NEOUCOM Radiation Safety Manual

INDEX

NORHTEASTERN 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 REASONABLE 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 exposures 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 practices, 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 management as safe, reasonable, and enforcable. 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 10CFR20 entitled "Standards for Protection Against Radiation", and other pertinent sections of the Code dealing with academic institutional programs. Similiar regulations are also specified by the Ohio Sanitary Code (Part I, Chapter HE-38 to Chapter HE-41, Part II Section 3701, 90 to 3701.99). Copies of these regulations are on file in the Radiation Safety Office and library.

C. Administrative Line of Authority

Responsibility for administration and enforcement of policies at NEOUCOM is vested with the Provost. N.R.C. regulations require him to appoint a Radiation Safety Officer and a Radiation Safety Committee. He has delegated appropriate authority and responsibility to the following:

1) Director of the Basic Medical Sciences - The Director is charged with

the executive administration of the radiation safety program. With the approval of the provost he appoints a Radiation Safety Officer. He also appoints a Radiation Safety Committee comprised of faculty who are included in Part Six of the NRC Byproduct Materials License as "individuals who will use or directly supervise the use of licensed material. The faculty of the Division of Basic Medical Sciences, the Radiation Safety Committee, and the Radiation Safety Officer report directly to the Director.

The Director oversees all aspects of the radiation safety program. He is charged with making the ultimate decisions regarding correction of violations of the radiation safety program.

2) Radiation Safety Office - The Radiation Safety Officer and his staff are appointed by the Director of Basic Medical Sciences to carry out the procedures and policies of the radiation safety program, to be advisory to the Radiation Safety Committee, and to maintain permanent records in the Radiation Safety Office. The Radiation Safety Officer or his designate perform the following duties:

a. Monitoring personnel occupational radiation exposures through a monthly badge program.

b. Monitoring laboratory working conditions through a weekly wipe and survey program.

c. Identifying unsafe practices and suggesting improvements to faculty and the Radiation Safety Committee.

d. Review all grants proposing the use of radioactive materials to determine if the proposed work can be accomplished within the existing licenced procedures and isotope possession limits.

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

f. Receiving and monitoring of incoming packages of radioactive materials and delivering those materials to appropriate safe storage places.

g. Disposing of radioactive materials and maintaining all necessary current disposal site permits.

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

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

j. Maintaining permanent records of:
   - personnel occupational exposures
   - receipt of radioactive materials
   - disposal of radioactive materials
   - laboratory monitoring

k. Maintaining the Radioiodination Laboratory.

In addition to the RSO, there will be sufficient Radiation Safety Staff to maintain a continual presence during normal working hours. At other times the Radiation Safety Officer and/or his staff can be reached by telephone in the event of an emergency.

The Radiation Safety Office has for its authorized use the following instruments and equipment. These instruments are for the primary purpose of laboratory monitoring. They are not "core equipment", but may be loaned to investigators at the discretion of the RSO or his designate on a short term temporary basis when the need for additional monitoring equipment in special situations arises.

a) 2 - Victoreen model #493 survey meters with 491-40 GM probe
b) 1 - Victoreen model #493 survey meter with 489-110 GM probe
c) 1 - Victoreen model #495 Frisker meter with 491-40 GM probe
d) 1 - Victoreen model #490 Thyac III meter with 425-110 Scint probe
e) 1 - Victoreen model #470A Panoramic Survey Meter
f) 2 - Victoreen model #541R Pocket dosimeters with #2000A charger

The office also has at its disposal use of the following:

a) 1 - Packard model #9012 Multichannel Analyser
b) 2 - Beckman model #LS 9000 Scintillation Counters
c) 1 - Beckman model #LS 100C Scintillation Counter

3) Radiation Safety Committee - The committee will be comprised of faculty licencees appointed by the Director of Basic Medical Sciences. The Director and the RSO will be non-voting members of the Radiation Safety Committee. Its purpose is to recommend policy to the Director. In situations where an unsafe procedure is identified by the RSO, the committee may be called upon to recommend corrective procedures. Requests for license amendments (eg. changes in list of licensed investigators, changes in isotope possession limits, etc.) shall be directed to the committee for approval.

   The Chairman of the Radiation Safety Committee will maintain records of meetings of the committee. All grant proposing the use of radioactive materials must be approved by the Chairman of the committee to assure that the proposed work can be safely accomplished within the existing licensed procedures and isotope possession limits.

   Either the Chairman or the Director can schedule a meeting of the committee. The committee will meet as often as necessary but not less than once a year.

4) Faculty Licensees - Licensees are responsible for the health and safety of persons entering their laboratories. Program chairpersons are responsible for the health and safety of persons within the core or communal areas of their program. Faculty licensees are responsible for identifing and correcting unsafe situations in their

laboratories. They will abide by decisions made by the Radiation Safety Officer, the Radiation Safety Committee, and the Director regarding corrective procedures.

When necessary, faculty mambers may request the Chairman of the Radiation Safety Committee to schedule an agenda item in their behalf.

C) NEOUCOM Policy Governing Violations of NRC Regulations

The Director of Basic Medical Sciences is responsible for making final 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 technical advice from the Radiation Safety Committee and/or Radiation Safety Officer, the Director will determine the severity of the violation and the appropriate prompt action. Those individuals committing serious violations or frequently violating safety standards are liable to have their priviledge to use radioactive materials revoked.

The Radiation Safety Officer has the right to fully investigate a possible hazard at any time.

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. Faculty - All faculty whose research involves handling radioisotopes will be named in the license in Item 6 as "individuals who will directly supervise the use of radioactive material". To be included on the license, the faculty member must complete Form 1 (see following page). This provides a summary of his past training and experience in handling radioactive materials. The completed form will be submitted to the RSO who will submit a request for license amendment to the NRC. The NRC will either accept his credentials as sufficient or recommend additional procedures to follow before accepting him as a licensee.

The licensed faculty member will be responsible for the health and safety of persons 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:

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

b. Assuring that all personnel on the project are included in the personnel monitoring program if necessary.

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

Name of investigator_____

TRAINING AND EXPERIENCE OF INDIVIDUAL NAMED

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

9. EXPERIENCE WITH RADIOACTIVE MATERIALS

ISOTOPE	MAXIMUM AMOUNT	WHERE EXPERIENCE WAS GAINED

DURATION OF EXPERIENCE	TYPE OF USE (e.g. chemical synthesis,etc.)

d. Labeling of rooms and materials with the proper warning signs.

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

f. Notifying the RSO of any significant changes in techniques or physical facilities outlined in the original approval form.

B. Students - Undergraduate, graduate, and post-doctoral students as well as visiting faculty must meet specific requirements before beginning work with radioactive materials.

a. All must pass a written examination approved by the Radiation Safety Committee and administered by the Radiation Safety Officer. 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. The test results will be kept on file in the Radiation Safety Office.

b. All must work under the supervision of one of the faculty members named in the license. 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 faculty member responsible for that area or the Radiation Safety Officer.

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

Past coursework or experience gained on the job will not exempt a student from completing the above requirements. Students (eg. medical students, undergraduates, etc.) not conducting their own research projects, but performing tasks in a technical manner under the direct supervision of a faculty member will be expected to meet the requirements of "Technical Support Staff" rather than as "Students".

C. Technical Support Staff - All technical staff working in laboratories where radioactive materials are handled must demonstrate adequate knowledge of radiation safety procedures by passing a written examination approved by the Radiation Safety Committee and administered by the Radiation Safety Officer. Results of the exam will be kept on file in the Radiation Safety Office.

Technicians shall be responsible for completing their assigned tasks in as safe a manner as possible. Whenever questions arise regarding the safety of a procedure they must ask the RSO or the faculty member under whom they work to correct any potentially unsafe procedures.

D. Ancillary Personnel - All ancillary personnel (eg. security, cleaning, maintenance, etc.) who enter laboratories containing radioactive materials will be briefed either by memo or by group meetings at least once a year by the RSO and his staff.

II. Safety Monitoring Program

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

1) To maintain safe conditions for all personnel working in radiation 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 levles remain as low as reasonably achievable (ALARA).

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

A. Personael 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. 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 and quarterly to all individuals monitored.

Who should wear a film badge?

All individuals handling gamma-ray and high energy beta emitting isotopes (eg. 125-I, 131-I, 32-P) or x-ray producing equipment must wear a film badge. Workers in areas where these isotopes or equipment are handled should also vear 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 exposure per calendar quarter for individuals over the age of 18 is listed below. The maximum permissible exposure for minors under the age of 18 is one tenth of these amounts.

1. Whole body, head, trunk, eyes, gonads, and active blood forming organs.	1250 mRem
2. Hands, forearms, feet, and ankles.	18750 mRem
3. Skin of whole body.	7500 mRem

For institutional purposes, the maximum permissible exposure level of

1250 mRem per calendar quarter is broken down to 400 mRem per month. This provides an additional small safety factor which may be exceeded if conditions warrant, provided that the maximum permissible dose for the quarter is not exceeded.

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

Exposures above 1250 mRem in a quarterly period must be reported by the Radiation Safety Officer 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 quarterly basis, all individuals on the badge service will receive a copy of their "Current Occupational Radiation Exposure". The report must be signed and returned to the Radiation Safety Office.

This signed acknowledgement of radiation exposure history must be kept on permanent file in the Radiation Safety Office. All individuals have the right to examine their exposure reports. Future employers of the individual have the same right.

B. Bioassay Program

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 radioisotopes 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 who handle large quantities of tritium (3-H) labeled compounds and/or large quantities of 125-I or 131-I labeled compounds must be bioassayed.

All workers involved in the processing of 3-H under conditions specified or sufficiently close that intake is possible must participate in urinalysis for the presence of 3-H. The conditions requiring urinalysis are shown on the following page.

It is anticipated that seldom, if ever, will the 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 50uCi/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)

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, Director, Program Chairman and Faculty Licensee in charge of the area will all 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 5uCi/liter (ie. 11000 dpm/milliliter) are seen for 2 consecutive weeks.

In the event that greater than 5uCi/liter but less than 50uCi/liter are observed, the urinalysis procedure will be repeated within 48 hours. If levels are still above 5uCi/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 490

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.

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 of 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.

Thyac III survey meter equiped with a model 425-110 thin window scintillation 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 individual's 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.

   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 area 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 on 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 within 2 weeks of the last possible exposure to 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 position 5-1, and within 1 week for levels exceeding those given in 5-2.

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

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

   b. Corrective actions 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 0.5uCi of 125-I or 0.14uCi

of 131-I, the following actions will be taken immediatly:

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

b. Carry out steps 3a-d above.

c. Notify the Director, Radiation Safety Committee Chairman, faculty licensee and Program Chairman of the area the exposure occured in.

d. Carry out repeated measurements at 1 week intervals until the thyroid burden is less thar 0.12uCi of 125-I or 0.14uCi 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 Monitoring Program

On a weekly basis, the Radiation Safety Office 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. Radiation areas (eg. radiation labs, x-ray rooms) — 2 mRem/hour

c. Restricted Radiation Areas (eg. radioiodination laboratory) — 5 mRem/hour

Wipes are performed to detect removable surface contamination. Areas of approximately 100 square centemeters 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 first counted on an "open window" program to determine gross CPM. Any vials showing CPM more than twice background levels are counted a second time on a 3 window program to determine more accurately the amount and type of radioisotopes present. Investigators will be notified in writing of any contamination or unsafe conditions in their laboratories.

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 Radiation Safety Office has a limited supply of survey meters which can be borrowed for short periods of time.

NEOUCOM SAFETY INSPECTION REPORT

Inspection date :_____ Performed by :_____

Location :_____

A routine safety inspection of the above location revealed the following unsafe conditions. Please correct these conditions as soon as possible. If the same condition is found to exist on a subsequent inspection, copies of the reports will be forwarded to the appropriate individual (i.e. Division Director, for chemical and radiation hazards; Vice Provost, for all other hazards). Otherwise, all inspection reports will be maintained in confidential files in the safety office. If you have any questions regarding this matter, please contact the Safety Office, D-119 east, Ext. 280.

HAZARDS

Radioactive

Surface location	CPM	Isotope

Chemical

_____

_____

_____

Electrical

_____

_____

_____

Mechanical

_____

_____

_____

Miscellaneous

_____

_____

_____

IV. Routine Operating Procedures

A. Radiation Areas and Restricted Radiation Areas

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 Director with the advice of the Radiation Safety Committee and the Radiation Safety Officer. Approval will consider the isotope to be used, the maximum activity expected, the volatility and dispersibility of the radioactive material, 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 a faculty member currently listed as a licensee. This faculty member 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.

1. Radiation Areas

All rooms approved for use of radioactive materials or radiation producing equipment are shown in the building diagrams on the following pages. These rooms are designated as Radiation Areas. Radiation Areas must be properly identified by approved signs on all doors entering the area. All radioactive materials within the area must be secured from unauthorized removal unless under direct and constant supervision. This means that if the radioactive materials are not under "direct and constant supervision", they must be either locked in suitable enclosures or all doors entering the area must be kept locked. Radiation levels in Radiation Areas may not exceed 2 mRem/hour.

2. Restricted Radiation Areas

Room C-125 has been designated as a Restricted Radiation Area. This room is reserved for the handling and storage of 125-I, 131-I, and other more hazardous radioisotopes in a volatile or dispersible form. ^{3}H in hydrogenation reactions involving tritiated borohydride present a special hazard in research laboratories. Experiments involving greater than 1mCi 125-I or 131-I, or greater than 10mCi tritiated borohydride will be handled in the shielded box in the hood of that room.

This Restricted Radiation Area is under the responsibility of the Radiation Safety Officer and his staff. Access to the room is obtained by borrowing the key from a member of the Radiation Safety staff. The key must be returned by the end of that working day (ie. 5 pm), and cannot be kept for evening or weekend use of the area. Following use of the area, the Radiation Safety Office will survey the room for radioactive contamination. If any is found, the most recent user of the room will be notified and held responsible for returning the room to a safe contamination-free condition.

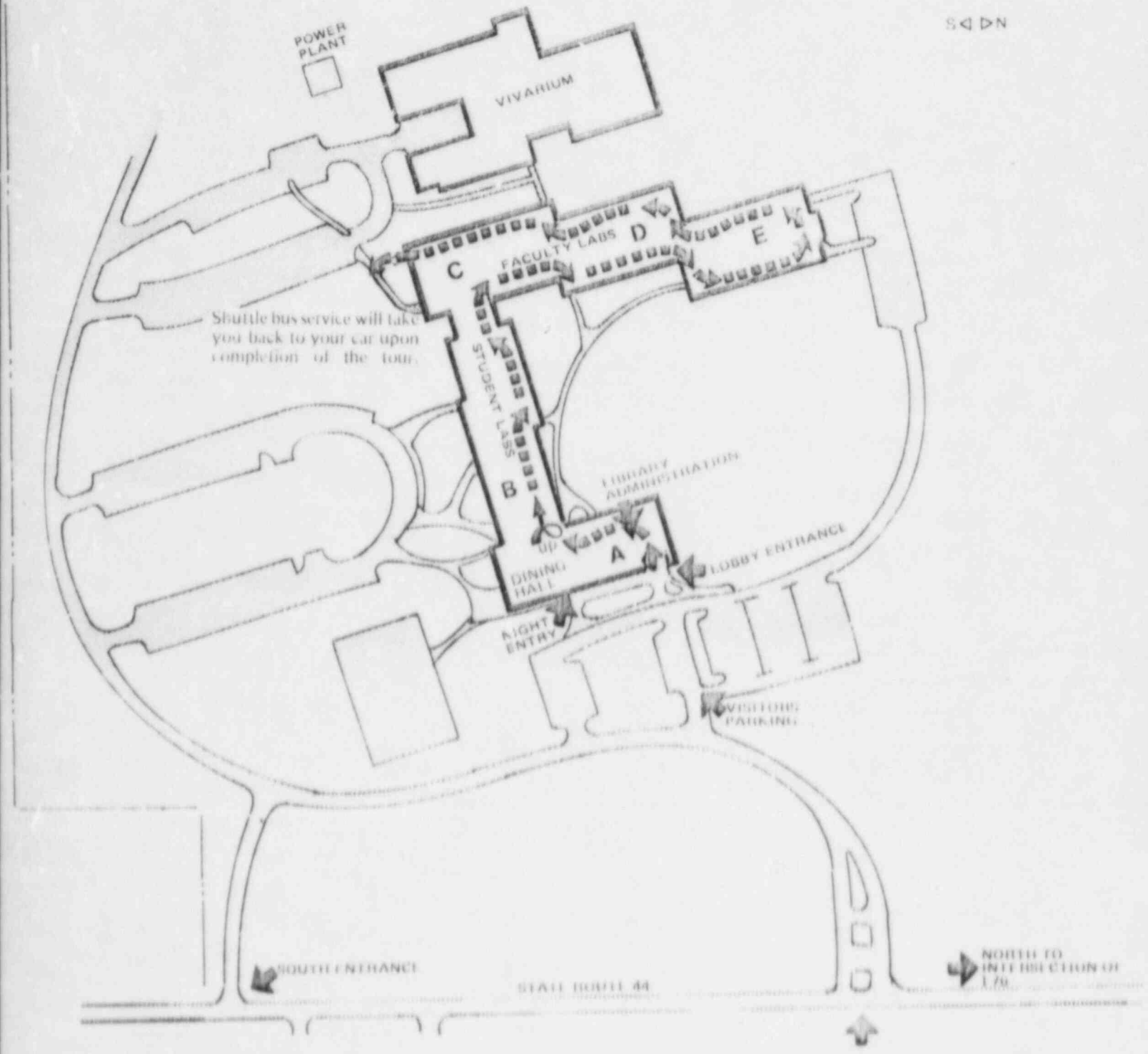
B. Before Beginning an Experiment in an Approved Area.

SELF-GUIDED TOUR

of the

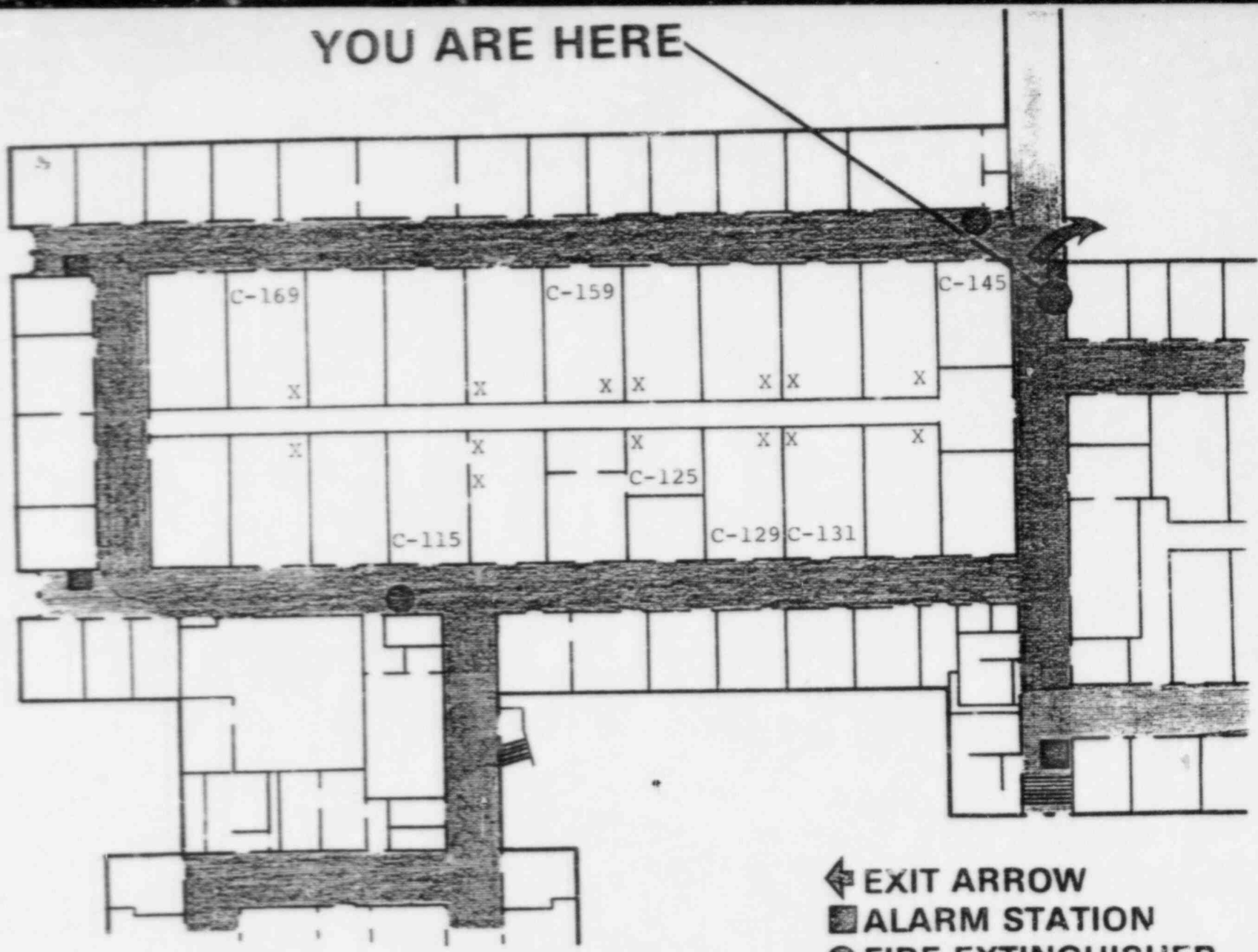
NORTHEASTERN OHIO UNIVERSITIES COLLEGE OF MEDICINE

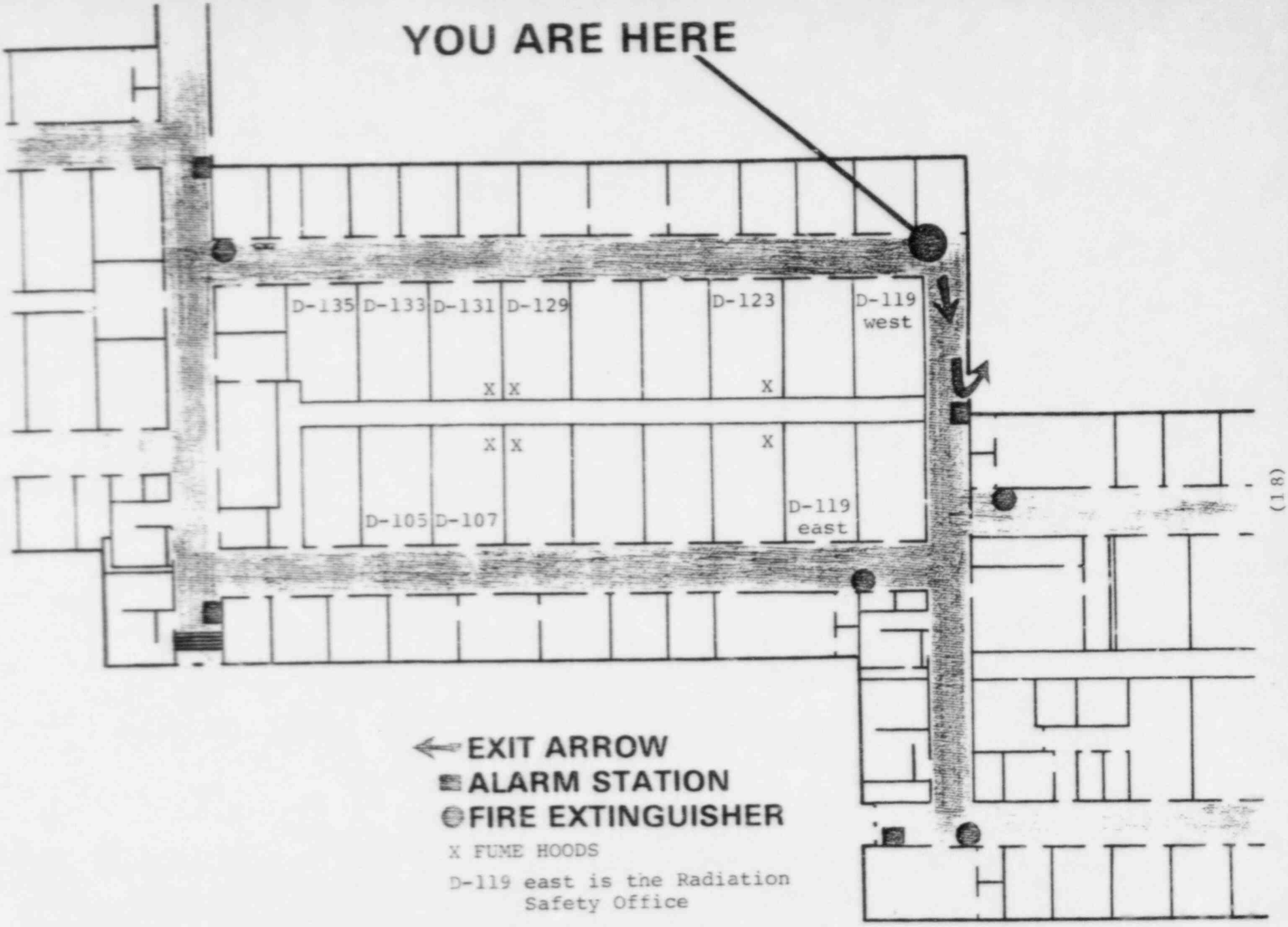
4209 STATE ROUTE 44, ROOTSTOWN, OHIO 44272 PHONE (216) 325-2511, AKRON CALLS (LOCAL CHARGE) 678-4160

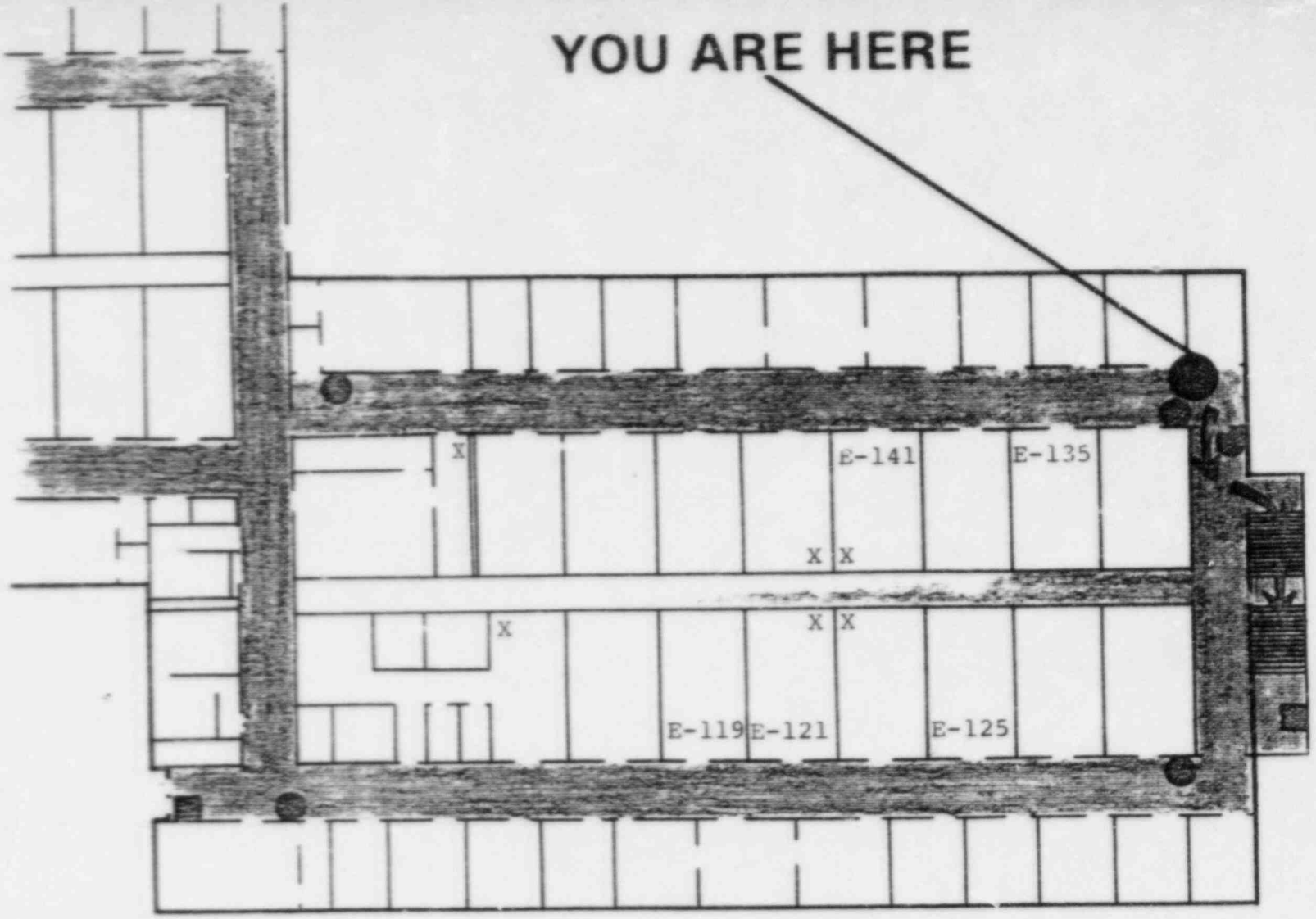


NOTES: Local hosts/hostesses will be placed to answer questions about the College. They will be stationed at key points along the tour route.

Please do not smoke while in the building.


YOU ARE HERE
C-169
C-159
C-145
C-125
C-115
C-129
C-131
EXIT ARROW
ALARM STATION
FIRE EXTINGUISHER
X FUME HOODS
C-125 is the Iodination Lab.


YOU ARE HERE
D-135
D-133
D-131
D-129
D-123
D-119
west
X X
X
X X
X
D-105
D-107
D-119
east
EXIT ARROW
ALARM STATION
FIRE EXTINGUISHER
X FUME HOODS
D-119 east is the Radiation Safety Office



EXIT ARROW
ALARM STATION
FIRE EXTINGUISHER
X FUME HOODS

Before working in a Radiation Area or a Restricted Radiation Area, 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 faculty licensee supervising the research project is responsible for the health and safety of personnel on the project. The licensee 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 Radiation Safety Officer 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. Ultra-violet 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 the faculty licensee ordering the material and the Radiation Safety Officer or member of his staff, regardless of the type or quantity of radioactive materials being ordered. Once a requisition is received, the Radiation Safety Officer will examine the current inventory and verify that receipt of the material ordered will not exceed the possession limits for that isotope. The Radiation Safety Officer will file a copy of the signed and dated requisition in the file marked "Ordered But Not Yet Received". He will also anticipate receipt of the isotope by entering it on the investigators inventory form and on the overall monthly inventory summary sheet for that isotope. Once signed and recorded, the purchase requisition is forwarded to the Accounting Office for routine processing.

D. Receiving Radioactive Materials

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 Radiation Safety Office immediatly. The Radiation Safety Officer will inspect the package, the receiving area, the carrier's vehicle, and all personnel who handled the package to determine the extent of possible contamination. The carrier will not be released from campus until it is determined that neither he or his vehicle are contaminated.

If the package is received in good condition, the receiving personnel will sign for its receipt and notify the Radiation Safety Office of its arrival. As soon as possible, the Radiation Safety Officer will monitor the package with a survey meter and surface wipes, and complete a

"Receipt of Radioactive Materials Form" (see next page). Wipes will be performed on the surfaces of the package down to the inner container delivered to the investigator. The receipt form, the packing slip, and the copy of the original requisition will be placed in a file labeled "Materials Received" and retained indefinitly.

The package will be delivered to the appropriate investigator's lab (or restricted area in the case of 125-I or 131-I). The licensee who ordered the material will be notified of its arrival and it is his responsibility to store and secure the material accordingly.

E. Storage

All radioactive 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 a laboratory that can be locked when personnel authorized to handle the material are not present. If any radioactive materials are to be stored in an uncontrolled area such as a hallway refrigerator or freezer, the container must be lockable to assure that no unauthorized removal can occur.

The licensee 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 community facilities must also bear the users initials.

Millicurie quantities of 125-I and 131-I must be stored in the lead storage box in room C-125, the Restricted Radiation Area.

F. Use

All radioactive materials must be handled in designated Radiation Areas or Restricted Radiation Areas. Radioactive material 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 in Restricted or Radiation Areas.

2. Film badges must be worn if 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.

RADIATION SAFETY REPORT

RECEIPT OF RADIOACTIVE MATERIALS

P. O. #_____

Date ordered_____

Date Received_____

Isotope_____

Activity_____

Investigator_____

Shipping Label

White I _____

Yellow II _____

Yellow III_____

Other_____

None_____

Package Condition

Good _____

Other_____

(Describe below)

Shipper_____ Carrier_____

Agreement between Purchase Order and Packing Slip:

	Purchase Order	Packing Slip	Agree (Y/N)
Isotope	_____	_____	_____
Activity (mCi)	_____	_____	_____
Chemical Form	_____	_____	_____

Surface Monitored:	G/M Shielded (mR/hr)	Filter Wipe (cpm)
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

Inspected By:_____ Date:_____ Time:_____

4. Glassware, tongs, pipetters, and other similiar tools used in a radioactive area should be suitably marked if possible and not used in a non-radioactive area. "Hot" glassware should be disposed of or washed 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 aerosol production must be done in hoods, glove boxes, or similiar protective devices.

7. Work surfaces should be covered with an absorbant 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.

10. Monitor the area with a sufficiently sensitive survey meter 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 lead storage box or lead pig in a remote spot of the laboratory (eg. back corner of a hood or refrigerator). Use long handled forceps or tongs if possible to reduce exposures.

G. Inventory

The Radiation Safety Officer 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 licensed 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 Radiation Safety Officer will send each licensee a personal inventory form indicating the activity of each radioisotope under their supervision at the beginning of the month. The Radiation Safety Officer notes on the form the activity of any isotopes received through the office during that month (see Receiving), 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, the annual average number of days per month)

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

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 placed down the drain for release 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. Even though the inventory form is not due until the 7th day of the following month, transactions during that first week should not be reported until the following month. For example, material received on February 2nd should not be included in the January inventory report, even though the report may not be turned in until February 7th. The material should be entered on the February form due by March 7th. The completed inventory form must be signed by the licensee and returned to the Radiation Safety Officer.

On receipt of the signed personal inventory form, the Radiation Safety Officer records the receipt, disposal, and decay of each isotope onto an Isotope Summary Inventory Form (see following page). 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 Radiation Safety Officer 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 Radiation Safety Officer may consider requesting an amendment from the NRC to increase possession limits, or disposing of stored waste labeled with that isotope.

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 (eg. 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.

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 and excreta, 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 table.

1. Liquids - a. Organic based - must be collected in linear polyethylene

Date _____

NEOUCOM Radioisotope Inventory Report
(All Values Reported In mCi)

Isotope _____

Decay rate _____ (30.5 days)

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

	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			
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												

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 _____

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 sewerage systems if the activities present are below the amounts outlined in NRC 10 CFR 20.303. 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 mannor as organic based liquid waste.

2. Solids - Solid wastes must be completely dry and 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 wrapped 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 up to facilitate placement of the carcass into a standard 30 gallon drum.

4. Liquid Scintillation Vials - Due to recent changes at our Richland, Washington disposal site, scintillation vials will no longer be accepted for disposal. The only scintillation vials we may dispose of are "deregulated vials" ie., vials containing only 3-H or 14-C in activities less than .05 uCi/gm or ml. Liquid scintillation vials containing activities greater than .05 uCi/gm or ml, or isotopes other than 3-H or 14-C must be emptied prior to disposal. The liquid scintillation fluid is to be disposed of as "organic liquid waste", and the dried used vials as "solid waste".

5. Short Half-Life - Short half-life isotopes (those with a half-life of less than approximately 60 days) are to be separated from long half-life isotopes, for each catagory listed above. Long half-life wastes are shipped for disposal, where short half-life wastes are decayed on site.

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. On the recomendation of the Radiation Safety Committee, the Director may remove 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 the acceptable limits of 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.

4. The total quantity of material spilled is greater than 1 uCi but less than 1 mCi.

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

1. If the spill was absorbed by bench paper, collect the paper and place into a plastic bag. Label the bag and place it into the appropriate radioactive waste drum.

2. If the spill was confined to an impervious tray, wash the tray with decontamination solution. The rinse water may be disposed of in the sink if levels of radiation are below allowable limits (see Disposal). Otherwise, it must be disposed of as radioactive liquid waste and placed into the appropriate polyethylene container.

3. Clean the surrounding area with decontamination solution.

4. Following decontamination procedures, the area should be monitored with a survey meter and surface wipes. If contamination persists, decontamination procedures must be repeated until detectable radiation levels are as low as reasonably achievable (ALARA).

The principle investigator is responsible for submitting a Radioactive Contamination Report to the Radiation Safety Officer within 7 days. The report will be retained in the Radiation Safety Office.

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 any of the following criteria.

1. Quantities greater than 1 mCi.

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

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

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 _____

THE RADIATION SAFETY OFFICER MUST BE NOTIFIED IMMEDIATLY WHEN A MAJOR HAZARDOUS SPILL OCCURS.

The Radiation Safety Office 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 principle investigator is responsible for promptly executing the decontamination procedures deemed necessary by the Radiation Safety Officer.

The Radiation Safety Officer 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 principle investigator may enter the area until the decontamination procedures are completed.

The Radiation Safety Officer and the principle investigator will complete a Radioactive Contamination Report and submit it to the Chairman of the Radiation Safety Committee and the Director. A meeting of the Radiation Safety Committee will be convened to determine corrective measures to assure that similar hazardous spills do not occure.

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

C. Bodily Contamination (External only)

Radioactive materials in contact with body surfaces (eg. hands) should be removed promptly using approved decontamination products such as D-Con or Radiacwash. The area should be scrubbed gently and rinsed with luke warm water.

DO NOT USE HARSH OR CAUSTIC SOAPS.

DO NOT SCRUB THE AREA WITH AN ABRASIVE TOOL (eg. SCRUB BRUSH).

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

The Radiation Safety Office should be notified if the material in contact with the skin:

1. Exceeds 10,000 dpm

2. Is in a chemical form that may readily be absorbed

3. Gives a dose greater than 7500 mR in 3 months. (10 CFR 20.101)

If any of these conditions are exceeded the Radiation Safety Officer will determine whether decontamination can proceed on site or that 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 Radiation Safety Officer, he will perform urinalysis bioassay to determine when the individual is considered decontaminated. The Radiation Safety Officer will complete the Radioactive Contamination Report.

D. Bodily Contamination (Internal)

Ingestion or injection of radioactive materials must be reported to the Radiation Safety Officer or his staff immediately. They will transfer the individual as a patient to the Nuclear Medicine Section of Robinson Memorial Hosapital.