

NEUROSCIENCE, INC.

RADIATION SAFETY GUIDE

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Approved:

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INTRODUCTION

All uses of radioactive material at Neuroscience, inc. are controlled by the radiation protection program.

NO WORK WITH SOURCES OF IONIZING RADIATION CAN
BE INITIATED UNLESS AUTHORIZATION HAS BEEN
OBTAINED FROM THE RADIATION SAFETY OFFICER.

All uses of ionizing radiation (except ultra-violet radiation) in Massachusetts are controlled and regulated by the U.S. Nuclear Regulatory Commission (NRC). Neuroscience, Inc. has received a license from the NRC to use limited amounts of radioactive material in biological research. We have established a radiation safety program to give the necessary assurances to the NRC as well as the company management that all potentially hazardous sources of radiation will be used safely.

This guide describes the organization of the program and specifies the regulations, policies and procedures and practices which are to be followed in using radiation sources at Neuroscience. The guide was presented to the NRC as describing the Neuroscience radiation safety program. It was accepted as such and so referenced in the license subsequently issued. Consequently, the guide is a legal document governing all uses of radiation at Neuroscience.

It is Neuroscience's policy to encourage the use of radiation where appropriate, but always with the insistence that there be no unwarranted radiation exposure; thus, due regard must always be given to the safety and welfare of the radiation workers and the general population as well as to the protection of Neuroscience property and liability. The Neuroscience operational policy places ultimate responsibility on the person who is supervising the use of radiation sources. These supervisors can satisfy their responsibilities by adhering to this guide and by requesting assistance from the Radiation Safety Officer (RSO) when there are questions or suspected problems.

This guide is organized in the following manner:

Section 1 - General description of the Neuroscience Radiation Safety Program, Organization and Responsibilities

Section 2 - Detailed Procedures and Practices

1. Description of the Neuroscience Radiation Safety Program

There are three levels of authority in the radiation safety program:

The Radiation Safety Officer (RSO)

The RSO together with the management of Neuroscience establishes the radiation safety policy such that:

1. Unwarranted radiation safety exposures of Neuroscience employees and general public are avoided.
2. Compliance with all the federal and state regulations is assured.
3. Neuroscience property and liability are protected.

Specifically, the RSO meets these responsibilities by routinely monitoring all uses of radioactive material to ensure that: (a) each use is by or under the supervision of a properly authorized supervisor, (b) that the appropriate personnel and environmental monitoring equipment is being used and (c) that radioactive material is properly secured against unauthorized removal when not in use.

The Supervisor

The supervisor is a person permitted by the RSO and NRC to use radiation sources. (S)he has primary responsibility for the radiation safety associated with each source under his/her control. He must ascertain that each person under his supervision using these sources is properly trained and aware of the attendant hazards (see Training Requirements). He must also assure that use of the sources conform to all the safety conditions of this authorization and those of this guide.

The Supervised User

These individuals must use the sources of radiation only under the direction of a supervisor. They must follow those procedures and practices established by the supervisor. All users are required to attend a Radiation Safety Orientation lecture before they begin work (see Training Requirements).

2. Radiation Regulations, Policies, Procedures and Practices

a. Federal Regulations

The Nuclear Regulatory Commission has established "Standards for Radiation Protection" 10CFR20 (see Appendix for a copy). These standards must be strictly adhered to during all uses of by-product material. The NRC also has adopted regulations which assure that workers will be advised of the sources of radiation being used, the hazards, the safety precautions in effect, etc. at the place of employment. These rights are present in "Notice of Instructions and Reports to Workers; Inspections" 10CFR19 (see Appendix for a copy).

b. Neuroscience Policies and Procedures

The management of Neuroscience recognizes both the NRC regulations and company policy of preventing unnecessary exposures to radiation as the basic criteria for establishing the radiation safety policies and procedures. The principal means by which the company assures the safe use of sources of radiation are:

1. To require that a person be authorized to use or supervise the use of radiation sources.
2. To require that the acquisition of radiation sources be approved by the RSO and that all receipts and transfers, including disposal of radioisotopes, be channeled through the RSO.

Specific procedures and practices have been established for most routine or recurrent situations to assure compliance to the regulations and company policy. For unusual situations, the RSO will interpret the existing regulations, policies and procedures to establish guidelines.

These are the established procedures and practices:

1. Authorization to Use Radioisotopes (Appendix 1)
2. Training of Workers (Appendix 2)
3. Use of Radioisotopes (Appendix 3)

c. Professional Standards

The RSO also uses as operational guides the published data and recommendations of professionally recognized national and international committees and organizations concerned with health physics or radiation protection, examples of which are:

1. National Council on Radiation Protection (NCRP)
2. International Committee on Radiation Protection (ICRP)
3. International Atomic Energy Agency (IAEA)
4. Health Physics Society (HPS)

APPENDIX 1**Authorization to Use Sources of Radiation**

An individual can use or possess a source of radiation only after (s)he is authorized. To be authorized, an individual must be able to present evidence of proper training and experience. An application must be submitted to the RSO and the RSO must approve the application and forward it to the NRC. A formal written authorization must be obtained from the RSO before work can begin.

The authorization will be reviewed and updated when the company NRC license is submitted for renewal. If an authorized supervisor wishes to use sources of radiation different from those for which his group has been authorized, if he wishes to increase the possession limits or change the experimental conditions, he must receive an amendment to his authorization before the change can be put into effect. The RSO will evaluate requests for amendment and, as necessary, inform and request approval from the NRC for amendments to the company license.

A copy of the application for authorization to use radionuclides is on the next page.

NEUROSCIENCE, INC.
APPLICATION FOR USE OF RADIONUCLIDES

Instructions. Complete application and submit to Radiation Safety Officer.
Authorization for use requires signed approval of Radiation Safety Officer.

Name of Applicant

Social Security Number of Applicant

Department & Supervisor

Location where Isotopes will be used / stored

Radioactive material(s):List chemical symbol and
mass number of eachForm of Material
(Chemical and/or Physical)Possession Limit
(mCi)**Training and Education**

Subject Covered	Course	On-Job Training	Institution	Date Completed
	Yes No	Yes No		
A. Principles and Practices of Radiation Protection				
B. Measurements and Monitoring Techniques				
C. Mathematical principles for Calculating Activity				
D. Biological Effects of Radiation				

Experience (actual use of radioactive materials)

Isotope	Maximum Activity	Where Used	Duration of Use	Type of Use
---------	------------------	------------	-----------------	-------------

I have read, understand, and agree to abide by Neuroscience's Radiation Safety Protection program.

Applicant Signature _____ Date: _____

RSO Signature (Approval): _____ Date: _____

APPENDIX 2

TRAINING OF WORKERS

Individuals using radioisotopes under an NRC license have certain rights as prescribed in 10CFR190 "Notices, Instructions and Reports to Workers; Inspections" (see Appendix 4). In accordance with Part 19, a copy of the Neuroscience license and a copy of the Notice posted in radioisotope areas to advise persons in those areas where work is being done and to describe the documents and regulations pertinent to that work are included in this Appendix.

Neuroscience has designed its training program to assure that all persons working in or frequenting areas of radioisotope usage are aware of the attendant hazards. All persons using radioisotopes or frequenting areas where radioisotopes are used must attend a Radiation Safety Orientation lecture consisting of material as shown in the outline appearing in this appendix. The RSO shall keep records of attendance at these orientations.

There will be two portions to the orientation lecture: 1. A portion targeted for all prospective users of radioisotopes within the company dealing with both the scientific background of radiation and safe procedures for personal use and 2. A portion targeted for ancillary personnel (custodial, security, maintenance, etc.) describing the practical aspects of working in a radiation area -- understanding signage, basic work and emergency procedures, and commonly used equipment and areas, etc.

The RSO shall determine at the time of application for authorization amendment or renewal if the training and experience of the user is adequate or if additional training or experience is required. All company personnel handling radioisotopes will attend both portions of the radiation orientation. Ancillary personnel will attend the second portion of the orientation lecture when beginning work with the company and annually thereafter.

CAUTION

Work with sources of radiation is being carried out in this area.

In accordance with the United States Nuclear Regulatory Commission Regulation 10CFR19.II, the following documents relating to the work are available to you from the Radiation Safety Officer.

1. 10CFR20 - which describes the Nuclear Regulatory Commission Standards for Radiation Protection which must be adhered to in the use of sources of radiation.
2. 10CFR19 - which describes the Nuclear Regulatory Commissions Regulations pertaining to notices, instructions, and reports to workers and inspections of radiation activities.
3. Regulatory License and Applications - which specify the special conditions under which radiation work must be carried out.
4. Neuroscience Radiation Safety Guide - which specifies Neuroscience radiation safety policies and procedures.
5. Neuroscience Authorization - under which the work in this area is being carried on.

Radiation Safety Orientation Outline

1. Why are we here?
 - a. Regulations
 - b. Orientation to Neuroscience Radiation Safety Program
2. All uses of radiation require a license
3. Description of Neuroscience license
4. Licenses require Neuroscience to assure safe use through:
 - a. Organization
 - b. Facilities and Equipment
 - c. Evaluation
 - d. Control
 - e. Services
5. Radioactivity and radioactive decay
6. Interaction of radiation with matter
7. Dosimetry (Roentgen, the Rad, the Rem)
8. Bioeffects:
 - a. Somatic
 - b. Genetic
9. Regulations - based on ICRP and NCRP recommendations
 - a. 10CFR20
 - b. 10CFR19
 - c. Radiation Protection Guides
 - 8.10 As low as reasonably achievable
 - 8.13 Pregnant Women
 - d. Posting
 - e. Privacy Act; NRC Forms 4 and 5

Radiation Safety Orientation Outline (Con'd)

10. Neuroscience Radiation Safety Program
 - a. Management Responsibility
 - b. Radiation Safety Officer
 - c. Evaluation
 - d. Compliance
 - e. Services
11. Laboratory Practices
 - a. External hazards, including X-rays
 - b. Internal hazards
 - c. Surveys
 - d. Instrumentation-which do you use?
 - e. Records
 - f. Waste disposal
 - g. Labelling and marking
 - h. Storage
 - i. Restriction of access
 - j. ALARA-As low as reasonably achievable
 - k. Emergency Procedures (posted)
12. Specific Problems
 - a. Tritium (H-3)
 - b. Carbon-14
 - c. Phosphorous 32
 - d. Iodine 125
 - e. Concept of MPC and regulatory requirements
 - f. Radiation Exposure Artifacts
 - g. Care of Personnel badges
 - h. Ordering radioisotopes
 - i. Marking of waste containers
 - j. Changes in experimental procedure
 - k. Hesitancy to ask for help; where to get help
 - l. Rules for use of radioisotopes

Maintenance Staff

Procedures for Handling Equipment in Labs Using Radioactive Materials

1. Any device which has a radiation symbol on it (except X-ray producing machines) might be contaminated with radioactive material. Before you work on or around such a device, contact the Radiation Safety Officer (RSO) so that the device may be checked for safety.
2. Equipment within or servicing a radioisotope laboratory which may be contaminated by radioactive material includes hoods, exhaust blower motors, pumps, drain pipes, ventilation ducts, etc. Call the RSO to check before beginning work on any such equipment.
3. If you think you may have gotten some radioactive material on your skin or clothing, wash it off as soon as possible, and then call the RSO so that he can assure you that all the contamination has been removed. Do not leave the general area until you have been checked. Do not panic! The risk is quite low.
4. If you have questions, call the RSO.

Custodial Staff Instructions

What to do About Radioactive Materials

1. Rooms which have the radiation symbol shown on doors or on equipment may contain radioactive materials. You should be careful when working in these rooms. You can sweep, mop, and wax the floors and remove the waste which is not labelled with the radiation symbol, just as in any other room.
2. Any container (box, bottle, carton, etc.) which has radioactive material in it will have the radiation symbol on it. You should not touch these containers. If the contents of these containers are spilled, **DO NOT TOUCH THEM OR ATTEMPT TO CLEAN THEM UP.** Tell your supervisor or the Radiation Safety Officer (RSO).
3. **DO NOT** empty any waste container which has the radiation symbol on it.
4. **DO NOT** empty any waste container which has waste material, such as boxes or bottles, with the radiation symbol in it. Tell your supervisor about it.
5. **DO NOT** eat, drink, smoke or apply cosmetics in any lab or in any room which has the radiation symbol on its door.
6. In an emergency, or if you have any questions, ask your supervisor or the RSO for help.

APPENDIX 3

USE OF RADIOISOTOPES

The authorized supervisor is responsible for seeing that the users of radioisotopes under his authorization comply with all the governmental regulations, the specific conditions and limitations of his authorization, and the procedures and practices outlined in this appendix. He ascertains that all persons who use radioisotopes under the coverage of his authorization are supervised, properly trained and experienced, aware of the attendant hazards, and observe the procedures of this guide.

Training and Experience

See Appendix 2 of this guide.

Receipt, Transfer and Disposal of Radioactive Material

The RSO must approve all intended receipts and subsequent transfers of radioisotopes. All radioisotopes must be shipped to this address:

Neuroscience, Inc.
One Kendall Square, Building 700
Cambridge, MA 02139
Attn: Radiation Safety Officer

A purchase order must be used to order radioisotopes. It must be signed by the RSO before distribution. The NRC license number and Authorized Supervisor's name must be typed on the purchase requisition beneath a description of the radioisotope ordered. A purchase requisition cannot be used to confirm a radioisotope order unless the authorized user obtains prior verbal approval from the RSO. Radioisotopes cannot be ordered on a blanket order without approval from the RSO.

All radioisotopes are checked for contamination and their receipt is recorded for legal purposes by the RSO or his designate. The radioisotope is then delivered to the authorized supervisor. See Appendix 4 for procedures and forms.

If an authorized supervisor wants to: (a) move the radioisotope to a location other than those specified on his authorization, or (b) transfer an isotope to another authorized person, he must first obtain approval from the RSO.

Receipt, Transfer and Disposal of Radioactive Material (Con'd.)

All radioactive material must be disposed of through the RSO. Only those small amounts of liquid radioactive waste allowed by law may be disposed of down the drain of designated sinks. Liquid waste must be placed in a properly labelled plastic container. Solid waste must be placed in a properly labelled container lined with a plastic bag. Liquid scintillation vials should be kept separate. All radioactive waste will be packaged according to the waste vendor's specifications for removal to the disposal site.

Radiation Surveys

The RSO conducts routine radiation and contamination surveys of all laboratories. The user must supplement these routine surveys as follows:

RADIATION SURVEYS ARE TO BE MADE BY THE USER AFTER EACH EXPERIMENTAL RUN OR AT THE END OF DAY RADIOISOTOPES ARE USED IN ORDER TO DETERMINE THE EXTENT OF RADIOACTIVE CONTAMINATION AND TO ASCERTAIN THAT ALL WASTE AND STOCK MATERIAL HAS BEEN STORED OR PROPERLY DISPOSED OF.

The RSO survey is conducted biweekly when millicurie amounts of radiation are in use and monthly whenever microcurie amounts are used. All labs are surveyed with an appropriate calibrated survey meter. Wipe tests are taken on all bench tops, hood ledges, sink areas, storage and waste disposal areas. Surveys will also check for proper labelling, signage, and adherence to rules and regulations by users.

When material is known to have been spilled or become airborne, wipe test surveys of the affected area should be made. Such tests can be made with filter paper or squares of any absorbent paper, and the wipes counted with an appropriate counting instrument. The RSO should be called if a researcher has reason to believe his work has resulted in gross contamination or constitutes an emergency situation. (See Emergency Procedures below.)

No levels of removable contamination are acceptable. Users with contaminated work areas will be given 24 hours to decontaminate their area after which a follow-up survey will be made. Fixed contamination (if and when discovered) will be shielded to background for the duration of isotope activity.

All radiation survey reports will be maintained by the RSO for inspection by the NRC.

Storage of Radioisotopes

Radioisotopes must be stored to permit access only to the authoree and those whom he designates. Each area and room where radioisotopes are stored must be posted with a radioactive material sign. Radiation levels around storage areas should be measured. If radiation doses could exceed five (5) millirem per hour in an occupiable area, the area must be posted with a radiation area sign. Proper signs can be obtained from the RSO.

See Appendix 5 for Radioisotope Inventory Form.

Records

Each user should maintain a radioisotope log to record the receipt use and disposal of all radioisotope he/she receives. This is a government regulation. The log should also be used to record the date and results of radiation and contamination surveys, even when the results are negative. This log is subject to inspection by the NRC. See Appendix 5 for examples of these logs.

Other records required by federal law are kept by the RSO.

Restriction of Radioisotopes Areas

Access to areas where radioisotopes are stored and used must be restricted to those persons cognizant of the associated hazards. This is a government regulation.

Radioactive Waste

Radioactive waste must be disposed of through the RSO. No waste is to be washed down drains, incinerated, or otherwise disposed without prior clearance from the RSO. A copy of the detailed procedures for waste disposal is given in Appendix 4.

Movement of Radioisotopes

Radioisotopes are not to be moved from authorized places of storage and use without the prior approval of the RSO.

Emergency Procedures

A radiation emergency occurs when a set of circumstances results in hazardous radiation levels, hazardous concentrations of airborne radioisotopes, or gross contamination of property. Examples of radiation emergencies and actions to be taken are:

- a. Personnel Contamination
 - 1) Remove contaminated clothing.
 - 2) Wash contaminated skin with mild soap and water. Do not use abrasives.
 - 3) Call the RSO. After hours, contact security guard who will reach RSO.
- b. Spill of radioisotope where radioisotope does not become airborne
 - 1) Wipe up with absorbent paper using a blotting motion so you do not spread contamination.
 - 2) Dispose of contaminated paper in radioactive waste container.
 - 3) Call the RSO. After hours, contact security guard who will reach RSO.
- c. Volatilization of liquid or dispersal of solid radioisotope outside a ventilated enclosure
 - 1) If possible, keep contamination localized by closing doors and restricting access to area.
 - 2) Leave the area.
 - 3) Call the RSO. After hours, contact security guard who will reach RSO.
- d. Fire in radioisotope area.
 - 1) Treat fire in normal manner.
 - 2) Call the RSO. After hours, contact security guard who will reach RSO.

ALWAYS USE COMMON SENSE IN HANDLING RADIATION EMERGENCIES, AND CALL THE RSO AS SOON AS PRACTICAL. DO NOT TRACK OR OTHERWISE PERMIT RADIOISOTOPES TO BE SPREAD INTO CLEAN AREAS.

NEUROSCIENCE RADIATION SAFETY OFFICER: _____
DAYTIME PHONE: _____
WEEKEND AND EVENINGS: Contact guard at security desk (intercom _____)

A more detailed procedure can be found below.

Personnel Monitoring

The RSO determines the need for personnel dosimetry during the authorization evaluation or evaluation of amendment requests.

The authorized supervisor has the responsibility to assure that all persons who use radioisotopes or work in his(her) area wear appropriate radiation dosimeters when required.

Radioisotope Laboratory Design

The design and furnishings of a laboratory must be commensurate with the hazards presented by the radioisotope and its condition of use. Each laboratory must, therefore, be evaluated individually by the RSO in light of its intended use. In practical terms, some possible requirements are that:

- a. Bench tops or other surfaces on which radioisotopes will be used must be stainless steel or covered with a permanently impervious surface.
- b. Floors must be covered with an impervious material; properly waxed, vinyl asbestos tiles are normally acceptable.
- c. Walls must have a smooth, crack-and hole-free surface.
- d. Proper room ventilation and adequate radioisotope storage must be provided.

Rules for Working with Radioactive Materials

A set of laboratory rules found to be very useful in reminding laboratory workers of good radiation safety practices is found below. Copies of these pages should be posted in each laboratory by the RSO. Each authorized supervisor should assure that these instructions are kept prominently displayed in work areas.

RULES FOR WORKING WITH RADIOACTIVE MATERIALS

ROUTINE PROCEDURES

<i>Eating, drinking, smoking</i>	Eating, drinking, smoking or using cosmetics is not permitted in this laboratory.
<i>Wash hands</i>	Wash hands after handling any radioactive material before going about other work. Always wash before handling objects which go into the mouth, nose, or eyes. Keep fingernails short and clean.
<i>Pipetting</i>	<u>Never</u> pipette anything, even water, by mouth.
<i>Protective Clothing</i>	Always use rubber or plastic gloves when handling radioisotopes. Lab coats should be worn in the lab and left in the laboratory.
<i>Confine the Activity</i>	Always work over trays lined with absorbent material. Keep and transport radioactive materials doubly contained.
<i>Spills</i>	Notify the Radiation Safety Officer <u>of all spills</u> except those of a very minor nature.
<i>Labelling</i>	Label radioactive material with your name, date, isotope and quantity of isotope.
<i>Before Leaving</i>	Before leaving the laboratory, clean up and monitor your work area and yourself.
<i>Disposal of Liquid radioactive waste</i>	Liquid radioactive materials should be disposed of through the Radiation Safety Officer. They should be held in plastic containers or in metal containers if the material is incompatible with plastic. The quantity of isotope, the isotope name, date, and the user's name should be recorded in a log kept with the container. <u>No radioactive material should be disposed of via the sink without approval from the RSO or group supervisor.</u>

RULES FOR WORKING WITH RADIOACTIVE MATERIALS

ROUTINE PROCEDURES (Con'd.)

Disposal of Solid

Solid radioactive waste should be placed in plastic-lined boxes or containers. The quantity being disposed of, date, user and the isotope should be recorded in the waste log kept with the container.

Counting Room

Take only prepared samples into the counting room. No potentially contaminated material or apparatus is permitted in the counting room. This includes lab coats.

Hoods

Materials which could become airborne must be stored and used in a hood. Hood ventilation should be left "ON" at all times.

Food

Never keep or store beverages or food in radioisotope labs, in refrigerators or freezers with radioisotopes.

RULES FOR WORKING WITH RADIOACTIVE MATERIALS

EMERGENCY PROCEDURES

Be prepared for an emergency by mentally rehearsing the following:

EXTREME HAZARDS

Hazards such as high radiation levels or the possibility of airborne contamination from dry or volatile radioactive materials.

Evacuate

Evacuate the laboratory immediately; close the door and lock it.

Call RSO

Call the RSO immediately. If you have to leave the area to do so, remove your shoes if you suspect contamination and do not touch anything unnecessarily.

OTHER HAZARDS

Hazards such as spills or suspected spills of radioactive material where the material does not become airborne.

Keep Calm

Keep calm, use common sense, protect people, do not spread contamination (always assume you are contaminated until a survey proves otherwise).

Confine Contamination

Localize the spill. Right tipped container; drop absorbent material on the spill. Damp down a dry spill.

Do not track contamination about the laboratory. Call, do not go for help, if possible!

Close door, and where possible adjust the ventilation to prevent spread of airborne material.

Check shoes before leaving the area of a cleaned up spill.

RULES FOR WORKING WITH RADIOACTIVE MATERIALS

EMERGENCY PROCEDURES (Con'd.)

Protect Personnel

Remove contaminated clothing and wash contaminated parts of the body with detergent.

Be especially thorough in flushing out wounds.

Warn other workers.

Decontaminate

If thorough washing with detergent does not remove contamination from body, consult the RSO.

You will be expected to perform the major work of decontamination of the area of your spill. The RSO will survey for contamination and advise on procedures and assist as necessary.

All suspected contaminated persons and areas must be monitored after decontamination and before work is resumed.

IN ALL EMERGENCIES, EXCEPT VERY MINOR SPILLS OF RADIOACTIVE MATERIALS, THE RSO SHOULD BE CALLED AS SOON AS POSSIBLE.

DO NOT TRACK OR OTHERWISE PERMIT RADIOISOTOPES TO BE SPREAD INTO CLEAN AREAS.

APPENDIX 4

SPECIAL PROCEDURES

Laboratory Survey Procedure

1. Laboratory contamination surveys should be done on a routine periodic basis with the period determined by the level of activity. They should be done often enough so that the possibility of contamination is minimized.

Surveys should be done by anyone using radioactive material immediately after the completion of an experimental procedure.

2. A survey data notebook should be kept, containing layouts of the laboratories indicating the points at which the wipes were made and data tables containing the results of the counting of the wipes.
3. Wipes are made using filter paper moistened with water or if necessary, another solvent for the material in use. Approximately 100 square centimeters of surface should be wiped.
4. Penetrating radiation, e.g. P-32, I-125, can be monitored with the G-M survey instrument.

NEUROSCIENCE, INC.**LABORATORY SURVEY RECORD**

Room: _____ Supervisor: _____

Radionuclides Used: _____

See room plan on reverse side for key to locations.

<u>Survey Date</u>	<u>Surveyer</u>	<u>Contamination</u>	<u>Radiation Field</u>
		Location dpm/wipe	Location mR/hr.

Instructions

1. On the reverse side sketch a plan of the lab indicating by number the locations at which the wipes are taken.
2. Contamination surveys shall be done using absorbent filter paper (moistened with an appropriate solvent if necessary). Wipe approximately 100 cm² of surface area. Count the wipes in the LSC (open channel). An Activity of 200 dpm/wipe or greater indicates significant contamination. Contaminated areas must be cleaned immediately and the area resurveyed.
3. Radiation surveys (if necessary) should be performed with a properly operating, calibrated G. M. survey instrument. An exposure rate in excess of 0.1 mR/hr in areas frequently occupied by humans should be shielded.

Radioactive Material Receipt and Opening Procedure

Package Receipt

1. Do not accept a radioisotope shipment that is damaged.
2. A contamination survey must be made within three (3) hours after receipt of a radioactive material shipment (within 18 hours if the delivery is after hours).
3. Radioactive material shipments should be separated from the non-radioactive shipments upon receipt. The Radiation Safety Officer should be notified immediately.
4. The date and time of the receipt should be recorded on the delivery form.

Package Opening

1. Wear gloves and protective clothing when opening the package.
2. Wipe the outside shipping container surface and count the wipes to check for contamination (see note below). Record the results.
3. Using the G. M. survey meter, measure the radiation levels at the surface of the container and if necessary at one meter from the surface. Record the results.
4. Open the package, and take wipe of the successive layers of containment, down to the vial containing the radioisotope (or the outside of the package if it is sterile wrapped). Count these and record the results. If there are no counts above background, container may be discarded in regular trash; otherwise container must be discarded with solid radiation waste.
5. Record any signs of damage to the package or to the vial.
6. If there is contamination or an excessive radiation level check the NRC regulations (10CFR20.205) to see if the NRC or the shipper must be notified.
7. The wipes should be counted in the Liquid Scintillation counter.

Delivery of Radioisotope to User

Do not leave the package unattended; deliver it immediately to the user so that it may be stored correctly. If the user cannot be found, contact the supervisor of the lab where delivered was to be made for proper disposition.

Neuroscience, Inc.

Radioisotope Receipt and Delivery

Radioactive Material _____

P.O. # _____

Activity _____

Date of Receipt _____

Location of Use _____

Contamination Survey (counts per minute)

Radiation Levels (mR/hr)

Date and Time of Delivery to User _____

User Signature _____

**Guidelines for Iodine-125 Iodinations
(and Tritium Experiments of >45 Millicuries)**

Iodine-125 emits 27-31 keV X-rays and a 35 keV gamma. Approximately 2 mm. of lead are required to completely attenuate I-125 in quantities typically used for iodinations. Iodine in the unbound state volatilizes readily and is efficiently taken into the body by inhalation or absorption through the skin. Approximately 30 percent of the activity taken in remains in the thyroid with an effective half life of about 40 days. Thus, the predominant concern on handling unbound iodine should be given to minimizing the contact with body.

1. Always work in a well-ventilated hood. Preplenum activated charcoal impregnated filters are recommended. A lucite inner hood (mini-hood) with a charcoal filter may be used. Neuroscience provides a stainless steel isotope fume hood which is equipped with a continuous air sampler (Eberline RAS-1) installed in the duct system to evaluate release to the environment. The sampling cartridge will be evaluated semi-monthly initially. If data indicates minimal release, cartridges will be changed monthly. Charcoal filters will be installed in the duct if release data indicate that greater than 25% of the permissible level ($> 2 \times 10^{-11}$ $\mu\text{c/cc}$ averaged over the sampling period) is being released. The sampling cartridges will be counted and evaluated by Mr. Robert Johnson (who, as mentioned previously, will handle the Neuroscience film badge and personnel monitoring programs as well). All reports will be forwarded to the RSO.

The cartridges themselves will be counted on a thin-crystal scintillation detector attached to a multichannel analyzer which has been calibrated for I-125.

Any tritium labelling experiments of 50 mc or greater will be sampled by pumping the effluent through a liquid collection system and counting an aliquot in a liquid scintillation counter. This result will also be compared to a materials balance performed by the investigator. All persons handling tritium will, in accordance with regulation, submit urine samples for bioassays within 48 hours.

2. Prepare a detailed written procedure for the iodination and submit it to the RSO for his approval. The procedure should be designed to minimize the opening of any vials through the use of syringe injection of material through septum topped vials. All containers of the radioactive material should be sealed in some manner, e.g., rubber stoppers, plastic cups or parafilm.
3. Conduct a dry (cold) run of the procedure to minimize the chance for error when the activity is used.
4. A baseline bioassay (either urine analysis, or preferably, a thyroid exam) should

be done on anyone participating in the procedure. See reference 2 below.

5. Wear a personnel radiation dosimeter.
6. Wear the proper protective clothing, safety glasses and two layers of protective gloves. Iodine diffuses rapidly through vinyl and rubber so replace the outer layer immediately when it becomes contaminated. Keep the inner pair free of contamination.
7. Have a properly operating Geiger Muller survey instrument on and readily available for quick contamination checks. Be careful not to contaminate the instrument itself. The instrument will not detect very low levels of contamination but will be useful for higher levels.
8. Avoid handling the vials directly. Use remote handling devices such as tongs or forceps.
9. To decontaminate equipment or surfaces use a solution of 0.1M NaI, 0.1M NaOH, and 0.1M $\text{Na}_2\text{S}_2\text{O}_3$ in order to efficiently remove the contamination without releasing iodine to the atmosphere.
10. All waste should be sealed in double layers of plastic and disposed of immediately.
11. If exhaust filters are not used, the activity concentration of the exhaust must be monitored to assure compliance with NRC regulations concerning the release of Iodine-125 to the environment. See 10CFR20.103.
12. Clean and check all the working surfaces and equipment for contamination immediately after the procedure is finished. Take contamination wipes and count them with your samples. The survey instrument is useful for this work, but should not be used to perform the final check.
13. IT CANNOT BE EMPHASIZED TOO STRONGLY THAT NEAT, CAREFUL WORK HABITS WILL MINIMIZE BOTH CONTAMINATION PROBLEMS AND UNNECESSARY EXPOSURE TO PERSONNEL.

References

1. New England Nuclear Corp. Pamphlet: "Iodine-125 Guide to Safe Handling".
2. U.S. NRC Regulatory Guide 8.20 "Applications of Bioassay for I-125 and I-131".

Handling Procedures for Millicurie Quantities of Phosphorus-32

Phosphorus 32 emits a distribution of energetic beta particles, up to a maximum energy of 1.7 Mev, which can travel as far as 7 meters in air. The absorbed dose rate close to containers of millicurie quantities of P-32 is on the order rads/min. A significant fraction of P-32 entering the body deposits in the bone structure. The maximum permissible bone burden is 6 microcuries.

The following procedures should offer a guide to using sources of P-32 in excess of one millicurie.

1. Prepare a written set of procedures and submit them to the RSO for approval prior to the run.
2. Avoid handling the vial directly. Use remote handling tools, such as tongs or special holders when handling the source containers.
3. Use low density shielding (e.g. a minimum of 0.25 in. of plexiglass) to absorb the beta particles without generating significant amounts of X-rays by an interactive process called Bremsstrahlung. Heavy materials (high atomic number) should not be used close to the source because the Bremsstrahlung process is much more efficient for these materials. However, a small amount of lead on the outside of a plastic shield will absorb the Bremsstrahlung X-rays efficiently.
4. Wear Safety glasses to protect eyes from splashes and unnecessary radiation when working with more than 10 mCi.
5. Wear two sets of gloves; strip the outer pair off and replace if they become contaminated. Keep the inner pair clean at all times.
6. Have immediately available a properly operating G. M. detector for use in detecting contamination and radiation fields.
7. Wear personal dosimeter and finger dosimeters. The finger dosimeters are important because they will monitor the dose given to the fingers which the body dosimeter will not see.
8. Have your supervisor or the RSO observe during your first procedure.
9. After each procedure, survey the area with both the G. M. and wipes to eliminate any contamination.

Radioactive Waste Handling Procedures

Radioactive waste from experiments is taken from lab bench receptacles and put in the properly labeled 10 gallon galvanized cans located throughout the labs. When these cans are full, it is the responsibility of the Group Safety Coordinator to see that this radioactive waste is properly bagged, labeled and taken to the floor drop-off disposal area. Experiments involving large amounts (200 micro curies) of radioisotope should be bagged, labeled and taken directly to the floor disposal facility.

It is advised that each group leader make a duty roster of names for radioactive waste removal. In this way each scientist shares in the disposal burden and also shares in maintaining a safe environment.

Custodial personnel exchange full barrels for empty ones on an as-needed basis. To arrange for a barrel in your area to be picked up: 1. call xxxx and give your floor and location; 2. be sure that the barrel is labelled properly on the top and side and that it is completely sealed.

SPECIFIC GUIDELINES FOR BAGGING WASTE

Persons handling radioactive waste should wear film badge, disposable gloves, and a lab coat. Persons should avoid working over the uncovered waste, since an uncovered direct path from a concentrated radioactive surface is not attenuated.

Make sure that dry waste is bagged in heavy duty polyethylene bags, the bags are tightly sealed, and labeled as the contents. Labels are available at the floor drop-off area.

The label should have the following filled out:

Category: On the back of the form are the possible categories. Label the tag A, B, C, D, E or F as it pertains to the contents. Liquid waste should be absorbed with absorbent material. This absorbent can be obtained from the RSO. Double the bags for scintillation vials. Cocktail can dissolve the bag.

Isotope: Enter isotope or isotopes in bag ^{32}P , ^{125}I , ^{35}S , ^3H or ^{14}C .

Chemical Name: dATP, dCTP, nucleotide, methionine, leucine, etc.

Activity (UA): Please estimate on the high side the amount of activity in the bag.

Date: Enter today's date

Dept.: List your lab group/department

Bldg.: Enter 'Neuroscience' and room number.

Packed By: Person who filled the bag, and their extension.

DISPOSAL CATEGORIES

There are seven categories of radioactive waste recognized at Neuroscience. Waste must be bagged separately by category and labeled accordingly.

- 1) **^3H and ^{14}C Liquid Scintillation Vials.** Vials of these isotopes which have less than 100,000 cpm per vial on average. Double bag with no more than 200 20cc vials or 400 10cc vials per bag. This volume is about half of a 10 gallon can. (Disposal cost: \$130/30 gallon barrel.)
- 2) **Liquid Scintillation Vials - Other Isotopes.** Double bag, no limit to number of vials per bag. (Disposal cost: \$245/30 gallon barrel.)
- 3) **^{125}I and ^{131}I Solid Waste.** Bag all solid waste together, both burnables and non-burnables. Waste is stored until it decays to background. (Disposal cost: \$90/30 gallon barrel.)
- 4) **Paper and Plastic (Burnable) Solid Waste.** Includes ^{32}P , ^{35}S , ^3H , and ^{14}C . Bag these isotopes together, but no metal or glass. (Disposal cost: \$90/30 gallon barrel.)
- 5) **^{32}P and ^{35}S Non-Burnable Solid Waste.** Bag these isotopes together but exclude paper and plastics. Barrels are stored until decayed and disposed of in garbage. (Disposal cost: \$90/30 gallon barrel.)
- 6) **^3H and ^{14}C Non-Burnable Solid Waste.** Bag together but exclude paper and plastic. (Disposal cost: \$245/30 gallon barrel! Shipped out of state.)
- 7) **Liquid Waste.** Most aqueous waste can be disposed of down a properly labeled and designated lab sink at the following rates per day. Amounts disposed must be recorded at the sink and total per sink per day cannot exceed unity (i.e., 50% of daily limit for ^{32}P and no more than 50% of daily limit for ^{125}I). See list below.

<u>Isotope</u>	<u>Daily Limit Per Sink</u>
^{35}S	100uCi
^{32}P	10uCi
^3H	1mCi
^{14}C	100uCi
^{125}I	1uCi

If the aqueous waste is significantly higher than the daily limits, they can be stored in separate containers (separated by isotope) and taken to the disposal storage area.

*****NOTE*****Use of absorbent for liquid ^3H or ^{14}C generates solid waste which is very bulky and must be shipped out of state at \$245 per barrel, so avoid this method of disposal whenever possible.

BE SURE TO ASK IF YOU HAVE ANY QUESTIONS ABOUT PROPER ISOTOPE HANDLING PROCEDURES.

THE FLOOR DISPOSAL SITES ARE REGULATED AND INSPECTED BY THE NRC. VIOLATION OF ANY OF THESE DISPOSAL PROCEDURES COULD RESULT IN THE SHUTDOWN OF THE FLOOR DISPOSAL FACILITY AND RESTRICTIONS ON FUTURE COMPANY USE OF ISOTOPES!

Neuroscience, Inc.**Radioactive Material Inventory**

Radioactive Material _____ User _____

Date Received _____ P.O. # _____

<u>Date</u>	<u>Activity Used</u>	<u>Activity Remaining</u>	<u>Used by</u>
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

Neuroscience, Inc.
Radioactive Waste Inventory

Disposed of empty container: _____ User: _____

Date

Radioisotope

Activity

User

TOTALS: (To be completed when the radioactive waste is shipped.)

Radioisotope

Total Activity (mCi)

APPENDIX 5

NUCLEAR REGULATORY COMMISSION REGULATIONS AND GUIDES

10CFR20

10CFR19

Regulatory Guide 8.10

Regulatory Guide 8.13