

**Radiation Safety Policy
& Procedures**



**Brock
University**

**Radiation Safety Committee
Revised May 2004**

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A. RADIATION SAFETY - ADMINISTRATION

1. Radiation Safety Committee (RSC)

- 1.1 The RSC receives its authority from the President of Brock University. It is responsible for coordinating and controlling all activities related to radiation safety.
- 1.2 The RSC consists of:
 - 1.2.1 A person with competence in radiation safety and practical knowledge of the nature and use of radioactive material, who will act as the Radiation Safety Officer;
 - 1.2.2 A representative of each department using radioactive material;
 - 1.2.3 A representative of the administration;
 - 1.2.4 A union or staff representative;
 - 1.2.5 One staff member from technical services.
- 1.3 To meet its responsibilities, the RSC has the following authority:
 - 1.3.1 To authorize and control by the issue of internal permits the use of radiation emitting sources and materials within the limits of the radioisotope licenses issued by the Canadian Nuclear Safety Commission (CNSC). Internal permit holders are bound by the regulations stated in section A.3.
 - 1.3.2 To administer a radiation safety program to ensure that all persons involved in the handling of radioisotopes have appropriate training to enable them to perform their duties safely. The program is designed to ensure that radiation exposure by any person be kept as low as reasonably achievable (ALARA principle).
 - 1.3.3 To suspend the use, at the University, of radiation emitting sources and materials, regardless of any other source of authorization.
 - 1.3.4 To inform the Associate Vice President, Research and the Deans of all faculties in which radioactive sources are used of the hazards associated with all radiation emitting sources and materials.
 - 1.3.5 To produce and continually review the Brock University Radiation Safety Policies.
 - 1.3.6 To maintain a file on all radiation laboratories and operations. The file shall include a copy of internal permit applications and authorized permits, an inventory of radioactive sources, a copy of RSC laboratory inspection reports, a copy of Personnel dosimeter records. Such files shall be considered active until all of the radioactive sources have been accounted for, either by disposal or by safe storage.

- 1.3.7 To approve the purchase of radioactive materials and x-ray sources in accordance with the specifications of authorized projects.
- 1.3.8 To approve the storage of radioactive waste on campus and to organize the removal of radioactive waste from the campus.
- 1.3.9 To administer a personnel dosimetry service on behalf of the users and to maintain all necessary records.
- 1.3.10 To receive information from the Office of Research Services of research applications that may require oversight of the RSC and to inform the Office of Research Services of researchers who require a radioisotope permit in order to carry out their proposed research programs and/or operate research equipment. Annual Reports of the RSC will be filed with the Office of Research Services.

2. **Radiation Safety Officer (RSO)**

2.1 The responsibilities of the RSO are:

- 2.1.1 To chair meetings of the committee normally held every six months.
- 2.1.2 To present an annual report (Jan.-Dec.) of the activities of the RSC to the CNSC.
- 2.1.3 To ensure that each incident involving radioisotope spillage or exposure to ionizing radiation is evaluated to decide if decontamination procedures and/or medical examination should be carried out.
- 2.1.4 To receive documentation for internal permit applications and to administrate their authorization.
- 2.1.5 To ascertain the requirements for personnel monitoring and approve the use of radiation detection instruments and dosimeters.
- 2.1.6 With the assistance of the RSC, inspect and approve according to Government standards, all proposed radiation laboratories and to inspect annually all such laboratories.
- 2.1.7 With the assistance of the RSC, supervise the leak testing of all large sealed radioisotope sources as required by Government regulations and make periodic checks on contamination in radioisotope laboratories.
- 2.1.8 To ensure that general advice on radiation hazards and protection is available to users.

3. Internal Permit Holders

- 3.1 Will be faculty members with experience in the safe handling of radiation emitting sources and materials. Each permit holder is responsible for:
- 3.1.1 Provision of adequate facilities, equipment, instruments, supervision and instruction to control radiation hazards and to comply with the University's radiation protection standards.
 - 3.1.2 Maintain an up to date listing with the RSO of the rooms in which radioactive material is stored or handled, and of rooms in which radiation-emitting equipment is used.
 - 3.1.3 The maintenance of an inventory of radioactive materials used in his/her project, and to ensure that the project does not exceed its allotment of radioactive material. An up to date inventory must be submitted annually at the request of the RSO, outlining the quantity received, disposed and the balance.
 - 3.1.4 Keeping records of the disposal of radioactive material.
 - 3.1.5 Ensuring that personnel wear appropriate film badges or pocket dosimeters, if required.
 - 3.1.6 Allowing only authorized persons to enter rooms that are specified as restricted areas for reasons of radiation protection. These rooms must be kept locked when unattended. All radioactivity inventory must be kept in a secure location.
 - 3.1.7 The posting of warning signs and labels as required by CNSC Regulations and Radiation Safety Policy.
 - 3.1.8 Posting appropriate basic or intermediate laboratory rules in the radioisotope laboratories. Copies may be obtained from the RSO.
 - 3.1.9 Establish a daily laboratory procedure to ensure that at the end of the workday:
 - (a) measurements have established that external radiation and contamination levels are within permissible limits that are given in Appendix 1. Records are to be kept and maintained for 3 years.
 - (b) radiation sources are properly labeled and stored;
 - (c) experiments that will be in progress after normal working hours will be properly attended;
 - (d) each laboratory is secured against unauthorized access.
 - 3.1.10 Performing leak tests capable of detecting the presence of radioactive material on each specified sealed source (normally sources less than 50 MBq and gaseous sources such as Krypton 85 are excepted) at least once every 6 months for sources in active use, 12 months for sources within a radiation

device, 2 years for sources in storage and after any incident which could result in source damage. All test samples will be sent to a CNSC approved company for measurement. Records shall be maintained for at least 3 years. If removable contamination in excess of the CNSC contamination criterion for the particular radioisotope is detected, the source shall be isolated, its use immediately discontinued, and the CNSC notified.

3.1.11 Report all radiation incidents in accordance with Radiation Incidents - Emergency Procedures, Section G.

4. **Radiation User**

4.1 Each individual who may use radioactive materials or sources of ionizing radiation is responsible for complying with the procedures and precautions contained in the Radiation Safety Policy and Procedure and with those prescribed in the permit. Every user must have received appropriate training and have been informed of the risks associated with exposure to radiation prior to commencement of work procedures.

B. **RADIATION - WORK PROCEDURES**

1. **Definition of A Nuclear Energy Worker**

1.1 "Nuclear energy worker" means any person who in the course of his work, business or occupation, is likely to receive a dose of ionizing radiation in excess of any dose specified in Appendix 1, Table 2. Minors (persons under the age of eighteen) may not be employed as "nuclear energy workers".

1.2 Each person who, in the opinion of the RSC, may be exposed to external or internal radiation (except prescribed medical treatment) in excess of the limits listed in Appendix 1, Table 2, will be considered as a "nuclear energy worker".

1.3 Each "nuclear energy worker" as defined in Section 1.1, must register with the Chairman RSC and receive a radiation protection instruction-interview.

2. **Medical Examinations**

2.1 Each person registered as an "nuclear energy worker" shall be required to have medical examinations of such a nature and at such intervals as required on the advice of the CNSC.

2.2 Any person using radioactive substances may be removed from such work on the advice of CNSC.

3. **Exemption Quantity of a Radioisotope**

3.1 "Exemption Quantity" means, in relation to an isotope, the quantity listed in the CNSC document "Nuclear Substances and Radiation Devices Regulations". Sources less than exemption quantities are license exempt according to the Regulations. However, on the Brock University campus the exemption quantity is used only as a reference and approval must be obtained for work involving any radioactive material, even quantities less than the exemption quantity. Some exemption quantities are listed in Appendix 3.

4. **Permissible Exposures**

4.1 Exposure to ionizing radiation shall be kept as low as reasonably achievable (ALARA principle).

4.2 The exposure from sources of radiation shall normally be controlled in such a way as to provide assurance that no individual or user, except a nuclear energy worker, shall receive an absorbed dose in excess of the values listed in Appendix 1, Table 2. Non-nuclear energy workers should not incur a whole body dose in excess of 0.1 mSv/week.

4.3 Maximum permissible doses for nuclear energy workers are listed in Appendix 1, Table 2. Nuclear energy workers shall not incur a whole body dose in excess of 1 mSv/week.

5. **Personal Monitoring**

5.1 Each radiation user must ensure that radiation exposure and contamination are properly controlled during the work with radiation so that the prescribed permissible limits given in Appendix 1 are not exceeded.

5.2 Personal dosimetry badges (TLD badges) to users who perform work that meets or exceeds the criteria given in Appendix 1, Table 3. All users must have received radiation safety training prior to being issued a badge and prior to starting work procedures involving radioisotopes.

5.3 Bioassay for I125 and I131 Users.

All users of volatile I125 or I131 who perform work that meets or exceeds the limits in the following table must participate in the Bioassay program.

<u>Work Site</u>	<u>Single Use Quantity of I125 or I131</u>
Open bench	5 MBq or 0.135 mCi
Fume hood	50 MBq or 1.35 mCi
Glove box	500 MBq or 13.5 mCi

All users who plan on exceeding these limits must obtain written permission from the RSC prior to use so that bioassays can be scheduled.

All users exposed to a spill of 5 MBq or greater must notify the RSO and must participate in the Bioassay program.

Bioassays will be arranged with the Niagara Health System. Results will be returned to the RSO who will notify the user of the outcome.

Internal exposure to I125 or I131 will be estimated with an instrument that can detect 1 KBq of I125 or I131 in the thyroid or by another bioassay authorized by the CNSC. If more than 10 KBq of I125 or I131 is detected, a second bioassay will be performed as soon as possible.

6. Laboratory Monitoring

- 6.1 Permit holders and all users of radioisotopes must monitor radioactive contamination on work surfaces as part of each work procedure. Design plans for areas where radioisotopes are used should indicate the areas tested for contamination. Wipe test records must be stored in the laboratory and must correspond to inventory records indicating the date of use.
- 6.2 **Wipe test procedures.** Cut a 5 cm x 1 cm piece of absorbent filter paper and moisten it with alcohol or water. Rub the last 1 cm over the test surface to cover a total area of approximately 100 cm. Allow the paper to dry and cut the final, exposed 1 cm x 1 cm piece into a scintillation vial. Add scintillation fluid, cap the vial and count for 1 -2 minutes in a scintillation counter with a broad spectrum (wide open) channel setting. Write the results in the lab record book and staple the counter print out to the page. Decontaminate any controlled work area with a recorded measurement of 300 Bq/cm² or greater or any public area with a count of 30 Bq/cm² or greater for any Class C substances, 30 Bq/cm² or greater or any public area with a count of 3 Bq/cm² or greater for any Class B substances or 3 Bq/cm² or greater or any public area with a count of 0.3 Bq/cm² or greater for any Class A substances (see Appendix 3, Table 2, p. 16). The decontaminated area must be re-tested to ensure that contamination does not exceed the acceptable limits above.
- 6.3 **Contamination meter procedures.** All survey meters must be checked for efficiency at least annually. To do this check, obtain three certified radioisotope standards that emit beta particles with maximum energies from 50 KeV to 2 MeV. Place one of the standards on a flat surface and hold the detector probe over the source at a distance of 1 cm. Record the count rate. Repeat with the other standards and calculate efficiency as:

$$\text{Efficiency} = \frac{\text{Counts from standard} - \text{background counts}}{\text{Known standard activity}}$$

Graph efficiency vs. beta-particle maximum energy.

For daily operation, check the battery of the instrument. Hold the detector approximately 1 cm from the surface to be tested and move the detector slowly over the surface. Do not touch the surface. Record the measurement in the lab record book. Surface contamination is calculated by:

$$\text{Surface contamination} = \frac{\text{Counts} - \text{background}}{\text{Probe area (cm)}} \times \frac{1}{\text{Efficiency}}$$

Decontaminate any controlled work area with a calculated measurement of 300 Bq/cm² or greater or any public area with a count of 30 Bq/cm² or greater for any Class C substances, 30 Bq/cm² or greater or any public area with a count of 3 Bq/cm² or greater for any Class B substances or 3 Bq/cm² or greater or any public area with a count of 0.3 Bq/cm² or greater for any Class A substances (see Appendix 3, Table 2, p. 16). The decontaminated area must be re-tested to ensure that contamination does not exceed the acceptable limits above.

7. Decontamination Procedures

Good work procedures will help to prevent contamination problems. If contamination does occur use one or more of the methods given below. The initial method of choice is scrubbing with minimal amounts of hot water with decontamination solutions. All waste materials must be disposed of appropriately. Consult the RSC for large-scale problems.

Method	Application	Advantages	Disadvantages
Water and Detergent	All surfaces	Very effective if done immediately after spill	Poor for porous surfaces
Decon	Nonporous surfaces	Contamination remains in solution; non-toxic	Long soaking required; little penetration
Organic Solvents	Nonporous surfaces	Quick	May be toxic or flammable.
Abrasion	Nonporous surfaces	Remaining contamination very low	Ineffective on porous surfaces

8. Authorization for Use of Radioisotopes

8.1 Prior to possessing or using radioactive material, authorization must be obtained from the RSC.

8.1.1 Complete an "Application for Radioisotope Permit" and forward to the RSO. A copy of the application is illustrated in Appendix 4. The requested "possession quantity" of radioactive material relative to the

exemption quantity, Appendix 3, and the limits given in Appendix 2, determines the manner in which approval is given.

- (a) for quantities less than 100 exemption quantities, immediate conditional approval may be given.
- (b) for quantities less than the limits given in Appendix 2, the application must be circulated to all members of the RSC and if no objections are received, approval may be granted seven days after circulation.
- (c) for quantities greater than the limits given in Appendix 2, the application must be considered at a meeting of RSC.

8.1.2 After approval, an internal permit will be issued and a copy of the application will be returned to the applicant stating the conditions of approval.

8.1.3 If any changes are to be made to a Radioisotope operation, the permit holder must apply in writing to the RSO for an amendment to the permit.

8.2 Each room or laboratory in which radioactive material is to be handled or stored must be approved for use by the RSC. A copy of the internal permit must be posted in plain view in the room.

9. Procurement of Radioisotopes

9.1 To receive authorization for radioisotope purchase, all permit holders must complete and submit their radioisotope purchase requisition. Authorization to sign radioisotope purchase orders is vested in designated members of the RSC.

9.1.1 Personnel receiving radioisotope shipments from off campus must be authorized by the RSC. Only those individuals who have had Transport of Dangerous Goods training will receive this authorization. Shipments must be inspected in the receiving laboratory as soon as possible for damage or contamination of the packaging material. CNSC poster INFO-0426 "Receiving of Radioactive Packages" should be used as a guide. The RSC must be notified of any damaged materials.

10. Use and Storage of Radioisotopes

10.1 Any laboratory in which radioactive material is used or stored shall be classified as a radioisotope laboratory and authorized by the Brock University RSC.

10.2 The quantity of radioactive material used or stored in a laboratory shall not exceed that specified on the internal radioisotope permit issued by RSC. The permissible radioactivity, and appropriate modifying factors, that can be accommodated in a normal radioisotope laboratory may be estimated from the data in appendices 2 and 3.

- 10.3 Radioactive material shall be kept or stored in a manner that:
 - 10.3.1 the storage container is labeled in accordance with the regulations of Radiation - Signs and Labels, Section E.
 - 10.3.2 provides adequate radiation shielding as prescribed in the users permit.
 - 10.3.3 provides adequate protection against theft, fire, explosion, flooding or accidental breakage of primary storage containers.
- 10.4 Containment and disposal of radioactive waste will be in accordance with the procedure outlined in Radioisotopes - Disposal, Section C.

11. **Termination of Radioisotope Operation: Decommissioning Rooms**

- 11.1 The permit holder is responsible for removal of all radiation warning signs, monitoring all areas, decontaminating areas to meet CNSC limits, updating and maintaining all records for a period of three years after the termination of operations. The RSC must be notified of all users who were issued personal dosimeters and whose names will be removed from the dosimetry list. Complete Section 3 of the Application for Radioisotope Permit and forward to the RSO. Account for all radioisotopes acquired and used for the project in the preceding year. Indicate the amounts and storage location of any remaining radioactive material.
- 11.2 Radioactive material may not be transferred to the possession of any person nor used for any purpose in any place other than originally authorized without prior approval of the RSC.
- 11.3 The RSC will arrange and coordinate the disposal and/or relocation of radioisotopes.
- 11.4 Residual contamination in decommissioned rooms must not exceed 30 Bq/cm² in any area.

APPENDIX 1

MAXIMUM PERMISSIBLE LEVELS

Dosage Units

"The seivert (Sv)" means a dose of ionizing radiation that has the same biological effects as 200-250 kilovolt X-rays whose energy is absorbed by the body or any tissue or organ thereof in an amount 1 joules per kilogram.

For purposes of evaluating the biological effects of different radiations "Weighting Factors" are employed as given in Table I.

TABLE 1

Radiation	Weighting Factor
200-250 KeV X-rays	1
γ -rays, $-\beta$ rays and electrons	1
Thermal neutrons	3
Fast neutrons (greater than 0.8 MeV), protons and α -particles	10
Heavy recoil nuclei	20

Maximum Permissible Doses

TABLE 2

	Members of the Public	Nuclear Energy Workers
Organ, Tissue	mSv per year	mSv per year
Whole body	1	50*
Skin	50	500
Extremities: hands and feet	50	500
Extremities: head, eye lens	15	150

* If the person is known to be pregnant, the dose shall not exceed 4 mSv during the period of the pregnancy.

APPENDIX 1 (Cont'd)

Personal Dosimetry

TABLE 3

Radioisotope	Process or Quantity per Single Use	Whole Body TLD	Extremity: Wrist or Ring
H3, C14, S35	Not applicable.	Not required	Not required
P32	<50 MBq	Yes	No
	>50 MBq	Yes	Yes (Ring)
I125, I131	Iodination	Yes	Yes
	RIA	Yes	No

Maximum permissible contamination of work surfaces

The internal permit holder shall ensure that the levels of loose beta and gamma radioactive contamination on all normally accessible working surfaces in a radioisotope laboratory do not exceed 300 Bq/cm² or greater or any public area with a count of 30 Bq/cm² or greater for any Class C substances, 30 Bq/cm² or greater or any public area with a count of 3 Bq/cm² or greater for any Class B substances or 3 Bq/cm² or greater or any public area with a count of 0.3 Bq/cm² or greater for any Class A substances (see Appendix 3, Table 2, p. 16). The contamination level may be averaged over an area not exceeding 100 square centimeters.

The maximum permissible levels of loose alpha contamination should be one tenth those specified for beta or gamma emitting isotopes. For fixed contamination, maximum permissible levels should depend upon the measured radiation fields. Notwithstanding these levels, licensees are expected to keep radiation fields and contamination levels as low as reasonably achievable.

APPENDIX 2

PERMISSIBLE ACTIVITY IN RADIOISOTOPE LABORATORY

TABLE 1

1 Bequerel (Bq) = 1 disintegration per second (dps)

1 curie (Ci) = 3.7×10^{10} dps = 37 GBq.

RADIOTOXICITY OF THE INDIVIDUAL RADIONUCLIDES	PERMISSIBLE LEVEL OF ACTIVITY
Very High	100 μ Ci
High	10 mCi
Moderate	** 100 mCi
Slight	1 Ci

** Except for Mo/^{99m}Tc generators and ⁹⁹Tc eluate, for which the permissible activity is 3 Ci.

TABLE 2

TYPE OF OPERATION	MODIFYING FACTORS
Storage	x10
normal chemical operations	x1
dry and dusty operations	x .01

APPENDIX 3

TABLE 1
Half Life and Exemption Quantity of Some Radioisotopes

<u>Isotope</u>	<u>Half Life</u>	<u>Exemption Quantity (MBq)</u>
Americium 241	458 y	0.001
Beryllium 7	54 d	1.0
Bismuth 207	30 y	0.1
Cadmium 109	470 d	1.0
Calcium 45	165 d	1.0
Carbon 14	5770 y	100
Cerium 144	285 d	0.1
Cesium 137	30 y	0.01
Chlorine 36	3 x 10 ⁵ y	0.01
Chromium 51	28 d	1.0
Cobalt 60	5.3 y	0.1
Copper 64	13 h	0.1
Curium 242	163 d	
Hafnium 181	45 d	
Hydrogen 3	12.3 y	1000
Iodine 125	60 d	1.0
Iodine 131	8 d	0.01
Iron 55	2.7 y	1.0
Iron 59	2.7 y	0.1
Lead 210		0.01
Manganese 54	291 d	0.1
Mercury 203	47 d	0.1
Molybdenum 99	66 h	0.01
Nickel 63	92 y	10.0
Phosphorus 32	14 d	0.01
Radium 226		0.01
Rubidium 86	19 d	0.01
Selenium 75	120 d	0.1
Sodium 22	2.6 y	0.01
Strontium 90	28 y	0.01
Sulfur 35	87 d	100
Thorium 228		0.0001
Zinc 65	245 d	1.0

TABLE 2
Classification of Radioisotopes

The following radioisotopes have been grouped by the CNSC into class A, B or C based upon radiological properties. Contamination monitoring limits for public or work areas are dependent upon this classification. When using more than one radioisotope in a room, the radioisotope with the lowest limit must be used to determine the contamination limit, Class A, B or C that applies to that room. Contact the RSO for information on radioisotopes not included in this table.

CLASS	RADIOISOTOPE				
Class A	All alpha emitters and their daughter isotopes.			Na-22	Na-24
	Co-60	Ir-192	Sb-124	Ta-182	Zn-65
Class B	As-74	Au-198	Br-82	Co-58	F-18
	Fe-59	Ga-67	Gd-153	Hg-203	I-131
	In-111	In-114m	Nb-95	Rb-84	Rb-86
	Sc-46	Se-75	Sm-153	Sn-113	Sn-123
	Sr-85	Sr-90			
Class C	Au-195m	C-14	Ca-45	Cd-109	Ce-144
	Cl-36	Co-57	Cr-51	H-3	I-123
	I-125	Ni-63	P-32	P-33	Re-186
	Re-188	Ru-103	S-35	Sr-89	Tc-99
	Tc-99m	Tl-201	Y-90	Yb-169	

APPENDIX 4

1. APPLICATION FOR RADIOISOTOPE PERMIT

Complete Section 1 and forward to the Radiation Safety Officer (RSO). When approved, the application will be assigned a number and a copy will be returned to the permit holder. The conditions of approval will be indicated in Section 2.

2. TERMINATION OF RADIOISOTOPE LABORATORY OPERATIONS

Complete Section 3 and forward a copy, along with your records to the RSO. Account for all radioisotopes acquired and used for your project.

Radioactive material may not be transferred to the possession of any person nor used for any purpose in any place other than originally authorized, without prior approval of the Radiation Safety Committee.

Radiation Safety Committee, Brock University
APPLICATION FOR RADIOISOTOPE PERMIT
SECTION 1

The completed application will be returned upon permit approval.

1. APPLICANT

Name	Department	Building	Room No.	Tel Ext.

2. TECHNICIANS and others handling the material

NAME	DEPARTMENT	BUILDING	ROOM NO	TEL. EXT.

3. BUILDING AND ROOMS where material will be handled

DELIVERED TO	PREPARATION IN	USED IN	STORED IN

4. **DESCRIPTION** (Attach additional list if necessary)

Open Sources

Activity				
Isotopes	Maximum Held At one Time	Per Experiment	Annual Requirement	Form

Sealed Sources

Isotopes	Activity	Manufacturer	Model No.	Type of Device

5. STATEMENT OF INTENDED USE

6. **LIST OF INSTRUMENTS TO BE USED FOR RADIATION DETECTION AND MONITORING**

TYPE	SENSITIVITY mr/hr

7. **WASTE DISPOSAL***

ISOTOPE	PROPOSED METHOD OF DISPOSAL

* attach additional list if necessary

8. **ANTICIPATED DATE FOR PROJECT TERMINATION** _____

9. **APPLICANT'S SIGNATURE** _____

DATE _____

Permit No. _____
Permit Holder _____

Date Approved _____
Termination Date _____

SECTION 2. RADIOISOTOPE PERMIT

A. Comments related to the application

B. Conditions of approval

C. Requirements:

1. The proposed work shall be performed in the manner specified in Section 1 and 2B. There shall be no change in the procedures, equipment, radioactive material, or places of use without prior approval of the Radiation Safety Committee.
2. The use, storage and disposal of radioactive material shall be in conformity with,
 - (a) the Canadian Nuclear Safety Commission regulations,
 - (b) the provisions for radiation protection as stipulated in Brock University Radiation Safety Policy and Procedures.

APPROVED BY: _____
Radiation Safety Officer

RADIOISOTOPE - WASTE STORAGE AND DISPOSAL

C.

1. **Responsibility of Permit Holder**

Each radioisotope permit holder is responsible for the control, containment and identification of active wastes generated within his or her laboratory, and removal to waste containers provided by RSC.

2. **Containment**

2.1 In general, laboratory radioactive wastes should be segregated and contained such that:

2.1.1 the total amount of radioactive material put in any container must be controlled so that the radiation intensity at 30 centimeters is less than 0.5 mSv/hr.

2.1.2 material must not be put into waste collection containers if there is any possibility of a chemical reaction.

2.2 A record must be kept of the quantity and kinds of radioactive material disposed into each collection container.

3. **Disposal of Level One Radioactive Wastes**

3.1 Radioactive wastes may be disposed into the environment if the level of radioactivity is low enough to satisfy the following criteria:

3.1.1 Via the sewer, annual disposal limits for the University as a whole of some radioisotopes in a form readily soluble and dispersible in water are:

H-3	1000000 MBq/yr
C-14	10000 MBq/yr
P-32	1 MBq/yr
S-35	1000 MBq/yr
I-125	100 MBq/yr
I-131	10 MBq/yr

3.1.2 To the atmosphere provided that the resulting concentration in air at the point of release is less than:

H-3	37 KBq/m ³
I-125	0.03 KBq/m ³
I-131	0.175 KBq/m ³

3.1.3 Via normal garbage provided that the activity concentration is less than:

H-3	37 MBq/kg
C-14	3.7 MBq/kg
P-32	0.37 MBq/kg
S-35	0.37 MBq/kg
I-125	0.037 MBq/kg
I-131	0.037 MBq/kg

4. **Disposal of Level Two Radioactive Wastes**

4.1 **Solid Wastes**

- 4.1.1 Active dry waste should be collected in an appropriately labeled container lined with a heavy polyethylene bag. Sharp objects should first be placed in protective containers. Active dry waste should be removed to waste containers provided by RSC.
- 4.1.2 Disposal of other active waste (carcasses, sealed sources) must be done in consultation with RSC.

4.2 **Liquid Waste**

- 4.2.1 Non-aqueous radioactive waste solutions, including scintillation counter fluids, should be emptied into the appropriately designated containers. An inventory of volumes, chemical nature of all materials, and maximum level of radioactivity must be kept on the form adjacent to the container. No halogenated compounds are to be disposed of in this way.
- 4.2.2 Aqueous radioactive liquids should be emptied into an appropriately designated container.
- 4.2.3 Radioactive liquid wastes are stored in the flammable stores room and their disposal should be arranged through RSC.

D. **Radioisotopes - General Requirements and Precautions**

Observe Radioisotope Laboratory Rules posted in the Laboratory.

E. **Radiation Signs and Labels**

1. **Radioisotope Laboratories**

- 1.1 Laboratories in which radioactive isotopes are present shall have posted at each entrance to that laboratory, a sign with the radiation warning symbol and the words "Caution - Radioactive Materials". This sign must also include the names and local and home telephone number of responsible persons to be contacted in an emergency, and other special emergency instructions.
- 1.2 Cupboards, cabinets, refrigerators and other containers used to store active materials in the radioisotope laboratory must be identified with a radiation-warning label.
- 1.3 Primary storage containers must be identified with a radiation-warning symbol and information respecting the nature, form, quantity and date

of measurement of the radioactive isotopes contained within. Labelling is not required for containers such as beakers, flasks and test tubes used while the responsible individual is present.

2. **Other Radiation Areas**

2.1 Areas, rooms, or enclosures where the activity of any radioisotope may exceed 100 exemption quantities or where radiation fields may exceed 25 $\mu\text{Sv/h}$ must be posted with a radiation warning sign with information concerning the nature and extent of the radiation hazard. Appropriate radiation warning labels are required on all x-ray and other ionizing radiation producing devices.

3. **Unauthorized Use of Radiation-Warning Signs**

3.1 Radiation-Warning Signs must not be used in any location where radioisotopes are not present.

F. **X-ray Sources and other Radiation Producing Devices - Work Procedures**

- (a) A copy of the "Regulation made under the Public Health Act respecting X-ray Safety" shall be available in each area where X-ray equipment is used.
- (b) Care shall be taken to avoid personal exposure in a primary X-ray beam. Exposure in areas where radiation scatter is possible shall be kept to a minimum.
- (c) No interlock or other safety device shall be deliberately defeated. No "live" adjustments or alignments shall be made with any safety cover removed, except where the procedure has been specifically checked for safety and the method is documented.
- (d) When a modification to an X-ray source is introduced, either temporary or permanent, in operating technique, equipment arrangement or in ancillary equipment the modification shall be checked for safety and all changes documented.
- (e) Any person to whom a Monitoring Film Badge has been issued must wear it when in the vicinity of an X-ray source.
- (f) Any defect in X-ray equipment resulting in possible radiation hazard shall be reported to the responsible user who will inform the RSO.
- (g) Precautions must be taken to prevent personal injury from laser beams, in particular special care must be taken to ensure that light from a laser does not enter the eye of any person.
- (h) Eye protection should be worn when approaching an Ultra Violet light source.

G. **Radiation Incidents - Emergency Procedures**

1. All radiation incidents (exposure, spill, contamination, loss of source, etc.) must be reported immediately to the RSO. The RSO must report the incident to the CNSC within 24 hours and a written follow-up report must be sent to the CNSC within 21 days.
2. Persons exposed to internal or external radiation present no hazards to others. Such persons will be placed under medical supervision. Re-entry into the radiation area is prohibited, until authorized by the RSO or any member of the RSC.

3. In the event of personnel contamination, clothing and other articles that may be contaminated must be left in the controlled area. Contamination should be washed from the skin under running water until the arrival of experienced assistance.
4. In the event of a large spill, laboratory contamination, or environmental contamination, vacate the area. Do not attempt decontamination procedures and do not remove contaminated articles from the area. The RSO or a member of RSC will direct decontamination operations and authorize re-entry into the radiation area. Procedures used to decontaminate the area will be as outlined in Section B 7: "Decontamination Procedures" of the Radiation Safety Manual.