



Boston College
Environmental
Health and
Safety

RADIATION SAFETY MANUAL
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Appendix Q. Student Radiation Worker Permit Form

New Worker/Worker Update (circle one) Appl. Date ____/____/____

Name _____ Dept. _____ Apprvd. Date ____/____/____

Office _____ Building _____ Extension _____ Exp. Date ____/____/____

Isotopes to be used in:

Room _____ Building _____ Lab Extension _____

Isotopes Used:

Isotope Principal	Emission	t1/2	Physical and/or Chemical Form	Amount used in Typical Experiment (μ Ci)
____ 3H	β^- (0.02 MeV)	12.26 y	_____	_____
____ 14C	β^- (0.16 MeV)	5,730 y	_____	_____
____ 32p	β^- (1.7 MeV)	14.3 d	_____	_____
____ 35S	β^- (0.16 MeV)	88 d	_____	_____
Other	_____	_____	_____	_____

Purpose and Nature of Use (Also cite specific operations that may affect contamination and/or exposure (e.g. grinding, evaporations, volatile compounds, etc. Attach additional sheets.):

Training:

Attach form: "Record of Personnel Training & Isotope Use" Appendix N.

STUDENT PERMIT

Monitoring Devices:

Available in Laboratory Available for Use

from Other Site (give location)_____

___ Film Badges

___ Ring Badges

___ Geiger Counter ___ Geiger Counter _____

___ Scintillation Counter ___ Scintillation Counter _____

___ Other _____ ___ Other _____

Storage and Disposal Methods:

The radioisotope material will be stored and disposed of in the following manner (attach sheet if necessary):

Safety Procedures:

Describe safety procedures to be implemented while carrying out work with this (these) isotopes. Be specific for each isotope.

PI AUTHORIZATION

As principal investigator for research using the specified radioisotopes, I certify that I am familiar with the regulations for radioisotope use as specified in the BC Radiation Safety Manual and that a copy of this is available in my laboratory; also, that this worker under my supervision has been provided with written guidelines for handling the specified isotopes. (Application will not be reviewed unless a copy of analytical procedures is attached and form is signed by PI.)

_____ Date ___/___/___
Principal Investigator

_____ Date ___/___/___
Radiation Safety Officer

Note: Permission to use radionuclides automatically expires after 5 years.

Appendix R - PRENATAL RADIATION EXPOSURE POLICY

Introduction and Background

Exposure of the embryo/fetus to high levels of ionizing radiation is believed to present an increased risk to the embryo/fetus. At occupational exposure levels this risk may be manifested as an increased chance of the exposed embryo/fetus developing leukemia during childhood. The Nuclear Regulatory Commission (NRC) using the recommendations of the National Council on Radiation Protection (NCRP) and 105CMR120.218 have established the level of concern as an exposure to the embryo/fetus of greater than 500 mrem (5 mSv) during the entire gestation period. The occupational whole body equivalent exposure limit for all personnel working at Boston College is 5000 mrem (50 mSv).

The NRC requires that all employees and students who may potentially become pregnant, their supervisors and their co-workers be informed of this risk and the controls to be employed to limit the risk. The details of this information are outlined in NRC Regulatory Guide 8, 13, "Instructions Concerning Prenatal Radiation Exposure", available at the Office of Environmental Health and Safety (OEHS) in St. Clements Hall.

All current research work at Boston College involves exposures substantially below the recommended NRC action level for prenatal exposure. The exception would be an emergency resulting in the release of large quantities of radioactivity or grossly negligent handling of radioactive materials. While both are an extremely unlikely possibility, inform workers of the risks and their options is a prudent action.

Policy Declaration

The purpose of this policy is to inform employees of the known potential health risks to the embryo/fetus associated with radiation exposure and to provide pregnant employees a means to maintain their exposure below the NRC recommended prenatal dose limits, if they so choose. Boston College will so limit occupational radiation exposure of pregnant employees who request such an accommodation during their pregnancies. However, while the NRC and the University recommend that employees limit their exposure during their pregnancy, the decision to limit exposure beyond the occupational standard requirement belongs exclusively to employees. The University will implement the recommended prenatal limit when an employee submits a written request stating she wishes to be categorized as a declared pregnant worker for this particular aspect of employment.

Information and Training

The University will provide to all employees information on the potential hazards of radiation exposure to the embryo/fetus. This information will include summaries of Regulatory Guide 8.13 and a copy of this policy. An opportunity for questions and discussion will be provided and employees may be tested or questioned to determine if they understand the information and instructions. Supervisors of employees or students performing research that results in radiation exposure at other, non-Boston College locations must inform the Radiation Safety Office of those activities.

Appendix S. Proper Segregation, Minimization and Disposal of Radioactive Wastes

The office of Environmental Health & Safety's Radiation Safety Technician will collect and process for disposal the various forms of radioactive waste generated at Boston College provided that the waste is properly segregated, packaged and identified according to the methods detailed in this package.

Disposal of the various forms of low-level radioactive waste (radwaste) is complex, extremely difficult, and very costly. Radioactive and mixed waste (radioactive/chemical) minimization and chemical/radionuclidic waste segregation are critical to reducing costs, ensuring regulatory compliance, maintaining a safe work place, and protecting the environment. All radioactive waste generators must adhere to the waste minimization and waste segregation guidelines established by the Radiation Safety Committee working in conjunction with the Office of Environmental Health & Safety.

Failure to adhere to the segregation and disposal procedures outlined here may result in:

1. Radioactive waste being returned to the laboratory of origin for repackaging,

OR

2. Laboratory personnel repackaging the radioactive waste at the radioactive storeroom.

Thank you for your assistance and cooperation in complying with the following RSC protocols for the proper segregation and disposal of radioactive wastes at Boston College. Please contact the Office of Environmental Health & Safety (0363 or 0308) should you have any questions, comments, or concerns regarding these protocols.

SOLID RADIOACTIVE WASTE SEGREGATION AND DISPOSAL

Solid radioactive waste generally consists of dry contaminated laboratory materials, equipment, and supplies such as paper, glass and plastic products.

- Segregate solid radioactive waste by radionuclide(s).
- Dispose of waste in clear plastic bags. Do not leave radioactive labels and tape on short lived waste.
- Use a separate bag per category or radionuclide grouping. Acceptable solid radioactive waste radionuclidic categories are noted below. Special radionuclidic segregation may be necessary and can be made at the discretion of the RSO or RSC.

A. Long-Lived Radionuclidic Categories [>90 day half-life]:

1. ^3H and/or ^{14}C

2. ^{99}Tc , ^{22}Na , ^{36}Cl , ^{45}Ca , ^{57}Co , ^{58}Co , ^{55}Fe , ^{63}Ni , ^{90}Sr , ^{75}Se , ^{137}Cs , ^{65}Zn
(excluding ^3H and ^{14}C)

B. Intermediate-Lived Radionuclidic Categories [>18 day - < 90 day half-life]:

1. 125I
2. 35S, 124Sb NOTE: DO NOT combine 35S with 125I.
3. 33P, 59Fe, 89Sr, 203Hg, 51Cr, 86Rb

C. Short-Lived Radionuclidic Categories [< 18 day half-life]:

1. 32P, 123I, 131I, 64Cu, 11C, 115Cd, 111Ag
2. 24Na, 99mTc, 42K

IMPORTANT REMINDERS:

- Employ waste minimization techniques at all times.
- Only the RST can dispose of solid radioactive waste.
- DO NOT discard radioactive materials as normal trash.
- DO NOT discard non-radioactive waste with radioactive wastes.
- DO NOT discard vials or other containers which contain standing liquid (>0.5ml) with solid waste.
- DO NOT discard liquid scintillation vials in with radioactive solid waste.
- DO NOT discard lead or leaded materials in with radioactive waste. Request a special collection.
- DO NOT discard chemicals in with radioactive waste.
- DO NOT discard SHARPS in with regular solid waste. Use Rad Sharps containers only.
- DO NOT use translucent or opaque bags to discard radioactive waste. Use clear bags only.
- DO NOT leave radioactive labels or tape on short-lived waste.
- DO NOT mix radionuclides except as noted above.
- Maintain a record of each radionuclide, activity (uCi or mCi), and date bag filled.
- Inform the RST prior to collection if contact exposure rate on container exceeds 50 mrem/hr.

INAPPROPRIATELY DISCARDED MATERIALS DISCOVERED IN WASTE CONTAINERS WILL RESULT IN THE CONTAINER BEING RETURNED TO THE LABORATORY OF ORIGIN FOR REPACKAGING.

LIQUID RADIOACTIVE WASTE SEGREGATION AND DISPOSAL

Liquid radioactive waste generally consists of rinse water from contaminated glassware and laboratory equipment, Liquid Scintillation Fluids, and other chemicals/solvents.

Water soluble/dispersible non-hazardous liquid waste can be sinked disposed within the limits of Tables 2 and 3 of Appendix C of the Radiation Safety Manual and 360 CMR (Code of the Massachusetts Register) Sections 10.023-10.025 of the MWRA Sewer Discharge Regulations. Calculation of minimum diluent volume must be performed in accordance with the formulas

given in Appendix C of the Manual. Sink disposal should be followed by repetitive flushings with water and can only be performed in the designated radioactive disposal sink in the laboratory. Sink disposal log sheets must be filled out for each sink discharge of radioactive material specifying the date, amount, activity, and the person responsible.

Inorganic, water soluble Liquid Scintillation fluids (LSF) may be disposed of down the sink as long as they meet the criteria outlined in Tables 2 and 3 of Appendix C of the Radiation Safety Manual and Sections 10.023-10.025 of the MWRA Sewer Discharge Regulations.

Organic LSF is not to be used at Boston College beyond April 1, 1993. Organic radioactive liquids generated as an inherent part of an experiment should be avoided. If generated they must be disposed of as radioactive and chemical hazardous waste. Short-lived and long-lived organic radioactive waste must be separated.

Short-lived radioactive organic liquid waste with half-lives <18 days should be labelled and stored-for-decay in the BC Radioactive Waste Storage Facility. After 10 half-lives the waste will be disposed of as chemical hazardous waste. Combine the material vermiculite or plaster of Paris and call the RST for a pick-up of full containers.

Long lived Organic Liquids should be avoided at all costs. There are currently no disposal outlets for this mixed waste. Treat to separate radioactivity by carbon filtration or ion exchange. Filters and ion exchange media will then be treated as mixed waste while the organic eluent will be treated as chemical hazardous waste. Monitor activity to ensure that levels are at background. Combine untreatable waste with adsorbent material and separate from all other waste categories. Label as "Mixed" Waste, Radioactive and Chemical Hazardous Waste.

- DO NOT mix radionuclidic categories.
- DO NOT pour organic radioactive liquids down the drain. They MUST be labelled as radioactive and chemical waste and stored in organic waste containers for treatment as specified above.
- DO NOT mix bleach or acid with radionuclides. Bleach and acids enhance volatile nature of radionuclides.
- DO NOT use Organic Liquid Scintillation Fluids. Switch to the inorganic, biodegradable fluids.

LIQUID SCINTILLATION VIAL SEGREGATION AND DISPOSAL

FILLED LIQUID SCINTILLATION VIALS (LSF)

The Radiation Safety Technician will collect filled or partially filled liquid scintillation vials containing RSC approved non-hazardous or biodegradable scintillation fluids provided the vials are sorted and packaged according to the methods below. Toluene and xylene based scintillation fluids will be collected for disposal by the RST until prohibited from use on the BC Campus as of April 1, 1993. The use of organic LSF beyond this date will result in a report of non-compliance. Liquid Scintillation Vials can be disposed of by incineration as hazardous waste as long as average concentrations per box are below background.

Segregate vials by radionuclidic content. Acceptable categories per tray or box are:

- 3H and/or 14C

- 32P, 99mTc, 131I
- 35S, 33P, 125I

Segregate vials by type: Glass or plastic.

- DO NOT mix glass and plastic within the same box or tray.
- DO NOT mix organic and inorganic LSF vials within the same tray or box.
- Ensure that vial cap is tightly secured.
- Label each tray or box with the appropriate radionuclides.
- Seal boxes securely with masking tape. DO NOT use radioactive material tape.
- Label box with the following information:
 - radionuclide(s)
 - activity (uCi) of each radionuclide
 - the word "Plastic" or "Glass"
 - the words "Organic" or "Inorganic" LSF

IMPORTANT REMINDERS

- DO NOT discard organic LSF down sink drains
- DO NOT discard other forms of radioactive waste (gloves, paper, syringes, etc.) in with vials.
- DO NOT discard of vials in with other solid radioactive waste.
- DO NOT discard "hot" commercial stock vials in with scintillation vials.
- DO NOT use radioactive material tape to seal boxes of scintillation vials.
- Maintain a record of the radionuclide(s) and activity (uCi) of each radionuclide placed in the scintillation waste box; be as accurate as possible.
- REUSE/RECYCLE scintillation vials whenever possible.

EMPTY SCINTILLATION VIALS

- Follow procedures for Filled vials except note activity as <10 uCi.
- DO NOT discard of empty scintillation vials in with other solid radioactive waste.

RADIOACTIVE SHARPS

Sharps are those objects which represent a puncture or laceration hazard. Such objects include, but are not limited to; syringe needles (capped or uncapped), razor blades, scalpel blades, xacto knife blades, sharp metal objects, pastuer pipettes, capillary pipettes, and broken glass.

To avoid potential injury to yourselves and the Radiation Safety Technician, radioactive sharps are not to be placed in with other solid radioactive waste. All radioactive sharps must be disposed of in commercially available sharps containers labelled with radioactive material tape. These containers are to be used for sharps ONLY. Sharp objects discovered in regular radioactive waste bags will result in the bag being returned to the laboratory of origin for proper segregation and repackaging and will also result in a report of non-compliance.

MIXED-WASTE (RADIOACTIVE/CHEMICAL)

Mixed waste is defined as a mixture of low-level radioactive waste (LLRW) and a hazardous

chemical. Specifically, a waste is considered hazardous if it is: 1) a RCRA listed waste, and/or 2) a characteristic waste as defined in the Code of the Federal Register (CFR), Title 40, Environmental Protection Agency (EPA), Section 261.30, Subpart D. Wastes or chemicals not listed in the RCRA list should be tested to determine if they have the properties or characteristics that render them hazardous. These properties include 1) Reactivity; release cyanide or sulfide when exposed to a pH between 2 and 12, react violently with water, generate toxic gases, vapors or fumes when mixed with water, or is capable of detonation or explosive reactions at standard temperature and pressure or when subjected to a strong initiating force, 2) Corrosivity; pH <2 or > 12, 3) Ignitability; Flashpoint < 140oF (60oC) and 4) exhibits toxicity characteristics as outlined in CFR 40, Part 261, Appendix II. In order to determine whether or not the LLRW generated in your laboratory is mixed waste, contact the RSO at ext. 0163.

Radionuclide users are strongly encouraged NOT to generate mixed waste at Boston College. Segregate radioactive waste from chemical waste whenever possible. DO NOT combine chemicals and radioactive waste in the same container unless the combination is an inherent part of your experimental protocols. Isolate chemical and mixed waste from all forms of pure aqueous or solid form radioactive wastes. Minimize the volume of unavoidable mixed waste at all times. Try using micro procedures if possible. The generation of mixed waste by merely mixing chemical and radioactive wastes together in the same container as a means of disposal is unacceptable and prohibited and will result in a report of non-compliance. Contact the RSO or RSC for guidance and recommendations.

Appendix T

Radioisotope User Self-Monitoring Record

NRC Regulations require all users of radioactive isotopes to perform daily self monitoring and keep records of the monitoring activity. Please fill in the form below each day when you complete your work with radioactive materials. Monitoring should include your work area, hands, labcoat, shoes, refrigerator doors, scintillation counter, etc. Record NDA (No Detectable Activity) under activity if everything is clean. Note the location of contamination if any is found and actions taken to clean-up.

Principle Investigator: _____

Laboratory Room #: _____ Building: _____

Performed by: _____

Appendix U. Authorization to Posses and Use Equipment that Produces Ionizing Radiation

SECTION 1.0

1.1 Name of Principal Investigator who will supervise the use of the equipment and provide hands-on-training to authorized users:

1.2 Location of the equipment: Building _____ Room _____

1.3 Description of equipment, including operating parameters (voltage, amperage), target materials, detector attachments and use. Maximum kV: _____ ,

Maximum mA: _____ .

1.4 Description of safety devices including enclosures, shutter beam ports, warning lights, interlocks, and shielding.

1.5 Description of routine uses of the x-ray equipment including the purpose of experiments and the users.

1.6 Radiation survey meter available in the lab: Brand_____

Model_____

SN _____ .

1.7 Diagram of x-ray location and setup:

1.8 General conditions of the authorization:

1.8.1 The proposed work will be performed in the manner described in the sections above.

There will be no charges to the operating without the prior approval of the Radiation Safety

Officer (RSO). The RSO shall be notified in writing prior to a change in location or use of the equipment.

1.8.2 The use of the equipment will conform to all the requirements outlined in the BC Radiation Safety Manual.

1.8.3 All personnel will receive radiation safety training from the Radiation Safety Office and hands-on-training from myself prior to the use of the equipment.

Project Supervisor Signature _____ Date _____

Project Supervisor Name (Print) _____

SECTION 2.0

2.1 Specific conditions required by the Radiation Safety Office:

Approved by: _____ Title: _____ Date: _____

Appendix V. X-Ray Machine Annual Monitoring Record

Date Performed: _____

Performed by: _____

Location of Unit (Building & Room #): _____

Responsible Staff Member: _____

Brand Name: _____

Model (#): _____

Serial #: _____

Description (i.e. spectrometer, generator) _____

Year purchased or installed: _____

Monitoring Information:

Radiation at 5 cm from surface of closed shutters: _____ mRem/hr.

(Must be less than 2.5 mRem (0.025 mSv) in 1 hour)

Radiation at 5 cm from generator cabinet: _____ mRem/hr.

(Must be less than 0.25 mRem (2.5 uSv) in 1 hour)

Radiation in surrounding area? _____ (mRem/hr)

Distance from generator: _____ (ft)

Background Readings: _____ (mRem/hr)

Appendix W. Radioactive Materials Inventory

Isotope: Laboratory: _____

Used Total (mCi)

Name Date Recieved (mCi) Waste (mCi) Sink (mCi) in Lab

APPENDIX X: RADIOACTIVE MATERIAL ORDER/REPORT FORM

NOTE: Orders for radioactive materials cannot be processed unless this form is completed and returned to the Radiation Safety Technician.

LAB: _____ BLDG & RM # _____

NUCLIDE: _____ SUPPLIER: _____

LAB HOLDING LIMITS FOR THIS
NUCLIDE: _____ (mCi)

CURRENT HODINGS FOR THIS
NUCLIDE: _____ (mCi)

NOTE: BE SURE THIS AMOUNT AGREES WITH YOUR LAB LOG BOOK.

AMOUNT BEING
ORDERED: _____(mCi)

ORDERED BY: _____ DATE:
_____/_____/_____

This form is to be faxed for approval to the Radiation Safety Technician, 617-552-1093

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