NRC FORM 313
(1-84)
10 CFR 30, 32, 33, 34, 35 and 40

APPLICATION FOR MATERIAL LICENSE

U.S. NUCLEAR REGULATORY COMMISSION
APPROVED BY OMB
3150-0120
Expires: 5-31-87

INSTRUCTIONS: SEE THE APPROPRIATE LICENSE APPLICATION GUIDE FOR DETAILED INSTRUCTIONS FOR COMPLETING APPLICATION. SEND TWO COPIES OF THE ENTIRE COMPLETED APPLICATION TO THE NRC OFFICE SPECIFIED BELOW.

FEDERAL AGENCIES FILE APPLICATIONS WITH:

U.S. NUCLEAR REGULATORY COMMISSION
DIVISION OF FUEL CYCLE AND MATERIAL SAFETY, NMSS
WASHINGTON, DC 20555

ALL OTHER PERSONS FILE APPLICATIONS AS FOLLOWS, IF YOU ARE LOCATED IN:

CONNECTICUT, DELAWARE, DISTRICT OF COLUMBIA, MAINE, MARYLAND, MASSACHUSETTS, NEW JERSEY, NEW YORK, PENNSYLVANIA, RHODE ISLAND, OR VERMONT, SEND APPLICATIONS TO:

U.S. NUCLEAR REGULATORY COMMISSION, REGION I
NUCLEAR MATERIAL SECTION B
631 PARK AVENUE
KING OF PRUSSIA, PA 19406

ALABAMA, FLORIDA, GEORGIA, KENTUCKY, MISSISSIPPI, NORTH CAROLINA, PUERTO RICO, SOUTH CAROLINA, TENNESSEE, VIRGINIA, VIRGIN ISLANDS, OR WEST VIRGINIA, SEND APPLICATIONS TO:

U.S. NUCLEAR REGULATORY COMMISSION, REGION II
MATERIAL RADIATION PROTECTION SECTION
101 MARIETTA STREET, SUITE 2900
ATLANTA, GA 30323

IF YOU ARE LOCATED IN:

ILLINOIS, INDIANA, IOWA, MICHIGAN, MINNESOTA, MISSOURI, OHIO, OR WISCONSIN, SEND APPLICATIONS TO:

U.S. NUCLEAR REGULATORY COMMISSION, REGION III
MATERIALS LICENSING SECTION
799 ROOSEVELT ROAD
GLEN ELLYN, IL 60137

ARKANSAS, COLORADO, IDAHO, KANSAS, LOUISIANA, MONTANA, NEBRASKA, NEW MEXICO, NORTH DAKOTA, OKLAHOMA, SOUTH DAKOTA, TEXAS, UTAH, OR WYOMING, SEND APPLICATIONS TO:

U.S. NUCLEAR REGULATORY COMMISSION, REGION IV
MATERIAL RADIATION PROTECTION SECTION
611 RYAN PLAZA DRIVE, SUITE 1000
ARLINGTON, TX 76011

ALASKA, ARIZONA, CALIFORNIA, HAWAII, NEVADA, OREGON, WASHINGTON, AND U.S. TERRITORIES AND POSSESSIONS IN THE PACIFIC, SEND APPLICATIONS TO:

U.S. NUCLEAR REGULATORY COMMISSION, REGION V
MATERIAL RADIATION PROTECTION SECTION
1450 MARIA LANE, SUITE 210
WALNUT CREEK, CA 94596

PERSONS LOCATED IN AGREEMENT STATES SEND APPLICATIONS TO THE U.S. NUCLEAR REGULATORY COMMISSION ONLY IF THEY WISH TO POSSESS AND USE LICENSED MATERIAL IN STATES SUBJECT TO U.S. NUCLEAR REGULATORY COMMISSION JURISDICTION.

1. THIS IS AN APPLICATION FOR *(Check appropriate item)*

- [ ] A. NEW LICENSE
- [ ] B. AMENDMENT TO LICENSE NUMBER _____
- [X] C. RENEWAL OF LICENSE NUMBER 18-02774-01

This is a resubmittal of renewal application

2. NAME AND MAILING ADDRESS OF APPLICANT *(Include Zip Code)*

The Jackson Laboratory
Otter Creek Road
Bar Harbor, ME 04609

3. ADDRESS(ES) WHERE LICENSED MATERIAL WILL BE USED OR POSSESSED.

Same as Item 2.

4. NAME OF PERSON TO BE CONTACTED ABOUT THIS APPLICATION

Frederic J. Driscoll III

TELEPHONE NUMBER: 207-288-3371, X265

SUBMIT ITEMS 5 THROUGH 11 ON 8½ x 11" PAPER. THE TYPE AND SCOPE OF INFORMATION TO BE PROVIDED IS DESCRIBED IN THE LICENSE APPLICATION GUIDE.

5. RADIOACTIVE MATERIAL
a. Element and mass number, b. chemical and/or physical form, and c. maximum amount which will be possessed at any one time.

6. PURPOSE(S) FOR WHICH LICENSED MATERIAL WILL BE USED.

7. INDIVIDUAL(S) RESPONSIBLE FOR RADIATION SAFETY PROGRAM AND THEIR TRAINING AND EXPERIENCE

8. TRAINING FOR INDIVIDUALS WORKING IN OR FREQUENTING RESTRICTED AREAS

SEE ITEM 10

9. FACILITIES AND EQUIPMENT

10. RADIATION SAFETY PROGRAM

11. WASTE MANAGEMENT

SEE ITEMS 9 and 10

12. LICENSE FEES *(See 10 CFR 170 and Section 170.31)*

FEE CATEGORY: 3K

AMOUNT ENCLOSED: $ submitted 14 April 1984

13. CERTIFICATION *(Must be completed by applicant)* THE APPLICANT UNDERSTANDS THAT ALL STATEMENTS AND REPRESENTATIONS MADE IN THIS APPLICATION ARE BINDING UPON THE APPLICANT.

THE APPLICANT AND ANY OFFICIAL EXECUTING THIS CERTIFICATION ON BEHALF OF THE APPLICANT, NAMED IN ITEM 2, CERTIFY THAT THIS APPLICATION IS PREPARED IN CONFORMITY WITH TITLE 10, CODE OF FEDERAL REGULATIONS, PARTS 30, 32, 33, 34, 35, AND 40 AND THAT ALL INFORMATION CONTAINED HEREIN, IS TRUE AND CORRECT TO THE BEST OF THEIR 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.

SIGNATURE–CERTIFYING OFFICER	TYPED/PRINTED NAME	TITLE	DATE
Barbara H. Sanford	Barbara H. Sanford	Director	7/12/85

14. VOLUNTARY ECONOMIC DATA

a. ANNUAL RECEIPTS

- [ ] < $250K
- [ ] $250K–500K
- [ ] $500K–750K
- [ ] $750K–1M
- [ ] $1M–3.5M
- [ ] $3.5M–7M
- [ ] $7M–10M
- [ ] > $10M

b. NUMBER OF EMPLOYEES *(Total for entire facility excluding outside contractors)*: Approximately 500

c. NUMBER OF BEDS: N/A

d. WOULD YOU BE WILLING TO FURNISH COST INFORMATION *(dollar and/or staff hours)* ON THE ECONOMIC IMPACT OF CURRENT NRC REGULATIONS OR ANY FUTURE PROPOSED NRC REGULATIONS THAT MAY AFFECT YOU? *(NRC regulations permit it to protect confidential commercial or financial—proprietary—information furnished to the agency in confidence)*

- [X] YES
- [ ] NO

FOR NRC USE ONLY

TYPE OF FEE	FEE LOG	FEE CATEGORY	COMMENTS	APPROVED BY
			8510290507 850925 REG1 LIC30 18-02774-01 PDR	
AMOUNT RECEIVED	**CHECK NUMBER**			**DATE**

PRIVACY ACT STATEMENT ON THE REVERSE

ITEM 5. RADIOACTIVE MATERIAL

5a. Element and Mass Number	5b. Chemical and/or Physical Form	5c. Maximum Amount to Be Possessed at Any One Time
(1) Any byproduct material with atomic numbers 3-83 except as specified below.	(1) Any	(1) One hundred millicuries of each radionuclide with atomic numbers 3 to 83, with a total possession limit of 5 curies except as specified below.
(2) Hydrogen-3	(2) Any	(2) 5 curies
(3) Carbon-14	(3) Any	(3) 200 millicuries
(4) Sulfur-35	(4) Any	(4) 200 millicuries
(5) Iodine-125	(5) Any Sealed Source Norland Corp. Model 178A519A	(5) 500 millicuries

ITEM 6. PURPOSE(S) FOR WHICH LICENSED MATERIAL WILL BE USED

Research and diagnostic use in small laboratory animals. Tracer studies *in vivo* and *in vitro* with tissues and subcellular fractions from laboratory animals.

7. INDIVIDUALS RESPONSIBLE FOR RADIATION SAFETY PROGRAM AND THEIR TRAINING AND EXPERIENCE

Radiation Safety Committee:

CHAIRMAN	Douglas L. Coleman, Ph.D.; Senior Staff Scientist
SECRETARY	Frederic J. Driscoll III, Radiation Safety Officer
	Wesley G. Beamer, Ph.D.; Staff Scientist
	David E. Harrison, Ph.D; Senior Staff Scientist
	Andrew A. Kandutsch, Ph.D.; Senior Staff Scientist
	Edward H. Leiter, Ph.D.; Staff Scientist
	Jaffrey D. Saffer, Ph.D.; Associate Staff Scientist

A description of these member's training and experience with radiation and radioactive material follows.

Robert Howell, P.E./C.P.E., Director of Engineering, Facilities and Maintenance. Mr. Howell reports directly to the Director of the Jackson Laboratory.

Karol Hagberg, Manager, Personnel Health Service;
Qualifications: R.N., B.S.N., Certified Nurse Practitioner.

Radiation Safety Committee: Douglas L. Coleman, Ph.D.

Type of Training	Where Trained	Duration of Training	On the Job?	Formal Course?
a. Principles and practices of radiation protection	Univ. of Wisconsin	3 years	Yes	No
	The Jackson Laboratory	27 years	Yes	No
b. Radioactivity measurement standardization and monitoring techniques and instruments	As above	As above	Yes	No
c. Mathematics and calculations basic to the use and measurement of radioactivity	Univ. of Wisconsin	1 year	Yes	Yes
d. Biological effects of radiation	As above	As above	Yes	No

Experience with Radiation

Isotope	Maximum Amount	Where Experience was Gained	Duration of Experience	Type of Use
Hydrogen 3	100 millicuries	The Jackson Laboratories	27 years	Live animal studies (rats, mice), invitro assays, chemical and immunologic hormone assays
Carbon 14	10 "	As above	27 years	
Iodine 131	1 millicurie	As above	15 years	
Iodine 125	2 millicuries	As above	15 years	

Dr. Coleman is present Chairman of the Radiation Safety Committee.

Dr. Coleman was Supervisor of Radioisotopes at the Jackson Laboratory from 1961-1978 and worked in this position in conjunction with the Radiation Safety Officer.

Radiation Safety Officer: Frederic J. Driscoll III.

Type of Training	Where Trained	Duration of Training	On the Job?	Formal Course?
a. Principles and practices of radiation protection	Mass. General Hosp.	2 years	Yes	Yes
	Tufts Univ. Sch. of Den. Med.	3 years	Yes	Yes
	Tufts/New Eng. Med. Center	3 years	Yes	Yes
	Univ. Texas/San Antonio (RSO Course)			Yes
b. Radioactivity measurement standardization and monitoring techniques and instruments	As above	As above	Yes	Yes
c. Mathematics and calculations basic to the use and measurement of radioactivity	Univ. of Vermont	3 years	No	Yes
	Mass. General Hospital	2 years	Yes	Yes
	TUSDM	3 years	Yes	Yes
	Tufts/NEMC	3 years	Yes	Yes
	UTSA (RSO Course)			Yes
d. Biological effects of radiation	Mass. General Hospital	2 years	Yes	Yes
	TUSDM	3 years	Yes	Yes
	Tufts/NEMC	3 years	Yes	Yes
	UTSA (RSO Course)			Yes

Frederic J. Driscoll supervised the Health Physics Section at Tufts/New England Medical Center, Boston, MA., serving as Assoc. Radiation Safety Officer from October 1982-May 1985. Mr. Driscoll was directly responsible for all activities/programs involved with the Broad Medical NRC License at New England Medical Center (20-03857-06) and Broad Research NRC License at Tufts University School of Medicine (20-00045-08) and the Cesium Irradiator Licenses at both these institutions (20-03857-08, 20-00045-10). Direct experience with radiation includes research and clinical work at the Massachusetts General Hospital and Tufts University School of Dental Medicine, as well as extensive hands-on experience at Tufts/New England Medical Center managing their Radiation Safety Programs. Mr. Driscoll has also maintained contractual affiliations in the radiation safety area with various other institutions, both through the Tufts/NEMC Health Physics group and as an individual consultant, conducted full Quality Assurance, Radiation Safety Program for New England Medical Center Radiology Department. Member of Health Physics Society, American Association of Physicists in Medicine, participation in numerous continuing education seminars.

Radiation Safety Committee: Wesley G. Beamer, Ph.D.

Type of Training	Where Trained	Duration of Training	On the Job?	Formal Course?
a. Principles and practices of radiation protection	Univ. of California	5 years	Yes	No
	The Jackson Laboratory	8 years	Yes	No
b. Radioactivity measurement standardization and monitoring techniques and instruments	As above	As above	Yes	No
c. Mathematics and calculations basic to the use and measurement of radioactivity	Univ. of California	0.5 year	Yes	No
d. Biological effects of radiation	As above	As above	Yes	No

Experience with Radiation

Isotope	Maximum Amount	Where Experience was Gained	Duration of Experience	Type of Use
Hydrogen 3	5 millicuries	The Jackson Laboratory	9 years	Live animal studies (sheep, horses, rats, mice), *in vitro* assays, chemical and immunological hormone assays
Iodine 131	10 "	Above and Univ. of California	12 years	
Iodine 125	5 "	As above	11 years	
Phosphorus 32	2 "	The Jackson Laboratory	7 years	
Calcium 45	2 "	As above	3 years	
250 KVP 30 mA G.E. Maxitron X-ray machine, The Jackson Laboratory			1 year	

Dr. Beamer was the Radiation Protection Officer at the Jackson Laboratory from 1976 to Feb 1985.

Radiation Safety Committee: David E. Harrison, Ph.D.

Type of Training	Where Trained	Duration of Training	On the Job?	Formal Course?
a. Principles and practices of radiation protection	The Jackson Laboratory	1 year	Yes	No
b. Radioactivity measurement standardization and monitoring techniques and instruments	As above	1 year	Yes	No
c. Mathematics and calculations basic to the use and measurement of radioactivity	As above	1 year	Yes	No
d. Biological effects of radiation	As above	As above	Yes	No

Experience with Radiation

Isotope	Maximum Amount	Where Experience was Gained	Duration of Experience	Type of Use
Hydrogen 3	2 millicuries	The Jackson Laboratory	15 years	Tracer
Carbon 14	1 millicurie	As above	5 years	Tracer
Chromium 51	1 millicurie	As above	15 years	Tracer
Iron 59	2 millicuries	As above	15 years	Tracer
X-ray	250 KVP	As above	9 years	Irradiation
Cesium 137	12,000 Ci	As above (as Supervisor of Cesium Source Irradiator)	6 years	Irradiation

Radiation Safety Committee: Andrew A. Kandutsch, Ph.D.

Type of Training	Where Trained	Duration of Training	On the Job?	Formal Course?
a. Principles and practices of radiation protection	Univ. of Wisconsin	0.5 years	Yes	Yes
b. Radioactivity measurement standardization and monitoring techniques and instruments	As above	As above	Yes	Yes
c. Mathematics and calculations basic to the use and measurement of radioactivity	As above	As above	Yes	Yes
d. Biological effects of radiation	As above	As above	Yes	Yes

Experience with Radiation

Isotope	Maximum Amount	Where Experience was Gained	Duration of Experience	Type of Use
Hydrogen 3	20 millicuries	The Jackson Laboratory	27 years	Biochemical tracers
Carbon 14	5 "	As above	27 years	
Iodine 131	2 "	As above	27 years	
Rubidium 86	2 "	As above	3 years	
Chromium 51	2 "	As above	27 years	

Dr. Kandutsch served 10 years as Radiation Safety Officer at the Jackson Laboratory.

Radiation Safety Committee: Edward H. Leiter, Ph.D.

Type of Training	Where Trained	Duration of Training	On the Job?	Formal Course?
a. Principles and practices of radiation protection	Univ. of Texas/Austin The Jackson Laboratory	3 years	Yes	No
b. Radioactivity measurement standardization and monitoring techniques and instruments	As above	As above	Yes	No
c. Mathematics and calculations basic to the use and measurement of radioactivity	As above	0.5 year	Yes	No
d. Biological effects of radiation	Emory Univ., Atlanta	0.5 year	Yes	Yes

Experience with Radiation

Isotope	Maximum Amount	Where Experience was Gained	Duration of Experience	Type of Use
Hydrogen 3	1 millicurie	Univ. of Texas, Austin	13 years	*In vitro* incorporation of labelled precursors by cells in culture; radioimmunoassay
Carbon 14	1 "	The Jackson Laboratory	13 years	
Sulfur 35	1 "	As above	2 years	
Iodine 125	100 microcuries	As above	9 years	

Radiation Safety Committee: Jeffrey Saffer, Ph.D., Associate Staff Scientist

Type of Training	Where Trained	Duration of Training	On the Job?	Formal Course?
a. Principles and practices of radiation protection	NIH Yale University	5 years 3 years	Yes Yes	1 day course at each institution
b. Radioactivity measurement standardization and monitoring techniques and instruments	As above	As above	Yes	As above
c. Mathematics and calculations basic to the use and measurement of radioactivity	As above	As above	Yes	As above
d. Biological effects of radiation	As above	As above	Yes	As above

Experience with Radiation

Isotope	Maximum Amount	Where Experience was Gained	Duration of Experience	Type of Use
Hydrogen 3	5 millicuries	As above	8 years	In vitro labelling of nucleic
Carbon 14	5 "	As above	3 years	acids and proteins, in vitro
Phosphorus 32	20 "	As above	8 years	assays, labelling cellular
Iodine 125	1 millicurie	As above	2 years	components in culture

ITEM 9.FACILITIES AND EQUIPMENT

Throughout most of the complex covered by this license, standard laboratory facilities and equipment are in use and provide adequate controls. Most studies utilizing radioisotopes are conducted in the laboratory of individual investigators. Individual laboratories are equipped with sinks, stand-up and sit-down work benches, refrigerators, etc. and either have fume hoods or ready access to a fume hood. Refrigerators and freezers associated with individual laboratories are authorized for storage of radioisotopes in accordance with Radiation Safety Committee approved possession limits and storage regulations.

Radioisotopes Hot Laboratory - This laboratory is located on the second floor of the Main Laboratory (Radioisotope Suite) and is designated on Floor Plan #1. Rules for its use are provided to all investigators (Appendix Item 7). The Hot Lab is used for all iodination procedures, working with radioiodine compounds above 1.0 millicurie, and all other procedures so indicated by the Radiation Safety Committee in their review of applications for use of radioactive materials.

The hood in the Hot Lab is an outside ventilating device in operation 24 hr/day. The air flow rate through the Hot Lab is 1.337×10^{11} ml/7 days and is measured by hot-wire anemometer annually or more often if hood fan servicing is necessary. The Hot Lab also contains workbench space, stainless steel sink, freezer for storage of chemicals or contaminated animal carcasses, and a small well-shielded storage area for lead pigs containing stock solutions of radioisotopes. Special equipment available for use during execution of procedures is the Hot Lab consist of:

1. Variable rate of flow 1 to 20 L/min air pump (Bendix Model 19102) with in-line device that holds activated charcoal or other appropriate filters.

2. Fixed rate of flow (2 L/min) air pump (Fisher Scientific Model 18-309X) with in-line device that holds activated charcoal or other appropriate filters.

3. Nuclear Equipment Chemical Corporation survey meter Model H-572 assigned solely to the Hot Lab for monitoring contamination.

4. Mini-hood - Activated charcoal filtered hood for radioiodine control, with one cubic foot of working space. Integral blower capable of pulling 100 ft^3/min with approximately 75 linear ft/min face velocity. Used within the existing fume hood in the Hot Lab.

5. Glove Box - Disposable Aldritch AtmosBags are used in situations where the Radiation Safety Committe has dictated that operations be carried out in a glove box. These controlled atmosphere chambers with built-in gloves are available in the Hot Lab.

Radioactive Waste Processing Area - This area is located in the Radioisotope Suite and is designated on Floor Plan #1. Radioactive waste generated in the individual laboratories is brought to this area for further processing, segregation by half-life, packaging for storage, or shipment, and final disposal preparation.

All radioactive waste material from animal housing rooms(Floor Plan #1) comes directly into this processing area for treatment and disposal. Disposable animal cages used for radioisotope studies are directed to the appropriate waste stream.

This area is equipped with a sink and has ready access to the Hot Laboratory for waste processing procedures requiring a fume hood, or more rigid control and monitoring methods. A survey meter is available at all times in this area. Room surveys and wipe tests are done at least weekly.

These rooms are locked at all times. Access is restricted to the Radiation Safety Office Staff and registered radiation workers who have a need to be in the area.

Radioactive Waste Storage Facilities - There are two isolated areas at the Laboratory designated as storage areas for radioactive waste. See Floor Plan #2 and Campus Map. These areas are properly ventilated and prepared for easy decontamination, if necessary. The need for additional shielding of these areas does not exist at this time. Adjacent unrestricted areas are identified on the above diagrams, radiation levels in adjacent unrestricted areas will not exceed the requirements of 10 CFR 20.105.

Radiation levels in the storage areas will be surveyed and recorded at least weekly. These areas will be used for our storage for decay program as well as a holding area for materials to be shipped off site to a licensed disposal site. Both areas will be locked at all times. Access is restricted to Radiation Safety Office staff and registered radiation workers who have a need to be in the areas. Security personnel routinely patrol the outside perimeters of the areas during off hours.

Incinerator Facilities - The Burnzol Pathological Waste Incinerator (Model LB-200) is located in a separate utilities building(Campus Map), approximately 125 meters from the Main Laboratory building, 50 meters from the carpentry and maintenance shop and adjacent to general purpose storage buildings. The Burnzol unit is approximately 62 meters from the Jackson Laboratory boundary and at least 400 meters from the nearest residence. The nearest air intake ducts are located at the Main Laboratory.

Other characteristics of the Burnzol unit are capacity, 200 lb waste/hr; fuel, propane; operational temperature, 1600-2000 F; stack height, 6.2 meters; measured exhaust stack flow rate, 8.04×10^{10} ml/hr. The required negative pressure in the incinerator is maintained by a draft Inducer, located in the stack above the roof.

Liquid Waste Injection System - The Burnzol incinerator unit will be modified to accept a liquid waste burner, for introduction of volatile liquids in the secondary chamber. This provides approximately 2 seconds retention time at 1600 F when fired at a rate of 2.5 to 3 gallons per hour. The liquid waste burner is a Maxon 508 oven pack burner rated at 800,000 BTU/hr maximum input, with a turndown ratio of 20:1. The flame is maintained by an electronic flame safeguard system with UV scanner. The

fuel trains include liquid waste, atomizing air and gas pilot. The burner is equipped with an integral combustion air blower.

The liquid waste is pumped from the storage drum with a Viking positive displacement pump which features a suction filter, flow switch and flow scope indicator. The operating controls include the necessary safety interlocks, solenoid valves, relays and indicators for safe combustion of the liquid waste material.

Hoods - Laboratory hoods used for storage or work with radioisotopes are designated as such, and are required to provide a face velocity of at least 100 fpm under normal working conditions. These hoods are routinely monitored for contamination and function. Face velocity measurements are done and recorded at intervals of no more than 6 months.

Personnel Dosimetry Equipment - Film badge, TLD'S are supplied by R. S. Landauer Jr. & Company, Glenwood, Il. 60425, on a monthly basis.

Radiation Detection Equipment and Calibration

1. Survey meters:

a. Nuclear Chicago 2650M, Johnson CSM-5, Eberline E-120, and Nuclear Equipment Corp. H-572 are calibrated by Warington, Inc., 7801 North Lamor, D-111, Austin, TX 78752, License #NRC-6-3074. Victoreen 470-A and 493 are calibrated by Victoreen Instrument Division, 10101 Woodland Ave., Cleveland, OH 44104, License #NRC-34-00486-04.

b. These instruments will be calibrated annually and after servicing.

2. Research gamma and beta counters:

a. Nuclear Chicago Model 1185 (Main Laboratory) - method, frequency and standards used in calibrating gamma counter for testing: (1) surface wipe samples and (2) thyroid bioassays.

(1) Calibration of elevator-access deep well scintillation crystal through use of:

(a) Simulated ^{125}I (^{129}I; 0.1 mCi, Nuclear Chicago No. S-600)

(b) Simulated ^{131}I (^{133}Ba and ^{137}Cs; 0.28 mCi 10/14/74; New England Nuclear NES-214)

(c) ^{137}Cs (0.1 mCi $\pm$ 10%; 4/71; Amersham/Searle No. 184642) Calibration is carried out for the deep well crystal at least once a year for the above source. Verification of at least one source is made each time the deep well crystal is used to check surface wipes for contamination. On at least an annual basis, additional calibration will be made with ^{51}Cr, ^{59}Fe, or other short-lived radioisotopes that may be obtained for research purposes. These calibration sources are obtained from New England Nuclear Corp.

(2) Calibration of the special 5 cm (dia.) external scintillation crystal used for thyroid bioassays is accomplished with the same sealed sources described in (1) above. Each time thyroids are counted, calibration of the equipment is carried out with a phantom containing 2.5 cm water between the radioactive source and scintillation crystal.

b. Packard Tricarb 300C (Main Laboratory) - Method, frequency, and standards used in calibrating beta counter for testing (1) surface wipes and (2) urine bioassays.

(1) Calibration of dual channel crystals through use of:

(a) ^{3}H (255200 DPM, 27 Nov 79, Packard, Serial No. 322)

(b) ^{14}C (103000 DPM, 26 Feb 80, Packard, Serial No. 322)

(2) Calibration is carried out multiple times monthly with one or both of the above standards during research use and during surveys of surface wipes, effluent samples, ash, or biological specimens (i.e., urine) for presence of radioactive contamination. On at least annual basis, additional calibration will be carried out with calibrated standards of short half-life radioisotopes such as ^{32}P, ^{35}S, or other radioisotopes that may be obtained for research. These calibrated sources are purchased from New England Nuclear Corp.

(3) The Radiation Safety Office has assembled the above equipment and supervises the use of that equipment and thyroid bioassays. Ms. K. Hagberg, Manager, Personnel Health Service is also trained in the bioassay procedures.

c. The other research gamma and beta scintillation counters are calibrated on site frequently with standard isotopes of known activity described as are. Calibration is carried out with one to two different isotopes with calibration standards obtained from several vendors, including New England Nuclear (Boston, MA), Amersham/Searle (Downers Grove, IL), Nuclear Chicago (Chicago, IL), LKB-Wallace (Gaithersburg, MD), and Packard Instruments (Downers Grove, IL). In addition, service personnel from Gamma Sonics (Hopedale, MA 01747; Nuclear Chicago Instruments), Beckman Instruments (Beckman Instruments), Packard Instruments (Tricarb 300 C), and LKB-Wallace (RackBeta models 1211 and 1217) make frequent visits to the Jackson Laboratory for the purpose of repair and calibration of the respective vendors' instruments. These visits typically occur more frequently than once a year.

Radiation Detection Instruments

Type of Instrument	Manufacturer	Model	Number Available	Radiation Detected	Sensitivity
Survey meter	Nuclear Chicago	2650M	2	Beta and gamma	0.01-100 mR/hr
" "	Johnson	CSM-5	1	" "	0.01-20 mR/hr
" "	Victoreen Instrument	493	2	" "	0.1-50 mR/hr
" "	Nuclear Equip. Corp.	H-572	1	Gamma	0.1-50 mR/hr
" "	Victoreen Instrument	470-A	1	Beta and Gamma	0.01-1000 mR/hr
Research gamma	Nuclear Chicago	1185	2	Gamma	0.005 microcuries
" "	Beckman	5500	2	"	0.005 microcuries
" "	Beckman	8000	1	"	0.005 microcuries
Research beta	Nuclear Chicago	Isocap-300	3	Alpha, beta	0.005 microcuries
" "	Beckman	LS-800	1	" "	0.005 microcuries
" "	Packard	Tricarb 300C	1	" "	0.005 microcuries
" "	LKB-Wallace	1211	1	" "	0.005 microcuries
" "	LKB-Wallace	1217	1	" "	0.005 microcuries

ITEM 10. RADIATION SAFETY PROGRAM

THE JACKSON LABORATORY
RULES AND MODE OF FUNCTIONING OF THE RADIATION SAFETY COMMITTEE

TABLE OF CONTENTS

I. PURPOSE

The rules and regulations contained in this document have been established for the following purposes:

1.) To provide for the protection of Laboratory personnel and of the general public against radiation hazards associated with the Jackson Laboratory's possession, use, transportation and disposal of radioactive materials.

2.) To provide for The Jackson Laboratory's compliance with applicable regulations of federal, state, and local agencies.

II. ORGANIZATION OF THE COMMITTEE

The Radiation Safety Committee, which was appointed by the Director of the Laboratory, is presently composed of the following members:

CHAIRMAN	Douglas L. Coleman, Ph.D.; Senior Staff Scientist
SECRETARY	Frederic J. Driscoll, Radiation Safety Officer
	Wesley G. Beamer, Ph.D.; Staff Scientist
	Karol A. Hagberg,Manager, Personnel Health Service
	David E. Harrison, Ph.D.; Senior Staff Scientist
	Robert M. Howell, Administration; Director Engineering, Facilities and Maintenance
	Andrew A. Kandutsch, Ph.D.; Senior Staff Scientist
	Edward H. Leiter, Ph.D.; Staff Scientist
	Jeffrey D. Saffer, Ph.D.; Associate Staff Scientist

III. DELEGATION OF AUTHORITY

The Radiation Safety Committee receives its authority from the Director of the Laboratory. The Committee is charged with the following responsibilities:

1) Establish policies regarding radiation protection at the Jackson Laboratory.

2) Provide direction and advice to the Radiation Safety Office on matters regarding radiation safety.

3) Receive, review, and act on all applications for the use of radiation sources at the Jackson Laboratory.

4) Receive and review periodic reports from the Radiation Safety Office on monitoring contamination and personnel exposure.

5) Review instances of alleged infractions of use and safety rules with the Radiation Safety Office and the responsible individuals.

6) Conduct an annual audit of the Radiation Safety Program, reviewing the activities of the Radiation Safety Office and the records that must be maintained to ensure compliance with conditions of the license and applicable parts of NRC's regulations.

In carrying out these responsibilities the Radiation Safety Committee conducts a program of licensing, review and evaluation of proposals for use of radionuclides, and continuing surveillance of the use of such materials with a view to maintaining standards of safe handling practice.

The Committee will meet on a quarterly basis. The secretary will maintain permanent records of the Committee proceedings. A quorum for the purpose of conducting business shall be five(5) committee members.

IV. RADIATION SAFETY OFFICER

The Radiation Safety Officer operates under the authority of the Radiation Safety Committee. He is in charge of the Laboratory's Radiation Safety Office which is responsible for the following:

1) Implementing policy decisions of the Radiation Safety Committee and insuring compliance with regulatory agencies.

2) General surveillance of all health physics activities, including personnel and environmental monitoring.

3) Furnishing consulting services to personnel at all levels of responsibility on all aspects of radiation protection.

4) Establishment of procedures for purchase, receipt, and shipment of all radioactive materials coming to or leaving the Jackson Laboratory.

5) Radioisotope laboratory inspection, radiation surveys, and area monitoring as necessary.

6) Distribution and processing of personnel monitoring equipment including the keeping of records of internal and external personnel exposures and notifying individuals and their supervisors of exposures as well as recommending appropriate remedial action.

7) Conducting continuing Radiation Safety education programs for all levels of personnel.

8) Supervision and coordination of the waste disposal program, including the processing, storage, and disposal of radioactive waste and the keeping of required records.

9) Storage of radioactive materials not in current use, including wastes.

10) Supervising the leak testing of sealed sources, and maintaining required records.

11) Maintaining an inventory of all radioisotopes at the Jackson Laboratory and limiting quantities of radionuclides to amounts authorized by the license.

12) Supervision of corrective action following radiation incidents and supervision of special decontamination procedures.

13) Maintenance of all required radiation protection records.

V. NRC BYPRODUCT MATERIALS LICENSE

The Jackson Laboratory is applying for a continuation and extension of current license # 18-02774-01 to that of a Type A Specific License of Broad Scope. This license covers all uses of NRC regulated radioactive materials within the Laboratory, giving full responsibility for control and proper use of such materials to the Jackson Laboratory Radiation Safety Committee. This license covers receipt, acquisition, ownership, possession, use and transfer of any chemical or physical form of byproduct material specified in the license for authorized purposes. Byproduct material shall be used by, or under the supervision of individuals, designated by the Jackson Laboratory Radiation Safety Committee. This license also specifies a list of conditions of approval, all of which must be continually satisfied in the conduct of work involving radioactive materials. One such condition is that the rules and regulations specified in Title 10, Code of Federal Regulation, Part 20, "Standards for Protection Against Radiation" are satisfied. Compliance with these conditions and regulations is included in the responsibilities of the Radiation Safety Committee.

VI. INDIVIDUAL LICENSEES

A policy of "individual licensees" has been adopted within the Radiation Safety Committee's rules whereby only persons licensed by the local Committee may be "designated" as outlined in section V above.

New Licensee candidates must make a formal application(Appendix Item 1) to the Committee and submit to a writen examination conducted by the

Radiation Safety Committee. Those who qualify with regard to experience and who have successfully completed the above examination will be granted licensure to use radioisotopes on their own responsibility at the Jackson Laboratory. Only licensees are authorized by the Committee to requisition byproduct materials. Each such licensee is directly responsible for the safe use of the material and for the qualifications of those who use the material under his/her supervision. A current list of licensees is available from the Radiation Safety Office.

Each project in which radioactive materials are used at the Jackson Laboratory must have one such licensee who holds a staff rank. Non-staff personnel, while they are eligible for and encouraged to pursue licensure, may not be charged with the prime responsibility for radiation safety in the project.

VII. RESPONSIBILITIES OF LICENSEES

Each licensee under whom radioisotope work is being conducted is responsible for the following:

1) Adequate planning of experiments and determination of the type and quantity of radiation or radioactive material to be used. This determination will generally give a good indication of the safety measures required. Experimental procedures must be well outlined to allow adequate review of safety precautions. Where possible, a cold run using the planned procedures is recommended to avoid unforeseen safety problems. In any situation where there is appreciable radiation hazard, the Radiation Safety Office shall be consulted before proceeding.

2) Instructing those employees for whom they are responsible in the use of safe techniques and on the application of approved radiation safety practices and insuring attendance in required radiation safety courses.

3) Providing the Radiation Safety Office with up-to-date data as necessary, relative to the rooms or areas in which radioactive materials are stored or handled.

4) Notifying the Radiation Safety Office of any changes in the listing of personnel who may be handling radioactive material or who may be exposed to ionizing radiation during the course of their work.

5) Maintaining an adequate inventory of the amount of radioactive material under his/her control at any one time, and establishing an adequate system to insure that he/she does not possess more than that quantity of material for which he/she is licensed.

6) Ensuring that radioactive material is disposed of only by authorized means.

7) Using the radioactive material for which he/she is licensed only for those uses specifically authorized.

8) Informing the Radiation Safety Office of changes in procedure which may increase the probability of radiation exposure or laboratory contamination.

9) Establishing appropriate procedures to insure that radioactive materials are properly labelled.

10) Establishing that radioactive materials are properly controlled within his/her project, and that they are properly stored at the end of each work day.

11) Equipping the laboratory with adequate survey and\or monitoring equipment to aid in the safe handling of radioactive material, and performing routine surveys of work areas as necessary.

12) Ensuring that service personnel are not permitted to work on equipment, hoods, or sinks in radiation areas without the presence of a member of the laboratory staff to provide specific information.

13) Complying with proper procedures for termination of employment or termination of work using radioactive materials. The licensee must return to the Radiation Safety Office all radioactive materials, including waste, assigned to him under the license. Particular care should be exercised to see that specialized equipment such as personnel monitoring devices, survey instruments and shielding materials are returned to the Radiation Safety Office. A final termination survey is also necessary.

14) Ensuring that the following individual user responsibilities are discharged by those under their control.

VIII. RESPONSIBILITIES OF INDIVIDUAL USERS

Each individual registered(Appendix Item 2) as a radiation worker is responsible for:

1) Keeping his/her exposure to radiation as low as possible, and specifically below those levels outlined in section XVI. Control of Radiation Exposure. Laboratory air and water concentrations shall be maintained below the levels listed in Title 10, Code of Federal Regulations, Part 20 "Standards for Protection Against Radiation".

2) Wearing the prescribed monitoring equipment such as film badges and TLD ring dosimeters in radiation areas. Personnel who work only with pure alpha emitters, or only with pure beta emitters having a maximum energy of less than 0.2 MeV (e.g. ^{3}H, ^{14}C, ^{35}S) will not be required to wear film badges.

3) Utilizing all appropriate protective measures such as:
   a) Wearing protective clothing whenever contamination is possible, and not wearing such clothing outside the laboratory area.
   b) Wearing gloves and respiratory protection when necessary.
   c. Using protective barriers and other shields when indicated.
   d) Using mechanical devices when appropriate to reduce exposure.
   e) Using pipette filling devices. Never Pipette Radioactive Solutions by Mouth.
   f) Performing radioactive work within confines of an approved hood or glove box unless serious consideration has indicated the safety of working in the open.

4) Not eating, drinking or smoking in areas where unsealed radioactive materials are being used, handled, transferred or stored. Refrigerators may not be used jointly for food, beverages and radioactive materials.

5) Maintaining good personal hygiene. Do not work with radioactive materials if there is an open or unprotected break in skin below the wrists. Wash hands and arms thoroughly after working with radioactive materials. Hands, shoes and clothing should be surveyed and decontaminated as necessary before leaving the laboratory.

6) Checking periodically for contamination in the immediate areas in which radioactive materials are being used. (hoods, benches, etc.) A log record should be maintained of these surveys including results that are entirely negative. Any minor contamination observed should be decontaminated, larger amounts of activity found should be decontaminated under Radiation Safety Office supervision.

7) Keeping the laboratory neat and clean. The work area should be free from equipment and materials not required for the immediate procedure. Keep or transport materials in such a manner as to prevent breakage of spillage (double container) and to insure adequate shielding. Wherever practical, keep work surfaces covered with absorbent material, preferably in a tray or pan, to limit and collect spillage in case of accident.

8) Label and isolate radioactive waste and equipment, such as glassware, used in laboratories for radioactive materials. Once used for radioactive substances equipment should not be used for other work, and should not be permitted to leave the area until demonstrated to be free of contamination.

9) Requesting Radiation Safety Office supervision of any emergency repair of contaminated facilities or equipment by shop personnel or commercial service contractors.

10) Reporting accidental inhalation, ingestion or injury involving radioactive materials to his/her supervisor and the Radiation Safety Office, and carrying out their recommended corrective measures. The individual shall cooperate in any and all attempts to evaluate his/her exposure.

11) Carrying out decontamination procedures when necessary, and for taking the necessary steps to prevent the spread of contamination to other areas.

12) Prompt compliance with requests from the Radiation Safety Office concerning body burden measurements and the submission of bioassay samples.

IX. APPLICATION FOR PERMISSION TO USE RADIOISOTOPES

Each proposed use of radioisotopes must be applied for by a licensee through the Radiation Safety Committee. This is accomplished by submitting an Application for Permission to Use Radioactive Materials,(Appendix Item 3) which provides a written protocol of the experiment and its methodology. Included are descriptions of the facilities, equipment and training of various users. The application is submitted to the Committee through its secretary, the Radiation Safety Officer, reviewed by the Committee and appropriate action taken in regard to the proposed use. Each approval is issued for a period of not more than 3 years. Application for renewal should be submitted at least 30 days prior to expiration of the approval. Records of these proposed uses will be maintained for inspection for the duration of our NRC license.

X. AMENDMENTS TO ESTABLISHED RADIOISOTOPE USE

Application for amendment to an approved application should be made in writing to the Radiation Safety Committee for any change in responsible personnel use or procedure mentioned in the original application. Applications involving major changes require the completion of a new application form. Minor changes involving only personnel or minor procedural changes may be requested by letter. However, any amendment, regardless of its magnitude must be requested in writing. The Radiation Safety Office should be informed in writing of any change in the employees of a project working with radioisotopes. Changes in film badge listings should be requested of the Radiation Safety Office in writing as soon as possible in order to insure that each such person receives prompt film badge monitoring.

XI. SPONSORS

New projects with plans to work with radioisotopes but which have no licensee within the group, may apply to begin work under the supervision of a licensee from another project serving as a "sponsor". That "sponsor" must become thoroughly familiar with the proposed use and assume full responsibility for that work during his sponsorship. At least one member of such a project should apply for licensing as soon as practicable. The Committee limits the time during which a project can be sponsored in this way, to six months. If a member of the project has not satisfied the requirements for licensure within that period, work with radionuclides must terminate.

XII. PROCUREMENT AND INVENTORY

A) Ordering - Persons licensed by the Radiation Safety Committee may order those radioactive materials for which they are authorized by submitting a requisition(Appendix Item 4) to the Radiation Safety Office with the specifications of the order, isotope and amount on hand. The Radiation Safety Office checks the requisition for validity of signature application and possession limits, and countersigns it before it is forwarded to the purchasing department. The Jackson Laboratory Purchasing Department will not place orders for radioisotopes without confirmation by the Radiation Safety Office. All packages are addressed to the Radiation Safety Office.

B) Receipt - When the shipment is received, Radiation Safety personnel will check it for content, monitor it for radiation level, check for contamination and deliver the package to the requesting licensee's laboratory.(Appendix Item 5) The licensee is required to keep an accurate record of each shipment, while it is in his/her possession, and thereby maintain the possession limits for the approved applications assigned to him.(Appendix Item 6) Final disposal of all radioisotope containers is to be through the Radiation Safety Office.

C) Transfer - (Internally) The transfer of radioisotopes between licensees or laboratories is generally discouraged, however when a real need exists the following rules apply.

Except as noted below, the transfer of isotopes requires a completed radioisotope requisition to be submitted to the Radiation Safety Office from which it will be forwarded to the supplying project. Transfers may only be made to other licensees with approvals for the possession and use of the radioisotope involved. No requisition is required for the transfer of radioisotopes in the amounts listed in 10 CFR Part 30, Schedule B.

For example, the following radioisotopes may be transferred without a requisition:

1 uCi of: ^{131}I, ^{125}I

10 uCi of: ^{32}P, ^{75}Se, ^{45}Ca, ^{59}Fe

100 uCi of: ^{14}C, ^{35}S

1000 uCi of: ^{3}H, ^{51}Cr

This exemption does not apply to isotopes coming into the Jackson Laboratory. All isotopes in any quantity obtained from outside the Jackson Laboratory must be ordered as indicated in A above.

D) Possession Limits - Each approved authorization includes a maximum possession limit for the radioisotopes covered in the application. This limit is the maximum which may be possessed by the licensee for the proposed use and must be adhered to by the licensee. Radiation Safety Committee processing of the application includes comparison of the possession limit requested, plus that previously assigned to other projects, with the Nuclear Regulatory Commission imposed possession limit for that isotope for the entire Jackson Laboratory. Observance of such assigned possession limits by all licensees is essential to insure compliance with the NRC overall limit. Inventory records maintained by the licensee should readily yield information on adherence to possession limits. The licensee is reminded that all radioactive waste within his/her laboratory must be considered in this inventory until it is transferred to Radiation Safety control.

XIII. STORAGE

The Jackson Laboratory is a restricted-access facility for health and safety reasons. To further insure security of radioactive materials in use at The Jackson Laboratory, each project stores its own radioisotope stocks in a designated place under lock and key. These storage areas may or may not be shielded depending on the amount and type of activity to be stored there. The licensee of the laboratory is in charge of all storage. He/She is to provide the Radiation Safety Office with a duplicate key and a list of authorized users and is responsible for informing these users concerning storage regulations and for keeping the list up to date. Each storage area should have a single key which is kept in a place known to the users but not public. The storage area is to be kept locked and the key kept in its place at all times except when an isotope withdrawal is being made.

XIV. MONITORING

Laboratories using millicurie amounts of radioisotopes are monitored weekly by the Radiation Safety Office. Laboratories using less than millicurie amounts may be monitored less frequently but at least monthly. A record of this monitoring and of personnel monitoring(film badges) is kept by the Radiation Safety Office. Unusually high results or a spill area uncovered in such monitoring will be communicated to the local licensee and decontamination will be performed. A summary of the results of the monitoring is reported to the Radiation Safety Committee at its regular meetings. Included in this report will be specific coverage of any accidents or violations.

The above described monitoring program is designed to provide only a broad overview with respect to radiation monitoring. It provides for routine monitoring by a person from outside the laboratory at intervals that would presumably catch any serious spread of contamination or loss of activity before the consequence becomes serious. The program is intended as a supplement to the radiation monitoring that is required of any individual working routinely with radioactive material. It is the prime responsibility of the laboratory personnel to provide whatever monitoring is necessary on a day to day or hour to hour basis depending entirely on the procedures involved and the radioisotopes being handled at the time. These laboratory records of monitoring will be periodically audited by the Radiation Safety Office.

Each licensee must appropriately equip his laboratory to conduct such surveys and they are to be conducted at a frequency that is commensurate with the level of activity being handled in the laboratory. Following is a detailed outline of what is expected in this regard:

A. Laboratories in which millicurie amounts of gamma-emitting or hard beta-emitting radionuclides are routinely handled.

1) Daily close-out surveys of the laboratory shall be made by a responsible individual. Survey will include a check to be sure that radionuclides are properly identified and secured from unauthorized persons, that areas in which gamma or high energy beta-emitting materials are handled are contamination free (GM survey meter measurements) and that major equipment necessary for the handling of such material (hood, etc.) is functioning. The performance of each such survey shall be permanently logged by a simple statement that the survey was made. by whom, and the listing of unusual findings.

2) Weekly surveys of these same laboratories shall be a more thorough version of A 1 above, and shall include wipe tests of bench areas on which radionuclides are handled. The logging of these weekly surveys shall include radiation measurements and wipe test results superimposed on a diagram of the room.

B. Laboratories in which tritium (^{3}H) or lesser amounts of gamma or hard beta-emitting radionuclides are routinely handled.

1) Daily close-out surveys shall be made to determine that radionuclides are properly identified and secured against unauthorized personnel.

2) Weekly surveys of these same laboratories shall include the B 1 procedure above, plus wipe tests of bench areas on which radionuclides are handled. The results of these wipe tests shall be recorded on a diagram of the laboratory, which shall become part of the weekly survey log.

C. Additional surveys shall be made as necessary, following any unusual procedure or incident in the laboratory which may have resulted in unusual external radiation or contamination levels. Excessive contamination levels (more than 1000 dpm/100 cm^2) shall be brought to the attention of the Radiation Safety Office and the area in question shall be decontaminated and resurveyed.

The log book containing the on-going data for each of these surveys shall be available for review by Radiation Safety on their routine surveys through the laboratories, and for review by NRC compliance inspectors during their annual inspection. Laboratory supervisors shall ascertain that the necessary survey equipment is available to perform the required procedures and that a specific individual is assigned the tasks. Radiation Safety personnel are available to assist in setting up an appropriate survey program.

ACTION LEVELS FOR REMOVABLE SURFACE CONTAMINATION

Type of Surface	Alpha Emitters		Beta or X-ray Emitters	
	(uCi/cm^2)	($dpm/100cm^2$)	(uCi/cm^2)	($dpm/100cm^2$)
Unrestricted areas	10^{-7}	22	10^{-6}	220
Restricted areas	10^{-6}	220	10^{-5}	2200
Personal clothing worn outside restricted areas	10^{-7}	22	10^{-6}	220
Protective clothing worn only in restricted areas	10^{-6}	220	10^{-5}	2200
Skin	10^{-6}	220	10^{-6}	220

Averaging is acceptable over nonliving areas of up to 300 cm^2 or, for floors, walls, and ceiling, 100 cm^2. Averaging ia also acceptable over 100 cm^2 for skin or, for the hands, over the whole area of the hand, nominally 300 cm^2.

XV. WASTE DISPOSAL

All radioactive waste disposal is managed by the Radiation Safety Office. Laboratories which handle unsealed radioactive material are equipped with radioactive waste containers which are clearly marked "Caution, Radioactive Waste, Do Not Empty ". These receptacles are emptied on request, or as the radiation levels become significant. All waste material that is contaminated with radioisotopes at any level should be disposed of as radioactive waste.

Pertinent information to ensure that the volume of low level radioactive waste is minimized and that such waste is processed into acceptable chemical or physical form prior to ultimate disposal is provided to personnel during initial and refresher training. Material must not be put into radioactive waste collection containers if there is a possibility of a chemical reaction during storage or shipment that may cause the release of radioactive gases, fire or explosion. Volatile or potentially volatile radioactive wastes should be appropriately treated with strong alkali, detergent or acid whenever possible to render radioactive material non-volatile.

As any receptacle is being filled, records must be kept of the date, isotope and quantity being placed in the containers. The procedures for disposal of the various types of radioactive waste generated are as follows:

DRY SOLID WASTE

A. This category forms the bulk of radioactive waste generated at the Jackson Laboratory. Due to increasing restrictions on low level radioactive waste disposal, we have requested permission to segregate and store for decay to background, wastes with half-lives of less than 100 days. Waste segregated and stored for this purpose will be carefully monitored after storage for at least 10 half-lives before being incinerated as normal trash. Monitoring will be done:

a. in a low background area
b. with a low level GM type survey meter appropriate for contamination surveys, using the most sensitive scale
c. with all shielding removed

Non-combustible waste will be similarly stored and monitored prior to disposal as part of the sanitary waste stream. Permanent records will be kept of all such monitoring, which will also serve to assure that radioactive labels have been properly obliterated or removed.

The storage areas for decay will be under the control of the Radiation Safety Office and be properly secured from unauthorized access. The containment vehicles for this waste will be standard DOT 7A 55 gallon drums with plastic liners. All drums stored in this way will be clearly identified, dated and properly cataloged. To insure the safety and integrity of the storage process, these materials will be monitored and controlled at all times. Weekly surveys will be done and recorded to ensure that radiation exposure levels do not present a hazard. Adjacent unrestricted areas may not exceed limits specified in 10 CFR 20.105.

B. Combustible dry solid waste that is not held for decay to background, will be segregated and incinerated in our Burn-zol Pathological Waste Incinerator (Model LB-200) which was purchased as a replacement for the Silent-Glo unit in which such waste was formerly incinerated under our license. The Burn-zol incinerator is licensed as a Class VI Incinerator by the State of Maine, Department of Environmental Protection (License No. 1339). Confirmation that all appropriate state and local regulations concerning incineration of radioactive material have been met, will be submitted to the NRC. Log books are maintained recording dates, specific isotopes and quantity of isotope disposed of in this manner. The stack discharge will be controlled by limiting the amount of radioactive material that is incinerated, such that the stack effluent concentration will not exceed the limits in 10 CFR 20 Appendix B, Table II, Column I, when averaged over 24 hours, and will not exceed 10% of these levels when averaged over a one year period. It will be assumed that all radioactive material will be released in the stack effluent in determining the maximum amount of material that may be incinerated.

Ashes from this procedure will be sampled for determination of residual activity. It will be ascertained that concentrations of licensed material appearing in the ash residues do not exceed the concentrations (in terms of microcuries per gram) specified for water in 10 CFR 20 Appendix B, Table II, prior to disposal as ordinary waste. Ash that does not fit these criteria will either be stored for decay and resurveyed or shipped to a licensed disposal site.

All persons involved with these processes will be provided with appropriate training, equipment and monitoring devices. The incinerator will be surveyed before release for unrestricted use.

TABLE 1

Calculations for combustion of waste materials containing radioisotopes in Burn-zol Pathological Waste Incinerator with flow rate of 8.04 x 10^{10}ml/day.

ISOTOPE	10 CFR 20 APPENDIX B Table II Col 1 (uCi/ml)	CALCULATED MP DISPOSAL (uCi/day)	ALARA FRACTION (10% of MPD) (mCi/yr)
^{3}H	$2x10^{-7}$	$1.60x10^{4}$	586.9
^{14}C	$1x10^{-7}$	$8.04x10^{3}$	293.4
^{32}P	$2x10^{-9}$	$1.60x10^{2}$	5.86
^{35}S	$9x10^{-9}$	$7.26x10^{2}$	26.40
^{45}Ca	$1x10^{-9}$	$8.04x10^{1}$	2.93
^{51}Cr	$4x10^{-7}$	$3.21x10^{4}$	1173.0
^{59}Fe	$5x10^{-9}$	$4.02x10^{2}$	14.60
^{75}Se	$4x10^{-8}$	$3.21x10^{3}$	117.3
^{125}I	$8x10^{-11}$	6.43	0.234
^{131}I	$1x10^{-10}$	8.04	0.293

24 hour burn

There will be a maximum of two burns performed in any one week, with no more than 60 burns per year. Overall release will be evaluated in accordance with 10 CFR 20 Appendix B. $\frac{CA}{MPC_A} + \frac{CB}{MPC_B} + \frac{Ci}{MPC_i} \leq 1$ for both individual burns and 1 year period assessments (10% fraction).

C. Solid, noncombustible wastes which are not amenable to storage for decay (half-life > 100 days), are collected in DOT TYPE 7A 55 gallon drums and periodically shipped via HMM Associates, Concord, Massachusetts (NRC Lic.# 20-20795-01) for disposal in a licensed disposal site. All applicable requirements set by the NRC, DOT and Agreement States hosting landfill sites are followed when shipments are prepared. Training for this task is provided by review of appropriate regulations and telephone conversations

with HMM Associates personnel, prior to final packaging and shipment. This assures that all the latest changes are incorporated in our shipment preparations. Our records include detailed accounts of materials disposed of in this manner (dates, isotope, amounts, etc.). The Radiation Safety Office is responsible for the safe transfer, packaging and transport of this low level radioactive material.

Liquid Waste

D. Radioactive waste materials which are soluble or dispersible in water may be disposed of in the sewage system in amounts and concentrations conforming on a Laboratory wide basis to NRC regulations. Only designated sinks/drains may be utilized for this disposal.

TABLE 2

The following table outlines disposal limits for The Jackson Laboratory. Calculations based on 1.68×10^{8} ml/day average sewage system rate.

ISOTOPE	10 CFR 20 Appendix B Table I Col 2 uCi/ml	Calculated MPD uCi/day	ALARA Fraction 10% uCi/day	ALARA Fraction 10% mCi/month(30 d)
^{3}H	1×10^{-1}	1.68×10^{7}	1.68×10^{6}	5.04×10^{4}
^{14}C	2×10^{-2}	3.36×10^{6}	3.36×10^{5}	1.008×10^{4}
^{32}P	5×10^{-4}	8.4×10^{4}	8.4×10^{3}	2.52×10^{2}
^{35}S	2×10^{-3}	3.36×10^{5}	3.36×10^{4}	1.008×10^{3}
^{45}Ca	3×10^{-4}	5.04×10^{4}	5.04×10^{3}	1.512×10^{2}
^{51}Cr	5×10^{-2}	8.4×10^{6}	8.4×10^{5}	2.52×10^{4}
^{59}Fe	2×10^{-3}	3.36×10^{5}	3.36×10^{4}	1.008×10^{3}
^{75}Se	9×10^{-3}	1.512×10^{6}	1.512×10^{5}	4.53×10^{3}
^{125}I	4×10^{-5}	6.72×10^{3}	6.72×10^{2}	2.016×10^{1}
^{131}I	6×10^{-5}	1.008×10^{4}	1.008×10^{3}	3.024×10^{1}

Overall release will be evaluated by the principal of $\frac{CA}{MPC_A} + \frac{CB}{MPC_B} + \frac{Ci}{MPC_i} \leq 1$ in accordance with 10 CFR Appendix B.

No more than 5 times the amount of material specified in the above table column 3 (calculated ALARA fraction uCi/day) will be disposed of in any one day. The quantity of radioactive material released in any one month, if diluted by the average monthly quantity of water released, will not result in an average concentration exceeding 10% of the limits specified in 10 CFR 20 Appendix B, Table I Col. 2. The gross quantity of licensed and other radioactive material, excluding ^{3}H and ^{14}C released into the sanitary sewer system will not exceed 1 Curie per year. The quantities of ^{3}H and ^{14}C released into the sanitary sewer system will not exceed 5 Curies per year for ^{3}H and 1 Curie per year for ^{14}C. Records will be maintained of all such disposal, indicating dates, isotope and quantities.

E. Disposal of larger amounts, or liquids that are not soluble in water must be done under the supervision of the Radiation Safety Office. Insoluble or high level liquid waste should be neutralized (pH 6.5-7.5), collected in inert polyvinyl chloride containers and the Radiation Safety Office notified. All iodine liquid waste should be made strongly alkaline. Contents of polyvinyl chloride bottles should be liquid only. Bottles should be stored in plastic dishpans or metal trays lined with absorbent material to catch spillage or leakage. This material will ultimately be stored for decay and appropriate disposal or solidified and shipped to a licensed disposal site.

F. Combustible liquid waste meeting the criteria outlined previously for incineration of radioactive materials will be incinerated in the Burnzol Pathological Waste Incinerator unit, which will be equipped with a liquid waste injection system.(see section facilities) The burning of this material will be included as part of the procedures, schedules and limitations for incineration stated in B above. Exempt quantities of ^{3}H and ^{14}C (less than 0.05 uCi/gram) will also be disposed of in this manner subject to the restrictions stated in 10 CFR 20 20.306.

G. Animal carcasses which contain radioactive material will be labelled as to date, isotope and quantity of isotope and stored in the Radiation Safety freezers located in the radioisotope suite area or storage for decay areas. After storage for decay, as applicable, these carcasses will be incinerated in accordance with the procedures, schedules and limitations outlined previously for incineration of radioactive material (B).

H. Excess or Unwanted Isotopes and Sources - The Radiation Safety Office must be contacted for disposal of unwanted isotopes or sources to arrange appropriate disposal.

In light of the fact that Maine is unlikely to meet the federal low level Radioactive Waste Policy Act 1986 deadline, and has indicated that waste generators should plan for long range storage of radioactive wastes, we also request permission to store those wastes for which storage for decay is impractical when it is no longer possible to ship to available waste disposal sites. Obviously, we will continue to ship to the Richland, Washington site via our current broker, HMM Associates, as long as possible, but wish to establish the capability for long term storage for long lived wastes in anticipation of the inevitable gap between our ability to ship out of the region and the availability of a waste facility for Maine generators.

XVI. CONTROL OF RADIATION EXPOSURE

Under all circumstances exposure to ionizing radiation shall be kept at the lowest practical level. The external and internal total exposure from sources of radiation shall be controlled in such a way as to assure that no individual shall receive a total dose in excess of the following values:

A. Maximum permissible doses for persons who are registered as radiation workers:

		REMS PER CALENDAR QUARTER
1.)	Whole body; head and trunk; active blood forming organs; lens of eyes; or gonads	1.25
2.)	Extremities	18.75
3.)	Skin of whole body	7.50

B. Maximum permissible doses for minors (including those persons under 18 years of age who are working in radioisotope laboratories) and for persons who are not registered as radiation workers are one-tenth of the values listed in A above.

C. Maximum permissible doses to pregnant workers with respect to the fetus shall be no more than 500 millirem per gestation period.

D. The above values are in addition to natural background radiation exposure and to radiation administered for medical reasons.

Internal exposure is controlled by minimizing airborne release of radionuclides through the proper utilization of hoods, closed reaction systems, temperature control, mechanical pipetting devices and/or any such appropriate mechanism.

Research procedures requiring the use of volatile or gaseous radioisotopes are restricted to appropriate fume hoods. All work with unsealed radioiodine compounds above 1.0 millicurie is conducted in the fume

hood of the Main Laboratory Hot Lab. This hood is equipped with a charcoal filtered minihood, used for all such procedures. The Radiation Safety Committee, in its review of applications for use, may require that the Hot Lab be used for other procedures as safety, monitoring and control considerations dictate. Research personnel using the Hot Lab are provided with written instructions for proper usage that include prior approval of experimental protocols, environmental monitoring and bioassays. Required data are submitted to the Radiation Safety Office on the Hot Lab and Personnel Monitoring Report form.(Appendix Item 7) Research personnel required to use the Hot Lab, wear protective lab gowns, film badge monitors and gloves. Hot Lab work areas are wipe tested and equipment and personnel monitored after each use. While work is being carried out airborne radioactivity inside the fume hood and outside the hood at the researchers breathing zone is monitored by independent air sampling devices equipped with filters appropriate for entrapment of radioactive particles.

Thyroid counts are required within 48 hours whenever protein iodination is performed or when unsealed quantity of radioiodine exceeds 1 millicurie. Individuals who use an accumulated amount of unsealed radioiodine exceeding 1 millicurie in a 1 month period will observe a monthly schedule for thyroid counting. Thyroid monitoring is accomplished with an external scintillation crystal capable of detecting less than 0.05 microcuries.

Tritium urinalysis is performed on all persons who handle in excess of 10 millicuries of tritium compounds at any one time. The bioassay consists of a baseline measurement and urinalysis following exposure to the above quantity. Bioassay samples will be taken at least 24 hours post exposure, but no more than 72 hours.

Procedures are reviewed by the Radiation Safety Office whenever bioassays indicate any positive results. Results that indicate the presence of 10% or more of a permissible body or organ burden will lead to a thorough investigation by the Radiation Safety Committee and additional procedural restrictions will be adopted as indicated.

The Radiation Safety Office shall be notified immediately of any of the following circumstances is known or suspected to have occurred:

a) Exposure to external radiation in excess of the maximum permissible exposure values stated above.

b) Exposure to inhalation, ingestion, or accidental injection of radioactive materials.

c) Accidental release or radioactive materials into laboratory atmosphere, drains or ventilation systems or onto surfaces.

XVII. TRAINING FOR INDIVIDUALS WORKING IN OR FREQUENTING RESTRICTED AREAS

During orientation at the Jackson Laboratory, new workers are informed of the laboratory safety programs, and directed to appropriate Safety Office or supervisor for applicable safety training.

OCCUPATIONALLY EXPOSED WORKERS; It is the responsibility of the individual licensee under our broad NRC license, to provide instruction for those employees under his control, in the use of radiation safety techniques, in the application of approved radiation safety practices, and to insure attendance at required radiation safety seminars. The Radiation Safety Office routinely provides seminars that fulfill initial and refresher requirements for radiation safety education. Topics covered are outlined below:

(1) characteristics of ionizing radiation;
(2) radioactive contamination;
(3) radiation dose-equivalent limits;
(4) background radiation;
(5) acute and chronic radiation effects on man, including the effects on fetuses;
(6) modes of exposure-internal, external;
(7) estimation of dose equivalent;
(8) basic protective measures-time, distance, shielding, contamination control, protective clothing, work place design;
(9) responsibilities of employees and of the organization;
(10) interaction with radiation safety staff;
(11) warning signs, alarms;
(12) radiation monitoring programs and procedures; and
(13) emergency procedures.

OCCASIONALLY EXPOSED WORKERS: Individuals who do not routinely work with radioactive material but whose duties may bring them into areas where radiation exposure may occur, are given radiation safety instruction specific to their circumstances on an annual basis.

STUDENTS, VISITING PROFESSIONALS: Students engaged in educational or training activities are given appropriate radiation education prior to being permitted to work with radioactive materials. Visiting scientists assigned to Jackson Laboratory for an extended period of time will be trained in a manner comparable to regular employees.

Records of attendance will be maintained.

XVIII. TRANSPORTATION OF RADIOACTIVE MATERIAL

The Jackson Laboratory NRC Byproduct Material License includes no provision for the transportation of radioactive material out of the Laboratory premises. Under no circumstances should any user pick up

radioactive material from a supplier, return an improper shipment to the supplier, borrow radioactive material from another NRC licensee in the area, or in any way transport radioactive material in his private vehicle. Such transportation of material must be by authorized transportation agencies and in compliance with Department of Transportation regulations. Should such transportation become necessary, contact the Radiation Safety Office for assistance. The transportation of radioactive materials within the Laboratory (hand carrying from laboratory to laboratory) shall be done in such a manner as to assure a minimum chance of contamination. All material must be doubly contained, and must never be left unattended. Under no circumstances should the dose rate on the surface of the container being carried exceed 100 millirem/hour, nor should the dose rate one meter from the surface of the carrying container exceed 10 millirem/hour.

XIX. CAUTION SIGNS AND LABELS

Each laboratory storing or using radioactive material shall be posted with appropriate signs, in conformity with 10 CFR 20, section 20.203 and with appropriate informational material in conformity with 10 CFR 19, section 19.11. These postings shall be installed or removed only by or with the approval of the Radiation Safety Office. Additionally, the licensee of each project should post each laboratory with sufficient emergency notification information so that a knowledgeable laboratory person could be contacted in the event of a laboratory emergency during nonworking hours.(Appendix Item 9)

Each container in which radioactive material is to be stored for a period of time must be labelled in conformance with appropriate federal regulations. Specifically, the label must contain the words "Caution, Radioactive Material" along with information regarding the quantity, kind of radioactive material in the container, and date of assay. Labelling is not required for laboratory containers such as beakers, flasks, and test tubes used transiently in the laboratory in the presence of the user.

XX. LEAK TESTING OF SEALED SOURCES

Each sealed source containing byproduct material (other than tritium) with a half-life greater than thirty days shall be tested for contamination and/or leakage upon receipt, prior to use.

Such sources will be maintained according to the following rules:

a) Tests for leakage and/or contamination at intervals not to exceed six months.

b) Tests shall be capable of detecting the presence of 0.005 microcuries of removable contamination.

c) Test wipings shall be taken from the sealed source or from the surfaces of the device in which the source is mounted or stored and on which one might expect contamination to accumulate.

d) Alpha sources shall be tested at intervals not to exceed three months.

e) Results of tests shall be recorded and maintained for inspection by the NRC.

If the required tests reveal the presence of 0.005 microcuries or more of removable contamination, the Radiation Safety Office will notify the licensee in charge of the source and immediately withdraw the source from use, and shall cause it to be decontaminated and repaired, or to be disposed of in accordance with the Radiation Safety Committee regulations.

Exceptions to Leak Test Requirements

No leak tests are required for the following:

a) Sealed sources containing tritium.
b) Sealed sources containing byproduct material with a half-life of less than thirty days.
c) Any sealed source, provided the quantity of byproduct material contained does not exceed ten times the quantity specified in Schedule B, Section 30.71, 10 CFR 30.
d) A sealed source that is stored and not being used; such sources shall however be tested for leakage prior to any use or transfer unless they have been leak tested within six months prior to the date of use or transfer.

XXI. USE AND HANDLING OF LABORATORY ANIMALS

In vivo studies.(Appendix Item 8) Long term (overnight) studies using live animals treated with radioisotopes require the use of the Radioisotope Suite area in the Main Laboratory. The first room of the Radioisotpe Suite is the Hot Laboratory and is available for storing stock solutions and making solutions for injection into labortatory animals. Three small rooms are available for housing laboratory animals treated with radioisotopes.(Floor Plan #1) Facilities for maintenance of such animals are requested from the Supervisor, Research Animal Care Service, after the Radiation Safety Committee has approved the protocol and application to use radioactive materials, submitted by the licensee. The animals may be taken to the investigator's laboratory for brief periods of time in order to perform whole body counts or other metabolic and physiological studies requiring the use of specialized equipment located elsewhere in the laboratory. If such movement of the animals is necessary, it will be outlined in the protocol and appropriate monitoring and labeling requirements will be met. Otherwise, no animals, used or unused, which have been brought into these animal rooms for experimental purposes are to leave the area alive.

Contaminated cages, bedding and animal carcasses go directly from these rooms to the radioactive waste processing area, located immediately adjacent in the Radioisotope Suite area. Bedding is segregated and processed for incineration or disposal as radioactive waste. Animal carcasses are labeled with the name of the isotope, amount, date and researcher's name. They are then placed in a freezer designated for this storage located in the waste

processing area. The carcasses are eventually incinerated or disposed of as radioactive waste. Disposable cages are directed to the appropriate waste stream. This animal room is kept locked and access is restricted to personnel trained and registered as radiation workers.

XXII. EMERGENCY PROCEDURES

A. Minor spills - The research worker is to:

1) notify other persons in the area that a spill has occurred;

2) cover the spill with absorbent paper to prevent spreading of radioisotopes;

3) clean up spill, using disposable gloves and tongs or with dressing forceps by careful placement of absorbent paper in plastic bags. Dispose of clean-up materials in appropriate radioactive waste barrel;

4) survey clean-up area and clothing with low-range GM survey meter or by filter paper wipes and appropriate beta- or gamma- counting;

5) Wash hands after clean-up and report the incident to the Radiation Safety Office.

B. Major spills - The research worker is to:

1) notify all persons not involved in the spill to clear the area;

2) cover spill with absorbent paper, confine the movement of all personnel potentially contaminated to prevent the spread and notify the Radiation Safety Office.

3) shield the spill but only if it can be done without further contamination or significantly increasing radiation exposure.

4) close the room and prevent personnel entry;

5) remove contaminated clothing and save for evaluation by the Radiation Safety Office, and;

6) thoroughly wash all areas of skin that were potentially or actually exposed to the radioisotope spill.

These procedures have been posted in all areas where isotopes are used or stored. Contact personnel and telephone numbers are included with these postings for after hours emergencies.

XXIII. REFERENCES

Reports of the National Council on Radiation Protection and Measurements:

NCRP Report No. 22 - Maximum Permissible Body Burdens and Maximum Permissible Concentrations of Radionuclides in Air and in Water for Occupational Exposure. (1959) (Formerly NBS Handbook 69).

NCRP Report No. 30 - Safe Handling of Radioactive Materials (1964). (Formerly NbS Handbook No. 92).

NCRP Report No. 39 - Basic Radiation Protection Criteria (1971).

NCRP Report No. 48 - Radiation Protection for Medical and Allied Health Personnel (1976).

NCRP Report No. 50 - Environmental Radiation Measurements (1976).

NCRP Report No. 53 - Review of NCRP Radiation Dose Limit for Embryo and Fetus in Occupationally Exposed Women (1977).

NCRP Report No. 54 - Medical Radiation Exposure of Pregnant and Potentially Pregnant Women (1977).

NCRP Report No. 55 - Protection of the Thyroid Gland in the Event of Releases of Radioiodine (1977).

NCRP Report No. 57 - Instrumentation and Monitoring Methods for Radiation Protection (1978).

NCRP Report No. 58 - A Handbook of Radioactivity Measurements Procedures (1978).

The Jackson Laboratory will adhere to the rules and procedures outlined in this application for renewal of license Number 18-02774-01. The following changes may be made without prior notification to the NRC:

a. changes dictated by NRC rule changes.

b. changes in internal management forms.

c. changes in contractors for bioassay, waste disposal services or for servicing and calibrating personnel dosimeters, survey equipment and counting instruments.

d. references to particular pieces of survey equipment, counting instruments and calibration sources, when replaced by like or more effective substitutes.

THE JACKSON LABORATORY

APPLICATION FOR LICENSURE TO USE RADIOACTIVE MATERIALS (TRAINING + EXPERIENCE)

(Completed form to be submitted to Radiation Safety Office/Radiation Safety Committee)

1. Name of Applicant _____ Position _____

2. Proposed work location _____ Date of application _____

3. Has the applicant been licensed previously for use of radioactive material? _____
   If so, by what institution or agency? _____

4. Type of training

Type of training	Where trained	Duration of training	On the Job (circle answer)	Formal Course (circle answer)
a. Principles and practices of radiation protection			Yes No	Yes No
b. Radioactivity measurement standardization and monitoring techniques and instruments			Yes No	Yes No
c. Mathematics and calculations basic to the use and measurement of radioactivity			Yes No	Yes No
d. Biological effects of radiation			Yes No	Yes No

5. Experience with Radiation. (Actual use of radioisotopes or equivalent experience)

Isotope	Maximum Amount	Where Experience was Gained	Duration of Experience	Type of Study

Signature of Applicant _____ Date _____

( ) Examination Scheduled for: Date _____ Date passed _____

( ) Protocols submitted Date _____

( ) Committee Approval _____ Date _____
RSO or Chairman

THE JACKSON LABORATORY

Date Issd: _____
Sp. Badge# _____

REGISTRATION AND RADIATION BADGE REQUEST FORM

1. Full Name: _____
(last) (first) (middle) (maiden)

Date of Birth: _____ Social Security No. _____
(month/day/year)

Sex: Male Female (Circle One) Date of Request: _____

2. ISOTOPES AND AMOUNTS: Please list the different isotopes that you will be working with, with respective amounts in millicuries, in any one month.

_____

_____

3. Supervisor/Licensee with whom you will work: _____

Building/Room Number: _____ Ext.: _____

4. PREVIOUS EMPLOYMENT AT THE JACKSON LABORATORY: Yes No (Circle One)

a. Department: _____

b. Dates of Employment: From _____ To _____

c. Type of radiation monitor worn (if any) _____

5. PREVIOUS EXPOSURE HISTORY OTHER THAN AT THE JACKSON LABORATORY:

a. Have you been enrolled in a film badge program before? Yes No

b. Have calculations and/or analysis been made of external radiation received, and/or radioisotopes deposited in your body? Yes No

c. If the answer to either question above is "YES", please list the name of the institution involved and the dates during which you were involved in the badge program there, in the space below:

Institution where exposure received (Name and complete address) Dates (From-To)

1. _____

2. _____

3. _____

6. RELEASE STATEMENT:

Under the provisions of Title 10, Code of Federal Regulations, Part 20.404, I authorize the release of my radiation records to the Jackson Laboratory, Radiation Safety Office.

Signature: _____

This section to be completed by the Jackson Laboratory Radiation Safety Office

1. Jackson Laboratory Training: Lecture_____ Interview_____

(date) (date)

2. Instruction material supplied:

3. Personnel dosimetry assigned: Body_____Wrist_____Ring_____

4. Bioassays required: (type and frequency)

_____

_____

5. Medical examinations required and/or requested:

_____

6. Comments on past occupational exposure and history:

7. Requests for past records (Name, address, and date) .

8. Signature of R.S.O. Interviewer:_____Date:_____

_____

Termination Data: Badge #

1. Summary of radiation exposure during employment at The Jackson Laboratory:

_____ _____

Comments:

Signature of R.S.O. Interviewer_____ _____Date_____

THE ROCKEFELLER UNIVERSITY
RADIATION SAFETY COMMITTEE

APPLICATION FOR PERMISSION TO USE RADIOACTIVE MATERIALS

Name of Licensee:	
Staff Rank:	Telephone No.

1. Describe purpose for which radioactive material will be used.

2. Material, Procedure and Storage Information:

Radioactive Material	Requested Possession Limit(mCi) Maximum amount on hand at any one time	Chemical and/or Physical form

Outline Procedures involved in the use of this material:

	Building	Room
Material will be stored at		
Material will be used at		

3. Is any of the radioactive material used as a label for potentially biohazardous material, toxic chemicals, or carcinogenic/mutagenic material? If yes, explain below:

4. List facilities for handling isotope. (Note: dry smears, using #41 Whatman filter paper and counted in a liquid scintillation counter, should be taken to survey areas and equipment for radioactive contamination resulting from work using C-14, H-3 and S-35.

Hood	( )	Appropriate warning signs and labels	( )
Shielding	( )	Waterproof backed absorbent material	
Disposable gloves	( )	for bench and floor covering	( )
G.M. Survey Meter	( )	Monitoring badges, body, wrist,	
Mechanical pipette	( )	finger	( )
Stainless steel sink	( )	Handling tongs	( )
Liquid scintillation counter	( )	Air sampling equipment	( )
Shielded storage containers	( )	Glove box	( )

Other Special Facilities:

5. Waste Disposal:
Low level liquid waste into sinks in Bld/Rm No.
Solid waste into waste container in Bld/Rm No.
Will there be other wastes generated (animals, insoluble liquids, scintillation fluids, etc.)?
If yes, outline description and disposal method below:

6. The following list of persons who will use or be exposed to radiation under this authorization, have been instructed by the Principal Investigator in the radiation protection problems and appropriate precautions to minimize exposure associated with the above isotope. Everyone using radioactive isotopes must be listed and attend the Radiation Safety Seminar (presented by the Radiation Safety Office) on an initial and annual refresher basis.

Principal user_____

Others_____

Signature below affirms that the applicant/sponsor has read and will comply with the Rules and Mode of Function of the Jackson Laboratory Radiation Safety Committee.

Signature of License Applicant: Date:

Signature of Sponsor: Date:
(if needed)

FOR RADIATION SAFETY OFFICER AND COMMITTEE USE	
Comments	
APPROVALS	
Radiation Safety Officer:	Date:
Chairman of Rad. Safety Comm.:	Date:
Committee Approval by meeting [ ] Mail [ ]	Date:

THE JACKSON LABORATORY / REQ'N No. A 11900

RADIOISOTOPE REQUISITION

DATE _____ 19 ____

PROCURE FOR THE RADIATION SAFETY OFFICER

PLEASE PRINT

ITEM	QUANTITY IN MILLICURIES	SPECIFICATIONS (ISOTOPE, FORM, SUPPLIER, CAT. NO.)	UNIT PRICE	DO NOT WRITE IN THIS SPACE
1		Amt. on Hand _____ Millicuries		P. O. _____
2		Amt. on Hand _____ Millicuries.		P. O. _____

CHARGE TO: _____ REQUESTED BY _____ LICENSEE

NRC LICENSE NO. _____ APPROVED _____ RADIATION SAFETY OFFICER

WHITE-Original *CANARY*-Duplicate *PINK*-Triplicate

PROCEDURE FOR RECEIPT AND OPENING OF RADIOACTIVE MATERIALS SHIPMENTS

1. All radioactive materials coming into the Jackson Laboratory will be addressed to the Radiation Safety Office.

2. Upon receipt, a member of the Radiation Safety Office Staff will be responsible for opening the package and delivery to authorized user.

3. Procedures for opening of packages:

a. Use gloves to prevent contamination of hands.

b. Visually inspect package for signs of damage, noting unusual conditions.(e.g. crushed, punctured, wet)

c. Use survey meter to measure and record exposure rate at 1 meter and surface of package. If exposure rate > 10 mR/hr at 1 meter or 200 mR/hr at surface, take appropriate precautions and notify Radiation Safety Officer.

d. Open outer package(following manufacturers directions, if supplied) and remove packing slip.

e. Open inner package and verify that contents agree with those on packing slip. Compare requisition, packing slip and label on bottle.

f. Check integrity of final source container, inspecting for breakage of seals or vials, loss of liquid, and discoloration of packaging material.

4. Wipe external surface of final source container. Assay the wipe and record amount of removable contamination or negative results.

5. Monitor packing material and package for contamination before discarding:

a. If contaminated, treat as radioactive waste.

b. If not contaminated, obliterate radioactive labels before discarding as normal trash.

6. Each package received must be logged into the Radioisotope Receipt Log. The following information is recorded in this log: Date of Receipt/Isotope/Amount/Lot #/Vendor/PO #/Licensee(PI)/Exposure Rate, 1 Meter and Surface/Wipe Results/Comments/Checked in By.

Isotope _____ Period _____

MONTHLY SUMMARY

Investigator _____

Appendix Item 6

Date	Rec'd	Quantity used	Balance in stock	Decay	Disposal: Liquid waste barrel	Burn barrel	Non-burn barrel	Scintillation fluid to burn	Carcasses	Sewer	Other
Totals for Month											

RULES FOR HOT-LAB USERS

The Hot-Lab is available for storage of isotopes or contaminated animal carcasses and for special procedures involving large amounts of isotopes, potential or actual release of airborne radioisotope, etc. The rules outlined below are intended to minimize exposure of personnel using the Hot-Lab and to maximize the efficient use of the facility. All users of the Hot-Lab for any purpose are required to sign the Hot-Lab Schedule posted on the board to the right of the door.

STORAGE

1. Use of the Hot-Lab for storage does not require prior approval. It is recommended that the RSO be contacted prior to initial use for help with storage vessels, door key, etc. Stored materials must be identified by owner and isotope.

2. Wear lab gown, radiation badge at waist or chest level, disposable gloves, and cover bench with spill protection paper when transfering radioisotope.

3. Use of the Hot-Lab freezer for carcass storage requires each bag to:
   contain only carcasses (no paper, etc.)
   be identified by who, when, isotope, how much isotope

4. When experiments are completed or when a radioisotope has outlived its usefulness, do not forget to dispose of materials stored in the Hot-Lab.

EXPERIMENTAL USE

Use of the Hot-Lab for experimental purposes entails the following:

1. Prior to your utilization of the Hot-Lab facility, all of your protocols must have been approved by the Radiation Safety Committee;

2. When working in the Hot-Lab, you must be wearing the following protective apparel, with your radiation badge worn at chest or waist level:
   disposable lab gown (provided in bottom drawer)
   disposable shoe covers (provided in bottom drawer)
   disposable gloves (you provide)
   face mask (you provide)

3. When airborne radioactivity is anticipated, you must work in

hood and the air monitoring equipment must be used. See the RSO for instructions.

4. Upon completion of your work with radioisotopes, you must monitor the Hot-Lab surfaces specified on the appended "Hot-Lab and Personnel Monitoring Report" form by taking environmental wipes. In addition, depending on the radioisotope (iodine or tritium) and the amounts, you must also monitor for radioactivity in your thyroid (iodine) or in your urine (3-H). The form must be submitted immediately after completion of counting to the RSO. Contact the RSO for any additional help with these tasks.

5. Your signature affixed below indicates your acknowledgment of, and compliance with, these regulations.

Date: _____ Name: _____

HOT LAB AND PERSONNEL MONITORING DATA

Name:_____ Date:____ Isotope:_____ Amount:_____

Surface checks. Pre - (dpm) Post - (dpm)

Lead bricks
Hood apron
Floor
Bench top
Shoe
Sink
Background

Air Samples

Inside hood (20 l/min)
Outside hood (2 l/min)
Filter blank

Calculations: Airborne radioactivity

Total time in Hot Lab.....___hr
Radioactivity on 2 liter/min pump filter.....___dpm

$$\text{Hood exhaust load} = \frac{417 \text{ X (dpm on large pump filter)}}{2.22 \text{ X } 10^{*}6 \text{ dpm/uCi}} = \text{__uCi}$$

$$\frac{\text{uCi (from above calculation)}}{1.337 \text{ X } 10^{*}11 \text{ ml air/7 days}} = \text{___uCi/ml/7 day period}$$

Calculations: Thyroid survey

	uCi =
Isotope standard	____dpm
Phantom background	___dpm
Thryoid, pre-isotope usage	___dpm
Thyroid, post-isotope usage	___dpm
Estimate of isotope uptake	___uCi

Calculations: Urine survey

Urine reference sample (background) ___dpm
(correct for efficiency and quench)
Post-procedure urine sample (1 ml) ___dpm
(correct for efficiency and quench) ___dpm

$$\text{Urinary excretion (uCi/l)} = \frac{\text{___dpm/ml X } 10^{*}3 \text{ ml}}{2.22 \text{ X } 10^{*}6 \text{ dpm}} = \text{_____}$$

Large pump samples 1/417 of air flow; Hood vol.= 1.337 X 10*11ml/7 days.

Received: date_____ RSO_____

EMERGENCY PROCEDURES - RADIOISOTOPE SPILLS

In the event of a spill involving radioactive materials, the following procedures are to be executed:

MINOR SPILLS - The research worker is to:

1. notify other persons in the area that a spill has occurred;
2. cover the spill with absorbent paper to prevent spreading of radioisotopes;
3. clean up spill, using disposable gloves and tongs or with dressing forceps by careful placement of absorbent paper in plastic bags. Dispose of clean-up materials in appropriate radioactive waste barrel;
4. survey clean-up area and clothing with low-range GM survey meter or by filter paper wipes and appropriate beta- or gamma- counting;
5. wash hands after clean-up and report the incident to the Radiation Safety Office.

MAJOR SPILLS - The research worker is to:

1. notify all persons not involved in the spill to clear the area;
2. cover spill with absorbent paper, confine the movement of all personnel potentially contaminated to prevent the spread and notify the Radiation Safety Office;
3. shield the spill but only if it can be done without further contamination or significantly increasing radiation exposure;
4. close the room and prevent personnel entry;
5. remove contaminated clothing and save for evaluation by the Radiation Safety Office, and;
6. thoroughly wash all areas of skin that were potentially or actually exposed to the radioisotope spill.

EMERGENCY CONTACTS:

Laboratory Supervisor: Office_____ Home_____

Radiation Safety Office: Extension 265

After Hours: F. Driscoll 288-5307
O. Applegate 288-5113

PROCEDURES FOR RADIOISOTOPE STUDIES IN VIVO

INITIATION OF RADIOISOTOPE STUDIES IN VIVO

Prior to the start of radioisotope studies in vivo, an investigator must:

1. Submit a protocol to the Radiation Safety Committee for approval as required by the Nuclear Regulatory Commision. Replicate studies using a previously approved protocol need not be submitted again.

2. Request cages and space in the radioisotopes animal rooms through the Supervisor, Research Animal Care, using form provided by the RSO.

CLOTHING

All personnel working where isotope treated animals are housed must wear a long sleeved gown, disposable gloves, and their radiation badge. Clean gowns are kept in the "clean materials corridor". Soiled gowns are placed in the "laundry bag" in the "used materials corridor" at the end of the work day. Under certain circumstances, the Radiation Safety Committee may require shoe covers, caps and masks.

RESPONSIBILITIES FOR ANIMAL CARE

Research staff members or their assistants are required to change cages, feed and water animals, and dump soiled bedding from cages during the initial phases of the study when the largest amounts of isotope will be present in the cage and bedding.

The Research Animal Care Service is responsible for:

1. Cleaning the room and corridors, including cage racks, floors, lights, walls, sinks, etc., following schedules used in conventional animal rooms. The "clean materials corridor" is cleaned by the same personnel who clean the main corridor using the same equipment. The "used materials corridor" is cleaned by the Animal Care Technician assigned to the RI area using equipment kept there.

2. Preparing disinfectants and providing other supplies, i.e., gowns, disposable gloves, paper towels, absorbant paper, CO_2 cylinder, forceps, forceps jars, etc., needed in animal rooms.

3. Transporting soiled materials to the elevator servicing

the Wash Area.

4. Providing animal care when isotope treated animals are housed in nondisposable cages.

ANIMAL CARE, PROCEDURES AND EQUIPMENT

Isotope treated animals are to be housed in radioisotope animal rooms. Animals can be taken to an investigator's laboratory in order to inject radioisotopes or use specialized equipment. No animals, used or unused, that were brought to the radioisotopes animal room for isotope studies can be transferred to other animals rooms without prior permission of the Radiation Safety Committee and Laboratory Animal Medicine.

Details for maintaining isotope treated animals are outlined below:

1. Isotope treated mice must be housed in disposable cages with filter caps unless the Radiation Safety Committee authorizes their housing in nondisposable caging systems. No more than 4 adult mice (over 25 g body weight) can be maintained per cage. Disposable cages and their accessories are ordered through the Supervisor, Research Animal Care.

2. Each cage must have a cage card that has a radiation label and indicates the isotope used, amount per mouse, date of administration and responsible individual's name (no initials please).

3. Cage changing schedules will be individually designed for each experiment by the Radiation Safety Committee. However, cages, water bottles and bedding must be changed at least once a week.

4. Handling animals in disposable cages.

   a. Cover bench top with absorbant paper before opening cages. Discard paper in burnable waste barrel in RI-5 when animal work is done. Clean bench top, forceps jar and forceps with Radiacwash.

   b. Cages containing isotope contaminated bedding are emptied into a bag using the dump station that is located in the radioisotopes "used materials" corridor. Operating instructions are located on the front of the dump station.

   c. Used disposable cages are rinsed with Radiacwash in

the sink in the radioisotopes "used materials" corridor, placed in bags and disposed of as directed by the Radiation Safety Committee. Disposable cages may not be washed and reused.

d. Water for the animals in disposable cages is provided by means of special plastic bottles with force fitting stainless steel caps. Dirty bottles and the caps are rinsed with Radiacwash in the sink in the radioisotopes "used materials" corridor and are placed in bottle cases. Do not mix regular glass bottles and these bottles in the same bottle case.

e. Cage lids used with disposable cages remain in place throughout the experiment or are changed using the regular schedule whichever comes first. Dirty cage lids are rinsed in Radiacwash in the sink in the radioisotopes "used materials" corridor and are stacked in cover trays.

f. Staff members or their assistants are expected to clean up bench tops, dump station, and vacuum or damp mop the floor if bedding or animal food is spilled.

5. In the case of long term studies (over 1 week) animals may be transferred from disposable to nondisposable cages after the majority of the isotope has been excreted and levels in bedding are approaching background. These cages are handled using routine animal care procedures.

DISPOSAL OF CARCASSES OF ISOTOPE TREATED ANIMALS

Carcasses are double bagged and identified by Staff member, isotope used, date, amount per mouse and placed in the freezer in the Radioisotope Suite.

MONITORING OF THE WORK AREA

Staff members or their assistants are expected to cover the work bench with absorbant paper in order to minimize contamination by radioisotope solutions or mouse urine, and to clean up any spills, including bedding material. Environmental monitoring of the work area shall be done as designated by the Radiation Safety Committee. Results of wipe tests must be reported to the Radiation Safety Officer within 24 hours.

CHARGES

Costs unique to radioisotope studies in-vivo will be charged to research grants. When radioisotope treated animals are able to be transferred to nondisposable cages, the usual box charges will apply.

Replaces March 1981
Radiation Safety Committee
Assistant Director, Research Animal Facility

Date:_____

TO: Supervisor Research Animal Care Service

FROM: Radiation Safety Committee (RSC)

SUBJ: Radioisotope Study in vivo

The RSC has approved Dr._____'s protocol for use of radioisotopes in vivo with _____ at a dose of_____uCi per animal.

1. Number of disposable cages required: _____
2. Animals are to be maintained in:
   a. Investigator' laboratory (max. of 48 hrs)
   b. Radioisotope Room _____

At the end of the experiment (if short term) or the first week, Dr. _____ or a designated assistant (_____) will dispose of the original boxes properly and the animals will be:

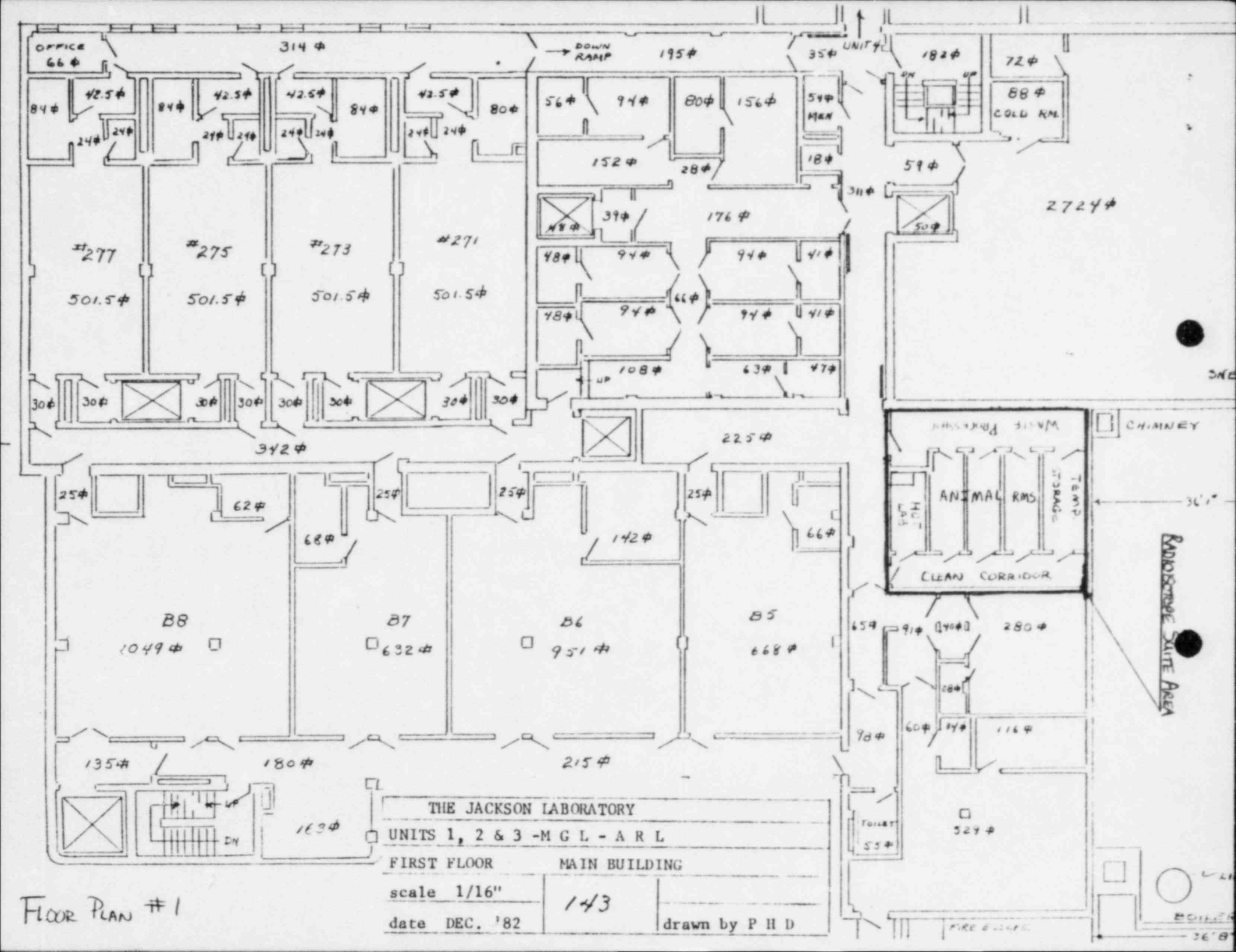
1. euthanized
2. maintained in disposable boxes
3. transferred to regular cages

Planned starting date:_____

SPECIAL INSTRUCTIONS:_____

_____

_____
Investigator/Assistant



THE JACKSON LABORATORY

UNITS 1, 2 & 3 - M G L - A R L

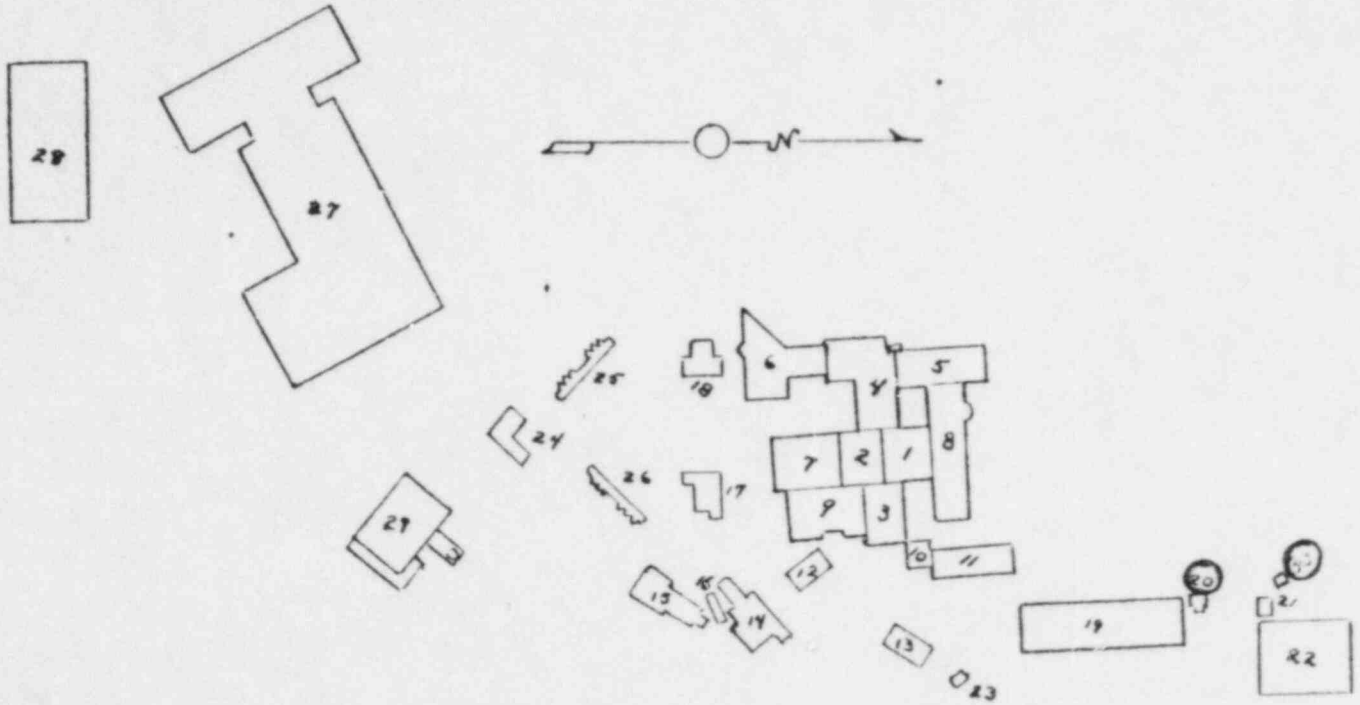
FIRST FLOOR MAIN BUILDING

scale 1/16" | 143 | drawn by P H D

date DEC. '82

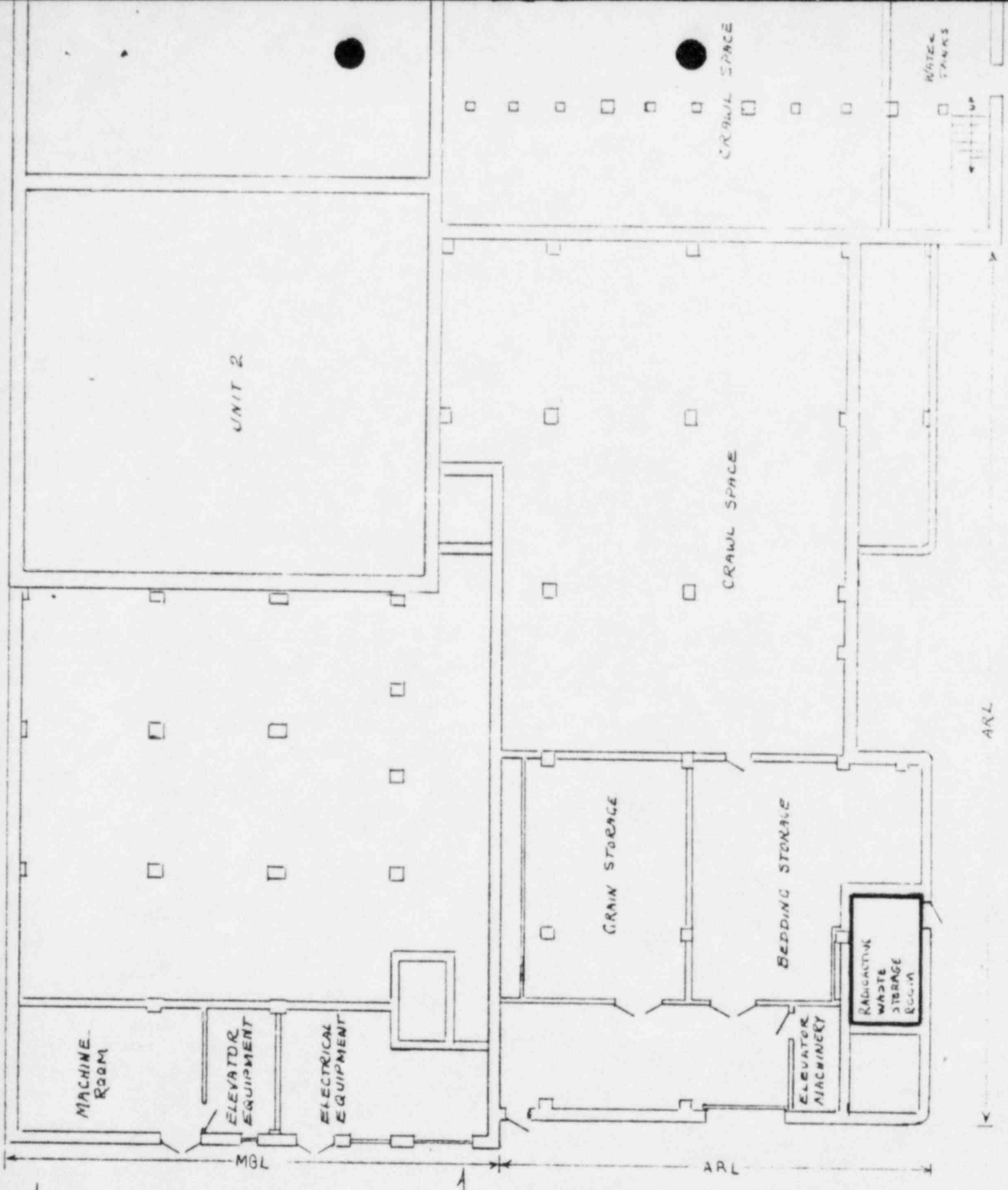
FLOOR PLAN #1

CAMPUS MAP



1 Unit 1
2 Unit 2
3 Unit 3
4 Unit 4
5 Unit 5
6 L C C
7 M G L
8 Snell Wing
9 A R L
10 Boiler Rm.
11 Chiller Bldg.
12 C1 & C2
13 D1 & D2
14 V L L
15 Animal Health
16 Trailer
17 Summer Invest.
18 Summer Kitchen
19 Shop & Garage
20 Incinerator
21 Salt Shed
22 Shaving Storage
23 Pump House
24 Councellor Cottage
25 Girls Dorm
26 Boys Dorm
27 Morrell Park Bldg
28 Annex
29 Boiler Plant
30 Rad. Waste Storage

THE JACKSON LABORATORY
MAIN CAMPUS BUILDINGS



FLOOR PLAN #3

THE JACKSON LABORATORY		
UNITS 1, 2 & 3 - M G L - A R L		
BASEMENT FLOOR PLAN		MAIN BUILDING
scale 1/16"	141	
date NOV. '82		drawn by P H D