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NORTHEASTERN OHIO UNIVERSITIES COLLEGE OF MEDICINE

RADIATION SAFETY PROGRAM

I. Design and Purpose of the Radiation Safety Program

A. The ALARA Goal

The chief goal of the NEOUCOM radiation safety program is to minimize the exposure to radioactive materials and their radiations to a level AS LOW AS IS REASONABLY ACHIEVABLE (ALARA). Not only are we concerned with maintaining radiation doses less than the maximum permissible limits, but also with maintaining doses to both workers and the general public to levels as far below the maximum permissible limits as possible. As outlined in U.S. Nuclear Regulatory Commission's Regulatory Guides 8.10 and 10.2, there are three objectives to an effective ALARA program.

1. To reduce occupational radiation exposure to levels reasonably achievable by means of good radiation protection planning and practice.

2. To reduce radiation exposures to the general public to levels as low as is reasonably achievable.

3. Commitment of management to encourage good radiation safety planning, to establish and enforce radiation safety practice, and to remain vigilant to the goal of improving the radiation safety program.

B. Purpose of the Radiation Safety Manual

1. This manual is designed to provide information to personnel and the general public concerning the structure of NEOUCOM's Radiation Safety Program. It presents those procedures adopted by the NRC and the Radiation Safety Committee as safe, reasonable, and enforceable. Because it is submitted as part of the application for renewal of our Byproduct Material License with the US NRC, it is designed to conform closely to the Code of Federal Regulations 10 CFR 20 entitled, "Standards for Protection Against Radiation", and other pertinent sections of the Code dealing with academic institutional programs. Similar regulations of the Ohio Department of Health are also specified by the Ohio Administrative Code (Chapters 3701-38, 3701-39, 3701-40). Copies of these regulations are on file in the Radiation Safety Office and library.

C. Administrative Line of Authority

1. Radiation Safety Officer (RSO)

The Radiation Safety Officer is vested with the responsibility and authority to administer and enforce the regulations of the NRC and the Ohio Department of Health. The RSO oversees all aspects of the safety program. He is charged with making the ultimate institutional decisions regarding violations of the radiation safety program. The RSO reports to the Director of Basic Medical Sciences and performs the following duties:

a. General surveillance of all health physics activities, including both personal and environmental monitoring.

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

c. Receiving, delivering, and shipping all radioactive materials coming to or leaving the NEOUCOM campus.

d. Monitoring of all materials, devices, or equipment capable of producing penetrating radiations.

e. Receiving, reviewing, and acting on all applications for the use of radiation sources to determine if the proposed work can be safely accomplished within the existing licensed procedures and isotope possession limits.

f. Instructing personnel in proper procedures for the use of radioactive materials.

g. Approving all purchase requisitions for radioactive materials assuming that receipt of the ordered material will not exceed the license possession limits.

h. Administration of the waste disposal program. Obtaining and keeping all Federal, State, and Local waste disposal records and permits.

i. Performing leak tests on all sealed sources at minimum 6 month intervals.

j. Maintaining an inventory of Radiation Safety detection equipment in proper working order and recalibrated on an annual basis.

k. Maintaining a current inventory of radioactive materials on campus to be updated on a monthly basis.

l. Storage of all radioactive materials not in current use.

m. Maintaining permanent records of:

- personnel occupational exposures
- receipt of radioactive materials
- disposal of radioactive materials
- laboratory monitoring

n. Maintaining the radioiodination laboratory, and storage and waste facilities.

The Radiation Safety Office maintains the following instruments and equipment to be distributed to investigators when the need for monitoring equipment arises.

Type of Instrument	Manufacturer	Model #	Number Available	Radiation Detected	Sensitivity Range
Survey Meter with GM Probe	Victoreen Victoreen	493 491-40	2	beta above 200 kev gamma above 12 kev	0 - 50 mR/hr
Survey Meter with Pancake GM Probe	Victoreen Victoreen	490 489-110	1	alpha above 3.5 Mev beta above 35 kev gamma above 6 kev	0 - 7.5 mR/hr
Frisker Meter with GM Probe	Victoreen Victoreen	495 491-40	1	beta above 200 kev gamma above 12 kev	0 - 500,000 CPM
Survey Meter with Scint. Probe	Victoreen Victoreen	290 425-110	1	gamma 10 - 40 kev	.2 - 20 mR/hr or 0 - 800,000 CPM
Ion Chamber	Victoreen	470A	1	alpha above 8 Mev beta above 120 kev gamma above 10 kev	0 - 3 R/hr
Contamination Meter with Pancake GM Probe	Victoreen	10900	2	beta, gamma, alpha	0 - 50,000 CPM
Pocket Dosimeter	Victoreen	541R	2	gamma 30 kev - 2 Mev	0 - 200 mR/hr

The office also has use of the following equipment:

1 - Packard model #9012 Multichannel Analyzer

2 - Beckman model #LS 9000 Scintillation Counters

1 - Beckman model #LS 100C Scintillation Counter

2. Radiation Safety Committee

The committee will be comprised of authorized users appointed by the Director of Basic Medical Sciences. The Director and the RSO will be non-voting members of the Radiation Safety Committee.

The Radiation Safety Committee performs the following functions:

a. Provide advice to the RSO on policies and technical matters regarding radiation safety.

b. Receive and review periodic reports from the RSO on monitoring, contamination, and personnel exposure.

c. Conduct periodic audits of the Radiation Safety Office to determine that all necessary functions are being performed at their required intervals, and all required records are intact.

3. NEOUCOM Policy Governing Violations of NRC Regulations

The RSO has the right to fully investigate a possible hazard at any time. He has the authority for making final institutional decisions regarding violations of NRC or NEOUCOM regulations involving the safe handling of radioactive materials. Violations of safety regulations can range from the incidental to being life-threatening. With advice from the Radiation Safety Committee and/or the Director of Basic Medical Sciences, the RSO will determine the severity of the violation and the appropriate prompt action. The RSO has the right to immediately terminate any activity found to be a threat to health or property. Those individuals committing serious violations or frequently violating safety standards will have their privilege to use radioactive materials revoked.

If necessary, individuals may appeal a decision to the Chairman of the Radiation Safety Committee who may schedule an agenda item in their behalf. In the event of a disagreement between the RSO and the Radiation Safety Committee, or at the request of the appellant representatives of the NRC will be contacted to review the situation.

II. Personnel Involved in the Use of Radioactive Material

This section discusses the requirements for participation in the radiation safety program, and outlines the training and responsibilities of each person in the program.

A. Authorized Users - Faculty

All individuals who desire to use radioisotopes or other forms of ionizing radiation must provide a summary of their past training and experience in handling radioactive materials (see following page 7). The completed form will be submitted to the RSO who will either accept the credentials as sufficient or recommend additional procedures to follow before accepting him as an authorized investigator.

The authorized investigator will be responsible for the health and safety of all personnel in his laboratory. He must be sure that procedures used to accomplish the intended research goals are as safe as possible. He is responsible for:

1. Determining that all individuals working in the laboratory have completed the necessary training programs before beginning to handle radioactive materials.

2. Assuring that all personnel working in the laboratory are included in the personnel monitoring program if necessary.

3. Monitoring his laboratory's ambient conditions as often as necessary to determine that exposure to radiation is maintained ALARA.

4. Labeling of all areas and materials with the proper warning signs, and assuring that the information is kept current and accurate.

5. Proper disposal of radioactive wastes and preventing the accumulation of excessive quantities of waste material in the laboratory.

6. Notifying the RSO of any changes in personnel, techniques, or physical facilities from those outlined in their original approved procedures.

TRAINING AND EXPERIENCE OF AUTHORIZED USERS

NAME OF APPLICANT _____ DATE _____

I. TRAINING	WHERE TRAINED	DURATION OF TRAINING	ON THE JOB	FORMAL COURSE
a. Principles and practices of radiation protection				
b. Radioactivity measurement standardization and monitoring techniques and instruments				
c. Mathematics and calculations basic to the use and measurement of radioactivity				
d. Biological effects of radiation				

II. EXPERIENCE

ISOTOPE	MAXIMUM AMOUNT	WHERE EXPERIENCE WAS GAINED

DURATION OF EXPERIENCE	TYPE OF USE

B. Individual Users - Visiting Faculty, Post-Doctoral Fellows, Technical Support Staff, and Students

All must meet the following specific requirements before beginning work with radioactive materials. Past coursework or experience gained on the job will not exempt an individual from completing these requirements.

1. All must pass a written examination approved by the Radiation Safety Committee and administered by the RSO. The examination will test the individuals knowledge of the fundamentals of radiation physics, the effects of radiation on living systems, principles and practice of radiation safety, measurement of radioactivity and monitoring techniques, and the mathematics and calculations basic to the use and measurement of radioactivity. All test results are kept on file in the Radiation Safety Office.

2. All must work under the supervision of an authorized investigator. All will be responsible for setting up and completing their experiments in as safe a manner as possible. They shall report all unsafe conditions to the authorized investigator responsible for that area or the RSO.

EXCEPTIONS: Only those individuals who are listed on another NRC license as individuals who will use or directly supervise the use of licensed material will be exempt from taking the exam.

C. Ancillary Personnel

All ancillary personnel (e.g., security, cleaning, maintenance, etc.) who enter laboratories containing radioactive materials will be briefed on current policies and procedures either by memo or by group meetings at least once a year.

II. Safety Monitoring Program

This section describes the monitoring of radiation exposure to personnel by dosimetry, bioassay, and laboratory survey programs. The goal of the monitoring program are:

1) To maintain safe conditions for all personnel working in restricted and unrestricted areas. Frequent monitoring of laboratories and personnel permits corrective steps to be taken when necessary to assure that individuals do not exceed their maximum permissible exposure limits, and that radiation levels remain as low as reasonably achievable (ALARA).

2) To maintain the required permanent records of personnel occupational exposure histories and laboratory working conditions.

A. Personnel Film Badge Dosimetry Program

NEOUCOM contracts with R.S. Laundauer Co., or other suitable firm, for a monthly radiation film badge program. The standard badge given to personnel is a "whole body" badge. Special ring or wrist badges are available for situations in which hand exposures may be excessivly high compared to whole body exposures. They are specifically required when handling > 1 mCi of strong beta or gamma emitters. Exposure to radiation is detected by photochemical exposure of film sealed in a paper holder and inserted into a plastic badge. The badge contains areas of varying densities of plastic and metal which differentially shield the underlying film. Subsequent development of the film allows the exposure dose to be estimated by dosimetry. This estimated dose is reported monthly to the Radiation Safety Office. Any individual receiving a dose above background levels (10 mR/month) will be immediately notified.

Who should wear a film badge?

Any individual handling x-ray, gamma-ray, or high energy beta emitting isotopes (e.g., 125-I, 60-Co, 32-P) or x-ray producing equipment must wear a film badge. Workers in areas where these isotopes or equipment are handled must also wear film badges. Individuals working exclusively with low energy beta emitters (eg., 3-H, 14-C) need not wear a badge since the radiations are not of sufficient energy to expose the film. The Radiation Safety Office also has several pocket dosimeters which may be borrowed for limited occasions. Dosimeters are best suited for more accurately measuring short term exposures, but must be worn in addition to the film badge. The maximum permissible exposures for NEOUCOM personnel are as follows:

MAXIMUM PERMISSIBLE DOSE LIMITS

	Dose in mRem		
Occupational Radiation Workers	Monthly	Ouaterly	Yearly
Whole Body	400	1,250	5,000
Skin	2,500	7,500	30,000
Hands and Feet	6,000	18,750	75,000
Pregnant Women	40	125	500
Non-Occupational Personnel	40	125	500
Minors under 18 years of age	40	125	500

All exposures above minimal (minimal (M) is less than 10 mRem) will be reported to the individual as soon as they are detected. The RSO will attempt to determine the cause of the exposure and try to eliminate it. In the event of whole body exposure greater than 100 mRem/month, the RSO will notify the individual exposed, the authorized investigator responsible for the individual, and the chairman of the Radiation Safety Committee. If deemed necessary, a meeting of the Radiation Safety Committee will be schedule. All concerned will attempt to determine the cause of the exposure and take corrective measures. Corrective measures may include revision of laboratory procedures, construction of additional shields, and/or suspension of the use of radioisotpoes by the individual for the remainder of the calendar quarter.

Exposures above 1250 mRem in a quarterly period must be reported by the RSO to the NRC. The individual must be removed from exposure and not allowed to work with radioactive materials until their time-average exposure falls below this amount.

On a annual basis, all individuals on the badge services will receive a copy of their "Current Occupational Radiation Exposure". The report must be signed and returned to the Radiation Safety Office. Individuals should keep a copy of the report for their records.

The signed acknowledgement of radiation exposure history will be kept on permanent file in the Radiation Safety Office. All individuals have the right to examine their exposure reports at any reasonable time in the safety office. Future employers of the individual have the right to obtain a copy of their exposure history.

B. Bioassay Programs

The bioassay program is designed to:

1. Assure the investigator that no radioactive material has been inhaled, absorbed, or ingested during the handling of certain radiosotopes under certain conditions.

2. Take appropriate clinical action if certain levels of radioactive materials are detected to assure the continued health of the individual.

Bioassays are performed on an "as needed" basis, and are only required under certain circumstances. NEOUCOM's policy is to minimize as much as possible those situations requiring bioassays.

Who must be bioassayed?

Guidelines published by the U.S. N.R.C. stipulate that individuals handling specific quantities of tritium (^{3}H) labeled compounds and/or specific quantities of ^{125}I or ^{131}I labeled compounds must be bioassayed.

All workers involved in the processing of ^{3}H under conditions sufficiently close to or exceeding those shown on the following page (pg. 12) must participate in the bioassay program.

It is anticipated that seldom, if ever, will that activities in the table be exceeded. Experiments involving ^{3}H nucleotide precursors at levels exceeding the table shall be performed in a radiological fume hood and investigators will wear lab coats throughout the experiment. The Radiation Safety Officer shall be notified at least 8 hours before such an experiment.

Urinalysis will be performed as needed. Within 48 hours following the use of excessive quantities of ^{3}H compounds, urine will be collected. Triplicate 1ml samples will be counted by liquid scintillation using an aqueous cocktail. If routine use of excessive quantities of isotopes are planned, urinalysis will be performed bi-weekly until one month after use of ^{3}H at excessive levels has ceased.

If ^{3}H excretion rates exceed 50 uCi/liter (ie. greater than 110,000 dpm per milliliter) the following steps will be taken:

1. The individual will be immediatly referred to the Medical Physics section of Robinson Memorial Hospital. (Ravenna, Ohio)

TRITIUM ACTIVITY LEVELS OR CONCENTRATIONS ABOVE WHICH BIOASSAY SHALL BE REQUIRED

TYPES OF OPERATION	HTO Form (and forms other than right column)	HT or T_2 Gas in sealed process vessels	Nucleotide precursers	HTO mixed with more than 10Kg of inert H_2O or other substances
Processes in open room or bench, with possible escape of tritium from process vessels.	10 mCi	10,000 mCi	1 mCi	1 mCi
Processes with possible escape of tritium, carried out within a fume hood of adequate design, face velocity, and performance reliability.	100 mCi	100,000 mCi	10 mCi	10 mCi
Processes carried out within gloveboxes, ordinarily closed, but with possible release of tritium from process and occasional exposure to contaminated box and box leakage.	1,000 mCi	1,000,000 mCi	100 mCi	100 mCi

Quantities present (less than 10Kg) may be considered either the amount processed by an individual at any one time (when accidental intake is more likely), or the amount of activity entered into process (throughput) during any one month when routine handling of repeated batches is the more likely source of exposure. Concentrations in the right hand column may be used when activity in process is always diluted in more than 10Kg of other reagents, as in nuclear reactor coolant systems.

2. The incident will be reported to the NRC in accordance with section 20.403 of 10 CFR 20.

3. The Radiation Safety Committee Chairman, Division Director, and Authorized Investigator in charge of the area will be notified.

4. A survey of the operation and the area it was performed in will be conducted to determine the cause of the exposure. Evaluations to determine how best to eliminate future possible exposures will be conducted.

5. Implement corrective procedures necessary to reduce further exposures. These may include removing the individual from further work with excessive quantities of ^{3}H or prohibiting use of excessive quantities of ^{3}H in that work area.

6. Perform urinalysis on a weekly basis until excretion rates of less than 5 uCi/liter (ie. 11000 dpm/ milliliter) are seen for 2 consecutive weeks.

In the event that greater than 5 uCil/liter but less than 50 uCi/liter are observed, the urinalysis procedure will be repeated within 48 hours. If levels are still above 5 uCil/liter, steps 3 - 6 will be implemented.

The activity levels above which bioassay shall be required for ^{125}I or ^{131}I are shown on the following page. The thyroid burden for each individual participating in the program will be determined as follows:

1. Bioassay measurements will be performed with a Victoreen model #290 Thyac IV survey meter equiped with a model 425-110 thin window scintiliation probe. The meter will be calibrated against a known standard enclosed in a lucite neck phantom to simulate tissue equivalency and thyroid position. Survey readings will be taken from the neck region of the individual and compared with a control reading taken from the individual's thigh. These values will be used to estimate the individuals thyroid burden.

2. Bioassays will be performed at the following frequencies:

   a. Initial preoperational baseline reading - Performed within 2 weeks prior to beginning work with radioactive iodine.

ACTIVITY LEVELS ABOVE WHICH BIOASSAY FOR 125-I OR 131-I IS NECESSARY

Types of Operations	Activity Handled In Unsealed Form Making Bioassay Necessary: Volatile or Dispersible	Activity Handled In Unsealed Form Making Bioassay Necessary: Bound to Nonvolatile Agents
Processes in open room or bench, with possible escape or iodine from process vessels.	.01 mCi	.1 mCi
Processs with possible escape of iodine carried out within a fume hood of adequate design, face velocity, and performance reliability.	.1 mCi	1 mCi
Processes carried out within gloveboxes, ordinarly closed, but with possible release of iodine from processes and occasional exposure to contaminated box and box leakage.	1 mCi	10 mCi

Quantities present may be considered the amount in process by a worker at one time. Quantities in the right-hand column may be used when it can be shown that activity in process is always chemically bound and processed in such a manner that 125-I or 131-I will remain in nonvolatile form and diluted to concentrations less than 0.1 uCi/mg of nonvolatile agent. Capsules (such as gelatin capsules given to patients for diagnostic tests) may be considered to contain the radioiodine in nonfree form, and bioassay would not be necessary unless a capsule were inadvertently opened (e.g., dropped and crushed). On the other hand, certain compounds were radioiodine is normally bound are known to release radioiodine when the material is in process, and the left-hand column may then be applicable. In those laboratories working only with 125-I in radioimmunoassay (RIA) kits, the quantities of 125-I are very small and in less volatile forms: thus, bioassay requirements may be judged from the right-hand column.

b. Routine - Performed at the frequencies listed in NRC 8.20, Regulatory Position 4. Initially, bioassays will be performed within 72 hours following entry of an individual into an areas where bioassays are required, but waiting at least 6 hours for distribution of a major portion of the iodine to the thyroid. For individuals who are continually using radioactive iodine, bioassays will be performed at a minimun of every 2 weeks thereafter. For individuals who use radioactive iodine in an infrequent basis (less than every 2 weeks), bioassays will be performed within 72 hours (but no sooner than 6) of the end of the work period. After a 3 month measurement period, the frequency of bioassays for continual users can be reduced to monthly or quarterly periods if criteria outlined in NRC 8.20 are met.

c. Postoperational - A bioassay will be performed with 2 weeks of the last possible exposure of radioactive iodine when the individual is terminating all potential exposure.

d. Diagnostic - Follow-up bioassays will be performed within 2 weeks of any measurement exceeding levels given as action points in NRC 8.20 regulatory postion 5-1, and within 1 week for levels exceeding those given in 5-2.

3. Whenever the thyroid burden is found to exceed 0.12 uCi of ^{125}I or 0.04 uCi of ^{131}I, the following steps will be taken:

a. The RSO will conduct an investigation of the operations involved to determine the cause of the exposure, and evaluate the potential for further exposure.

b. Corrective action will be implemented to eliminate or reduce the potential for further exposures.

c. Repeat bioassays within 2 weeks to confirm the presence of radioactive iodine and estimate the effective biological half-life.

d. Notify the NRC as required in 10 CFR 20, parts 20.108, 20.405, 20.408, and 20.409.

4. If the thyroid burden is found to exceed 0.5 uCi of ^{125}I or 0.14 uCi of ^{131}I, the following actions will be taken immediately:

   a. Refer the individual to the Medical Physics section of Robinson Memorial Hospital (Ravenna, Ohio).

   b. Carry out steps 3a-d above.

   c. Notify the Director, Radiation Safety Committee Chairman, and authorized investigator responsible for the area the exposure occurred in.

   d. Carry out repeated measurements at 1 week intervals until the thyroid burden is less than 0.12 uCi of ^{125}I or 0.14 uCi of ^{131}I.

   e. Evaluate the possibility of longer-term compartments containing ^{125}I or ^{131}I to ensure that appreciable exposures to these compartments do not go undetected.

C. Laboratory Surveys

1. Survey Methods

The RSO will monitor all rooms in which radioactive isotopes are either used or stored. Monitoring will consist of both surveys and surface wipes. Surveys will be used to verify that the radiation levels in all areas accessible to personnel are such that a major portion of the body could not receive exposures exceeding the following:

a.	Unrestricted areas (eg. halls, offices, non-radiation labs)	0.2 mRem/hour
b.	Radioactive Materials Areas (e.g. Type C radioisotope laboratory)	2 mRem/hour
c.	Restricted Radiation Areas (eg. Type B radioiodination laboratory)	5 mRem/hour

Wipes are performed to detect removable surface contamination. Areas of approximately 100-150 cm^2 are wiped with filter paper moistened in 50% ethanol. The filter paper is placed into vials and evaluated in a Beckman LS 9000 scintillation counter. All vials are counted on a 3 window program to determine the quantity and type of radioisotopes present. Investigators will be notified in writing of any contamination exceeding 200 dpm/100 cm^2 or any other unsafe conditions in their laboratories.

2. Survey Frequency

NEOUCOM designates 3 levels (LOW, MEDIUM, HIGH) of survey frequency based on the maximum activity of radionuclide, the physical and chemical form, and the specific proposed use. The table below gives ranges and appropriate modifying factors for various procedures.

Required Laboratory Survey Frequencies

Toxicity Class	Survey Frequency Category		
	LOW	MEDIUM	HIGH
1	< 10 uCi	10 uCi - 1 mCi	> 1 mCi
2	< 1 mCi	1 mCi - 100 mCi	> 100 mCi
3	<100 mCi	100 mCi - 10 Ci	> 10 Ci
4	< 10 Ci	10 Ci - 1000 Ci	>1000 Ci

Procedure	Modifying Factor
Simple Storage	x 100
Very simple wet operations	x 10
Normal chemical operations	x 1
Complex wet operations	x 0.1
Simple dry operations	x 0.1
Volatile radioactive compounds	x 0.1
Exposure of non-occupational personnel	x 0.1
Dry and dusty operations	x 0.01

The initial survey frequency must be multiplied by the appropriate modifying factor to determine the required survey frequency. Required frequencies are as follows:

LOW - Not less than once per month
MEDIUM - Not less than once per week
HIGH - Not less than once per normal working day

Every investigator, technician, student, or other individual is responsible for monitoring his own operations. Many projects are of such a nature that monitoring instruments must be on hand at all times. The RSO maintains an inventory of calibrated survey meters to be distributed to those laboratories desiring or needing such equipment.

D. Pregnant Workers

To assure the health and safety of a developing fetus, the NRC has outlined specific steps to be taken in the protection of pregnant radiation workers. Regulatory Guide 8.13 contains information which must be presented, both orally and in writing, to the pregnant worker, her supervisor, and all laboratory co-workers. In order that NEOUCOM may comply with these guidelines, all female employees must notify the Radiation Safety Officer if they become pregnant. This information will be held in strict confidentiality, and only those individuals listed above will be notified.

IV. Policies and Procedures

A. Authorization of Radioactive Materials Locations

All rooms in which radioactive materials or radiation producing equipment are used must be specifically approved for that purpose. Approval for use will be given by the RSO with the advise of the Radiation Safety Committee and the Division Director. Approval will consider the isotope to be used, the maximum activity expected, the volatility and dispersibility of the radioactive matierals, and the specific procedures to be carried out in the area. Other factors which may influence a decision are the amount of bench space, fume hoods, bio-hoods, shielding, storage space, and waste handling facilities.

All rooms approved for use of radioactive materials must also be under the direct control and supervision of an investigator authorized for radioisotope usage. The investigator must accept full responsibility for continual safe conditions in that laboratory. Core facilities such as the cold room are under the supervision of the Program Chairman and Director. All areas will be classified as Minimum Quantity, Type C, Type B, or Type A according to the following tables (pgs. 19-20). Laboratories will be restricted to the maximum allowable activities indicated.

Definitions: The Nuclear Regulatory Commission defines areas according to the following guidelines.

1) Unrestricted area - "means any area to which access is not controlled by the licensee for purpose of protection of individuals from exposure to radiation and radioactive materials. No licensee shall possess, use or transfer licensed material in such a manner as to create in any unrestricted area, radiation levels exceeding 2mR/hr. Licensed materials stored in an unrestricted area shall be secured from unauthorized removal from the place of storage. Licensed materials in an unrestricted area and not in storage shall be tended under the constant surveillance and immediate control of the licensee."

2) Restricted area - "means any area to which access is controlled by the licensee for purposes of protection of individuals from exposure to radiation and radioactive materials. No licensee shall possess, use or transfer licensed material in such a manner as to permit any individual in a restricted area to

GUIDELINES FOR MAXIMUM ACTIVITIES IN NEOUCOM LABORATORIES

Radiotoxicity Of Radionuclides	Minimum Significant Quantity	Type Of Working Laboratory Required		
		Type C	Type B	Type A
1) Very High	0.1 uCi	< 10 uCi	10 uCi - 10 mCi	> 10 mCi
2) High	1.0 uCi	<100 uCi	100 uCi - 100 mCi	>100 mCi
3) Moderate	10 uCi	< 1 mCi	1 mCi - 1 Ci	> 1 Ci
4) Low	0.1 mCi	< 10 mCi	10 mCi - 10 Ci	> 10 Ci

Type A is a specially designed laboratory for handling large activities of highly radioactive materials. Type B is a specially designed radioisotope laboratory. Type C is a good quality chemical laboratory with adequate ventilation, fume hoods, and non-absorbent surfaces. With the approval of the Radiation Safety Officer, it may be possible to increase the upper limits for Type C laboratories towards those of Type B laboratories for toxicity clases 3 and 4. Laboratories without hoods may not work with amounts greater than the minimum significant quantities.

Modifying factors must be applied to the allowable quantities indicated according to the complexity of the procedures to be followed. The following factors are suggested but due regard must be paid to all circumstances affecting individual cases.

Procedure	Modifying Factor
Storage (stock solutions)	x 100
Very simple wet operations	x 10
Normal chemical operations	x 1
Complex wet operations with risk of spills	x 0.1
Simple dry operations	x 0.1
Volatile radioactive compounds	x 0.1
Exposure of non-occupational personnel	x 0.1
Dry and dusty operations	x 0.01

Class 1 - Very High Toxicity

^{90}Sr ^{90}Y ^{210}Pb ^{210}Bi

Class 2 - High Toxicity

^{22}Na	^{36}Cl	^{45}Ca	^{47}Ca	^{46}Sc	^{54}Mn	^{56}Co	^{59}Fe
^{60}Co	^{85}Sr	^{89}Sr	^{91}Y	^{95}Zr	^{106}Ru	^{106}Rh	$^{110}Ag^{m}$
$^{115}Cd^{m}$	$^{114}In^{m}$	^{124}Sb	^{125}Sb	$^{127}Te^{m}$	$^{129}Te^{m}$	^{124}I	^{125}I
^{126}I	^{131}I	^{133}I	^{134}Cs	^{137}Cs	^{140}Ba	^{144}Ce	^{144}Pr
^{151}Sm	^{152}Eu	^{154}Eu	^{160}Tb	^{170}Tm	^{181}Hf	^{182}Ta	^{192}Ir
^{203}Hg	^{204}Tl	^{207}Bi	^{210}Bi				

Class 3 - Moderate Toxicity

^{7}Be	^{14}C	^{18}F	^{24}Na	^{38}Cl	^{31}Si	^{32}P	^{35}S
^{41}A	^{42}K	^{43}K	^{47}Sc	^{48}Sc	^{48}V	^{51}Cr	^{52}Mn
^{56}Mn	^{52}Fe	^{55}Fe	^{59}Fe	^{57}Co	^{58}Co	^{63}Ni	^{65}Ni
^{64}Cu	^{65}Zn	$^{69}Zn^{m}$	^{72}Ga	^{73}As	^{74}As	^{76}As	^{77}As
^{75}Se	^{82}Br	$^{85}Kr^{m}$	^{87}Kr	^{86}Rb	^{91}Sr	^{90}Y	^{92}Y
^{93}Y	^{97}Zr	$^{92}Nb^{m}$	^{95}Nb	^{99}Mo	^{96}Tc	$^{97}Tc^{m}$	^{97}Tc
^{99}Tc	^{97}Ru	^{103}Ru	^{103}Pd	^{109}Pd	^{105}Ag	^{111}Ag	^{109}Cd
^{115}Cd	^{113}Sn	^{125}Sn	^{122}Sb	$^{125}Te^{m}$	^{127}Te	^{129}Te	$^{131}Te^{m}$
^{132}Te	^{130}I	^{132}I	^{134}I	^{135}I	^{135}Xe	^{131}Cs	^{136}Cs
^{131}Ba	^{140}La	^{141}Ce	^{143}Ce	^{142}Pr	^{143}Pr	^{147}Nd	^{149}Nd
^{147}Pm	^{149}Pm	^{153}Sm	^{152}Eu	^{155}Eu	^{153}Gd	^{159}Gd	^{165}Dy
^{166}Dy	^{166}Ho	^{169}Er	^{171}Er	^{171}Tm	^{175}Yb	^{177}Lu	^{181}W
^{185}W	^{187}W	^{183}Re	^{186}Re	^{188}Re	^{185}Os	^{191}Os	^{193}Os
^{190}Ir	^{194}Ir	^{191}Pt	^{193}Pt	^{197}Pt	^{196}Au	^{198}Au	^{199}Au
^{197}Hg	$^{197}Hg^{m}$	^{200}Tl	^{201}Tl	^{202}Tl	^{203}Pb	^{206}Bi	^{212}Bi

Class 4 - Low Toxicity

^{3}H	^{15}O	^{37}A	$^{58}Co^{m}$	^{59}Ni	^{69}Zn	^{71}Ge	^{85}Kr
^{87}Rb	$^{91}Y^{m}$	^{93}Zr	^{97}Nb	$^{96}Tc^{m}$	$^{99}Tc^{m}$	$^{103}Rh^{m}$	$^{113}In^{m}$
^{129}I	$^{131}Xe^{m}$	^{133}Xe	$^{134}Cs^{m}$	^{135}Cs	^{147}Sm	^{187}Re	$^{191}Os^{m}$
$^{193}Pt^{m}$	$^{197}Pt^{m}$						

be exposed, such that the uptake of radioactive matieral by any organ from either inhalation or absorption or both routes of intake in any calendar quarter does not exceed that which would result from inhaling such radioactive material for 40 hours per week for 13 weeks at uniform concentrations specified in Appendix B, Table I, Column 1, of 10 CFR 20."

"For purpose of determining compliance with the requirements of this section the licensee shall use suitable measurements of concentrations of radioactive materials in air for detecting and evaluating airborne radioactivity in restricted areas and in addition, as appropriate, shall use measurements of radioactivity in the body, measurements of raidoactivity excreted by the body, or any combination of such measurements as may be necessary for timely detection and assessment of individual intakes of radioactivity by exposed individuals."

3) Radiation area - "means any area, accessible to personnel, in which there exists radiation, originating in whole or in part within licensed materials, at such levels that a major portion of the body could receive in any one hour a dose in excess of 5 mR/hr, or in any 5 consecutive days a dose in excess of 100 millirems."

4) High Radiation area - "means any area, accessible to personnel, in which there exists radiation originating in whole or in part within licensed material, at such levels that a major portion of the body could receive in any one hour a dose in excess of 100 millirems."

5) Radioactive Materials area - "Each area or room in which licensed material is used or stored shall be conspicously posted with a sign or signs bearing the radiation caution symbol and the words: Caution -Radioactive Materials."

All laboratories which do not restrict the access of non-occupational personnel at all times (e.g., cleaning crew, buildings and grounds, security, students, secretaries, etc.) will be classified as "unrestricted." The laboratory must not exceed the 2 mR/hr limits and will be held to a minimum of a 0.1 modifying factor for maximum permissible quantities.

Only those areas which control the access of non-occupational personnel at all times will be allowed to operate at the full levels.

Accordingly, all Minimium Significant Quantity or Type C radioisotope laboratories will qualify as radioactive materials areas. Type B laboratories such as rooms E-46 and E-48 qualify as restricted radiation areas. There are currently no areas qualified as high radiation areas on the NEOUCOM campus.

B. Before Beginning an Experiment in an Approved Area.

Before working with radioactive materials, all personnel must have successfully completed the training program listed in Section II and arranged for personnel radiation exposure monitoring including bioassay if necessary. The authorized investigator supervising the research project is responsible for the health and safety of personnel on the project. The investigator must be certain that all requirements and preparations have been met before assigning someone to work with any radioactive materials or radiation producing equipment. All personnel must also know how to contact the RSO in the event of an emergency, and be familiar with the emergency procedures outlined in Section V.

Before attempting any new procedures with radioactive materials, it is suggested that a "dry run" be carried out to help anticipate possible hazards during the experiment. An aid in detecting potential flaws is to perform the experiment with a fluorescent material or dye. Ultraviolet light can be used to survey the area following an experiment to help indicate where materials may have contaminated the area.

C. Purchasing Radioactive Materials

All purchase requisitions for radioactive materials must be signed by an authorized investigator ordering the material and the RSO regardless of the type or quantity of radioactive materials being ordered. Once a requisition is received, the RSO will examine the current inventory and verify that receipt of the material will not exceed the possession limits for the isotope. The Radiation Safety Officer will file a copy of the signed and dated requisition in the safety office. Once signed and recorded, the purchase requisition is forwarded to the Accounting Office for routine processing.

Blanket purchase orders can be arranged for those investigators requiring frequent shipments of identical materials. Purchase orders covering the desired number of shipments are processed as usual through the Radiation Safety and Accounting Offices. Unless the P.O. states specific dates for each of the shipments, the RSO must place all phone calls for subsequent shipments. This is necessary to insure that all materials will be properly received, and that receipt of material will not exceed licensed limits.

D. Receiving Radioactive Materials

1. Receipt During Normal Working Hours

Only materials that have been properly ordered through the Radiation Safety Office will be received. All materials not ordered through the Radiation Safety Office will be returned to the sender unopened. When a package of radioactive material arrives on campus, the receiving personnel will inspect the package for signs of damage (ie. crushed box or wet areas due to leaks) before accepting it from the carrier. If the package is damaged to the degree that radioactive material may have contaminated it's surface, the receiving personnel must contact the RSO and the Security Office immediately. The RSO will monitor the package, the receiving area, the carrier's vehicle, and all personnel who handled the package to determine the extent of possible contamination. The Security Office will not release the carrier from the campus until it is determined that neither he nor his vehicle are contaminated.

If the package is received in good condition, the receiving personnel will sign for its receipt and immediately notify the RSO of its arrival. As soon as possible, the RSO will monitor the package with a survey meter and surface wipes, and complete a "Receipt of Radioactive Materials Form" (see following page 24). Wipes will be performed on the surfaces of the package down to the inner container delivered to the investigator. If removable contamination in excess of 0.1 mCi (22,000 dpm) is detected, the RSO will immediately notify the final carrier and the Nuclear Regulatory Commission in accordance with 10 CFR 20.205. The receipt form, the packing slip, and the copy of the original requisition will be placed in a file labeled "Materials Received" and retained indefinitely.

The package will be delivered to the appropriate investigator's lab, or to Rooms E-48 or E-46 in the case of ^{125}I, ^{131}I, or other high toxicity isotopes.

RADIATION SAFETY REPORT

RECEIPT OF RADIOACTIVE MATERIALS

Investigator _____ Isotope _____

P.O. # _____ Activity _____

Date Received _____ Assay Date _____

SHIPPING LABEL

White I _____

Yellow II _____

Yellow III _____

Other _____

PACKAGE CONDITION

Good _____

Other _____
(Describe Below)

Shipping Company _____ Carrier _____

AGREEMENT BETWEEN PURCHASE ORDER AND PACKING SLIP

	Purchase Order	Packing Slip Agreement
Isotope	_____	_____
Activity (mCi)	_____	_____
Chemical Form	_____	_____

Surface Monitored	G/M Survey (mR/hr)	Filter Wipe (CPM)
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

Inspected By _____ Date _____ Time _____

2. Receipt After Working Hours

Any packages containing radioactive materials that arrive between 5:00 p.m. and 8:00 a.m., or on weekends or holidays shall be signed for and inspected by the Security Officer on duty. If the package is wet or appears to be damaged, the Security guard must ask the carrier to remain at the College until the RSO can determine that neither the driver nor the delivery vehicle are contaminated. Leave the package on the floor in the far corner of the security office, and restrict all personnel from entering the area until the RSO arrives.

If the package appears undamaged, the Security Officer will transfer the unopened package to Room E-48 and place it on the floor inside the door. The Security Officer must wear the Spare #1 film badge and disposable gloves when transporting the package. These items are provided in the security office. Carefully remove the gloves and leave them on top of the package in Room E-48. As a precautionary measure, thoroughly wash your hands after removing the gloves.

The Security Officer will contact the RSO at home immediately following the packages' arrival. The RSO will properly monitor the package as soon as possible, but no later than as outlined in 10 CFR 20.205.

E. Storage

All radioacitve materials must be stored in an area of controlled access to prevent unauthorized removal and/or use of the material. Normally, the material will be stored in an area that can be locked when personnel authorized to handle the material are not present. If any radioactive material are to be stored in an uncontrolled area such as a hallway refrigerator or freezer, the container must be lockable to assure that no authorized removal can occur.

The authorized investigator is responsible for seeing that all storage containers, vials, columns, glassware, or any other items containing radioactive material are marked with an approved label bearing the words "Caution Radioactive Material." The label must also indicate the isotope symbol, the activity, and the assay date. Containers or materials used in core facilities must also bear the users initials.

F. Use.

All radioactive materials must be handled in designated approved areas. Radioactive materials should be treated as hazardous substances and handled with all cautionary procedures normally accorded such substances. Normal precautions should include the following safety measures.

1. No eating, drinking, smoking, applying cosmetics, or any other procedure that could lead to inadvertent ingestion of radioactive materials is permitted.

2. Film badges must be worn when using gamma ray, x-ray, or high energy beta producing isotopes or equipment.

3. Clothing should be disposable in the event of a major spill. Lab coats and disposable gloves should be worn when handling radioactive materials. Care must be taken not to contaminate other surfaces when working with gloves. Traces of radioactive material are often inadvertently transferred to refrigerator handles, telephones, sink faucets, centrifuge doors and rotors, and instrument dials when handling them with a "hot" glove. Be sure to monitor such surfaces following use to assure no contamination has taken place. Potentially contaminated clothing is not to be worn out of the laboratory area.

4. Glassware, tongs, pipettors, and other similar materials used for radioisotope work should be suitably marked and must be decontaminated before being used in a non-radioactive area. "Hot" glassware should be disposed of or decontaminated promptly.

5. Work should be confined to as small an area as possible. This simplifies the problem of confinement and shielding, and aids in limiting the affected area in case of an accidental contamination.

6. All work involving the likelihood of aerosols, dusts, or gaseous products, must be done in hoods, glove boxes, or similar protective devices. All releases from these systems shall be ALARA, and may never exceed the maximum permissible concentration in air outlined in Appendix B, Table II of 10 CFR 20.

7. Work surfaces must be covered with an absorbent paper with waterproof backing or confine the handling of materials to an impervious tray. Change paper and wash trays frequently to prevent the spread of radioactive contamination.

8. Pipetting radioactive materials by mouth is prohibited.

9. Food or drink, even in sealed containers, must not be stored in the same refrigerator or cold room where radioactive materials are used or stored.

10. Each laboratory or area (other than those where ^{3}H or other exempt quantities of radionuclides are handled) shall be equipped with a portable or semiportable survey meter. These meters are available from the Radiator Safety Office. Work and storage areas should be monitored before, during, and after an experiment to detect contamination spots and to maintain radiation exposure levels within the allowable limits.

11. Minimize the duration of exposure to high activities of gamma and high energy beta emitting radioisotopes. Confine large quantities of such isotopes to a suitably shielded storage box in a remote spot of the laboratory (e.g., back corner of a hood or refrigerator). Use long handled forceps or tongs if possible to reduce exposures.

12. Any equipment used with radioactive materials (refrigerators, ovens, centrifuges, lyophilizers, vacuum pumps, etc.) shall not be removed from its authorized area until demonstrated to be free of contamination. No potentially contaminated equipment shall be repaired by buildings and grounds or other personnel without first being demonstrated to be free of any contamination prior to servicing. These regulations also apply to any equipment being returned to the manufacturer for servicing.

13. In general, no radioactive contamination in excess of 200 dpm/100 cm^2 will be tolerated. Exceptions to this will include items such as hood trays, glove box trays, or other equipment used frequently in active areas provided that the item is clearly labeled with standard radiation caution signs. All such items or areas must be approved by the RSO and must still be below the 2 mR/hr limits.

G. Inventory

The RSO is responsible for maintaining inventory records of all radioactive materials on the NEOUCOM campus, and insuring that the possession limits for each specific isotope are not exceeded. Investigators authorized to conduct research involving radioactive materials are responsible for maintaining up-to-date records of the receipt, disposal (both by drum and by drain), and decay of radioactive materials under their supervision.

At the end of each calendar month, the RSO will send each investigator a personal inventory form (see pages 29-30) indicating the activity of each radioisotope under their supervision at the beginning of the month. The RSO notes on the form the activity of any isotopes received through the office during that month and calculates the activity of each isotope lost by decay using the following formula. (Note that the duration of a month is taken as 30.5 days, an annual average number of days per month.)

$$A_{end} = A_{beg.} \left(\exp \frac{-.693 \times 30.5}{T^h}\right)$$

On receipt of this inventory form, each licensee is responsible for promptly (within 7 days) verifying the information on the form, and completing the sections on amounts placed into waste and amounts released into the sanitary sewer system. All entries should be made in millicuries.

Materials transferred from one investigator to another should be noted as a minus quantity in the receipt column of the donating investigator's form, with a notation as to whom the material was transferred to. The investigator receiving the material should note it in the receipt column and note from whom it was received. ALL TRANSACTIONS SHOULD BE REPORTED AS OF THE LAST CALENDAR DAY OF THE MONTH. Investigators may not transfer radioactive materials to other investigators who are not specifically approved for that isotope.

On receipt of the signed personal inventory form, the RSO records the receipt, disposal, and decay of each isotope onto an Isotope Summary Inventory Form (see following pages). He must ascertain that the Isotope Summary for receipt, storage in waste drums, disposal by sanitary sewer, and loss by decay balance to the nearest microcurie. The RSO will compare the total activity present on campus (both in laboratories and in waste drums) with the possession limits for each specific isotope. If the total present on campus exceeds 90% of the possession limits, he will notify all licensees. In such an event, the RSO may consider requesting an amendment from the NRC to increase possession limits, or disposing of stored waste labeled with that isotope.

Date _____

NEOUCOM Radioisotope Inventory Report
(All Values Reported In mCi)

$A = A_o e^{\frac{-.693\ t}{T_{\frac{1}{2}}}}$

Investigator _____

*Deregulated = ^{3}H & ^{14}C < .05 uCi/gm or ml
(110,000 dpm/gm or ml)

Isotope	Decay Rate (30.5D)	Activity At Start Of Month	Activity Received	Activity Placed Into Waste (End of Month)								Activity Lost By Decay	Activity At End Of Month
				Scintillation Vials, Deregulated*	Scintillation Vials All Other	Dry Solids	Animal	Organic Liquids	Aqueous Liquids	Released To Sewer			
^{3}H	.0047												
^{14}C	.0000												
^{22}Na	.0220												
^{28}Mg	all												
^{32}P	.7722												
^{35}S	.2148												
^{45}Ca	.1216												
^{46}Sc	.2228												
^{51}Cr	.5337												
^{85}Sr	.2782												
^{86}Rb	.6778												
^{99m}Te	all												
^{125}I	.2963												
^{131}I	.9278												

THE VALUES REPORTED ABOVE ARE TRUE AND ACCURATE AS TO THE BEST OF MY KNOWLEDGE.

Signed _____

Date _____

Isotope _____

Decay rate ____ (30.5 days)

*Deregulated = ^{3}H & ^{14}C < .05 uCi/gm or ml (110,000 dpm/gm or ml)

NEOUCOM Radioisotope Inventory Report
(All Values Reported In mCi)

	Activity At Start Of Month	Activity Received	Activity Placed Into Waste (End of Month): Scintillation Vials, Deregulated*	Scintillation Vials, All Other	Dry Solids	Animal	Organic Liquids	Aqueous Liquids	Released To Sewer	Activity Lost By Decay	Activity At End Of Month
1) Chiang											
2) Depew											
3) Finkelstein											
4) Gilliam											
5) Hutterer											
6) Kehoe											
7) Koo											
8) Nielsen											
9) Rosenthal											
10) Seide											
11) Steggles											
12) Stuesse											
13) Truitt											
Previous Waste Inventory										Waste Balances	
Monthly Waste Decay											
TOTAL											

H. Transportation of Radioactive Materials Off Campus

Limited quantities of radioactive materials may be transported off campus to another facility licensed by the NRC to receive the radioactive material (e.g., to one of the consortium universities or hospitals). Due to the numerous NRC and DOT regulations governing transportation of these materials on public highways, ALL TRANSPORTATION OFF CAMPUS MUST PROCEED THROUGH THE RADIATION SAFETY OFFICE. Transfers will only be arranged from the Radiation Safety Office of the NEOUCOM campus to the Radiation Safety Office of the other institution. All transfers must comply with all applicable regulations found in 10 CFR 71 and 49 CFR 173.

I. Radioactive Waste Disposal

The term "radioactive waste" includes any and all wastes that contain, or are contaminated with, any radioactive material used in the laboratory. This includes liquids, solids, trash, animal carcasses, infectious materials, excreta, and used scintillation counting liquids, etc. Waste and trash which are not radioactive should never be thrown in with radioactive waste, as the cost to NEOUCOM for disposing of radioactive waste is very high. All wastes must be classified and disposed of according to the following categories.

1. Liquids

   a. Organic based - must be collected in linear polyethylene jugs supplied by the Radiation Safety Office. Liquid wastes are not to be stored in any other containers.

   b. Aqueous based - certain amounts of radioactive materials may be released into sanitary sewer systems if the activities present are below the amounts outlined in NRC 10 CFR 20.303, and the chemical and physical form are shown to be readily soluble and dispersible. Because these amounts are based on the total volume of effluent released by the institution, and monthly and annual limits, all releases must be approved by the Radiation Safety Office and recorded on the individual's monthly inventory sheet. Liquid waste not disposed of by sanitary sewer is to be collected and disposed of in the same manner as organic based liquid waste.

2. Dry Solids

Dry solid wastes must be completely free of residual liquids. Solid wastes must be collected in the special waste containers supplied by the Radiation Safety Office. Needles, scalpels, and any other sharp objects must be placed in puncture-resistant containers such as cans or bottles to prevent injury to personnel handling bags of solid waste.

3. Animal

Animal carcasses and excreta containing radioactive material must be placed in polyethylene bags and delivered to the Radiation Safety Laboratory where they will be frozen until prior to disposal. Large animals such as dogs or monkeys should be cut into smaller pieces before freezing to facilitate placement of the carcass into a standard 30 gallon drug.

4. Liquid Scintillation Vials

Currently, either plastic or glass vials can be accepted for disposal. It is anticipated that this may soon change due to future disposal by incineration instead of shallow land burial. It is highly recommended that all investigators still using glass vials switch to plastic as soon as possible. Scintillation vials must be divided into two categories, regular and "deregulated". Deregulated vials are those containing only ^{3}H or ^{14}C with activities less than .05 uCi/ml (110,000 dpm/ml). Regular scintillation vials are those containing ^{3}H or ^{14}C with activities greater than .05 uCi/ml, or all other isotopes regardless of activity.

5. Short Half-Life

Short half-life isotopes (those with a half-life of less than approximately 90 days) are to be separated from long half-life isotopes, for each category listed above. Long half-life wastes are shipped for disposal, whereas short half-life wastes are decayed on site.

J. Animal Use

1. The authorized investigator is responsible for obtaining the permission of the Animal Care Committee and the RSO before beginning experiments

involving the use of radioactive materials in the Vivarium area. The investigator must complete and submit an application for Animal Use of Biohazardous Materials Form.

2. The authorized investigator is responsible for insuring that all vivarium personnel are informed as to the proper safety precautions to be exercised in conjunction with the experimentation.

3. Radioactive materials may only be administered to animals owned by the university. All animals must be identified by ear notches or other appropriate means to insure proper identification and disposal.

4. All cages containing animals treated with radioactive materials must be labeled with radioactive warning tape. The door to the room containing the cages must also be labeled, and locked when not under direct supervision. The authorized investigator is responsible for monitoring, and if necessary decontaminating, all vivarium equipment used in his experimentation.

5. All dead animals containing radioactive materials must be treated as radioactive waste items. Feces and urine from animals must also be treated as radioactive unless proven otherwise. No radioactive animals are to be delivered for incineration unless specifically approved by the Radiation Safety Office and coordinated through the Vivarium personnel.

6. Possible hazards resulting from air concentrations of radioactive materials arising from metabolism of the animal, or from cage waste, must be controlled. Metabolic cages may be required in order to meet safety standards.

V. Emergency Procedures

We are all human and occasionally make mistakes. There is no shame in reporting spills or contamination. There is considerable hazard in NOT REPORTING an accident involving radioactive materials. The RSO may discontinue the privilege to handle radioactive materials from persons failing to promptly report any emergencies involving radioactive materials.

A. Low Level Spill

A low level spill is one that is confined to a limited area and does not increase the radiation levels in the area beyond 2 mR/hr. It must conform to all of the following criteria.

1. The spill did not contact any part of a person's body.

2. The spill is confined to absorbant paper or an impervious tray.

3. Radiation levels 1 meter from the center of the spill do not exceed 2 mR/hr.

The authorized investigator supervising the activities in the laboratory where the spill occurred must be notified immediately. The investigator is responsible for assuring that the spilled material is collected and disposed of properly. Decontamination procedures should include the following steps.

Low Level Spills

1. NOTIFY: Immediately notify all other persons in the area that a spill has occurred.

2. PREVENT THE SPREAD:

   a) Liquids - Cover the spill with absorbent paper.

   b) Dry material - Dampen thoroughly, taking care not to spread the contamination. Water should be used unless chmeical reactions would generate an air contaminant, oil should then be used instead.

3. DECONTAMINATE: Use disposable gloves. Place all contaminated materials into a plastic bag and dispose of in the radioactive waste container.

4. SURVEY: With a G.M. Survey Meter, check the area around the spill, your hands, feet, and clothing for contamination. Wipes should be taken for weak beta contaminants.

5. REPORT: Report incident to Radiation Safety Officer.

B. Major Hazardous Spill

A major hazardous spill is any spill that is not a low level spill, and DOES NOT involve contact with any part of a person's body. A spill is hazardous if it meets either of the following criteria.

1. The spill is not confined to absorbant paper or an impervious tray.

2. Radiation levels 1 meter from the center of the spill exceed 2 mR/hr.

Major Spills:

1. NOTIFY: Immediately notify all persons to vacate the room.

2. PREVENT THE SPREAD.

   a) Liquid - Cover the spill with absorbent material, but do not attempt to clean it up. Confine the movement of all personnel to prevent the spread of contaminants.

   b) Dry material - Do not attempt to clean it up.

3. CLOSE THE ROOM. Switch off all fans and hoods. Leave the room and lock the door(s) to prevent entry.

4. CALL FOR HELP. THE RADIATION SAFETY OFFICER MUST BE NOTIFIED IMMEDIATELY WHEN A MAJOR HAZARDOUS SPILL OCCURS.

The RSO is responsible for monitoring the extent of the spill, directing the decontamination and assuring that the area is as free of contamination as reasonably achievable when decontamination procedures are completed. The authorized investigator is responsible for promptly executing the decontamination procedures deemed necessary by the RSO.

The RSO and his staff will determine the extent of the spill by survey meter and wipes of the surrounding area. The contaminated area will be labeled with tape and cordoned off to prevent inadvertant entry into the area. Only radiation safety personnel and the authorized investigator may enter the area until the decontamination procedures are completed.

The authorized investigator will complete a Radioactive Contamination Report and submit it to the RSO. An example of this report in included on page 36. A meeting of the Radiation Safety Committee may be convened to determine corrective measures to assure that similar hazardous spills do not occur.

If conditions warrant, the RSO will report the incident to the NRC as stipulated in 10 CFR 20.

RADIOACTIVE CONTAMINATION REPORT

I. Nature of the accident (check one) Date of the accident _____

___ Low level spill ___ Bodily contamination (external)

___ Major spill ___ Bodily contamination (internal)

II. Location of accident. _____

_____

III. Describe accident. (use extra page if necessary)

_____

_____

_____

_____

IV. Describe Decontamination Procedures. (use extra page if necessary)

_____

_____

_____

_____

_____

V. Survey Monitoring Report

Area Surveyed	CPM Before	CPM After
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

VI. Attach Bioassay Reports If Necessary

Report prepared by _____ Date _____

C. Bodily Contamination (External only)

Radioactive materials in contact with body surfaces (e.g., hands) should be removed promptly using approved decontamination products such as D-Con, Radiacwash, or I-Bind. The area should be scrubbed gently and rinsed with lukewarm water.

DO NOT USE HARSH OR CAUSTIC SOAPS.

DO NOT SCRUB THE AREA WITH AN ABRASIVE TOOL (e.g., scrub brush).

AVOID PROCEDURES THAT MAY BREAK THE SKIN CAUSING POTENTIAL TRANSFER OF MATERIAL INTERNALLY.

The RSO must be notified of all accidents involving bodily contamination.

The RSO will determine whether decontamination can proceed on site or whether the individual should be transferred as a patient to the Nuclear Medicine Section of Robinson Memorial Hospital, Ravenna, Ohio.

If decontamination is carried out on site under the direction of the RSO he will perform bioassays to determine when the individual is considered decontaminated. The RSO will complete the Radioactive Contamination Report.

D. Bodily Contamination (Internal)

Ingestion or injection of radioactive materials must be reported to the RSO immediately. They will transfer the individual as a patient to the Nuclear Medicine Section of Robinson Memorial Hospital.

EMERGENCY INFORMATION

1.	Radiation Safety Office: (Radiation Safety Officer: Michael D. Powell)	Ext. 439 or 248
	After working hours, call: or night security who will notify Radiation Safety Officer	654-5826 or Ext. 248
2.	Rootstown Fire Department	325-1414
3.	Hospital:	
	Robinson Memorial Hospital	297-0811

The emergency room at Robinson Memorial Hospital is an appropriate treatment center for cases of radiation ingestion or injury.

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

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

APPLICATION FOR MATERIAL LICENSE

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 34-18196-01

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

Northeastern Ohio Universities College
of Medicine
4209 State Route 44
Rootstown, Ohio 44272

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

4209 State Route 44
Rootstown, Ohio 44272

4. NAME OF PERSON TO BE CONTACTED ABOUT THIS APPLICATION

Michael D. Powell, Institutional and Radiation Safety Officer

TELEPHONE NUMBER: 216-325-2511 Ext.439

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.

9. FACILITIES AND EQUIPMENT.

10. RADIATION SAFETY PROGRAM.

11. WASTE MANAGEMENT.

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

FEE CATEGORY: Exempt

AMOUNT ENCLOSED $: 0.00

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
Glenn A. Saltzman	Glenn A. Saltzman	Director, Division of Basic Medical Sciences	3/28/85

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)*: 225

c. NUMBER OF BEDS: –

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

RECEIVED
APR 01 1985
REGION III

TYPE OF FEE	FEE LOG	FEE CATEGORY	COMMENTS	APPROVED BY

AMOUNT RECEIVED	CHECK NUMBER	DATE

PRIVACY ACT STATEMENT ON THE REVERSE

DUPE 8506070541

ITEM #5 - Radioactive Material

I. Radioisotopes

a) Element and mass number.

Any byproduct material of atomic numbers 1 - 83.

b) Chemical and/or physical form.

Any chemical or physical form.

c) Maximum possession limits.

A total of 2.5 curies, with a limit of 100 millicuries for each radionuclide with the following exceptions:

1) ^{3}H - 400 millicuries

2) ^{14}C - 200 millicuries

3) ^{125}I - 200 millicuries

4) ^{32}P - 200 millicuries

II. Sealed or Plated Sources

Any sealed or plated sources of atomic numbers 1 through 83 in quantities not to exceed 20 millicuries.

ITEM #6 - **Purposes for Which Licensed Material Will Be Used**

Byproduct material will be used in biomedical research and teaching. Examples of our current and anticipated uses are as follows:

1) ^{3}H

a) Radioimmunoassay of serum hormone levels from experimental animals.
b) Radioligand receptor binding assays and <u>in vitro</u> autoradiographic receptor localization.
c) Labeling of cells in tissue culture.
d) Labeling of proteins, column chromatography, and gel and electrophoresis.
e) Metabolic labeling of DNA, RNA, glycoproteins and glycolipids.
f) Alkylation of cysteine residues in proteins.
g) Measure rates of DNA and RNA synthesis in bacterial cultures.
h) Preparation of labeled plasmids as markers for cesium chloride equilibrium density banding.
i) Tracing of neural connections between different parts of the brain via autoradiographic analysis.
j) Conduct autoradiographic studies of cerebral glucose metabolism in experimental animals.
k) Metabolic labeling of viral and cellular components.
l) Assay of cholesterol hydroxylation.

2) ^{14}C

a) Assay of cholesterol hydroxylation.
b) Labeling of proteins, lipids, viral and cellular components.
c) Autoradiographic analysis of radiolabeled animal tissues for metabloic studies.
d) Autoradiographic analysis of neural connections.
e) Measurement of hormone blood levels.
f) Measure rates of DNA and RNA synthesis in bacterial cultures.
g) Preparation of labeled plasmids as markers for cesium chloride equilibrium density banding.
h) Alkylation of cysteine residues in proteins.
i) Column chromatography and gel or paper electrophoresis.
j) Tracing of enzyme induction <u>in vivo</u> and <u>in vitro</u>.
k) Metabolic labeling of viral and cellular components.

3) ^{32}P

a) Metabolic labeling of nucleic acids, phospholipids, and proteins.
b) Preparation of labeled plasmids for markers for cesium chloride equilibrium density banding.
c) Preparation of labeled substrates for metabolic studies.

4) ^{35}S

a) Labeling of proteins for enzymatic and metabolic studies.

b) Labeling of proteins for two-dimensional electrophoresis.
c) Labeling of nucleic acids for sequencing studies.
d) Labeling of antibodies.

5) ^{51}Cr

a) Labeling of cells in tissue culture.
b) Immunological cytotoxicity assays.

6) ^{85}Sr

a) Will be used to measure blood flow in body organs with labeled microspheres.

7) ^{125}I, ^{131}I

a) Labeling of proteins for radioimmunoassay, column chromatography, gel electrophoresis.
b) Cell receptor binding studies in tissue culture.
c) Autoradiographic receptor localization and binding analysis.
d) Study of vascular permeability in lung injury in experimental animals.
e) Labeling of virus surface proteins.
f) Labeling of proteins for peptide maping studies.

8) ^{141}Ce

a) Measurement of blood flow in body organs with labeled microspheres.

Activity levels for the above uses shall be consistant with the maximum permissible quantities outlined in item #9. Activity levels for experimental animals will normally be in the uCi range, and shall never exceed 2 mCi per animal.

ITEM #7 - **Training and Experience of Radiation Safety Officer and Authorized Users**

On August 22, 1984, the NRC approved amendment 12 to License No. 34-18196-01 making Mr. Michael D. Powell the Radiation Safety Officer at NEOUCOM. Mr. Powell was the assistant RSO at NEOUCOM since spring of 1982 and is also the Institutional Safety Officer.

Attached you will find a summary of his training and experience, as well as a detailed response to the 25 criteria outlined in the NRC Draft Regulatory Guide on **"Qualifications For The RSO In A Large-Scale Non-Fuel-Cycle Radionuclide Program"**. This information is identical to that submitted for the license amendment.

We have also included the training and experience of our current authorized users. All future authorized users will submit the same information to the RSO. The RSO will either accept the credentials as sufficient experience to carry out the desired work, or will outline additional steps to be taken before granting authorization.

Formal Training in Radiation Safety

Michael D. Powell
Assistant Radiation Safety Officer

	Where Trained (Person of Institution)	Duration of Training	Dates of Training
Principles and practices of radiation protection.	National Institutes of Health	1 day	4/1/82
	Kent State University / NEOUCOM	1 semester	9/82-12/82
Radioactivity measurement standardization and monitoring techniques and instruments.	Kent State University	1 semester	9/82-12/82
	NEOUCOM	4/82 to present	
Mathematics and calculations basic to the use and measurement of radioactivity.	Kent State University	1 semester	9/82-12/82
	NEOUCOM	4/82 to present	
Biological effects of radiation	Kent State University	1 semester	9/82-12/82
	NEOUCOM	4/82 to present	

Additional training and workshops

Radioactive Wastes and Regulatory Compliance Workshop	Washington, D.C. Sponsored by Nuclear Energy Waste Management Consultants and US Ecology	3 days	8/82
Packaging and Transportation of Radioactive Waste Materials	Philadelphia, PA Sponsored by US Ecology	3 days	9/83
All-Ohio Safety Congress and Exibit	Columbus, Ohio Sponsored by the Ohio Department of Health	3 days	4/84
Midwest Workshop on Low Level Radioactive Waste Management: LLW Management In Transition	Columbus, Ohio Sponsored by ERM Midwest, Inc., and Ohio Department of Health	3 days	5/84
Occupational Safety Management	Chicago, Illinois Sponsored by National Safety Council	5 days	6/84

Northeastern Ohio
Universities
COLLEGE OF MEDICINE

Rootstown, Ohio 44272 Phone: 216-325-2511

6/18/84

B. J. Holt
Region III Licensing Section
Material Licensing Branch
Division of Fuel Cycle and Material Safety

Dear Ms. Holt,

I have prepared the following in response to the 25 characteristics outlined in appendix A of the NRC draft regulatory guide on "Qualifications for the RSO in a Large-Scale Non-Fuel-Cycle Radionuclide Program. Although the Northeastern Ohio Universities College of Medicine has a specific license and relatively non-flexible program, I feel that I can meet your qualifications for a broad license flexible program outlined in appendix A.

Since 1977, I have held several technical and administrative positions at the NEOUCOM. I am currently performing four main duties: Histology Laboratory Supervisor, Institutional Safety Offcier, Assistant Radiation Safety Officer, and Instructor of Microscopic Anatomy. I spend approximately 20-40% of my time supervising the histology laboratory and teaching Microscopic Anatomy. The remainder of my time is spent on safety related issues, occupacional as well as radiation safety. Since becomming involved with the Radiation Safety Program in spring of 1982, I have spent a great deal of my time studying for this position.

APPENDIX A

1) Ability to communicate clearly, both verbally and in writing.

The various positions I hold at the NEOUCOM all demand strong communication skills. I continually interact with administrative officers, faculty members, staff employees, graduate students, and medical students. I am a member of several NEOUCOM committees and have held office as both a trustee and secretary of the Electron Microscopy Society of Northeastern Ohio.

2) Knowledge of mathematics, physics, chemistry, and biology ...

I currently hold a B.A. in Biology from the State University College at Buffalo, New York. My coursework included Calculus, Statistics, Inorganic and Organic Chemistry, Physics, Astronomy, Oceanography, Anthropology, Ecology, Philosophy, Sociology, and English, as well as numerous Biology Courses. I am nearing completion on an M.S. in Cell Biology from Kent State University. My coursework to date has included Electron Microscopy, Radiation Safety, Molecular

Genetics, Cell Biology, Microscopic Anatomy, Bioenergetics, and Biological Instrumentation.

3) Knowledge of current standards, guides, and reports ...

NEOUCOM's library and Radiation Safety Office contain information from numerous sources on Radiation and General Occupational Safety. I have spent a great deal of time researching this material and studying current and recommended safety practices. I have also visited and communicated with several regional universities to examine their radiation safety programs, and evaluate our own accordingly.

4) Knowledge of applicable NRC regulations, regulatory guides, ...

I believe that this is one of my strongest qualifications, and an area where I have contributed the most to NEOUCOM's present radiation safety program. The Radiation Safety Office maintains copies of all applicable NRC and DOT regulations, guides, and reports on file at all times. I have attended several workshops on regulatory compliance and radioactive waste disposal during the past two years, and anticipate continued attendance at similiar events in the future.

5) Knowledge and ability sufficient to operate instruments ...

I am knowledgable in the use and interpretation of all of the equipment listed in item #1. I was also instrumental in evaluating the equipment present in 1982, and purchasing new equipment to cover areas insufficiently monitored.

6) Knowledge and ability sufficient to perform calibrations ...

Although I routinely check the calibration of all radiation safety instruments with 137-Cs check sources, all equipment is recalibrated by the original vendor on an annual basis.

7) Knowledge and ability sufficient to select instruments ...

Most of the equipment listed in item #1 was purchased by the college prior to 1982, when Dr. Heath and I took over the program. An evaluation at that time revealed the need for meters specificly capable of efficiently detecting 125-I. I compared various types of equipment and finally purchased the Victoreen model #490 Thyac III survey meter with #425-110 scintillation probe. I have also just recently purchased (not yet received) two Minimonitor 125 Contamination Monitors from Atomic Products Corporation. These monitors are capible of detecting (.002 uCi 125-I surface contamination.

8) Knowledge and ability sufficient to evaluate the need for shielding ...

I was responsible for designing and building numerous new shielding devices for several investigators laboratories. Although all of these devices were built from conventional plexiglass or lead, or combinations of both, I am familiar with many of the more modern composit materials (borated polyethylene, lead polyethylene, lithium polyethylene, boro-silicone, acryl-lead) and their individual specific applications.

9) Knowledge and ability sufficient to calculate radioactive decay ...

I have covered most of the calculations relating to radioactive materials and radiation safety in Dr. Heath's and NIH radiation safety courses. My working experience at NEOUCOM has given me ample opportunity to perform various calculations on a frequent basis. The only calculations I have not routinely performed to date are secular and transient equilibrium equations, although I fully understand their applications and can perform their calculation when necessary.

10) Knowledge and ability sufficient to calculate radiation doses.

Dr. Heath's radiation safety course and NEOUCOM's on the job training have involved calculations of various types of external doses. Although my internal dose calculations to date have been limited to bioassay measurements for 3-H, 125-I,and 131-I, NEOUCOM's radiation safety office and library contain numerous health physics books outlining necessary calculations in detail.

11) Knowledge of personnel monitoring devices and the ability to select ...

NEOUCOM contracts with R. S. Landauer, Jr. & Company for a complete monthly film badge service. Landauer offers a wide selection of badge types for varying applications.

12) Knowledge and ability sufficient to manage or conduct a training program.

To date, Dr. Heath has conducted a formal course in radiation safety at Kent State University. The majority of users have taken his course before working with radioisotopes at NEOUCOM. He will continue to offer this course on an annual basis. Additionally, beginning in July of this year, Dr. Kenneth Rosenthal, chairman of the Radiation Safety Committee, and I will be conducting in house training programs for all new users. We will also be holding in house workshops to update all present users and ancillary staff personnel. Attendance at these workshops will be manditory.

13) Knowledge and ability sufficient to recognize and anticipate problems ...

Since joining the safety programs in spring of 1982, I have been instrumental in identifying and correcting several problem areas within the college dealing with both radiation and general occupational safety. I am a member of both the General Safety and Radiation Safety Committees, and work closely with NEOUCOM's administration in dealing with these issues.

14) Knowledge and ability sufficient to recognize criticality problems ...

Although criticality problems are not applicable to our program due to the radioisotopes presently being used, I have had some specific training at workshops in dealing with this issue.

15) Knowledge of current radioactive effluent treatment methods, equipment ...

I believe I am very knowledgable in this area. The workshops offered by Nuclear Energy Waste Management Consultants, US Ecology, and ERM Midwest, have had sessions devoted entirely to this subject.

16) Knowledge and ability to recognize and control contamination ...

Since May of 1982, I have been responsible for all laboratory and personnel monitoring at NEOUCOM. This responsibility entails the identification of contamination problems as well as supervising, and when necessary, performing decontamination procedures.

17) Knowledge and ability sufficient to prepare an emergency plan ...

Dr. Heath, the Radiation Safety Committee, and I worked together in developing NEOUCOM's present emergency procedures. These procedures utilize the principle investigator, the Radiation Safety Office and Committee, the Security Office, and if necessary, the Health Physics department at Robinson Memorial Hospital (Ravenna, Ohio; about 5 miles away).

18) Knowledge and ability to evaluate, select, and use respiratory ...

To date, routine use of respiratory equipment has rarely been needed due to the levels of radionuclides used and the laboratories and hoods they are restricted to. The college does possess several types of respirators which are available if needed; half facepiece, full facepiece, and pressure demand full facepiece respirators. I also recently attended a special respiratory protection workshop given by MSA Company at the All Ohio Safety Congress in Columbus, Ohio.

19) Knowledge and ability to evaluate, select and use protective clothing ...

I believe I am very knowledgable in the selection and use of protective clothing not only for radioactive materials but also for carcinogenic and viral biohazards in general.

20) Knowledge and ability sufficient to evaluate, use ... gloveboxes and hoods.

One of the first needs I addressed in 1982 was the refurbishing of the glovebox and hood in the iodination laboratory. As Institutional Safety Officer and Assistant RSO, I continually monitor and evaluate all hoods and associated procedures at NEOUCOM, radiologic as well as biohazards. I am currently working with the Vice Provost and Buildings and Grounds Superintendent on the purchase of several new hoods for particular labs.

21) Knowledge and ability sufficient to evaluate and test sealed sources ...

We currently have a very small inventory of sealed sources, mostly beta and gamma counting standards. We have one 63-Ni sealed sourse in a detector for an HPLC unit. All sealed sources are wipe tested at 6 month intervals.

22) Knowledge and ability to evaluate and dispose of radioactive waste ...

This is the area where I have had the most training. The majority of the workshops I have attended dealt with radioactive waste, waste management, regulatory compliance, and waste disposal. I have personally handled all radioactive waste collection, packaging, decay, and disposal since May 1982. The NEOUCOM is also a member of ORMUG (Ohio Radioactive Materials User's Group) which was instrumental in political efforts to get Ohio to join the Midwest

Interstate Compact.

23) Working knowledge of transport regulations and requirements ...

The workshops which were sponsored by Nuclear Energy Waste Management Consultants and US Ecology covered all applicable DOT regulations in considerable detail. The Radiation Safety Office also has a current copy of 49 CFR 100-199 on file.

24) Knowledge and ability sufficient to conduct a bioassay program.

I personally developed and instituted our present 125-I and 131-I bioassay program after discussions with Dr. Heath, the NRC, and Radiation Safety Officers at several regional universities. We also conduct 3-H bioassays in accordance with the conditions outlined in NRC regulatory guides.

25) Knowledge and ability sufficient to manage effectively the applicant's radiation safety program.

Dr. Heath and I took over the radiation safety program in spring of 1982. Since that time, I have spent approximately 20-30 hours per week of my time on radiation safety. Dr. Heath's involvement has been centered around the initial overhall and organization of the program, as well as the supervision of the safety office. I have undeniably been the actual individual responsible for the day to day working of the radiation safety program, and the contact person faculty and staff are accustomed to working with. I believe I am very qualified to handle our particular program, and have the full support of NEOUCOM's administration and safety committees. I would be happy to furnish you with any other materials deemed necessary to reach your decision.

Respectfully submitted,

Michael D. Powell

Hutterer, F.

Hutterer, F.

TRAINING AND EXPERIENCE OF EACH INDIVIDUAL NAMED IN ITEM 4

8. TYPE OF TRAINING	WHERE TRAINED	DURATION OF TRAINING	ON THE JOB	FORMAL COURSE
a. Principles and practices of radiation protection	Columbia University	9/59 - 7/60	Yes	Yes
b. Radioactivity measurement standardization and monitoring techniques and instruments	Columbia University	9/59 - 7/60	Yes	Yes
c. Mathematics and calculations basic to the use and measurement of radioactivity	Columbia University	9/59 - 7/60	Yes	Yes
d. Biological effects of radiation	Columbia University * 175 hours with Drs. Eeitelbert, Quimby)	9/59 - 7/60	Yes	Yes

9. EXPERIENCE WITH RADIATION

ISOTOPE	MAXIMUM AMOUNT	WHERE EXPERIENCE WAS GAINED
SEE	6A & 6B	Mount Sinai Hospital Mount Sinai School of Medicine

DURATION OF EXPERIENCE	TYPE OF USE
Mount Sinai - 1963 - 1975	Biochemical and Animal Experiments

Depew, R.

Depew, R.

TRAINING AND EXPERIENCE OF EACH INDIVIDUAL NAMED IN ITEM 4

8. TYPE OF TRAINING	WHERE TRAINED	DURATION OF TRAINING	ON THE JOB	FORMAL COURSE
a. Principles and practices of radiation protection	University of Chicago, Department of Biophysics	6 yrs.	Yes	
b. Radioactivity measurement standardization and monitoring techniques and instruments			Yes	
c. Mathematics and calculations basic to the use and measurement of radioactivity			Yes	
d. Biological effects of radiation			Yes	

9. EXPERIENCE WITH RADIATION

ISOTOPE	MAXIMUM AMOUNT	WHERE EXPERIENCE WAS GAINED
^{32}P	60m Ci	University of Chicago, Department of Biophysics
^{3}H	20m Ci	
^{14}C	10m Ci	

DURATION OF EXPERIENCE	TYPE OF USE
University of Chicago - 6 yrs.	Labeling nucleic acids and proteins in bacterial cultures (and phage infected cells)

Truitt, E.B.

Truitt, E.B.

TRAINING AND EXPERIENCE OF EACH INDIVIDUAL NAMED IN ITEM 4

8. TYPE OF TRAINING	WHERE TRAINED	DURATION OF TRAINING	ON THE JOB	FORMAL COURSE
a. Principles and practices of radiation protection	Battelle Memorial Institute George Washington University	8 yrs.	Yes	
b. Radioactivity measurement standardization and monitoring techniques and instruments	Ibid			
c. Mathematics and calculations basic to the use and measurement of radioactivity	Ibid			
d. Biological effects of radiation	Ibid			

9. EXPERIENCE WITH RADIATION

ISOTOPE	MAXIMUM AMOUNT	WHERE EXPERIENCE WAS GAINED
H^3	100 μC	Battelle Memorial Institute & George Washington University
C^{14}	100 μC	Battelle Memorial Institute & George Washington University

DURATION OF EXPERIENCE	TYPE OF USE
Battell & George Washington - 8 yrs.	Metabolism experiments

Steggles, A.

Steggles, A.

TRAINING AND EXPERIENCE OF EACH INDIVIDUAL NAMED IN ITEM 4

8. TYPE OF TRAINING	WHERE TRAINED	DURATION OF TRAINING	ON THE JOB	FORMAL COURSE
a. Principles and practices of radiation protection	Imperial Cancer Research Fund London University National Institutes of Health	1962 - 1970 1964 1972 - 1976	Yes Yes	 Yes Yes
b. Radioactivity measurement standardization and monitoring techniques and instruments	Ibid 8a.)		Yes	Yes
c. Mathematics and calculations basic to the use and measurement of radioactivity	University of London Ibid 8a.)	1964	 Yes	Yes
d. Biological effects of radiation	University of London Ibid 8a.)	1964	 Yes	Yes

9. EXPERIENCE WITH RADIATION

ISOTOPE	MAXIMUM AMOUNT	WHERE EXPERIENCE WAS GAINED
Tritium	10 m Ci	England & USA
^{32}P	5 m Ci	USA

DURATION OF EXPERIENCE	TYPE OF USE
Tritium - 14 yrs. (1962-1976)	Macromolecule systhesis measurements
^{32}P - 4 yrs. (1972-1976)	Synthesis of RNA and DNA

Seide-Kehoe, R.

Seide-Kehoe, R.

TRAINING AND EXPERIENCE OF EACH INDIVIDUAL NAMED IN ITEM 4

8. TYPE OF TRAINING	WHERE TRAINED	DURATION OF TRAINING	ON THE JOB	FORMAL COURSE
a. Principles and practices of radiation protection	Rockefeller University	1 month	Yes	Yes
b. Radioactivity measurement standardization and monitoring techniques and instruments				
c. Mathematics and calculations basic to the use and measurement of radioactivity				
d. Biological effects of radiation				

9. EXPERIENCE WITH RADIATION

ISOTOPE	MAXIMUM AMOUNT	WHERE EXPERIENCE WAS GAINED
^{125}I	10 m Ci	Rockefeller University & Mount Sinai School of Medicine
^{32}P	10 m Ci	Mount Sinai School of Medicine
^{35}S, ^{3}H,		
^{14}C	1-5 m Ci	Rockefeller University & Mount Sinai School of Medicine

DURATION OF EXPERIENCE	TYPE OF USE
^{125}I - 7 yrs.	Radioimmunoassay
^{32}P - 2½ yrs.	Nucleic acid labeling
^{35}S, ^{3}H,	
^{14}C - 5 yrs.	Protein and nucleic acid labeling

Koo, P.

Koo, P.

TRAINING AND EXPERIENCE OF EACH INDIVIDUAL NAMED IN ITEM 4

8. TYPE OF TRAINING	WHERE TRAINED	DURATION OF TRAINING	ON THE JOB	FORMAL COURSE
a. Principles and practices of radiation protection	University of Maryland	2 wks.	Yes	Yes
b. Radioactivity measurement standardization and monitoring techniques and instruments				
c. Mathematics and calculations basic to the use and measurement of radioactivity				
d. Biological effects of radiation				

9. EXPERIENCE WITH RADIATION

ISOTOPE	MAXIMUM AMOUNT	WHERE EXPERIENCE WAS GAINED
C^{14}	1 m Ci	University of Maryland & Johns Hopkins University
I^{125}	3 m Ci	Johns Hopkins University
H^{3}	2 m Ci	Johns Hopkins University
Cr^{51}	1 m Ci	Johns Hopkins University

DURATION OF EXPERIENCE	TYPE OF USE
University of Maryland, Johns Hopkins-12 yrs. (C^{14})	Chemical synthesis, protein modification
Johns Hopkins -5 yrs. (I^{125})	Iodination of proteins, incorporated into nucleotides
Johns Hopkins -7 yrs. (H^{3})	Incorporation into nucleotides
Johns Hopkins -2 yrs. (Cr^{51})	Labeling of cells

Kehoe, J.M. Kehoe, J.M.

TRAINING AND EXPERIENCE OF EACH INDIVIDUAL NAMED IN ITEM 4

8. TYPE OF TRAINING	WHERE TRAINED	DURATION OF TRAINING	ON THE JOB	FORMAL COURSE
a. Principles and practices of radiation protection	Cornell University	5 months		Yes
b. Radioactivity measurement standardization and monitoring techniques and instruments	Cornell University	5 months		
c. Mathematics and calculations basic to the use and measurement of radioactivity	Cornell University	5 months		
d. Biological effects of radiation	Cornell University	5 months		

9. EXPERIENCE WITH RADIATION

ISOTOPE	MAXIMUM AMOUNT	WHERE EXPERIENCE WAS GAINED
^{14}C ^{3}H ^{32}P	millicurie range	Cornell University Walter Reed Institute of Research Mount Sinai Medical Center

DURATION OF EXPERIENCE	TYPE OF USE
Cornell - 2 yrs. Walter Reed - 2 yrs. Mount Sinai - 7 yrs.	Biochemical Research Protein labeling

Finkelstein, J.

Finkelstein, J.

TRAINING AND EXPERIENCE OF EACH INDIVIDUAL NAMED IN ITEM 4

8. TYPE OF TRAINING	WHERE TRAINED	DURATION OF TRAINING	ON THE JOB	FORMAL COURS
a. Principles and practices of radiation protection	Johns Hopkins University School of Hygienic and Public Health	24 hours		Yes
b. Radioactivity measurement standardization and monitoring techniques and instruments				
c. Mathematics and calculations basic to the use and measurement of radioactivity				
d. Biological effects of radiation				

9. EXPERIENCE WITH RADIATION

ISOTOPE	MAXIMUM AMOUNT	WHERE EXPERIENCE WAS GAINED
$^{3}_{H}$	10m Ci	University of Wisconsin
$^{3}_{H}$	10m Ci	Johns Hopkins Medical School

DURATION OF EXPERIENCE	TYPE OF USE
University of Wisconsin - 2 yrs.	Whole animal
Johns Hopkins - 3 yrs.	Autoradiography

Name of investigator MICHAEL MARON, PhD

TRAINING AND EXPERIENCE OF INDIVIDUAL NAMED

TYPE OF TRAINING	WHERE TRAINED	DURATION OF TRAINING	ON THE JOB	FOR COU
a. Principles and practices of radiation protection.	NEOUCOM U.C. Santa Barbara	Semester Course 1 YR	X	X
b. Radioactivity measurement and monitoring techniques and instrumentation.	NEOUCOM U.C. Santa Barbara	Semester 1 YR	X	X
c. Mathemetics and calculations basic to the use and measurement of radioactivity.	NEOUCOM UC Santa Barbara	Semester 1 YR	X	X
d. Biological effects of radiation.	NEOUCOM UC Santa Barbara	Semester 1 YR	X	X

EXPERIENCE WITH RADIOACTIVE MATERIALS

ISOTOPE	MAXIMUM AMOUNT	WHERE EXPERIENCE WAS GAINED
^{3}H		U.C. Santa Barbara

DURATION OF EXPERIENCE	TYPE OF USE (e.g. chemical synthesis,e
U.C. Santa Barbara - 1 YEAR	RIA for cortisol, liquid scintillation

Name of investigator Dr. Jann A. Nielsen

TRAINING AND EXPERIENCE OF INDIVIDUAL NAMED

.TYPE OF TRAINING	WHERE TRAINED	DURATION OF TRAINING	ON THE JOB	FORMAL COURSE
. Principles and ractices of radia- ion protection.	University of Minnesota		3 years	
. Radioactivity easurement and onitoring techni- ues and instrumen- ation.	University of Minnesota		3 years	
. Mathemetics and alculations basic o the use and easurement of adioactivity.	University of Minnesota		3 years	
. Biological ffects of adiation.	University of Minnesota		3 years	

. EXPERIENCE WITH RADIOACTIVE MATERIALS

SOTOPE	MAXIMUM AMOUNT	WHERE EXPERIENCE WAS GAINED
3 - H	1.000 mCi	University of Minnesota
14 - C	0.010 mCi	University of Minnesota
45 - Ca	0.010 mCi	University of Minnesota

DURATION OF EXPERIENCE	TYPE OF USE (e.g. chemical synthesis, etc.)
Three Years	Biogenic amine metabolism

Name of investigator John Y. L. Chiang, PhD

Associate Professor, NEOUCOM

TRAINING AND EXPERIENCE OF INDIVIDUAL NAMED

TYPE OF TRAINING	WHERE TRAINED	DURATION OF TRAINING	ON THE JOB	FORMAL COURSE
. Principles and ractices of radia- ion protection.	Northeastern Ohio Universities College of Medicine (NEOUCOM)	1 week	x	
. Radioactivity easurement and onitoring techni- ues and instrumen- ation.	State University of New York, Albany	2 years	x	
. Mathemetics and alculations basic o the use and easurement of adioactivity.	SUNY - Albany	2 years	x	
. Biological ffects of adiation.	NEOUCOM	1 week	x	

. EXPERIENCE WITH RADIOACTIVE MATERIALS

SOTOPE	MAXIMUM AMOUNT	WHERE EXPERIENCE WAS GAINED
14-C	10 mCi	State University of New York at Albany
125-I	1 mCi	State University of New York at Albany

DURATION OF EXPERIENCE	TYPE OF USE (e.g. chemical synthesis,etc.)
Two Years	Labeling of enzymes with 125-I Tracing fate of 14-C labeled substrates

Name of investigator Theodore Voneida, Ph.D.

TRAINING AND EXPERIENCE OF INDIVIDUAL NAMED

TYPE OF TRAINING	WHERE TRAINED	DURATION OF TRAINING	ON THE JOB	FOR COU
a. Principles and practices of radiation protection.	Northeastern Ohio Universities College of Medicine (NEOUCOM)	1 semester	x	x
b. Radioactivity measurement and monitoring techniques and instrumentation.	Case Western Reserve University (CWRU) NEOUCOM	8 years	x	
c. Mathemetics and calculations basic to the use and measurement of radioactivity.	NEOUCOM	1 semester		x
d. Biological effects of radiation.	NEOUCOM	3 years	x	x

EXPERIENCE WITH RADIOACTIVE MATERIALS

ISOTOPE	MAXIMUM AMOUNT	WHERE EXPERIENCE WAS GAINED
3 - H	10 mCi	CWRU and NEOUCOM

DURATION OF EXPERIENCE	TYPE OF USE (e.g. chemical synthesis,etc.)
8 years	Autoradiography of neurobiological tracing experiments.

TRAINING AND EXPERIENCE OF INDIVIDUALS NAMED ON NRC LICENSE, ITEM #6

NAME OF APPLICANT Tim Taylor DATE 7 May 85

I. TRAINING	WHERE TRAINED	DURATION OF TRAINING	ON THE JOB	FORMAL COURSE
a. Principles and practices of radiation protection	NEOUCOM	2 mo		Dr. Metzger
b. Radioactivity measurement standardization and monitoring techniques and instruments				
c. Mathematics and calculations basic to the use and measurement of radioactivity	NEOUCOM	2 mo		"
d. Biological effects of radiation	NEOUCOM	2 mo		"

II. EXPERIENCE

ISOTOPE	MAXIMUM AMOUNT	WHERE EXPERIENCE WAS GAINED
^{32}P	incorporation into brain slice phosphoproteins	Dept Biochemistry, Harvard Med
^{14}C ^{3}H	Labelled amino acids incorporated	" " into brain proteins/peptides in brain slices
^{14}C ^{3}H	2-deoxyglucose incorporation	Dpt. Neurosurgery, U. Virginia Med. into 1st CNS, autoradiography

DURATION OF EXPERIENCE	TYPE OF USE
Harvard - experience over a 2 year period, leading to 2 papers Virginia - over a 2 month period leading to 1 paper.	see above

TRAINING AND EXPERIENCE OF INDIVIDUALS NAMED ON NRC LICENSE, ITEM #6

NAME OF APPLICANT KENNETH S. ROSENTHAL DATE 10/79

I. TRAINING	WHERE TRAINED	DURATION OF TRAINING	ON THE JOB	FORMAL COURSE
a. Principles and practices of radiation protection	Univ. of Delaware	20 hrs.		Yes
b. Radioactivity measurement standardization and monitoring techniques and instruments	Univ. of Illinois	6 hrs.	Yes	
c. Mathematics and calculations basic to the use and measurement of radioactivity	Harvard Medical School	2 hrs.		Yes
d. Biological effects of radiation				

II. EXPERIENCE

ISOTOPE	MAXIMUM AMOUNT	WHERE EXPERIENCE WAS GAINED
^{3}H	5mCi	Univ. of Delaware, Illinois, Harvard
^{14}C	5mCi	Univ. of Delaware, Illinois, Harvard
^{32}P	50mCi	Univ. of Illinois
^{125}I	50mCi	Harvard
^{51}Cr	10mCi	Harvard

DURATION OF EXPERIENCE	TYPE OF USE
Univ. of Delaware - 1 year Univ. of Illinois - 4 years Harvard Med. - 2 years	Metabolic labelling of bacteria, cells, virus. Radioiodination of protein. Cytotoxicity assays. Autoradiography.

ITEM #8 - **Training For Individuals Working In Or Frequenting Restricted Areas**

A. Authorized Users - Faculty

All faculty members who desire to use radioisotopes or other forms of ionizing radiation must provide the Radiation Safety Officer with a summary of their past training and experience in handling radioactive materials. The Radiation Safety Officer will either accept the credentials as sufficient or recommend additional procedures to follow before accepting him as an authorized investigator. Faculty members without previous documented experience must follow the procedures listed for Individual users.

B. Individual Users - Technical Staff, Students, Visiting Faculty

All must meet the following specific requirements before beginning work with radioactive materials. Past coursework or experience gained on the job will not exempt an individual from completing these requirements.

1. All must pass a written examination approved by the Radiation Safety Committee and administered by the Radiation Safety Officer. Individuals may attend one of the periodic radiation safety workshops, or study the materials on their own. The exam will cover the following topics:

   a. Fundamentals of Radiation Safety

      1. Characteristics of gamma and x-radiation
      2. Characteristics of beta and alpha particles
      3. Units of radiation dose and quantity
      4. Hazards of excessive exposure to radiation
      5. Levels of radiation from radiation sources
      6. Methods of controlling radiation dose
         a. Time
         b. Distance
         c. Shielding

   b. Radiation Detection Instrumentation

      1. Use of radiation survey instruments
         a. Operation
         b. Calibration
         c. Limitations
      2. Survey techniques
      3. Use of personnel monitoring equipment
         a. Film and ring badges
         b. Pocket dosimeters

   c. Mathematics and Calculations Basic to the Use of Radioactive Materials

d. NEOUCOM Radiation Safety Manual

e. US NRC Regulations - 10 CFR 19
10 CFR 20
Regulatory Guide 8.13

In addition, NEOUCOM's library contains several very informative video tapes and films on Radiation, Radiation Safety, Radioisotope Laboratory Techniques, and Emergency Procedures.

2. All individual users must work under the direct supervision of one of the authorized investigators.

C. Ancillary Personnel - Security, Cleaning, Maintenance, etc.

All ancillary personnel who may possibly enter laboratories containing radioactive materials will be briefed on current policies and procedures no less than once per year. Ancillary personnel are allowed to enter Minimum Quantity or Type C laboratories, but are not allowed access to Type B or Type A restricted areas such as the radioiodination laboratory or waste storage room.

EXCEPTIONS: Only those individuals who are listed on another NRC license as individuals who will use or supervise the use of licensed materials will be exempt from taking the exam.

ITEM #9 - **Facilities and Equipment**

NEOUCOM's facilities and equipment are outlined on the following pages. Radioactive materials areas will be categorized as Minimum Quantity, Type C, Type B, or Type A depending on various factors such as ventilation, shielding, equipment, and the proximity to unrestricted areas.

Attached are our proposed guidelines for the maximum allowable activities in NEOUCOM laboratories, a radiotoxicity classification system, and the required survey frequencies for corresponding areas. These guidelines are taken from those developed by the International Atomic Energy Agency.

GUIDELINES FOR MAXIMUM ACTIVITIES IN NEOUCOM LABORATORIES

Radiotoxicity Of Radionuclides	Minimum Significant Quantity	Type Of Working Laboratory Required		
		Type C	Type B	Type A
1) Very High	0.1 uCi	< 10 uCi	10 uCi - 10 mCi	> 10 mCi
2) High	1.0 uCi	<100 uCi	100 uCi - 100 mCi	>100 mCi
3) Moderate	10 uCi	< 1 mCi	1 mCi - 1 Ci	> 1 Ci
4) Low	0.1 mCi	< 10 mCi	10 mCi - 10 Ci	> 10 Ci

Type A is a specially designed laboratory for handling large activities of highly radioactive materials. Type B is a specially designed radioisotope laboratory. Type C is a good quality chemical laboratory with adequate ventilation, fume hoods, and non-absorbent surfaces. With the approval of the Radiation Safety Officer, it may be possible to increase the upper limits for Type C laboratories towards those of Type B laboratories for toxicity clases 3 and 4. Laboratories without hoods may not work with amounts qreater than the minimum significant quantities.

Modifying factors must be applied to the allowable quantities indicated according to the complexity of the procedures to be followed. The following factors are suggested but due regard must be paid to all circumstances affecting individual cases.

Procedure	Modifying Factor
Storage (stock solutions)	x 100
Very simple wet operations	x 10
Normal chemical operations	x 1
Complex wet operations with risk of spills	x 0.1
Simple dry operations	x 0.1
Volatile radioactive compounds	x 0.1
Exposure of non-occupational personnel	x 0.1
Dry and dusty operations	x 0.01

CLASSIFICATION OF RADIONUCLIDES ACCORDING TO RELATIVE RADIOTOXICITY

Class 1 - Very High Toxicity

^{90}Sr ^{90}Y ^{210}Pb ^{210}Bi

Class 2 - High Toxicity

^{22}Na	^{36}Cl	^{45}Ca	^{47}Ca	^{46}Sc	^{54}Mn	^{56}Cc	^{59}Fe
^{60}Co	^{85}Sr	^{89}Sr	^{91}Y	^{95}Zr	^{106}Ru	^{106}Rh	$^{110}Ag^{m}$
$^{115}Cd^{m}$	$^{114}In^{m}$	^{124}Sb	^{125}Sb	$^{127}Te^{m}$	$^{129}Te^{m}$	^{124}I	^{125}I
^{126}I	^{131}I	^{133}I	^{134}Cs	^{137}Cs	^{140}Ba	^{144}Ce	^{144}Pr
^{151}Sm	^{152}Eu	^{154}Eu	^{160}Tb	^{170}Tm	^{181}Hf	^{182}Ta	^{192}Ir
^{203}Hg	^{204}Tl	^{207}Bi	^{210}Bi				

Class 3 - Moderate Toxicity

^{7}Be	^{14}C	^{18}F	^{24}Na	^{38}Cl	^{31}Si	^{32}P	^{35}S
^{41}A	^{42}K	^{43}K	^{47}Sc	^{48}Sc	^{48}V	^{51}Cr	^{52}Mn
^{56}Mn	^{52}Fe	^{55}Fe	^{59}Fe	^{57}Co	^{58}Co	^{63}Ni	^{65}Ni
^{64}Cu	^{65}Zn	$^{69}Zn^{m}$	^{72}Ga	^{73}As	^{74}As	^{76}As	^{77}As
^{75}Se	^{82}Br	$^{85}Kr^{m}$	^{87}Kr	^{86}Rb	^{91}Sr	^{90}Y	^{92}Y
^{93}Y	^{97}Zr	$^{92}Nb^{m}$	^{95}Nb	^{99}Mo	^{96}Tc	$^{97}Tc^{m}$	^{97}Tc
^{99}Tc	^{97}Ru	^{103}Ru	^{103}Pd	^{109}Pd	^{105}Ag	^{111}Ag	^{109}Cd
^{115}Cd	^{113}Sn	^{125}Sn	^{122}Sb	$^{125}Te^{m}$	^{127}Te	^{129}Te	$^{131}Te^{m}$
^{132}Te	^{130}I	^{132}I	^{134}I	^{135}I	^{135}Xe	^{131}Cs	^{136}Cs
^{131}Ba	^{140}La	^{141}Ce	^{143}Ce	^{142}Pr	^{143}Pr	^{147}Nd	^{149}Nd
^{147}Pm	^{149}Pm	^{153}Sm	^{152}Eu	^{155}Eu	^{153}Gd	^{159}Gd	^{165}Dy
^{166}Dy	^{166}Ho	^{169}Er	^{171}Er	^{171}Tm	^{175}Yb	^{177}Lu	^{181}W
^{185}W	^{187}W	^{183}Re	^{186}Re	^{188}Re	^{185}Os	^{191}Os	^{193}Os
^{190}Ir	^{194}Ir	^{191}Pt	^{193}Pt	^{197}Pt	^{196}Au	^{198}Au	^{199}Au
^{197}Hg	$^{197}Hg^{m}$	^{200}Tl	^{201}Tl	^{202}Tl	^{203}Pb	^{206}Bi	^{212}Bi

Class 4 - Low Toxicity

^{3}H	^{15}O	^{37}A	$^{58}Co^{m}$	^{59}Ni	^{69}Zn	^{71}Ge	^{85}Kr
^{87}Rb	$^{91}Y^{m}$	^{93}Zr	^{97}Nb	$^{96}Tc^{m}$	$^{99}Tc^{m}$	$^{103}Rh^{m}$	$^{113}In^{m}$
^{129}I	$^{131}Xe^{m}$	^{133}Xe	$^{134}Cs^{m}$	^{135}Cs	^{147}Sm	^{187}Re	$^{191}Os^{m}$
$^{193}Pt^{m}$	$^{197}Pt^{m}$						

Required Laboratory Survey Frequencies

Toxicity Class	Survey Frequency Category		
	LOW	**MEDIUM**	**HIGH**
1	< 10 uCi	10 uCi - 1 mCi	> 1 mCi
2	< 1 mCi	1 mCi - 100 mCi	> 100 mCi
3	<100 mCi	100 mCi - 10 Ci	> 10 Ci
4	< 10 Ci	10 Ci - 1000 Ci	>1000 Ci

Procedure	Modifying Factor
Simple Storage	x 100
Very simple wet operations	x 10
Normal chemical operations	x 1
Complex wet operations	x 0.1
Simple dry operations	x 0.1
Volatile radioactive compounds	x 0.1
Exposure of non-occupational personnel	x 0.1
Dry and dusty operations	x 0.01

The initial survey frequency must be multiplied by the appropriate modifying factor to determine the **required survey frequency.** Required frequencies are as follows:

LOW - Not less than once per month
MEDIUM - Not less than once per week
HIGH - Not less than once per normal working day

Maps of the NEOUCOM campus are shown on the following pages. All byproduct materials will be confined to approved laboratories in buildings C, D, E, or the Vivarium. Exceptions to this would include Shipping and Receiving, or the Security Office in the event of materials received after normal working hours.

Diagrams of current Type C, and Type B laboratories are indicated as follows:

Type C - Rooms C-105, D-123

Type B - Room C-125

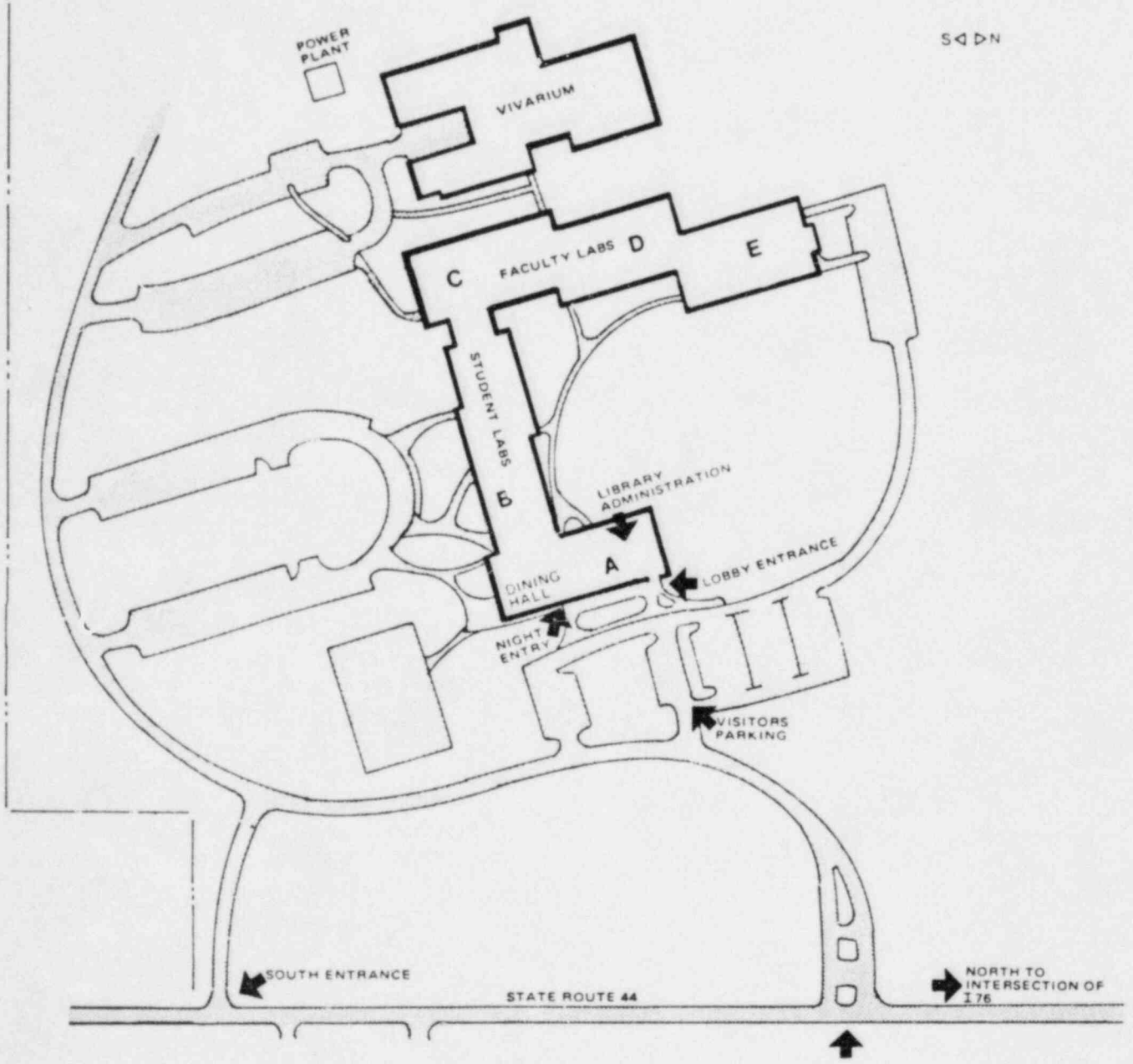
Diagrams of new facilities under construction in lower E wing are also shown. Room E-50 is completed and occupied. Rooms E-48 and E-46 are awaiting the installation of radioisotope fume hoods and bench tops. These facilities are planned for Type B work, with the capacity for Type A storage in E-46.

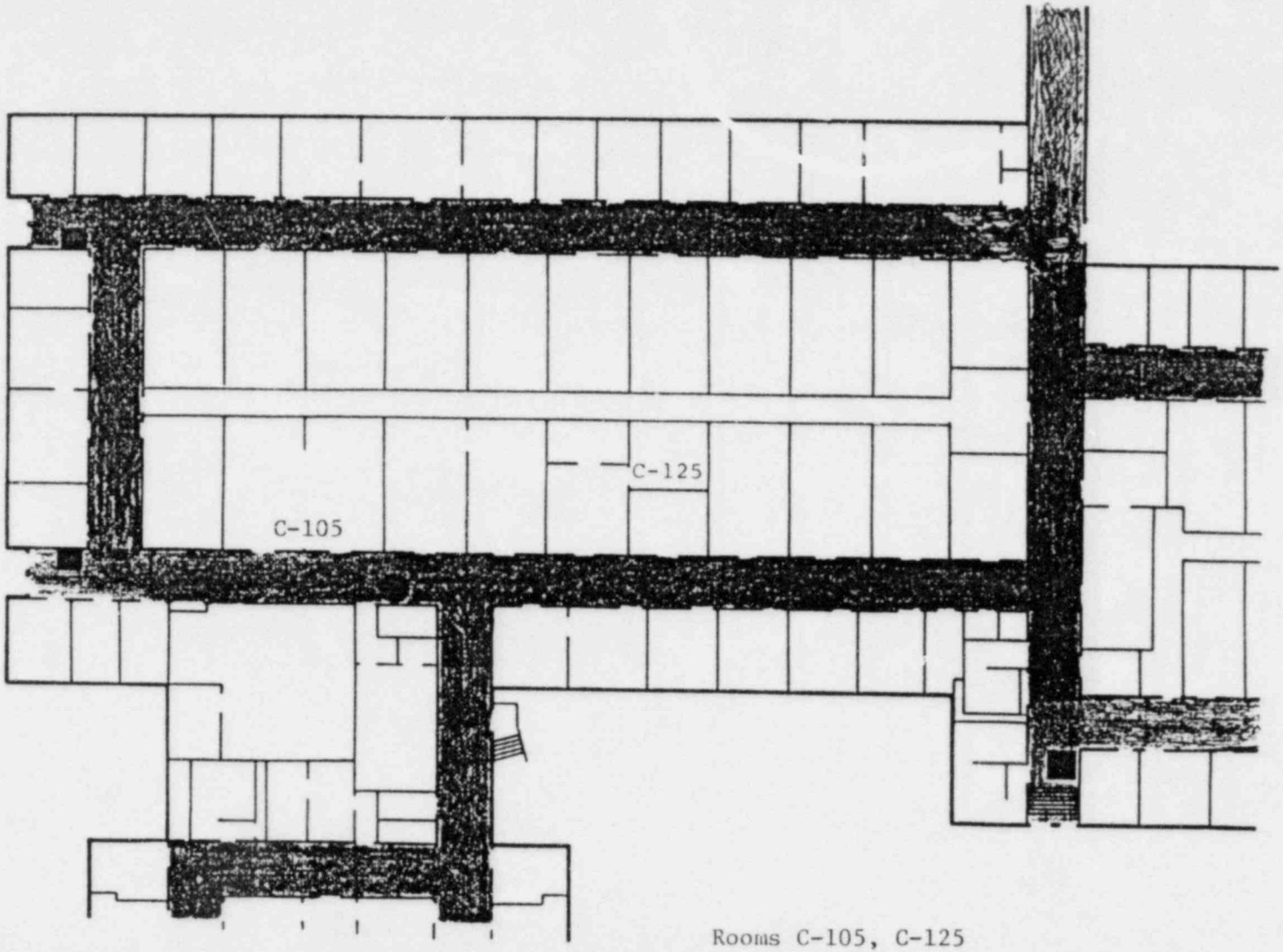
A diagram of our Receiving Area and Vivarium is also included.

Individual unit ventilators operate at approximately 1100 CFM. They are adjustable between 0-100% outside air, but are normally run at around 20% outside air. Unit ventilators and hoods are interconnected such that outside air increases during hood operation. Chemical and radioisotope fume hoods can exhaust between approximately 100 and 600 CFM depending on door position and model. The general exhaust system removes 80-90 CFM per room continuously.

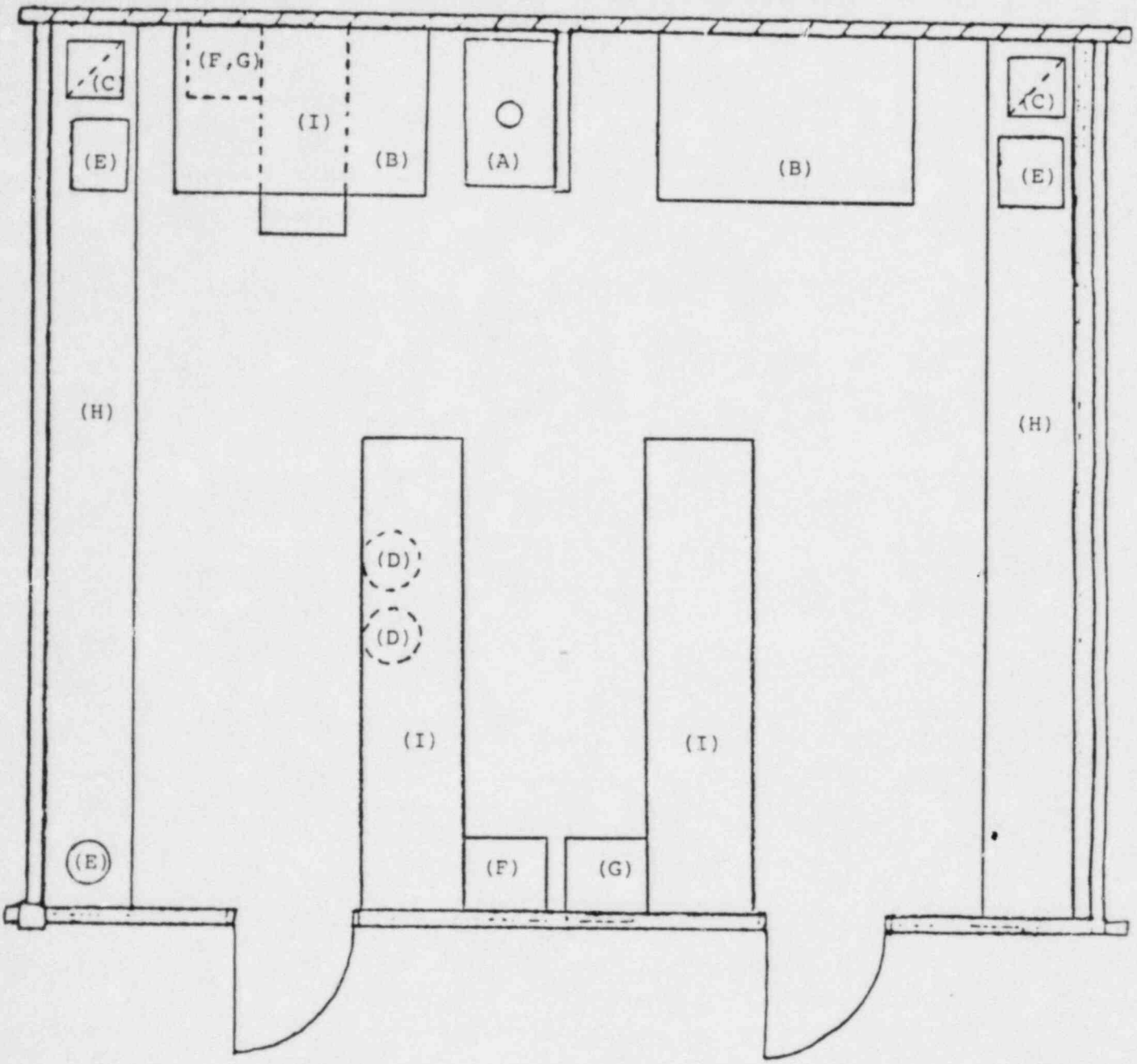
NORTHEASTERN OHIO UNIVERSITIES COLLEGE OF MEDICINE

4209 STATE ROUTE 44, ROOTSTOWN, OHIO 44272 PHONE (216) 325-2511, AKRON CALLS (LOCAL CHARGE) 678-4160



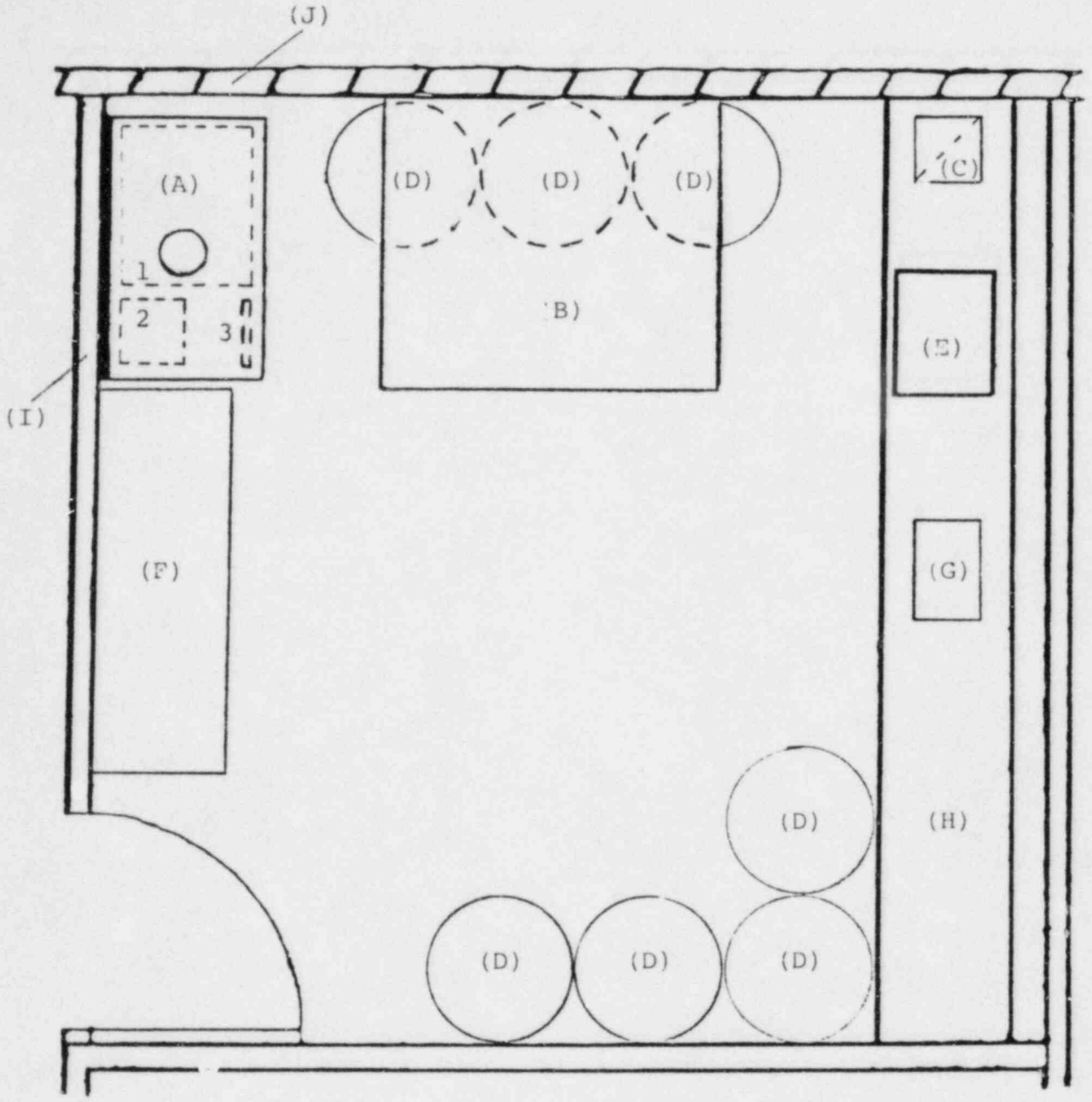


Rooms C-105, C-125



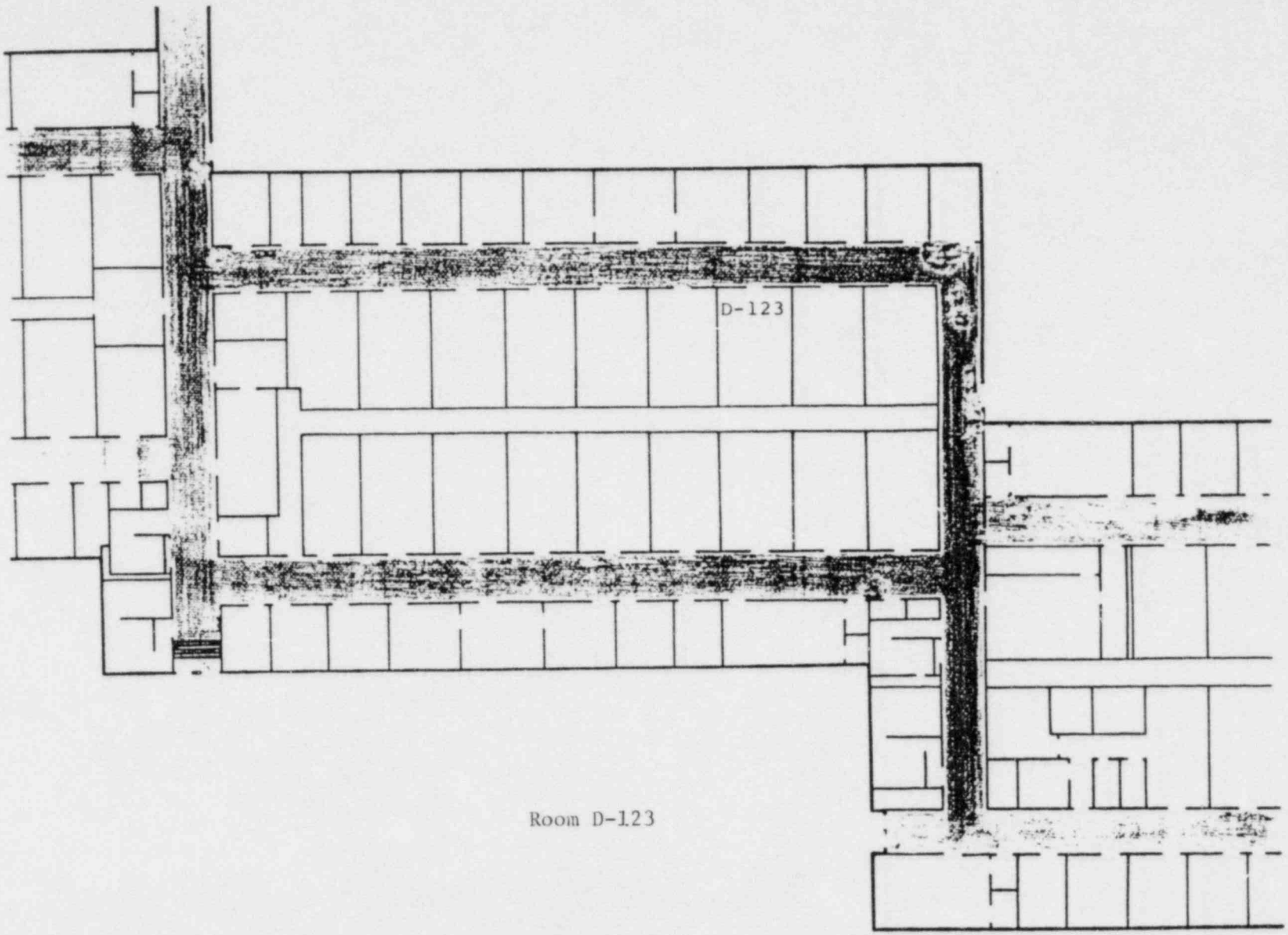
A - Chemical Fume Hood
B - Unit Ventilators
C - General Exhaust
D - Waste Drums
E - Sink
F - Freezer
G - Refrigerator
H - Chemical Resistant Bench Top
I - Tables

Room C-105

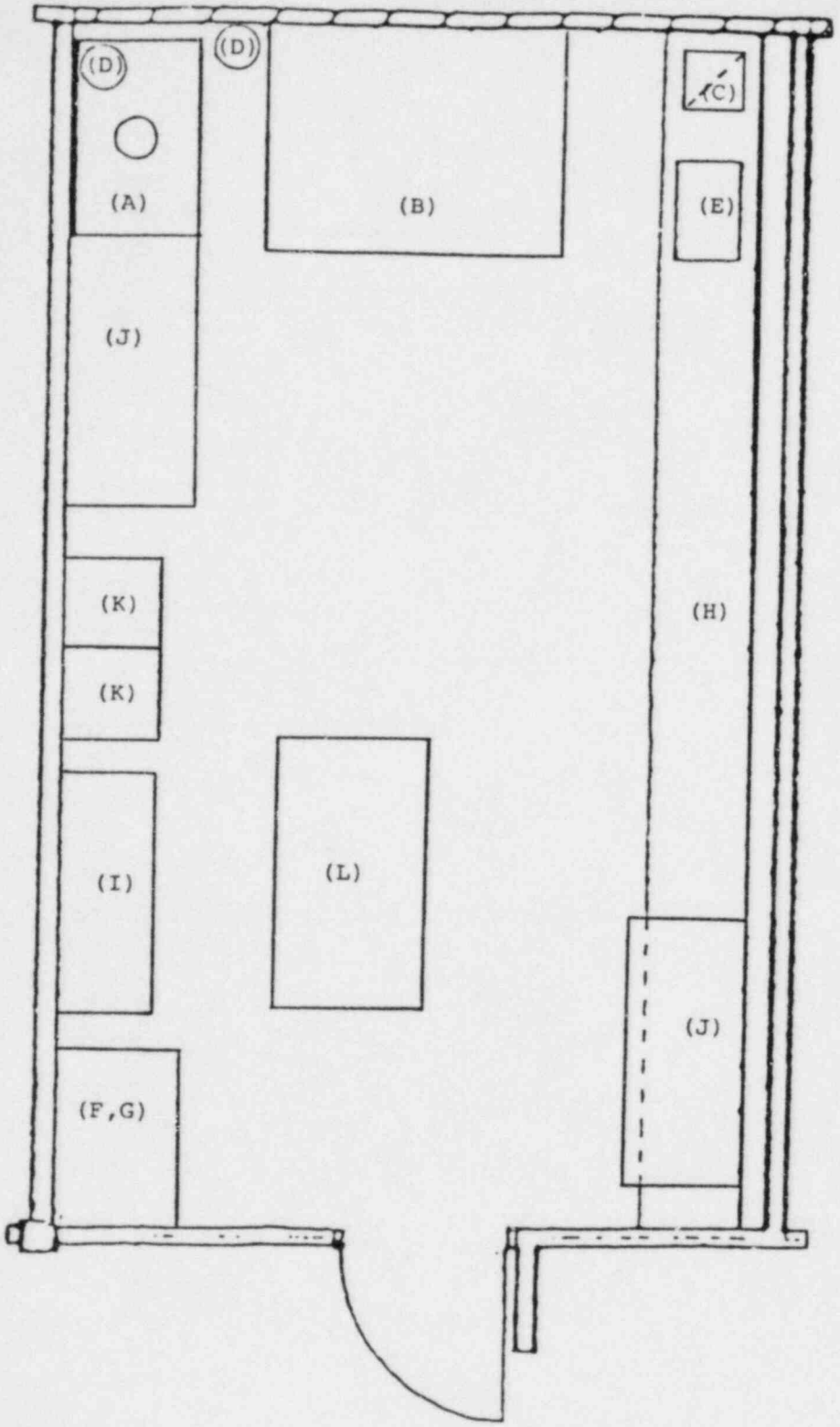


A - Radioisotope Fume Hood
A1- Glove Box with Charcoal Filter
A2- Lead Box
A3- Lead Shield
B - Unit Ventilator
C - General Exhaust
D - Waste Drums
E - Sink
F - Freezer
G - Lead Storage Area
H - Chemical Resistant Bench Top
I - Convential Drywall with 1/8 in. Lead
J - 8 in. Block Wall

Room C-125

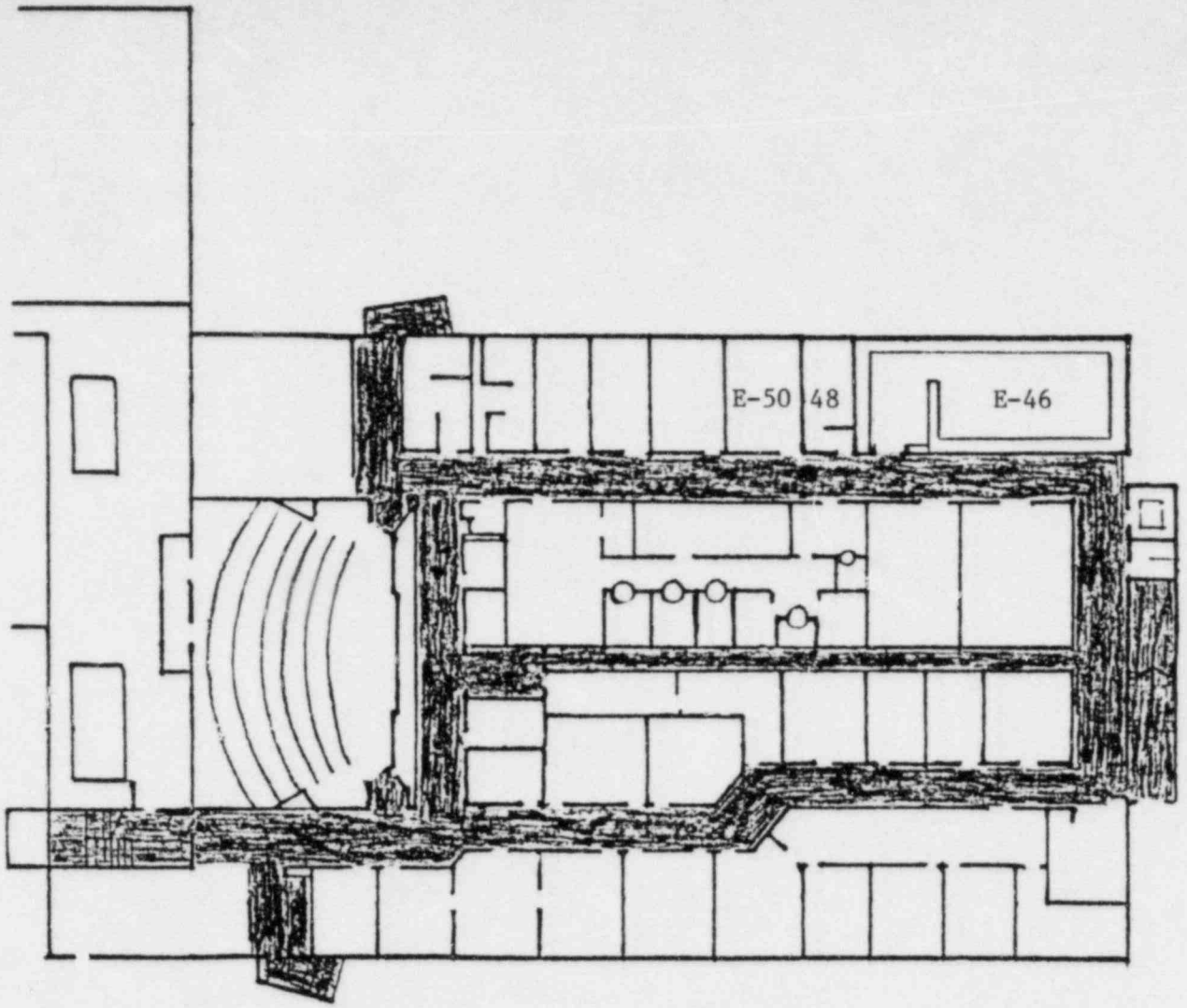


Room D-123

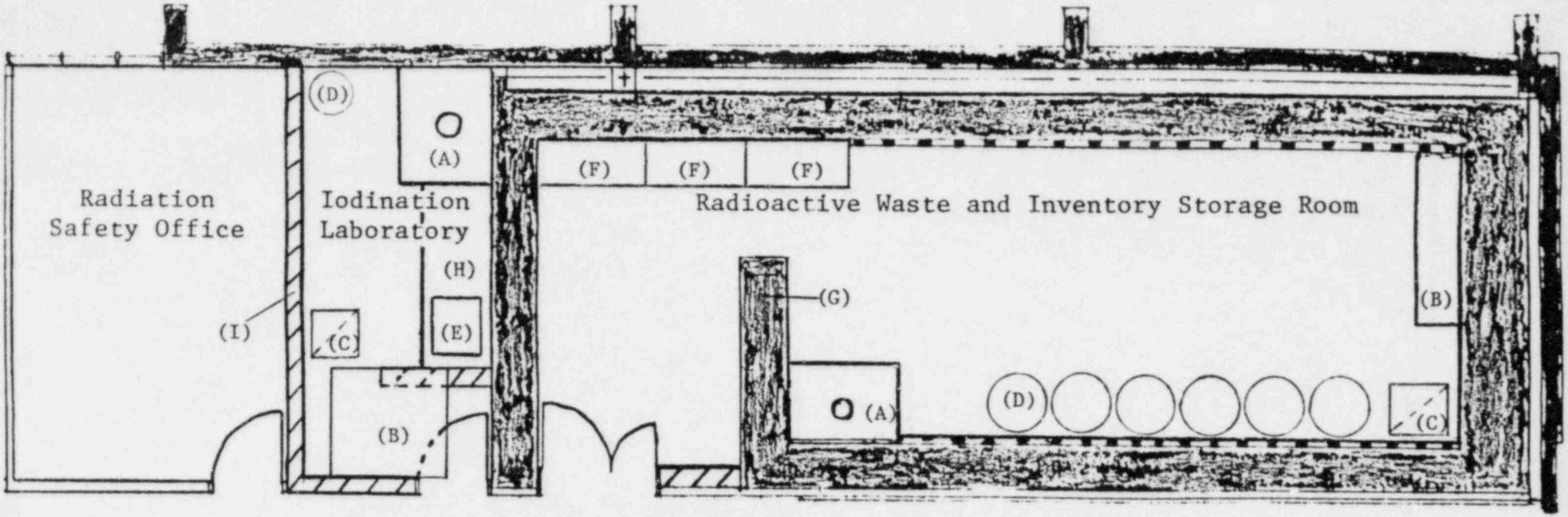


A - Chemical Fume Hood
B - Unit Ventilator
C - General Exhaust
D - Waste Containers
E - Sink
F - Freezer
G - Refrigerator
H - Chemical Resistant Bench Top
I - Table
J - Tissue Culture Hoods
K - Incubators
L - Desk

Room D-123

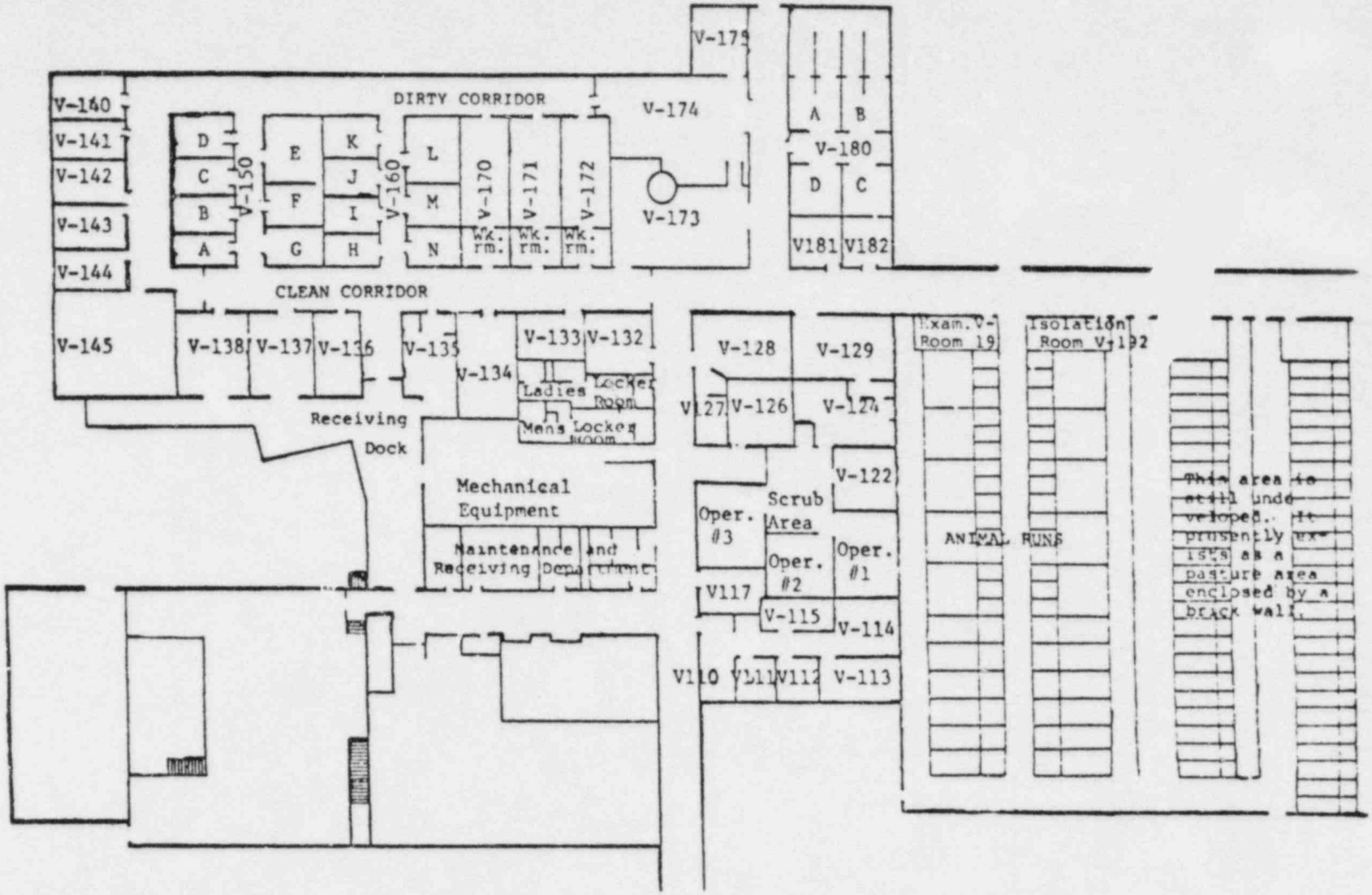


Rooms E-50, E-48, E-46



A - Radioisotope Fume Hood
B - Unit Ventilator
C - General Exhaust
D - Waste Drums
E - Sink
F - Cabinets and Shelves
G - 2 ft. Thick Reinforced Concrete Wall & Ceiling
H - Chemical Resistant Bench Top
I - 8 in. Thick Block Wall

Rooms E-50, E-48, E-46


V-175
DIRTY CORRIDOR
V-174
V-140
V-141
V-142
V-143
V-144
V-145
D
C
B
A
V-150
E
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V-171
V-172
Wk. rm.
Wk. rm.
Wk. rm.
V-173
A
B
V-180
D
C
V181
V182
CLEAN CORRIDOR
V-138
V-137
V-136
V-135
V-134
V-133
V-132
Ladies Locker Room
Mens Locker Room
Receiving Dock
Mechanical Equipment
Maintenance and Receiving Department
V-128
V-129
V127
V-126
V-124
V-122
Oper. #3
Scrub Area
Oper. #2
Oper. #1
V117
V-115
V-114
V110
V111
V112
V-113
Exam. Room 19
Isolation Room
ANIMAL RUNS
This area is still undeveloped. It presently exists as a pasture area enclosed by a brick wall.

VIVARIUM

ITEM #10 - **Radiation Safety Program**

NEOUCOM'S radiation safety program is described in detail in our Radiation Safety Manual. This manual was recently revised and contains many changes necessary under the new Broad Scope license application. We desire permission to make the following future revisions as needed without prior notification of the NRC.

1) Changes dictated by NRC rule changes.
2) Changes in internal management forms.
3) Changes in contractors for waste disposal.
4) Changes in contractors for personnel dosimetry.
5) Changes in contractors for instrument calibration.
6) Changes in NEOUCOM Policies and Procedures, so long as the changes are in compliance with all NRC Rules and Regulations and preserve the strict ALARA principle.

Under the philosophy of the Type B Broad Scope license, the Radiation Safety Officer is now the head administrative authority of the safety program. All other previously existing administrative authorities have been removed from the chain of command. Authority flows from the NRC, to the RSO, to the authorized users. The Radiation Safety Committee operates in an advisory capacity to the RSO. The RSO is vested with the full authority to make the ultimate institutional decisions regarding all aspects of the safety program. The RSO's full duties and responsibilities are outlined in Section I of the safety manual.

A list of the Radiation Safety Office's currently available instruments and equipment is also included in Section I. All survey equipment will be recalibrated on an annual basis by an NRC authorized firm. We are currently utilizing Victoreen Inc.; Cleveland, Ohio; for this function. All instruments will be periodicly checked with a 137-Cs sealed source for comparison against readings taken immediatly after return of the newly recalibrated instrument.

Personnel to be covered in the radiation safety program are outlined below. Their training and responsibilities are outlined in Section II of the safety manual.

1) Authorized Users - Faculty

2) Individual Users - Visiting Faculty
   Technical Staff
   Post Doctoral Fellows
   Graduate Students

3) Ancillary Workers - Security
   Maintenance
   Cleaning Crew

4) Non-Occupational - Secretaries
   Medical Students
   Technical Staff
   General Public

NEOUCOM's personnel and laboratory monitoring programs are described in Section III of the safety manual. Tables are included showing the conditions requiring bioassay, and the minimum laboratory survey frequencies. Information on personnel dosimetry and instructions to pregnant workers are also included.

Section IV outlines our proposed Policies and Procedures. This section includes authorization procedures, purchasing, receiving, storage, use, inventory, transportation off campus, disposal, and animal use.

Section V details our proposed emergency procedures. A copy of the emergency phone numbers to be posted in each radioisotope laboratory is shown on the last page.

ITEM #11 - **Waste Management**

All radioactive waste generated at NEOUCOM will be managed according to the following 4 methods.

1) Shipment to Richland, Washington site by an NRC approved Commercial Disposal Service.

We are currently contracting with ADCO Service Inc. (P.O. Box 35; Tinley Park, Illinois 60477) for disposal of the following wastes.

a) Dry solid waste (paper, glass, plastic, metal, etc.)

b) Organic liquid waste

c) Aqueous liquid waste

d) Animal carcasses

e) Scintillation Vials

Attached you will find a copy of their current specific packaging regulations.

2) Incineration

To date we have only incinerated animal carcassas containing ^{3}H or ^{14}C with activities less than 0.05 uCi/gm. We desire to continue this practice.

3) Release To Sanitary Sewer

We request permission to continue releasing small quantities of aqueous dispersible liquids within the quidelines of 10 CFR 20.303. All investigators must supply documentation to the RSO regarding the solubility and dispersibility of all items they intend to release. Releases in the past have been less than 2% of allowable quantities, and it is expected that this trend will continue in future years. Investigators are only allowed to release those isotopes approved by the Radiation Safety Officer and report their releases on the monthly inventory forms. In keeping with the ALARA goal, high activity solutions of short halflife materials (ex. 32-P, 125-I) are safely decayed before being released.

4) Decay On Site

We request permission to decay short halflife byproduct materials on site. These activities will be conducted in room E-46. All decayed materials will be thoroughly surveyed by the RSO before being disposed through conventional methods.

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ADCO SERVICES, INC.

P.O. BOX 35 • TINLEY PARK, ILLINOIS 60477 • 312/429-1660

RADIOACTIVE WASTE PACKAGING INSTRUCTIONS

WASTE TYPES:

A. Solid Waste - Compacted
B. Solid Waste - Uncompacted
C. Scintillation Vials - Radioactive
D. Scintillation Vials - Deregulated
E. Other Radioactive Vials
F. Absorbed Liquids - Organic
G. Absorbed Liquids - Aqueous
H. Bulk Scintillation Liquids
I. Animal Carcasses

A. SOLID WASTE - COMPACTED

Solid, compacted waste is to be packaged only in steel drums. Only DRY solid waste is to be compacted.

1. Open and carefully inspect a steel drum for cracks, holes or weak spots. If any are detected, set the drum aside, notify our office and our technician will exchange it on his next visit to your facility.

2. Compact dry, solid waste until full. IMPORTANT: Never compact to the point where drum deforms and warps, as this weakens the drum and greatly increases the chances of a seam separating or a crack occurring.

3. Close drum and call ADCO for pick-up of waste.

B. SOLID WASTE - UNCOMPACTED

Solid, uncompacted waste may be packaged in a variety of containers, such as steel or fiber drums, cardboard boxes or wooden crates, provided the waste is 1) compactible and 2) uniformly distributed throughout the container. This type of waste must also be free of liquids and must not contain any animal carcasses. It must also be free of loose syringe needles or needles of any other type. These must be snipped or removed and placed in a puncture-resistant needle receptacle such as a tin can, glass bottle or sturdy plastic jug and labelled "Needles."

Blood and urine samples are not to be packed in dry, solid waste drums. These are liquids and as such are to be packed in liquid waste drums.

To pack this waste:

1. Open and carefully inspect empty container for holes, cracks, or weak spots. If any are detected, set the container aside, notify our office and our technician will exchange it on his next visit to your facility.

2. Place one 4 mil. plastic bag inside of empty container. Drape top portion of bag over top edge of container to prevent contaminating the outside.

3. Add waste until container is full. Seal bag.

4. Close container, seal and call ADCO for pick-up.

C. SCINTILLATION VIALS - RADIOACTIVE

Scintillation vials are only vials having a capacity of 20 ml. or less that have been used in scintillation work. Only the following isotopes may be disposed of as radioactive scintillation vial isotopes:

I 125
Cr51
Fe59
S 35
P 32
Ca45
Na22
H 3
C 14
Co57
Rb86
Ga67
Zn65
In111
Cl36
Hg203

Bactec vials are not scintillation vials and are not to be packed with scintillation vials. They are classed as "Other Radioactive Vials" and are to be packaged according to the instructions found under that heading.

Scintillation vial drums are to contain ONLY scintillation vials containing small amounts of scintillation fluids and vermiculite. Boxes, trays, separators or other types of waste are not allowed in scintillation vial drums.

To pack this type of waste:

1. Open and carefully inspect a steel drum for cracks, holes or weak spots. If any are detected, set the container aside, notify our

office and our technician will exchange it on his next visit to your facility.

2. Place one 4 mil. plastic bag in drum. Drape top portion of bag over top edge of drum to prevent contamination of drum.

3. Place about 4" of vermiculite in bottom of drum. NOTE: Only vermiculite #3 or #4 grade may be used at this time.

4. Add scintillation vials and vermiculite in layers until drum is full.

5. Close plastic liner bag and seal with tape or wire.

6. Close drum and call ADCO for pick-up of waste.

D. SCINTILLATION VIALS - DEREGULATED

Deregulated scintillation vials must meet the following criteria to be classed as such:

1. They must have been used only for scintillation work.

2. They must contain only 14C and/or 3H at a rate of .05 microcuries per gram or less.

The scintillation fluid may be a commercially prepared solution or a scintillation "cocktail" prepared at your facility. Once again, Bactec and similar vials are not scintillation vials and must not be packaged as such.

To pack this type of waste:

1. Open and carefully inspect a steel drum for cracks, holes or weak spots. If any are detected, set the container aside, notify our office and our technician will exchange it on his next visit to your facility.

2. Place one 4 mil. plastic bag in drum. Drape top portion of bag over top edge of drum to prevent contamination of drum.

3. Place about 4" of vermiculite in bottom of drum. NOTE: Only vermiculite #3 or #4 grade may be used at this time.

4. Add scintillation vials and vermiculite in layers until drum is full.

5. Close plastic liner bag and seal with tape or wire.

6. Close drum and call ADCO for pick-up of waste.

DO NOT MIX DEREGULATED WITH RADIOACTIVE SCINTILLATION VIALS!!!

E. OTHER RADIOACTIVE VIALS

All vials not used in scintillation vial work are classed as "Other Radioactive Vials." These may not exceed 50 milliliters capacity and may contain either aqueous and/or organic liquids.

To pack this type of waste:

1. Open and carefully inspect a steel drum for cracks, holes or weak spots. If any are detected, set the container aside, notify our office and our technician will exchange it on his next visit to your facility.

2. Place one 4 mil. plastic bag in drum. Drape top portion of bag over top edge of drum to prevent contamination of drum.

3. Place about 4" of vermiculite in bottom of drum. NOTE: Only vermiculite #3 or #4 grade may be used at this time.

4. Add vials and vermiculite in layers until drum is full.

5. Close plastic liner bag and seal with tape or wire.

6. Close drum and call ADCO for pick-up of waste.

DO NOT MIX WITH DEREGULATED SCINTILLATION VIALS!!!

F & G. ABSORBED LIQUIDS - ORGANIC & AQUEOUS

Any organic or aqueous liquid in a container larger than 50 milliliters must be packaged in a drum set-up for disposal of liquids not contained in vials. Although sctinllation fluids may now be accepted in "bulk" form, other liquids, (blood, urine, sewage and other wastewaters, etc.) must be packaged as either an absorbed or solidified liquid. Solidification of liquids is a specialized operation and as it is requested by very few clients, will not be covered in this instruction manual. If you wish for information on this procedure, please contact our office.

To pack absorbed organic/aqueous liquids:

1. Open and carefully inspect a steel drum for cracks, holes or weak spots. If any are detected, set the drum aside, notify our office and our technician will exchange it on his next visit to your facility.

2. Place approximately 2" of vermiculite absorbent (#3 or #4 grade) inside drum before inserting plastic liner bag.

3. Insert one 4 mil. plastic liner bag and drape top over top edge of drum to prevent contamination of exterior of drum.

4. Begin adding liquid in ratio of approximately one part liquid to four parts vermiculite (EXAMPLE: If 1 liter of liquid is added, approximately 4 liters [or 1 gallon] of vermiculite should be added to drum FIRST). Liquid may then be added to drum. NOTE: It is not necessary to empty liquids if your container is 1 gallon or smaller provided that vermiculite is added first in the prescribed ratio.

IMPORTANT!!!

A. Do not mix liquids that may react with each other and result in a dangerous compound.

B. A maximum of 15 gallons of liquid may be disposed of in a 55 gallon drum.

C. Always add vermiculite first, then install liquids.

5. Continue adding vermiculite and liquids until drum is full. (A maximum of 15 gallons of liquid per 55 gallon drum).

6. Close bag and seal with tape or wire.

7. Label bag "RADIOACTIVE."

8. Close drum and call ADCO for pick-up of waste.

H. BULK SCINTILLATION LIQUIDS

Scintillation fluids, either the commercially prepared solutions or the scintillation "cocktail" liquids mixed at your facility may now be disposed of as a "bulk" liquid after being poured into our double-walled bulk liquid containers. This consists of a 20 gallon tighthead steel drum inside of a 55 gallon openhead steel drum. As this method of disposal is more economical than disposing of scintillation fluids as absorbed liquids, we strongly urge you to pack them in this manner.

To pack bulk scintillation fluids:

1. Open double-walled drum (Outer drum).
2. Remove 2" bung from inner drum and set bung aside.
3. Inspect drum for cracks, holes or weak spots. If any are detected, set the drum aside, notify our office and our technician will exchange it on his next visit to your facility.

4. Add liquids ONLY. Do not discard vials, bottles, syringes, etc. in bulk scintillation fluid drums. ONLY liquids are to

be put in these drums. Also, do not add vermiculite to inner drum.

5. Continue adding liquid until drum is full.

6. Reinstall bung cap to inner drum.

7. Label inner drum "RADIOACTIVE."

8. Close outer drum and call ADCO for pick-up of waste.

I. ANIMAL CARCASSES

Any animal body or portion thereof is classed as an animal carcass and as such must be packaged in a special double-walled container. This is generally a 30 gallon drum inside of a 55 gallon drum, but a larger container is also available for very large animals.

To pack animal carcasses:

1. Open and inspect a double-walled animal drum for cracks, holes or weak spots. If any are detected, set the drum aside, notify our office and our technician will exchange it on his next visit to your facility.

2. Remove plastic bag and lime from inner container and set aside.

3. Install plastic liner bag in inner container and begin adding the animal carcasses, layering in alternative layers of vermiculite and lime.

4. Fill drum to within 4"-6" of top.

5. Close bag and seal with tape or wire.

6. Label inner drum "RADIOACTIVE."

7. Attach lid to drum using ring and bolt.

8. Close outer drum and call ADCO for pick-up of waste.

IMPORTANT POINTS TO REMEMBER WHEN PACKAGING RADIOACTIVE AND DEREGULATED WASTE

1. Keep waste types separate. Don't pack radioactive vials with deregulated (C14 and 3H) vial material. Keep solid, dry waste separate.

2. Pack "BACTEC" vials in a separate drum altogether.

3. NEVER pack animal carcasses with any other type of waste.

4. NEVER throw loose syringe needles or needles of any type into waste drums. ALL needles, whether still attached to syringes or not, must be placed in a separate puncture-resistant container before being put in waste drum.

5. NO biohazardous materials may be disposed of with radioactive material. All viable microorganisms must be autoclaved or chemically rendered harmless before disposal.

6. Under no circumstances are substances (especially liquids) that can react with each other to be placed in the same waste drum.

If you have any question whatsoever regarding waste packaging, please do not hesitate to contact our office.

Thank you.