITH MORE THAN 1 MCI MUST HAVE A THYROID SCAN WITHIN TWO WEEKS FOLLOWING THE IODINATION. PERSONNEL USING SMALLER QUANTITIES MAY TAKE A THYROID SCAN WITHIN ONE MONTH FOLLOWING THE IODINATION. NO FURTHER IODINATIONS WILL BE ALLOWED WITHOUT A THYROID SCAN.

For further information call R. Johnson 495-2061

Attachment. Example of glove box designed for radioiodinations.

This bulletin transmits important notices relating to the safe use of radioactive materials and compliance with the requirements under the radioactive materials license issued by the Nuclear Regulatory Commission.

APPENDIX # 8

WASTE DISPOSAL

The radioactive waste disposal program is supervised by Environmental Health and Safety with a commercial firm, Interex Corp, Natick, Mass. contracted to dispose of the thirty gallon metal barrels. These barrels are supervised to include collections, labelling, monitoring, and handled by the health physics staff. Small quantities of liquid waste may be disposed via the sewerage system with records maintained in accord with Harvard regulations and 10-CFR-20. 303. Combustible waste is incinerated at the Power House in Boston (will be phasing out in 1-2 years) with special size boxes transported on a conveyor belt into the incinerator and incinerated only with an "incineration permit" issued by the Radiation Safety Office. Incineration is also carried out at Southboro, Mass. at the Regional Primate Center and both facilities are currently licensed under sections 16(A) and 16(B) of the broad license. The University also maintains a burial pit for burial of primarily short-lived material(physical half life of 90 days or less) with quantities of up to 100 times the limit specified in 10-CFR-20.304 (a). Longer lived material may be mixed in with the short-lived material and this is restricted to the amounts specified in 20.304 with the summation of the contribution of each not to exceed unity. For example, if 75% of the permissible short lived material were buried on a given day, the amount of the longer lived material would not exceed 25% of its permissible amount. The procedures were outlined in a letter dated May 5, 1969 and approved at that time by the Division of Licensing. We wish specific approval of such burial in accord with current licensing policies to eliminate the general burial approval in 10-CFR-20.302. Although no large quantities of gaseous material such as 133Xe or 85Kr are currently being used by any investigator, such use would be controlled under the ALARA principle and regulations imposed to assure that the release and concentrations in controlled areas would be in accord with the limits of 10-CFR-20.

APPENDIX # 9

EMERGENCY PROCEDURES

The emergency procedures are included in the rear of the Rules and Regulations with a copy of the posted regulations included for your information.

APPENDIX # 10

TRANSPORTATION

The transportation of radioactive materials between Harvard and other institutions including vendors and delivery to a carrier for transport will be in accord with the provisions of Section 71.5, Title 10, CFR 71, Packaging of Radioactive Materials for Transport and with 49CFR as currently licensed in Section 17 of the broad license.

APPENDIX # 11

RECEIVING PROCEDURES

See section 8, page 8 of the Radiation Safety Manual. A copy of the required receipt form is attached for your information. The receipt forms are matched with the purchase orders except for gifts or transfers.

APPENDIX # 12

SEALED SOURCE LEAK TEST PROCEDURES

Sealed sources are leak tested semi-annually, except those that are designed to emit alpha particles, which are leak tested quarterly. The leak test employs a 6" cotton swab moistened with alcohol or water and detergent. The moistened swab is wiped either on the source or the nearest accessible surface upon which contamination is likely to reside, if the source is mounted in a device. The swabs are counted in the appropriate scintillation counter (liquid, gamma-well, or ZnS phosphor). Results are recorded and maintained in terms of uCi/swab. Any source showing contamination exceeding 0.005 uCi/wipe is immediately removed from service and repaired or disposed, and the appropriate report is filed with NRC.

ENVIRONMENTAL HEALTH AND SAFETY

HARVARD UNIVERSITY HEALTH SERVICES

75 MT. AUBURN STREET, CAMBRIDGE, MASS. 02138

STATEMENT OF RECEIPT OF RADIOACTIVE MATERIALS

This statement must be completed by an individual authorized to accept shipment of radioactive materials and sent to Environmental Health and Safety, 75 Mt. Auburn Street, Cambridge, Mass. 02138 ATTN: Mr. Robert U. Johnson.

DATE:

PURCHASE ORDER NUMBER:

LOCATION:

ISOTOPE AND AMOUNT:

I have received, examined, and wipe tested the shipment of radioisotopes described above and have handled it in accordance with the Regulations for the Use of Radioisotopes at Harvard University and with any special instructions that I have received from Environmental Health and Safety.

WIPE TEST		c/min
BACKGROUND		
Package Surface		
INSIDE CONTAINER		
DATE	INITIAL	EFF. %

_____
Authorized Signature

FOR: _____
Licensee

The regulations for the Use of Radioisotopes at Harvard University require that no radioisotope may be delivered or left at any place in the University without a signed statement of receipt from a responsible investigator or other individuals authorized by Environmental Health and Safety. The receipt or a copy must be sent to Environmental Health and Safety. In the event a person authorized to receive the radioisotopes is not present, the radioisotopes may be delivered to Environmental Health and Safety, 75 Mt. Auburn Street, Cambridge, or the office may be called for further instruction (495-2061)

Section 15 RADIATION PROTECTION PROGRAM

A comprehensive radiation protection program has been established for the past twenty years for Harvard University and the teaching hospitals. This program begins with a course entitled, "Safe Handling of Radioisotopes" for all investigators who have not had formal training, and indoctrination course (first three sessions) for all other personnel who have not had formal training, and individual lectures to new personnel who arrive between the semi-annual course presentations. This course has been considered quite successful with approximately 300 technicians and 100 investigators attending each year. This program also includes the following:

a. film badges, dosimeters, finger rings, and other monitoring devices: See appendix # 7

b. Monthly surveys by the health physics staff as per the attached check list. (Depending on the levels of activity being used, some laboratories are monitored on a weekly or semi-monthly basis). There are no acceptable levels of loose contamination in either restricted or unrestricted areas which simply means that upon notification of the existence of any contamination, the user must immediately decontaminate the area and subsequent wipes taken to verify that the contamination has been removed. In addition, all users are required to monitor their hands after use of radioactivity as well as their clothing and facilities unless their use has been involved with tritium. The Assistant Radiation Safety Officer also makes unannounced auditing visits to the laboratories, with the frequency depending upon the level of use. See attachment # 1.

c. Thyroid scans and urinalyses - See Appendix # 7

d. Instrument Calibration

e. The issuance and maintenance of all necessary records including survey reports (see attached report), personnel monitoring reports, records of receipt, use and disposal.

f. Review of all areas for shielding, ventilation, posting, labelling, and handling facilities.

g. Availability of staff personnel on a 24 hour/day basis in the event of accidents, spills, or other emergencies.

h. Maintenance of waste disposal facilities including storerooms, freezers, and disposal containers.

i. Consultation service for all phases of the program.

j. Leak testing of all sealed sources on a required frequency.

The following information may be helpful in a review of the radiation protection program:

a. All iodinations must be performed in approved hoods with a flow rate of at least 100 linear feet/minute with the sash at a height of 12". The hoods are equipped with continuous air samplers (unless approval is otherwise granted for individual monitoring procedures) and charcoal filters and traps installed, where necessary. These pumps have sampling filters which are changed twice monthly for evaluation. All users must double bag any waste material and must wear laboratory coats and impervious gloves if working with any amount of radioactive material. All procedures which could result in the release of airborne material are required to be carried out in fume hoods and respirators are not recommended but may be used as a supplement to, and not a substitution for, other protective measures. Personnel air monitors are used as a supplement to the thyroid scans and in cases where these monitors indicate any significant airborne concentrations, thyroid scans are required within a period designated by the Radiation Safety Office.

b. Attached are instructions for "Personal Surveys" which are day-to-day procedures for surveying and monitoring laboratory areas and the personnel involved.

c. Labelling, posting, and other signs required are detailed in section 2.5 page 2 of the Radiation Safety Manual

d. Emergency procedures including spills, decontamination, and fires are covered in Sections 14 and 15 RSM and the appended notice.

e. Transportation must be in accord with section 13, page 10 of the Radiation Safety Manual.

f. Animal use must be in accord with Section 12, page 10 of the Radiation Safety Manual.

ATTACHMENT #1

HARVARD UNIVERSITY HEALTH SERVICES - ENVIRONMENTAL HEALTH AND SAFETY

RADIATION PROTECTION OFFICE

SURVEY CHECK LIST

MEASUREMENTS

____Meter check for external dose rates and contamination of surfaces (hot sinks, hoods, storage areas, refrigerators).

____Wipe tests of all suspected areas of contamination (sink ledge, hood ledge, bench top) plus check of "clean areas".

....Air sampling (where required).

INSPECTION

____NRC Form 3 posted.

____Institutional regulations posted.

____Proper signs (radiation area, radioactive material) posted.

____Storage area controlled, posted and secured.

____Waste disposal area controlled and posted.

....Hood flow satisfactory.

....Sources, waste solutions, etc., properly labelled.

....Sink disposal records posted and up to date.

MONITORING INSTRUMENTATION

....Available

....Performance check.

REVIEW OF HANDLING PROCEDURES

....Personnel monitoring devices worn (whole body and hands).

....Records of monitoring kept.

....No pipetting by mouth.

....Protective clothing utilized, including gloves, coats.

DATE_____ LICENSEE_____ LOCATION_____

SIGNED_____

PERSONNEL AND LABORATORY MONITORING PROCEDURES

FOR RADIOISOTOPE MONITORING

1. It is suggested that a sketch be made of each laboratory showing and identifying by number all working areas and facilities such as benches, sinks, hoods, refrigerators, centrifuges, etc. which could be involved in the use of isotopes. These sketches should be posted or maintained with the laboratory survey records and the locations surveyed be referenced by number on the Personal Survey Form (copy attached). Forms may be duplicated as necessary.

2. Tests of working areas are to be made after use of isotopes. Wipe tests, counted in a liquid scintillation counter, should be made for weak beta emitters, such as 3H, 14C and 35S. A single wipe test of all areas involved will suffice unless contamination is found, in which case the contaminated areas must be located with more detailed tests, A careful check with a survey meter after the use of higher energy beta and gamma emitters should suffice unless contamination is found. If decontamination procedures are necessary, their effectiveness should be confirmed by wipe tests.

3. Hands shall be washed and then tested. When necessary, clothing of personnel should be monitored with a survey meter immediately after each isotope use.

4. A separate line on the Personal Survey Form should be filled in for each individual user and/or each different working area used.

5. Entries must be made even if there is no detectable activity.

6. Forms should be kept on record, either in a laboratory notebook or office file.

For questions call the Radiation Safety Office. (495-2061)

Harvard University - Radiation Protection Office

PERSONAL SURVEY FOR RADIOISOTOPE CONTAMINATION

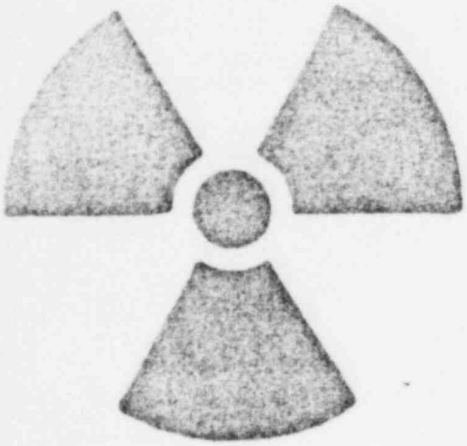
Laboratory:

Nuclides in Use:

Directions:
1. Hands and working areas should be surveyed after every busy day and no less than weekly if radioisotope use is irregular. Wipe tests are required for work with H-3 and C-14.
2. Wipes should be counted in the appropriate instrument.
3. Forms should be kept on record, either in laboratory notebook or office file. Notify Environmental Health (495-2061) of any results above 3x BKG.

Date	Name	BKG	Personal Survey (inc. hands) Net CPM	Location Survey Net CPM	Notes on High or Positive Results (Notify R.U. Johnson)

For any questions, contact R.U. Johnson at 495-2061.



REGULATIONS FOR THE USE OF RADIOISOTOPES AT HARVARD UNIVERSITY

Environmental Health & Safety
University Health Services
75 Mt. Auburn Street, Cambridge
Tel. 495-2061

TABLE OF CONTENTS

PLEASE CHECK THE BACK OF THIS MANUAL FOR SPECIAL PROCEDURES

1. Government Regulations Pertaining to the Use of Radioactive Materials and Machines Which Emit Ionizing Radiation.

1.1 By-product material, which is material yielded in or made radioactive through nuclear reactions utilizing plutonium, uranium-233, or uranium-235, may be used only under specific or general licenses issued by the United States Nuclear Regulatory Commission (NRC).

1.2 All licensees of the Nuclear Regulatory Commission are required to conform with standards for protection against radiation hazards established by the NRC. These standards are published in Title 10, Chapter 1, Part 20 of the Federal Register.

1.3 Special nuclear material, which includes plutonium, uranium-233, uranium enriched in the isotope 233, or in the isotope 235, or any material artificially enriched in any of the foregoing can be used only under a special nuclear material license issued by the Nuclear Regulatory Commission.

2. Control and Monitoring of Environmental Radiation and Personnel Exposure.

The Federal and State regulations define areas containing radiation which do and do not require special control measures and specify maximum levels of exposure in controlled areas.

2.1 Unrestricted Areas:

An area is unrestricted and does not require control measures for exposure from external radiation if an individual continually present in the area cannot receive more than 2 mrem in any one hour or 100 mrem in any seven consecutive days to any portion of his body.

2.2 Restricted Areas:

When an area contains radiation levels above those allowable for unrestricted ones, access to the area must be controlled by the user of radioisotopes.

Control must be such that no individual over 18 years of age will receive in any one calendar quarter from radioactive material and other source of radiation in the possession of Harvard University an occupational dose in excess of the following limits:

Whole body; Head and trunk: active blood-forming organs; lens of eyes; gonads	1 1/4 rem
Hands and forearms; feet and ankles	18 3/4 rem
Skin of whole body	7 1/2 rem

Maximum exposure of individuals under 18 is one-tenth of the above levels. Maximum exposure of all other individuals non-occupationally exposed to sources at Harvard is 0.5 rem/year. (These regulations do not apply to exposure for medical reasons.)

The government regulations allow for higher exposures than tabulated above if certain conditions are fulfilled. These exposures must have authorization of EH&S.

Regardless of the above limits, general policy is to avoid all unnecessary exposure to ionizing radiation.

2.3 Personnel Monitoring:

Personnel monitoring devices are required by law and records must be kept if an individual receives or is liable to receive a dose in any calendar quarter in excess of 25% of the above values (5% for individuals under 18). The Harvard Isotope Committee sets the policy for personnel monitoring to comply with the regulations and may broaden personnel monitoring coverage when additional exposure data and control appear useful. The use of wrist badges and finger rings may be required by the Radiation Protection Office.

(a) All persons performing iodinations with 1 mCi or more must have a thyroid scan within two weeks following the iodination. Persons using smaller quantities (more than 0.1 mCi) must have a thyroid scan within one month of the iodination. Those using less than 0.1 mCi will have thyroid scans at a frequency to be determined by EH&S.

(b) Any person using tritium in an organic form (including opening of vial) of 10 mCi or more must submit a urine sample within 7 days. If the tritium is in an inorganic form, the urine sample must be submitted after the use of 100 mCi or more. Bio-assays will also be made on request and after an accident or spill, at the option of EH&S.

2.4 Airborne Contamination Limits:

Airborne radioactivity concentration limits have been established to prevent overexposure of any organs in the body as a result of breathing contaminated air. Limits in microcuries/cc in unrestricted areas for continuous exposure are specified in Table 1, Appendix I, for some isotopes.

(a) No iodination may take place without notification of and clearance from EH&S to insure that there is adequate control of airborne discharges.

(b) All those performing syntheses using tritium at a level of 50 mCi or more must perform a materials balance after the synthesis.

2.5 Posting of Areas:

The following types of signs are required for significant levels of radiation and radioactivity.....

(a) "CAUTION RADIATION AREA" ....This sign is used in areas accessible to personnel in which a major portion of the body could receive in any one hour a dose of 5 mrem or in any 5 consecutive days a dose in excess of 100 mrem. A sign is not required in a room containing a sealed source if the radiation level at 12 inches from the surface of the source container or housing does not exceed 5 mrem/hr.

(b) "CAUTION RADIOACTIVE MATERIAL"....This sign is required in areas or rooms in which radioactive material is used or stored in an amount exceeding quantities listed in Table 2, Column (a), Appendix I.

(c) "CAUTION RADIOACTIVE MATERIAL" (label)....A durable, clearly visible label is required on any container in which is transported, stored or used, a quantity of any material greater than the quantity specified in Table 2, Column (b), Appendix I. When containers are used for storage, the labels shall state also the quantities and kinds of radioactive materials in the containers and the date of measurement of the quantities.

Other signs are required for High Radiation Areas (dose-rate greater than 100 mrem in an hour) and in Airborne Radioactivity Areas. Environmental Health & Safety must be consulted for appropriate control measures. Signs and labels are available from EH&S. Signs should not be used when they are not needed.

3. Organization for Control of the Use of Radioisotopes at Harvard University.

The University has a broad specific license from the Nuclear Regulatory Commission for the use of radioisotopes classified as by-product materials. Under the terms of this license, the radioisotope program is administered by an Isotope Committee which reviews and approves proposals for the use of these radioisotopes. The Isotope Committee also administers the control of radioactive materials utilized under special material licenses held by the University. The committee meets periodically to review the operations involving radioisotopes at Harvard University.

3.1 Composition of the Isotope Committee:

The Committee is composed of the Radiation Protection Officer, a representative of the business office, and at least one experienced user of radioisotopes from the Medical Area, Physics Dept., Chemistry Dept., Biology Dept., and the Primate Center.

3.2 Authority of the Isotope Committee:

The Committee has the authority to: (1) approve or disapprove proposals for radioisotope users prior to purchase or acquistion of the materials; (2) review safety procedures; (3) investigate incidents involving radioactive materials and violations of regulations; and (4) suspend authorization to use isotopes.

3.3 Control Functions of the Isotope Committee:

The control functions of the Committee are delegated to the EH&S section of the University Health Services. Following are some of the specific responsibilities of the section in connection with radiation control.

(a) Provision of film badge or other personnel monitoring services.

(b) Provision of bio-assays where indicated or upon request.

(c) Provision of laboratory and environmental monitoring. Laboratory monitoring is done at least monthly, and more frequent surveys are made in areas with potentially high radiation or contamination levels.

(d) Surveillance of procurement, transportation, storage, use and waste disposal of radioactive materials. Assistance in storage and waste disposal problems.

(e) Technical consultation on safe and proper use of isotopes.

(f) Conduct of education program in the safe use of radioisotopes and the orientation of new personnel between safety courses.

(g) Maintenance of records required by law.

(h) Periodic leak testing of sealed radioactive sources.

(i) Calibration and minor repairs of survey instruments.

(j) Supervision of emergencies or decontamination operations.

3.4 Radiation Protection Officer:

The Radiation Protection Officer is responsible to the administration for the execution of the established policies of radiation protection and for insuring compliance with Federal and State regulations.

He is a member of EH&S and supervises the radiation control activities.

The Radiation Protection Officer has the authority to stop all operations with radioactive materials where a hazard or violation exists. Resumption of operations may take place only upon authorization from the Isotope Committee.

4. Authority to Use Isotopes.

No one may use or bring into the University any radioisotopes in amounts which would ordinarily require a specific license from the Nuclear Regulatory Commission without authorization from EH&S. Such authority will be given to designated individuals, referred to hereinafter as responsible investigators, who will then be directly responsible for the safe and proper use, storage, and disposal of the radioisotopes under their jurisdiction.

Although special authorization is not required for use of isotopes in quantities less than those requiring a specific license,

EH&S must be informed prior to the time any source of radioactivity (except for radioactivity contained in devices sold to the general public) is brought into the University.

5. Application for Authorization to Use Isotopes.

All new programs or changes in established programs involving the use of radioisotopes must be discussed with the Radiation Protection Officer or his representative. The Radiation Protection Officer will obtain the following details:

(a) Names of persons who will supervise use of the materials, will be responsible for the safe use and proper handling of the radioisotopes.

Specific isotopes and maximum quantities involved.

emical and/or physical form.

pose for which by-product material will be used and cedures important to the consideration of contamination and exposure control, i.e. evaporations, grinding.

ing and experience of supervisory and responsible onnel.

aining and indoctrination provided technicians.

Monitoring instrumentation.

Storage methods.

(i) Disposal methods.

(j) All other information needed to evaluate the safety of the proposed program.

A report will be prepared by the Radiation Protection Officer including recommendations and any special precautions to be observed and copies will be forwarded to the Isotope Committee. The recommendations may require participation by the user in a special training program provided by EH&S.

It will be the responsibility of each member of the Isotope Committee to review the report and comment.

Unless vetoed or revised by the Committee, the recommendations of the Radiation Protection Officer will be binding upon the user.

Every approved proposal for the use of radioisotopes by a responsible investigator will be assigned an identification number. The number will have an expiration date. All requisitions for radioisotopes must be accompanied by the assigned identification number. The Purchasing Department will not process any purchases for radioisotopes without this number and without the endorsement of EH&S. Confirmation orders cannot be placed without prior approval of EH&S. Purchases for delivery to outside institutions must be approved by EH&S.

6. Responsibilities of Isotope Users.

Each responsible investigator is directly responsible for (1) the radioisotopes in his possession, (2) compliance with the conditions regarding the use of isotopes as listed on his authorization form, (3) compliance with the regulations governing the use of radioisotopes at Harvard University, and (4) the safe use by other investigators or technicians who may work with the material under his supervision. He has the following obligations:

(a) Insure that individuals working with radioisotopes under his control, including fellow investigators, students, and technicians, have obtained training and indoctrination required to enable safe working habits and prevention of exposure to others or contamination of the surroundings.

(b) Notify EH&S of the addition of any new personnel, including a brief resume of their training and experience with radioactive materials. New personnel will not be allowed to use radioactivity without the approval of EH&S.

(c) Avoid any unnecessary exposure, either to himself or others working under him.

(d) Limit the use of radioisotopes charged to him to individuals over whom he has supervision and to location specified on his authorization form. Individuals doing independent work shall obtain separate authorizations and assume responsibility for the safe use of isotopes.

(e) Keep current working records of the receipt and disposition of isotopes in his possession including use in research, waste disposal, transfer, storage, etc. Records will be collected and maintained by EH&S.

(f) Notify EH&S of any changes in rooms or areas in which radioactive materials may be used or stored.

(g) Keep an adequate inventory of the amount of radioactive material possessed and submit this inventory to EH&S upon request.

(h) Post supplementary rules or instructions pertinent to laboratory operations as requested by EH&S.

(i) Insure that a survey meter is available to enable personnel to monitor for radiation exposure and surface contamination for isotopes other than tritium. Environmental Health & Safety may be consulted for appropriate instrumentation information, repairs, and calibration services.

He shall inform EH&S when he cannot fulfill his responsibilities because of absence from the University. With the approval of EH&S he may designate another individual to supervise the work with radioisotopes in his absence.

He shall inform EH&S when a woman who is or will be working with a source of radiation under his supervision, is known to be pregnant.

ANY INVESTIGATOR USING RADIOISOTOPES MAY OBTAIN CONSULTATION, ASSISTANCE, TRAINING, INDOCTRINATION OF TECHNICIANS, AND THE USE OF RADIOISOTOPE HANDLING FACILITIES FROM EH&S.

7. Work Habits and Procedures.

7.1 Preparatory:

Before any work is undertaken with quantities of radioisotopes which have a potential for producing significant external or internal exposure, attention shall be given to precautionary measures including use of hoods, adequacy of hoods, remote handling equipment, air monitoring, respiratory protection, etc. Environmental Health & Safety should be consulted for recommendations on specific operations.

For non routine or high level operations, the user will conduct a trial run with inactive material or low activity to test the adequacy of procedures and equipment.

7.2 Protective Clothing:

Suitable gloves shall be worn whenever hand contamination is likely. Extreme care must be exercised to prevent contamination when there is a break in the skin.

Appropriate protective clothing such as coveralls, laboratory coats, and shoe covers should be worn wherever contamination of clothing with radioactive materials is possible. Protective clothing shall not be worn or taken out of the local areas in which their use is required, unless monitored and determined to be free of contamination. Under no conditions is protective clothing to be worn in eating places.

7.3 Handling Materials:

Work which can result in contamination of table tops and work surfaces shall be done in trays. The trays should be lined with an absorbent material.

Tongs or other suitable devices should be used when handling a source.

7.4 Hygiene:

Personnel working in areas containing radioactive material must "wash up" before eating, smoking, or leaving work and shall use appropriate equipment to make hand and shoe counts upon completing operations.

Smoking, eating, storing, or preparation of food is forbidden in a laboratory or rooms where work with unsealed radioactive sources is taking place or where contamination may exist.

Radioactive liquids shall not be pipetted by mouth.

8. Delivery of Radioisotopes.

No radioisotopes may be delivered or left any place in the University without a signed statement of receipt from a responsible investigator or other individual authorized by EH&S. The receipt must be sent promptly to EH&S. In the event a person authorized to receive the radioisotopes is not present, the radioisotopes may be delivered to EH&S and picked up at another time by the user.

Upon receipt, containers of radioisotopes must be examined carefully for evidence of leakage, breakage, and checked for surface contamination required by regulations.

The dose rate at the surface of the package will also be measured prior to opening the package (for radionuclides with surface dose rates).

9. Storage of Radioisotopes.

(a) Radioisotopes requiring a "Radioactive Materials" label shall be stored only in areas registered with EH&S in a manner that provides adequate protection against fire, explosion or flooding. These areas are to be locked normally and under the control of responsible investigators only, or other personnel specifically authorized by EH&S.

(b) The radioisotopes shall be stored in a suitable container and the direct radiation from the container must not create a "Radiation Area."

(c) Sources must be properly labelled and area signs posted.

(d) The probability of an explosion which would cause the dispersion of the stored material must be minimal.

(e) Environmental Health & Safety must be kept informed of any transfer of a source to new storage areas.

10. Storage of Wastes.

(a) Radioactive wastes must be stored only in restricted areas registered with EH&S. Liquid waste should be

stored in unbreakable containers, preferably in polyethylene bottles. If circumstances make this impracticable, double containers shall be used.

(b) Inflammable wastes should be held at a minimum in the laboratory. Waste containers shall be metallic, a fire extinguisher shall be located in the area vicinity, and a sign shall be posted giving its location.

(c) There must be no possibility of a chemical reaction during storage that might cause an explosion or cause the release of chemically toxic or radioactive gases.

(d) Liquids shall be neutralized (pH 6 to 8) prior to placement into the waste container.

(e) Containers of volatile compounds shall be sealed to prevent the release of airborne activity.

11. Waste Disposal.

Waste disposal by radioisotope users at Harvard is regulated to insure that the release of radioactive material from the University is in accordance with Federal and State regulations.

11.1 Liquid Wastes:

A laboratory may dispose of radioactive waste into a sink registered with EH&S if the following conditions are observed:

(a) The quantity of material discharged per day directly into the sink does not exceed the minimum amount requiring a radioactive materials label, (Appendix I, Table 2, Column b). The disposal must be accompanied by profuse flushing with water.

(b) The material is readily soluble or dispersible in water.

(c) A record is kept giving the date and approximate upper limits or the amount of activity discharged for the day.

Environmental Health & Safety must be consulted for daily disposal of larger quantities than the minimum amount requiring a radioactive materials label.

11.2 Solid Wastes:

Solid wastes with long half-lives shall be placed in properly labelled containers designed for the purpose. The collection will be supervised by EH&S for disposal through a commercial company. A record must be kept of isotopes and the quantity disposed in the barrels.

11.3 Incineration:

Incineration by users is not allowed. Harvard University has authorization from the NRC to incinerate under well defined limits of activity and activity concentration. Arrangements may be made with EH&S to incinerate wastes which come under the AEC authorization.

11.4 Special Disposal Methods:

Unusual situations may arise which cannot be covered by routine disposal methods. Environmental Health & Safety will arrange for and supervise the disposal in such instances.

12. Use of Radioactive Materials in Animals.

Injection of radioactive materials into animals should be performed in trays lined with absorbent material.

Cages housing animals injected with radioisotopes should be labelled as to isotope, quantity of material injected per animal, date of injection, and user. These cages should be segregated from those housing other animals.

Animal excreta may be disposed via the sewerage if the calculated activity does not exceed the quantity listed in Table 2, Appendix I, and not mixed with sawdust or wood shaving; otherwise, the excreta may be placed in plastic bags and disposed through EH&S.

Adequate ventilation must be provided in instances where animals are kept after an injection with radioactive materials that may become volatilized and dispersed into the room.

Animal handlers must be indoctrinated by the responsible investigator as to the dose levels, time limitations in the area, and the handling requirements of the animals and excreta.

Adequate freezer space to store the radioactive animal carcasses must be available prior to use of radioactivity in animals.

13. Transportation of Radioisotopes.

Radioactive isotopes may not be removed from University grounds without written authorization of EH&S and must be packaged in accordance with I.C.C. regulations. Environmental Health & Safety will advise on the requirements for packaging, radiation measurements, and transportation procedures.

All radioisotopes shall be transported in non-shatterable containers or carrying cases. There shall be no beta ray penetration through the container and the gamma dose-rate shall not exceed 200 mrem/hr in contact with the container and 10 mrem/hr at 1 meter from the surface. Checks must be made to insure there is no removable contamination on the surface of the container. Material

that is transported on foot should be routed to encounter minimal pedestrian traffic.

14. Contamination.

Loose contamination should not be tolerated on exposed surfaces such as bench tops and floors and should be removed as soon as possible.

Work areas should be monitored for contamination before and after work with radioactive materials. Environmental Health & Safety will monitor laboratories for contamination periodically.

No library books, periodicals or reports shall be used in areas where there is a reasonable possibility of their becoming contaminated with radioactive materials.

14.1 When hands, body surfaces, clothing or shoes become contaminated, steps should be taken as soon as possible to remove loose contamination. Some degree of fixed contamination may occur and the following maximum limits are suggested for hands, body surfaces, or personnel clothing and shoes:

Alpha activity - 100 d/m per 100 cm^2
Beta-gamma activity - 0.1 mrad/hr at 2 cm

14.2 Contaminated equipment shall be labelled, wrapped and stored in such a manner as to constitute no hazard to personnel or possibility of spread of contamination. Environmental Health & Safety can store equipment temporarily for decay or decontamination.

14.3 Airborne Contamination:

Any procedure which might result in the release of airborne contamination will require special exhaust ventilation and containment that is approved by EH&S.

(a) The following control measures are required for iodinations:

1. Iodinations must be performed in a glove box, in a completely closed system in a hood, or in a hood using a trapping system equivalent in control to a closed system unless otherwise exempted by EH&S (closed system control can be obtained by ordering and processing all solutions in vials with rubber septum closures and transferring all solutions through the septums with syringes).

2. Hoods must be approved by EH&S and have a minimum flow rate of 100 linear ft/min.

3. All personnel must wear gloves while handling radioiodine .

4. A personnel air monitor must be worn for iodinations of one or more mCi.

5. All radioactive waste must be double-bagged.

6. All accidents and spills must be reported immediately to EH&S.

7. Hands, clothing and laboratory surfaces must be surveyed following work with radioiodine and the results of the surveys recorded.

15. Cleaning of Spills.

Notify EH&S immediately of any spills. All spills of radioactive material must be cleaned up promptly. Responsibility for cleaning rests on the individual investigator. A survey shall be made after cleaning to verify that the radioactive material has been removed. Cleaning tools shall be assigned to the room in which the work operations are being performed and shall not be removed or used elsewhere without survey and approval by EH&S.

16. Notification of Environmental Health & Safety in Accidents and Other Incidents.

Notify EH&S immediately of all accidents involving possible body contamination or ingestion of radioactivity by personnel, overexposure to radiation, contamination of equipment, spread of contamination, or difficulty in cleaning up a contaminated area. Environmental Health & Safety must also be notified immediately in the event of loss or misplacement of radioisotopes and sources.

17. Termination of Work With Radioisotopes.

Notify EH&S at least 30 days prior to the termination of any use of radioisotopes. The area must be surveyed thoroughly by EH&S before it may revert to unrestricted use.

APPENDIX I

Table 1

Maximum Permissible Concentrations in Unrestricted Areas

ISOTOPE	CONCENTRATION* uCi/cc
C-14	1×10^{-7}
H-3	2×10^{-7}
S-35	9×10^{-9}
I-131	1×10^{-10}
I-125	8×10^{-11}
P-32	2×10^{-9}
Ca-45	1×10^{-9}
Na-24	5×10^{-9}
K-42	4×10^{-9}
Cr-51	8×10^{-8}
Kr-85	3×10^{-7}
Xe-133	3×10^{-7}
Br-82	6×10^{-9}
Cl-36	8×10^{-10}

*Maximum concentrat. . depends on several factors, including degree of solubility of contaminant. The lowest concentrations specified in the regulations have been listed.

Table 2

Quantities of Some Radioactive Materials Requiring Signs

Isotope	Minimum Quantity for Radioactive Materials Sign in Room* Microcuries	Minimum Quantity for Radioactive Materials Label** Microcuries
Au-198	1,000	100
C-14	1,000	100
Ca-45	100	10
Co-60	10	1
Cl-36	100	10
Cr-51	10,000	1,000
Cs-37 & Ba-137	100	10
Cu-64	1,000	100
Fe-55	1,000	100
Fe-59	100	10
H-3 (HTO or H_3^2O)	10,000	1,000
I-131	100	1
I-125	10	1
K-42	100	10
Na-24	100	10
P-32	100	10
Ra-226	0.1	0.01
S-35	1,000	100
Se-75	100	10
Sr-90	1	0.1
Zn-65	10	10
Unidentified	1	0.1

*Caution signs are not required to be posted at areas on rooms containing radioactive materials for periods of less than eight hours provided that (1) the 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 the regulations; (2) such area or room is subject to the authorized user's control.

**These are also minimum quantities requiring specific licenses from the AEC when an institution does not have a license.

**Daily permissible sink disposal limits.

PROCEDURES FOR RADIOISOTOPE USERS

1. Application for Authorization to Use Radioisotopes.

1.1 New Licenses:

Investigators who wish to obtain authorization for the independent use of radioisotopes must submit Application Form #EHS-1 in triplicate to Environmental Health and Safety. Upon receipt of these forms, the Radiation Protection Officer or his representatives will arrange for an interview and will obtain the information for review as specified in Section 5 of the regulations.

Upon approval of this application, one copy will be retained by Environmental Health and Safety, one copy will be sent to the Purchasing Department, and the third copy will be returned to the user. Each approval will be assigned an identification number which will include an expiration date. All requisitions for radioisotopes must be accompanied by this identification number. In addition, each individual purchase of one millicure (mCi) or more must be cleared through Environmental Health and Safety as the Purchasing Department will not process any orders for radioisotopes without the identification number and Environmental Health and Safety approval.

1.2 Renewals and Amendments:

Investigators wishing to renew their authorization must submit the Harvard Application Form #EHS-1 in triplicate to Environmental Health and Safety at least thirty (30) days prior to expiration. Notification in writing must also be given to Environmental Health and Safety of any changes in personnel, procedures, or locations.

2. Waste Disposal.

2.1 Disposal into Sewerage Systems: (see Section 11.1 of regulations)

2.2 Solid Waste:

Solid waste with long half-lives may be placed in plastic bags and brought to the storeroom in the basement of Bldg. B-1, Harvard Medical School, 25 Shattuck Street, Boston, Mass. The bags must be labelled as to user, date, isotope, and quantity, and delivered to the attendant at the storeroom on Friday afternoon between 3:00 to 3:30. Other times that are mutually convenient may be arranged with Environmental Health and Safety upon special request.

If found to be advisable, Environmental Health and Safety will make arrangements for users to place special barrels in laboratories for radioactive wastes. The users will be required to notify Environmental Health and Safety of barrels that are filled. Barrels are removed monthly by a commercial waste disposal company.

2.3 Incineration:

Users may incinerate animal carcasses and other combustible waste at the Power House Incinerator by sending a written request to Environmental Health and Safety. The request will state the number of cartons and the quantity of activity that will be placed in each. Upon approval of this request, an incineration permit will be sent to the user with a radioactive materials label. The label will be placed on the carton over the stamped section which reads:

NOT TO BE USED FOR RADIOACTIVE MATERIAL

The permit will be given to the driver at the time of pickup who will deliver it to the Power House with the package where it will be matched with a duplicate permit. The permit will be effective for the dates indicated and will not be accepted by the Power House beyond these dates.

All combustible material will be incinerated in standard cartons which may be obtained from the Department of Buildings and Grounds, Harvard Medical School.

2.4 Storage at the Animal Primate Center, Southboro, Mass.

Animal carcasses and other putrescent waste containing isotopes with a short half-life (one year or less) may be placed in plastic bags, properly labelled and delivered direct to the Animal Research Center, Harvard School of Public Health, where the bags will be stored in freezers until transferred to the Primate Center in Southboro, Mass.

2.5 Gaseous Waste - Consult Environmental Health and Safety.

3. Emergency Instructions in the Event of Release of Radioactivity and Contamination of Personnel.

3.1 Objectives of Remedial Action:

In the event of an accident involving the release of significant quantities of radioactive material, the objective of all remedial action are to:

(a) Minimize the amount of radioactive material entering the body, by ingestion, inhalation, or through any wounds.

(b) Prevent the spread of contamination from the area of the accident.

(c) Remove radioactive contamination on personnel.

(d) Start area decontamination procedures under qualified supervision. Inexperienced personnel should not attempt decontamination.

3.2 Procedures for Dealing with Minor Spills and Contamination:

Most accidents will involve only minor quantities or radioactivity (i.e. in the microcurie level).

(a) Put on gloves to prevent contamination of hands.

(b) Drop absorbent paper or cloth on spill to limit spread of contamination.

(c) Place contaminated cleaning materials into plastic bags or other closed containers. Seal and label.

(d) Mark area of spill as "contaminated" as soon as possible, if immediate decontamination is not instituted. A wet spill shall not be allowed to dry and become powdery if significant amounts of radioactivity are involved. This might produce serious air contamination.

(e) Notify Environmental Health and Safety of accident. (495-2061 or 2062.

(f) Start approved decontamination procedures as soon as possible.

If the body is suspected of being contaminated

(a) Scan with (alpha) and beta-gamma survey meters to determine contaminated areas of the body.

Contamination (con'd.)

(b) Do not immediately attempt decontamination if cuts, abrasions or open wounds are observed.

(c) If cuts, abrasions or open wounds are contaminated, dry-clean the area with suction apparatus and swabs. (Wet cleaning might increase absorption.)

(d) If the skin is contaminated in the area of cuts, abrasions and open wounds, use wet swabs in a direction away from the cut, abrasion or open wound, taking care not to spread activity over body or into wound.

If the skin appears to be intact, use the following procedures:

(a) Wet hands and apply mild soap.

(b) Work up good lather, keep lather wet.

(c) Work lather into contaminated area by rubbing gently for 3 minutes. Apply water frequently.

(d) Rinse thoroughly with lukewarm water (limiting water to contaminated areas).

(e) Repeat above procedures twice, if necessary.

(f) If the radiation level is still above background, initiate more powerful decontamination procedures, after consultation with Environmental Health and Safety.

3.3 For all major accidents including explosions and release of airborne radioactivity and leakage of sealed gaseous and powdered sources.

IF POSSIBLE, CUT OFF THE RELEASE OF RADIOACTIVE MATERIAL FROM THE SOURCE TO THE ENVIRONMENT.

(a) Report incident to Environmental Health and Safety (495-2061 or 2062) as soon as possible.

(b) Do not attempt to clean up spill immediately. Cover the radioactive areas if they are localized.

(c) Close windows, shut off fans, air conditioners, and any air outlets to other areas. Shut off hoods if they are not equipped with exhaust filters. Evacuate and isolate area. Close all doors. Seal with tape if powdered or gaseous sources are involved.

(d) Proceed to nearby uncontaminated control area; start personnel decontamination and radioactivity surveys. Remove contaminated shoes and laboratory coats (at laboratory door) to avoid tracking radioactive material around.

(e) Do not leave the control area until the extent of the hazard has been determined and you have been thoroughly surveyed for contamination.

(f) Have signs posted and guards stationed where necessary to prevent additional exposure or spread of radioactivity.

(g) In the event of a major contamination incident, no decontamination should be attempted without the advice and direction of personnel experienced in radiation protection.

3.4 In Case of Fire:

Unless necessary, avoid any fire extinguishing method likely to spread radioactive material.

Fires in boxes may be extinguished best by cutting off the air supply in the box.

Fires in hoods, if they cannot be extinguished without the danger of spreading radioactive materials, should be confined by closing the door of the hood and throwing a blanket or other cloth over the top air inlet so as to reduce the supply of air.

6/14/72

"SECTION COPY"

MAY 1 8 1983

MEMORANDUM FOR: Vandy L. Miller, Chief, Material Licensing Branch, NMSS

FROM: James H. Joyner, Chief, Nuclear Materials and Safeguards Branch, Division of Engineering and Technical Programs, Region I

SUBJECT: POLICY GUIDANCE ON RENEWAL OF HARVARD UNIVERSITY'S LICENSE NUMBER 20-00297-53

As currently written, License No. 20-00297-53 authorizes use at many institutions in the Boston area. Several of these institutions have been granted NRC licenses including a few of Broad Scope. Dr. Glenn has met with the Radiation Protection Staff at Harvard to discuss this renewal. The Harvard staff agrees that there is no need to include these institutions on this license with one exception.

The exception concerns common handling by the institutions of radioactive waste. Harvard currently has authorization granted pursuant to 10 CFR 20.302 to bury short-lived waste at the Animal Primate Center in Southboro, Massachusetts. They with to continue this authorization for themselves and the other institutions collectively known as the Harvard Affiliated Institutions. In addition, Harvard wishes to store short-lived waste for decay.

Region I proposes that Harvard resubmit two applications. The first application would be a renewal request for License No. 20-00297-53 and would cover only educational and research activities at Harvard operated facilities. The second application would be for a waste handling and disposal license for the Harvard affiliated institutions. Region I would review the first application and NMSS the second.

Our Regional Attorney, Jay Gutierrez, has been in discussions with Thomas Dorian of ELD. Their preliminary conclusion is that 20.302 does not prohibit this kind of licensing. Please note that investigators at affiliated institutions hold joint appointments at Harvard and the affiliated institution. However, the programs are administratively separate. In addition, it appears that the waste handling aspects of the license would not be exempt from licensing and inspection fees since the waste will be generated as part of medical diagnosis and therapy, as well as research and education.

2578 8502140312

2pp.

5

Region I requests your comments and concurrence prior to initiating this course of action. Please have your staff contact Dr. Glenn for any additional information you may need.

Original Signed By:

James H. Joyner, Chief
Nuclear Materials and Safeguards
Branch
Division of Engineering and
Technical Programs

cc:
Jay Gutierrez

RI:DETP	RI:DETP
Glenn/lp	Joyner
5/18/83	5/ /83

HARVARD UNIVERSITY
UNIVERSITY HEALTH SERVICES
ENVIRONMENTAL HEALTH AND SAFETY

"NMSS COPY"

MS-12
P5

46 Oxford Street
Cambridge, Massachusetts 02138
(617) 495-2061

October 4, 1983

John E. Glenn, Ph.D., Chief
Nuclear Materials Section B
Division of Engineering and Technical Programs
U.S. Nuclear Regulatory Commission, Region I
631 Park Avenue
King of Prussia, PA 19406

Subject: Renewal of Harvard University License No. 20-00297-53, Docket #03-00753, Control #9882.
Part I. Coverage of education and research activities at facilities operated by Harvard University.

Dear Dr. Glenn:

The following information is submitted in reply to your letter of July 28, 1983 regarding the subject license renewal.

1. An updated list of street addresses is submitted as Appendix I. This was rewritten to exclude any program which is currently authorized under a separate NRC license.

2. An updated membership of the Radiation Safety Committee is provided in Appendix 2. The members whose names are starred are new members, and a copy of their Curriculum Vitae is included.

3. The staffing of the radiation safety office at Harvard University is listed in Appendix 3 with a breakdown of the division of staff time between Harvard University and the affiliated institutions.

4. It is requested that the Harvard License renewal be amended to include authorization to dispose, by decay, radioactive waste that is stored at a special building at the New England Primate Research Center in Southboro, MA. Application for receipt of wastes from Harvard affiliated hospitals for decay in storage under the renewal is being made in a separate application. The building is located in an area that is at least one-half mile from any outside facility and approximately 100 feet from the closest Primate Center buildings. (see attached diagram Appendix 4)

(a) The materials to be stored for decay will consist of short lived materials with half-life less than 90 days.

8502140351

H-323

3pp.

6

OCT 06 1983

(b) The building is kept locked and access is under the control of the Radiation Protection Office.

(c) Surveys are made weekly in and around the building and the results of these surveys are recorded. Records will be retained as required by the regulations.

(d) The waste will be held until a survey in a low background area indicates no detectable activity. The survey will be made with a low level GM type survey meter as appropriate for contamination surveys, on the most sensitive scale. The results of the surveys and the monitoring of the waste will be retained as required by the regulations.

(e) Waste collection at Harvard facilities and subsequent storage and disposal is done by the waste disposal staff of the Harvard University Radiation Protection Office. The staff operates the waste storage and collection facilities at the institutuion and receives, records, segregates, and packages the waste depending upon the radionuclide, the form, and the quantity. The waste disposal staff has been trained to collect, package, and transport the waste and to supervise the storerooms and the storage facility at the Animal Research Center at Southboro. The qualifications established for the technicians are given in Appendix 5. The University uses a closed van to pick up and transport the waste as a sole use vehicle and in accordance with Office of Inspection and Enforcement Notice 80-32, dated 8/29/80, Clarification of Certain Requirements for Exclusive Use Shipments of Radioactive Materials. The waste material is brought from the user's laboratories to a local storeroom in plastic bags with appropriate labels indicating the radionuclide(s), amount, date, and user's name. It is then segregated into various categories depending upon the ultimate means of disposal which may be classified as follows:

1. Waste for storage for decay. This is shipped normally as LSA material to the Primate Center in Southboro in accord with 10-CFR-49.173.425, dated March 10, 1983. (Stock solutions are processed separately and stored for eventual decay to an acceptable concentration) The bags brought to the local disposal area are placed in strong, tight, containers (normally fiber drums secured with adjustable metal rings around the cover when shipped LSA) as required by the regulations cited. Shipping papers are made out and the shipment is transported by the disposal staff. After a sufficiently long decay time the material will be disposed as non-radioactive waste in accordance with all applicable regulations.

2. Animal carcasses. These are stored in freezers in plastic bags and eventually transported to the Primate Center for incineration or burial (renewal of burial license being applied for).

3. All other waste (except for deregulated scintillation vials of 3H and 14C). This is packaged in accordance with the regulations of the Hanford burial ground and picked up by Interex Corp. in 30 gallon metal drums.

The barrels are packaged, labelled, and shipped in accord with the regulations. Harvard University has a burial license and an Ecology Permit from Hanford for such disposal. Where practical the wastes are compacted before shipment to a commercial burial site.

Sincerely,

Jacob Shapiro, Ph.D.
Radiation Protection Officer

JS:dp

DEC 30 1983

MEMORANDUM FOR: Vandy Miller, Chief, Material Licensing Branch
Division of Fuel Cycle and Material Safety, NMSS

FROM: William O. Miller, Chief
License Fee Management Branch, ADM

SUBJECT: APPLICATION FOR WASTE DISPOSAL LICENSE

Enclosed is a copy of an October 4, 1983 application from Harvard University for a specific license to handle and dispose of radioactive waste for the Harvard affiliated institutions, including disposal of waste by land burial.

In our review of the application for license fee purposes, it appears that the University will pick up and dispose of wastes generated by other licensed institutions resulting from medical diagnosis and therapy and other programs conducted by the institutions under their NRC licenses. Normally, for fee purposes, the type of activity proposed by Harvard would be subject to fee Category 4A of Section 170.31. Category 4A prescribes an initial application fee of $32,000 and a new license fee of $291,000 for licenses authorizing the receipt of radioactive waste from other persons for disposal by land burial. The fees assessed in Category 4A are based on actual cost (staff-hours and any contractual costs) to process the application.

In trying to determine the proper fee category, however, it is not clear as to the type of license authorization that will be granted to Harvard in response to their application. To assist us in determining whether their application should be subject to fee Category 4A, please provide us with the following information:

1. Will a license be issued to authorize waste disposal by land burial?

2. Is Harvard now seeking authorization for any waste handling/disposal activities not currently authorized under their broad license (20-00297-53); and if so, please explain.

1

8502140318

2pp.

7

3. Approximately how many staff-hours are estimated to process the application?

   a. If we were to assess a fee under fee Category 4A, could your office provide us with the actual staff-hours and contractual costs, if any, upon completion of the review?

We appreciate your assistance in this matter.

Original Signed by
Wm. O. Miller

William O. Miller, Chief
License Fee Management Branch
Office of Administration

DISTRIBUTION:
License File (2)
Fee File 5-1
ASCabell, LFMB
GJackson, LFMB
LFMB R/F (2)

LFMB:ADM	LFMB:ADM	LFMB:ADM	LFMB:ADM
ASCabell:rej	GJackson	CJHolloway	WOMiller
12/ /83	12/ /83	12/ /83	12/ /83