RADIATION SAFETY PROGRAM

Health, Safety and Environment Unit
Human Resources Department
# Radiation Safety Program

**University of Regina**

**RADIATION SAFETY PROGRAM**

Regulations with respect to the use of radiation-emitting devices or materials at the University of Regina

Issued by
The President’s Advisory Committee on Radiation Safety
2011

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1 RADIATION SAFETY ADMINISTRATION

1.1 Introduction

This manual consists of seven sections. It is intended for use and reference by academic staff members and others with responsibility for radiation safety. This manual is concerned primarily with ionizing radiation from radioactive nuclides and emitting devices such as X-rays, but also addresses non-ionizing radiation such as hazardous laser, microwave or pulsed electromagnetic radiation.

The purpose of this document is to prescribe procedures and standards to be followed to comply with legislated standards and to ensure the safety of the University and surrounding community from the risks related to radiation.

There are various Federal and Provincial regulations for controlling the use of radiation and setting permissible exposures. In situations in which neither of these bodies has established procedures or regulations the guidelines of the appropriate bodies of the United Nations will be used. The University is responsible to ensure that these regulations are being enforced to protect the safety of staff, students and the public, while at the same time, the use of the radiation for the benefit of the public and the furtherance of the aims of the University is to be encouraged.

Those staff and students who use radiation and radioactive materials are required to be familiar with their characteristics, their hazards, and the regulations governing their use. To meet its responsibilities, the University must know where the radiation and radioactive material are being used, who the users are, and their qualifications.

A requirement of the federal government is that a local committee be established to implement the radioactive materials regulations. The President’s Advisory Committee will serve in this capacity and will also oversee the use of the other radiations.

The President’s Advisory Committee on Radiation Safety (PACRS) will oversee the Radiation Safety Program and delegate a subcommittee, the Radiation Safety Committee (RSC), to develop and implement policies and procedures. The RSC will report to the PACRS and the RSC policies, procedures and decisions are subject to review and amendment by the PACRS.

1.2 Glossary

“ALARA PRINCIPLE” means to keep all exposures As Low As Reasonably Achievable, taking into account social and economic factors.

“CNSC” means the Canadian Nuclear Safety Commission.

“PACRS” means the University of Regina’s President’s Advisory Committee on Radiation Safety.

“RSC” means the University of Regina’s Radiation Safety Committee.

“RSO” means the University of Regina’s Radiation Safety Officer.

“ARSO” means the University of Regina’s Assistant Radiation Safety Officer.
1.3 Radiation Safety Policy

Policy Number: 20.105.60
Name: Radiation Safety Policy
Origin: Health, Safety and Environment (Human Resources Department)
Approved: December 2007
Approval Process: Vice-President (Administration)
Revision Date(s): December 2010

Introduction

The University of Regina holds a Licence from the Canadian Nuclear Safety Commission for the use of nuclear substances and radiation devices. All procurement, use, storage, transfer and disposal of these materials by a University employee under the auspices of the University is governed by the terms of this Licence. In addition, other radiation-emitting devices such as x-rays and lasers are covered by this policy.

Policy Statement

The University of Regina is committed to protecting all members of the University community and the environment from any adverse effects resulting from the use of ionizing and non-ionizing radiation on campus. This will be achieved by:

- Ensuring all legislative requirements for the safe use, storage, transfer and disposal of radiation and radioactive materials are met.
- Using the ALARA (As Low As Reasonably Achievable) principle as the guiding principle for all decisions and actions concerning the use of radiation and radioactive materials.

The Radiation Safety Program has been developed and shall be maintained to ensure the required level of control without unduly hampering research. The Radiation Safety Program describes in detail the roles and responsibilities of the Vice-President (Administration), Permit Holders and individuals, for the safe use of radiation and radiation-emitting devices. The Program ensures compliance with legislative requirements (Federal/Provincial acts, regulations, standards and guidelines and Municipal by-laws pertaining to health, safety and the environment).

Scope and Application

This Policy and its related program apply to Academic Staff members, staff, students and visitors to the university community who are engaged in research or teaching activities involving ionizing or non-ionizing radiations.
Responsibilities

1. **Administrators will:**
   1.1 Ensure that the President’s Advisory Committee on Radiation Safety (PACRS) oversees and administers this Policy.
   1.2 Provide sufficient personnel and resources for the administration and enforcement of requirements and procedures following from this Policy.

2. **The President’s Advisory Committee on Radiation Safety (PACRS), will:**
   2.1 Oversee and administer the Radiation Safety Policy, to ensure the safe use of radioactive material and radiation in education and research at the University of Regina, by the formulation of necessary programs and procedures.
   2.2 Establish and oversee a Radiation Safety Committee.

3. **The Radiation Safety Committee (RSC) will:**
   3.1 Formulate and implement the University of Regina policies, regulations and procedures governing the use of radioactive materials and radiation.

4. **The Radiation Safety Officer (RSO) and Assistant Radiation Safety Officer (ARSO) will:**
   4.1 Provide professional advice and assistance in all matters related to radiation and radioactive material safety.
   4.2 Keep procedures and practices for the use of radiation and radioactive material up to date.

5. **All Permit Holders (Academic Staff Members) directing the use of radiation or radioactive materials will:**
   5.1 Ensure that they and those working under their direction know and carefully follow all procedures in the University of Regina Radiation Safety Program.
   5.2 Have appropriate training as determined by the Radiation Safety Officer.
   5.3 Use the ALARA principle to guide all their actions and decisions, thereby minimizing exposure of themselves or others to radiation or radioactive materials.
   5.4 Ensure that no unauthorized person can gain access to radioactive materials under his or her control.
   5.5 Cooperate with and assist the University administration in carrying out this policy and the Radiation Safety Program to ensure compliance.

6. **All persons using radioactive materials or radiation will:**
   6.1 Know and follow all procedures in the University of Regina Radiation Safety Program.
   6.2 Have appropriate training as determined by the Radiation Safety Officer.
   6.3 Use the ALARA principle to guide all their actions and decisions, thereby minimizing exposure of themselves or others to radiation or radioactive materials.
   6.4 Seek additional information if they do not have the knowledge and training for a particular use of radiation or radioactive materials.
   6.5 Ensure that radioisotope laboratories and storage areas are locked, and that no unauthorized person is given access to radioactive materials.
7. *All members of the University community are responsible for:*

7.1 Following the directions of all radiation warning signs or instructions.
7.2 Keeping out of unauthorized areas.

**Accountability**

Individuals who do not follow this policy or regulatory requirements may face disciplinary action and/or loss of privileges regarding the use of radioactive materials at the University of Regina.
1.4 President’s Advisory Committee on Radiation Safety (PACRS)

Terms of Reference

The President’s Advisory Committee on Radiation Safety (PACRS) is responsible for the oversight and administration of the University’s Radiation Safety Policy, to ensure the safe use of potentially hazardous radioactive material and radiation in education and research at the University of Regina. This includes the authority to establish and oversee a Radiation Safety Committee mandated to formulate and implement policies, regulations and procedures governing the use of all types of radioactive materials and radiation.

The committee consists of faculty members who are familiar with the critical importance of adhering to all regulations and prescribed procedures for the safe use of radioactive material and radiation, including Canadian Nuclear Safety Commission (CNSC) regulations and the ALARA (As Low As Reasonably Achievable) Principle. Committee members may represent various areas of expertise but will be concerned with regulations concerning all types of radiation.

Constitution of the Committee
The committee consists of the following members:
- The President of the University or designate
- Faculty members chosen by the President for their expertise in the safe use of radiation and radioactive materials
- The Radiation Safety Officer
- The Assistant Radiation Safety Officer
- The Director, Health, Safety and Environment, Human Resources

Duties of PACRS
This committee is authorized and responsible to:
- Establish a Radiation Safety Committee (RSC) to formulate and implement University of Regina policies, regulations and procedures governing the use of radioactive materials and radiation to ensure the safe use of radiation at the University of Regina in accordance with the University’s Radiation Safety Policy.
- Monitor, review and when it considers advisory amend or rescind the policies, procedures and decisions (including Permits issued) made by the RSC and RSO.
- Review all reports and license applications made to the CNSC

Frequency of Meetings
The Committee meets at least once per year.

Chair of the Committee
The Chair and Vice-Chair of the Committee are elected from Faculty members on the Committee by Committee members annually. The Chair is responsible for calling meetings and for correspondence with regulatory authorities. In the absence of the Chair, the Vice-Chair will assume the duties of the Chair.
1.5 Radiation Safety Committee (RSC)

Terms of Reference
The Radiation Safety Committee is delegated by PACRS to formulate and implement University of Regina policies, regulations and procedures governing the use of radioactive materials and radiation to ensure the safe use of radiation at the University of Regina in accordance with the University’s Radiation Safety Policy. Policies, procedures and decisions made by the RSC or the RSO are subject to review and amendment by PACRS.

Constitution of the Radiation Safety Committee
The RSC consists of the following members:

a. The Chair of the President’s Advisory Committee on Radiation Safety
b. The Radiation Safety Officer

duties of the Radiation Safety Committee
The RSC is responsible to:

a. Subject to direction of PACRS, formulate and implement University of Regina policies, regulations and procedures governing the use of radioactive materials and radiation to ensure the safe use of radiation at the University of Regina in accordance with the University’s Radiation Safety Policy;
b. Evaluate the qualifications of those who apply to work with radioactive material or radiation and issue written authorization to those who qualify;
c. In accordance with the Radiation Safety Program, issue Permits for the Use of Radioactive Materials (Permits) to qualified faculty members to use Radioactive Material;
d. Suspend Permits where in the opinion of the RSC the Permit Holder has failed to comply with Permit requirements or where the suspension is otherwise in the best interests of the University. When a Permit is suspended, the RSC shall advise the Permit Holder that it may appeal the suspension to PACRS;
e. Report its activities to PACRS at such times and to such extent as PACRS directs;
f. Review requests for and authorize the commissioning of new radioisotope labs in consultation with Facilities Management; and
g. Respond to radiation safety situations which require immediate action.

1.6 The Radiation Safety Officer (RSO)

The Radiation Safety Officer (RSO), reporting to the Director, Health, Safety and Environment, is appointed by the President of the University of Regina to give professional advice and assistance in all matters related to radiation and radioactive material safety, and to coordinate administration of the radiation safety program. The RSO is responsible for keeping procedures and practices for the use of radiation and radioactive material up to date, and for identifying improvements and opportunities to keep radiation exposures As Low As Reasonably Achievable (ALARA). The Assistant Radiation Safety Officer provides back-up to the RSO.

Among other duties, the RSO and ARSO:

a. Maintain contact as necessary with the Canadian Nuclear Safety Commission (CNSC) and with the Radiation Protection Unit of the Department of Labour of the Government of Saskatchewan, and ensure all information and reports required by legislation are submitted;
b. Make evaluations concerning the applications for permits, suitability of space, equipment, etc., and make recommendations regarding these to the RSC;
c. Immediately suspend the use of radioactive material by any person when, in the judgment of the RSO, the safety of any person is in jeopardy. Such suspension will be reported to the PACRS Chair as soon as possible. The RSC may rescind, extend or amend the suspension. Where the RSC extends the suspension, the RSO will inform the Permit Holder that the decision of the RSC may be appealed to PACRS;
d. Investigate and, where necessary, supervise after accidents or incidents involving radioactive materials, and report the event to the CNSC and to the chair of the PACRS;
e. Investigate any exposures over background levels recorded on dosimeters;
f. Arrange to provide radiation safety training for staff and students who wish to use radiation or radioactive materials at the University of Regina;
g. Prepare Annual Reports and Radioisotope Licence renewal applications and ensure the approved reports and applications are sent to CNSC;
h. Ensure radiation detection equipment is obtained, maintained and calibrated as required.
i. Submit a report on radiation and radioactive materials use and safety activities to the annual meeting of the PACRS, and submit other reports as requested;
j. Evaluate the knowledge, training and experience of those who apply to work with radiation and radioactive materials, and make appropriate recommendations to the RSC;
k. Maintain an inventory of all radioactive material;
l. Manage the ordering, receipt, distribution, storage and disposal of all radioactive material at the University;
m. Oversee the dosimetry program and report all exposures as required;

n. Ensure wipe testing is conducted in accordance with license requirements and that leak testing is conducted according to licence requirements and manufacturer specification;
o. Provide on-going advice and technical assistance to persons using radiation at the University;
p. Provide recommendations for the radiation budget;
q. Maintain records required by the Canadian Nuclear Safety Commission and the Radiation Protection Unit of the Department of Labour of the Government of Saskatchewan; and
r. Audit Permit Holder records regularly;
s. Inspect radioisotope laboratories and wipe test to confirm compliance at a frequency determined by the RSO, and no less than quarterly.
2 APPLICATION FOR A PERMIT FOR THE USE OF RADIOACTIVE MATERIAL

2.1 General Conditions for a Permit at the University of Regina

1. The President’s Advisory Committee on Radiation Safety (PACRS) only issues a Permit to a faculty member in a tenured or a tenure-track position. Permits are not issued to retired, emeritus or adjunct professors.

2. To obtain a Permit the faculty member must meet this program’s training requirements (see Section 5 – Radiation Safety Training) and demonstrate that he/she has sufficient knowledge about radioactivity and the procedures for handling radioactive materials to safely deal with the level of activity requested. No person may use radioactive material at the University of Regina without an appropriate level of training.

3. The Permit Applicant must show that he/she is sufficiently aware of the contents of the Canadian Nuclear Safety Control Commission Regulations and the radiation safety procedures and regulations described in this Program.

4. The space in which the material is to be used must be commissioned in accordance with CNSC requirements. It must also meet any other requirements that may be specified by the PACRS.

5. The Permit will be valid for:
   - Possession and use of the specified isotope(s) only
   - A specified maximum possession limit of activity for each isotope
   - A specified type of procedure or procedures.
   - A specified work area or areas.
   - A specified time period, after which a renewal must be applied for.

6. A Permit Holder may direct research assistants or associates, post-doctoral fellows, student assistants, etc. who also work with radioactive isotopes. It is the Permit Holder’s responsibility to ensure that all such persons have sufficient knowledge and training to ensure that they can use radioactive material safely. It is also the Permit Holder’s responsibility to ensure that all such persons are registered in writing with the RSO before their work with radioisotopes begins. Registration of all persons working with radioisotopes will also be required twice each year, to ensure that persons no longer working with isotopes are removed from the user list.

7. All students who work with radioactivity as part of a class or training program must be trained and supervised to a level appropriate to the type of work carried out by the student.

2.2 Applying for a Permit

The Radiation Safety Committee (RSC) issues Permits in accordance with the Radiation Safety Program.

Permit application forms may be obtained from the Radiation Safety Officer (RSO). Applicants should follow the appropriate application procedure described below. The completed forms are submitted to the RSO for consideration by the RSC. A sample
The purpose of the requirements for detailed information in CNSC licence applications is to ensure that the persons responsible for radioisotope use have sufficient knowledge of the properties of individual radioisotopes to use them safely. To maintain this purpose under the CNSC Licence, the RSC requires each permit holder to fill out his/her own application forms. Sources of the information required are given in the Permit Application Instructions (Appendix 1) which are included with the permit application forms. Copies of these references are available from the RSO.

2.2.1 Application for a Permit for the Use of Radioactive Material

The Permit for the Use of Radioactive Material allows general use of radioactive material including sealed sources, for research and teaching at the University of Regina, within the limits specified in the Permit.

Application for a Permit is made as follows:

1. The person wishing to use radioisotopes at the University of Regina informs the RSO, and receives a copy of this Radiation Program and an Application for a Permit for the Use of Radioactive Materials form. The RSO informs the Chair of the PACRS of the applicant's intent.

2. The person wishing to use radioisotopes reads the Radiation Program and fills out all applicable parts of the Application for a Permit for the Use of Radioactive Material (Appendix 2), following the Permit Application Instructions (Appendix 1) included with the forms. The completed forms are returned to the RSO.

3. The RSO checks the application for completeness. If all necessary information has been included, the application is forwarded to the Chair of PACRS. Otherwise, it is returned to the applicant for more information.

4. The RSO checks all locations listed in the application for radioisotope storage or use. If any of these locations are not already commissioned and registered for the storage or use of the radioisotopes and activities requested, the RSO informs the applicant that he/she must follow the procedure for Commissioning a New Radiation Laboratory (Section 4.5) of this Program.

5. The RSO meets with the applicant, and reviews all procedures for the ordering, receiving, inventory control, safe use, and disposal of the radioisotopes to be used. If the standard University of Regina procedures in this Program are not practical under the experimental conditions to be used, alternate procedures of equal effectiveness and safety are devised. These written alternate procedures will be attached to the Permit as Permit Conditions.

6. The RSC meets to evaluate the application to ensure it meets the requirements of this Program.

7. Should the RSC decline to issue a permit, it shall inform the Applicant what if any additional action is required on the part of the Applicant before the application will be reconsidered by the RSC, and that it may appeal the decision to PACRS.
2.2.2 Application for a Letter of Permission

A Letter of Permission is issued by the RSC to allow persons to use amounts of radioactive material so small that they may be exempt from CNSC licencing requirements, as defined in the Nuclear Substances and Radiation Devices regulations. These quantities are defined as:

a. an open source of a radioisotope with an activity no greater than the exemption quantity,

or

b. ten or less sealed radioisotope sources, each of which has an activity no greater than the exemption quantity.

The definition of exemption quantity and a list of the exemption quantity for each radioisotope is available on the CNSC website.

Application for a Letter of Permission is made using the Application for a Permit for the Use of Radioactive Materials Form (Appendix 2).

2.3 Amendment of Permits

An amendment to a permit must be obtained before any of the conditions required by the permit may be changed.

2.3.1 Permanent Amendment

Procedure for Application for a Permanent Amendment of a Permit:

a. All parts of a completed standard Application for a Permit for the Use of Radioactive Material Form (Appendix 2) must be submitted. In sections that would be identical to the permit holder’s original application, a simple reference to that application may be made.

b. The procedure followed will be the same as the procedure for an Application for a Permit for the Use of Radioactive Material, (Section 2.2.1) in this Program for a new Permit application.

c. Upon approval of the application, an amended permit will be issued by the RSC.

2.3.2 Temporary Amendment

Permit holders may apply for a temporary amendment of their permits for specific projects of a strictly limited duration. Temporary amendments such as the following will be considered:

a. an additional location for isotope use;

b. use of an isotope not specified in the permit;

c. a temporary increase in the maximum activity of an isotope which may be possessed or used.

Application is made as described in Section 2.3.1, including a description of the time frame for which the amendment is required.
2.4 Renewal of Permits

Permits and Letters of Permission are renewed every three years or immediately after the University of Regina consolidated Radioisotope Licence is renewed by the CNSC. In cases where no significant change is requested for a renewed Permit or Letter of Permission, the following procedure may be used:

Procedure for Application for Renewal of a Permit or Letter of Permission is as follows:
- a. The RSO informs Permit and Letter of Permission Holders that a renewal is required.
- b. The Application for a Permit for the Use of Radioactive Material is obtained from the RSO and completed by the Permit Applicant (Appendix 2).
- c. The RSC reviews the applications and issues a new Permit/Letter of Permission or informs the Permit Applicant that more information is required.
- d. Should the RSC decline to renew a Permit/Letter of Permission it shall inform the Permit Applicant that it may appeal the decision to PACRS.

3 DUTIES OF PERMIT HOLDERS

Permit Holders are ultimately responsible for meeting all regulatory requirements for the radiation and radioactive materials used by themselves and the persons under their direction. They are responsible for acting in accordance with the University of Regina Radiation Safety Policy and for ensuring that they and the persons under their direction follow all regulations and procedures of government agencies and of the University of Regina. They are also responsible for keeping their experimental procedures and practices using radioactive material up to date, and for identifying improvements and opportunities to keep radiation exposures As Low As Reasonably Achievable (ALARA). Failure to comply with these requirements may result in suspension of the Permit by the RSC.

It is the duty of Permit Holders:
- a. To keep exposure levels and contamination levels to an ALARA standard and in any event below the monitoring detection limit (less than twice background levels).
- b. To ensure that persons working under their direction are properly trained, both through classroom training and through on-the-job instruction. No person may use radioactive material at the University of Regina without an appropriate level of training. Successful completion of the University of Regina Radiation Safety Course will generally be the minimum level of training acceptable.
- c. To ensure that inexperienced laboratory persons working under their Permit are supervised by competent persons who have completed the appropriate training.
- d. To ensure that persons working with radioisotopes are registered with the RSO.
- e. To determine if any workers under their direction require TLD badge dosimeters or other dose monitoring, and to contact the RSO to arrange for dosimeters or monitoring as required.
- f. To post all required signs and permits.
- g. To adhere to the regulations listed in the CNSC Radioisotope Safety Poster that applies to their level of laboratory.
- h. To ensure that their laboratories are properly commissioned and decommissioned.
- i. To ensure that radioisotope inventory records are maintained.
- j. To ensure that radioisotope laboratories and storage areas are secure at all times. This includes ensuring that all areas are locked at all times when not in use, and that keys to the areas are limited to those issued by the RSO and are not copied.
- k. To ensure that all radioactive waste is properly labeled, handled and disposed of.
l. To ensure that laboratories are monitored weekly by persons using isotopes.
m. To ensure that radiation detection equipment is working properly, and that all persons working under their Permit are properly instructed in its use.
n. To ensure all persons working under their Permit are properly trained in emergency procedures regarding the use of radioactive materials.
o. To immediately report all accidents and incidents involving radioactive materials to the RSO. This includes loss, theft and unauthorized use of materials.
p. When away for a period of time in excess of 30 days, to arrange for a qualified person approved in writing by the RSO, to supervise their research and radiation sources during their absence to ensure compliance with permit holder duties.
q. Cover all costs associated with disposal of radioactive materials.

4 DETAILED PROCEDURES

4.1 Ordering and Receiving Radioactive Materials

Permit Holders may order any permitted radioactive material from any supplier and in any form consistent with the Permit, if and only if they follow and meet the requirements of the procedure for Ordering Radioactive Material and for Receiving Radioactive Material. It is the Permit Holder's responsibility to ensure that the activity of radioisotope ordered, when added to the amount currently possessed, does not exceed their Permit maximum. **Failure to follow these procedures can result in automatic cancellation of or delays in receiving an order. Repeated failure to follow these procedures is grounds for revocation of a Permit.**

Unless approval has been given in writing by the RSC, only Permit Holders may order radioactive material. A Permit Holder may apply to designate another suitably trained person to order radioisotopes by using the procedure for Designating an Alternate Person to Order Radioactive Material included in this section.

Arrangements for and receipt of gifts or donations of radioactive materials or devices containing radioactive sources must follow the same procedures, and must receive prior approval by the RSO.

4.1.1 Ordering Radioactive Material

The procedure for ordering Radioactive Material is as follows:

a. Prior to any order being placed, the RSO must approve the purchase order in writing.
b. To obtain the approval to order from the RSO, a copy of the Purchase requisition or equivalent document must be sent to the RSO by the Permit Holder. This document must contain:
   i. the name of the Permit Holder
   ii. the name of the supplier
   iii. the purchase requisition or purchase order number
   iv. the radioisotope(s) being ordered
   v. the total activity of each radioisotope being ordered
   vi. the expected arrival date
c. If the RSO approves the order, the RSO will authorize the purchase requisition and return it to the Permit Holder. The Purchase Requisition must have the words **"Radioactive Material"** written prominently on it, and the Purchasing Department must be informed that this is a radioactive material at the time the order is placed.
d. The delivery address on the Purchase Order must be:
   Radiation Safety Officer
   c/o Science Stores, RIC110
   University of Regina, Wascana Parkway
   Regina SK  S4S 0A2
This is the only address radioisotope suppliers will be authorized to make shipments to.

4.1.2 Designating Alternate Person to Order Radioactive Material

Unless approval has been given in writing by the RSC, only Permit holders may order radioactive material. A Permit Holder may apply to designate another suitably trained person to order radioisotopes by using the following procedures:

a. The Permit Holder obtains a copy of the Designation of Signing Authority form from the RSO. A copy of this form is shown in Appendix 3 of this Program.

b. The Permit Holder fills out the form, and it is signed by both the Permit Holder and designated person. The designation may be either open-ended or conditional, as specified by the Permit Holder.

c. The completed form is returned to the RSO.

d. The RSC considers the application. Upon acceptance, the chair of PACRS signs a copy of the designation form and returns it to the Permit Holder. A second signed copy is given to the RSO.

4.1.3 Receiving Radioactive Material

The following procedures apply to the receipt of radioactive material at the University:

a. The RSO checks each purchase order to ensure the Permit Holder has not exceeded the Permitted maximum activity. Orders exceeding this maximum will have to be modified or cancelled.

b. Only the RSO or ARSO may receive shipments of radioactive material.

c. Upon receipt of the shipment, the RSO or ARSO:
   i. checks the outside of the package for leakage or contamination.
   ii. opens the package and checks the inner packaging material for leakage or contamination.
   iii. checks the primary container for leakage or contamination.
   iv. confirms that the order has been filled correctly.

d. If no contamination is found, a University of Regina inventory control number is assigned to the container and recorded. The radioisotope is then released to the ordering Permit Holder, along with a University of Regina Radioisotope Inventory Sheet (Appendix 4) if it is an open source.

e. If contamination is found, arrangements will be made with the supplier to return or dispose of the radioactive material.

f. After ensuring the purchase order is closed out, the RSO keeps the packing slip with other order receipt documents.
4.2 Records and Inventory of Radioactive Isotopes

CNSC Regulations require that records be kept of all radioactive material from the time the material is obtained until final disposal. It is the Permit Holder's responsibility to ensure that inventory records for all the radioactive material in their possession are kept current, using the appropriate procedure for The Maintenance of Inventory Records below. These records must be available to the RSO, ARSO and CNSC Inspectors.

The inventory of radioactive materials is maintained by the RSO and is verified at least once per year.

4.2.1 Maintenance of Inventory Records for Open Sources in Use

An inventory record of open sources of radioactive material in use must be maintained as follows:

a. When open sources of radioactive material are received from the RSO they are delivered to the Permit Holder accompanied by a University of Regina Radioisotope Inventory Sheet. A copy of this sheet is shown in Appendix 4 of this Program. This sheet will have the University of Regina Inventory Control Number already written on it.

b. This sheet is used for keeping a running total of the amount of material still remaining, and also has space to record the amount of waste disposed and how it was disposed.

c. For short half life radioisotopes, a calculation of the current remaining activity should be done at least every two half lives, and included on the inventory sheet.

d. When the radioactive material has been used up or decayed to an unusable activity, the stock bottle and the inventory sheet must be returned promptly to the RSO as part of the radioactive waste disposal process. The RSO retains the record sheet as long as is required by CNSC regulations. See the procedure for The Disposal of Radioactive Material for full details.

4.2.2 Maintenance of Inventory Records for Sealed Sources

A Radioactive Source Signout Sheet is maintained in accordance with the following procedures:

a. A copy of the current University of Regina Inventory of Radioactive Material for the storage location is kept at that location at all times.

b. A log book is maintained at each location containing sealed sources. This book is used to record all use of the sealed sources, using the Radioactive Source Signout Sheet (Appendix 13).

c. It is the Permit Holder's responsibility to check this log book regularly, and to ensure that removed sources are returned in a timely manner.

4.2.3 Maintenance of Inventory Records for Open Sources in Storage

An Inventory Record of Open Sources of Radiation Material in Storage is maintained in accordance with the following procedures:

a. A copy of the current University of Regina Inventory of Radioactive Material for the storage location is kept at that storage location at all times.

b. It is the Permit Holder's responsibility to check sources in storage on a regular basis, to ensure that they are accounted for and undamaged.
c. If the Permit Holder decides to use a source in storage at any time, he/she must immediately update the *University of Regina Radioisotope Inventory Sheet*, and inform the RSO that the source is now in use. The procedure for *The Maintenance of Inventory Records for Open Sources in Use* now applies and must be used thereafter.

4.3 **Dosimetry**

4.3.1 **Introduction**

Dosimeter badges are used to measure the external radiation exposure of persons who work with open sources other than Hydrogen-3, Carbon-14, Sulphur-35, Phosphorus-33 and Calcium-45. In addition, they are issued to persons who work with sealed sources greater than 370 kBq, and may be issued to persons who work near or around x-ray emitting devices.

Ring badges are used to measure extremity doses, and are issued to persons who handle a container which contains more than 50 MBq of Phosphorus-32 or Yttrium-90.

In all cases, the ALARA principle will be applied to keep exposures to a minimum.

4.3.2 **Procedures**

TLD Badges are issued by the RSO to faculty, staff or students who meet the above criteria. They are worn in the radioisotope laboratories, and must be kept clean, out of direct sunlight and away from radioactive sources. Every three months, the RSO places a new insert in each badge and sends the removed inserts to National Dosimetry Services. Ring badges are handled in a similar manner.

Thyroid monitoring is required within five days for every person who

a. uses in a 24-hour period a quantity of volatile iodine-125 or iodine-131 exceeding:
   i. 2 MBq in an open room
   ii. 200 MBq in a fume hood
   iii. 20,000 MBq in a glove box
   iv. any other quantity in other containment approved in writing by the Commission or a person authorized by the Commission; or

b. is involved in a spill of greater than 2 MBq of volatile iodine-125 or iodine-131;

c. or on whom iodine-125 or iodine-131 external contamination is detected.

Baseline screening before work using iodine is strongly recommended.

More information is available from the RSO, and from CNSC Publication G-58 “Thyroid Screening for Radioiodine”.

4.3.3 **Results Reporting**

When the dosimetry report is received, the RSO advises each TLD Badge wearer of his or her result if detection levels have been exceeded.
No one at the University of Regina is designated as a Nuclear Energy Worker, therefore no exposures greater than 1 mSv per year are anticipated. The detection limit for the badges is 0.1 mSv, and exposures at or near this level are not normally investigated.

If a dosimeter reading exceeds 0.3 mSv in a three month period, the RSO investigates the cause of the reading, and if necessary instigates procedures to reduce the wearer's future exposures.

If a dosimeter reading exceeds 0.5 mSv in a three month period, the TLD Badge wearer will cease work with radioactive materials until procedures are in place to reduce any further exposures.

In all cases, dosimetry records are maintained by the RSO and made available to individual badge wearers and to CNSC inspectors.

4.4 Monitoring of Isotope Laboratories

4.4.1 Introduction

It is the responsibility of the Permit Holder to ensure that any area under his/her control where open sources of radioisotopes are being used is monitored at least once per week by those using the isotopes, and that the monitoring results are recorded. Records of this monitoring must be kept, and must be available to the RSO and CNSC Inspector. Forms for keeping such records are available from the RSO, and an example is included in Appendix 5 of this Program. Monitoring should be done following the procedure below unless special permission has been obtained from the RSO to use another procedure.

It is the responsibility of the Permit Holder to ensure that any contamination disclosed by routine monitoring is cleaned up promptly. The contamination limits allowable under CNSC regulations are available in Appendix 6 of this Program, and any time these numbers are met or exceeded the RSO must be immediately notified. Any contamination detected which exceeds twice background levels must be immediately cleaned up. The counter readings equivalent to the CNSC allowable limits for the two available scintillation counters are also included in Appendix 7 these are the numbers which, when obtained in a wipe test, indicate immediate action is required under CNSC regulations.

The RSO conducts regular monitoring of all active radioisotope laboratories. Any contamination detected by the RSO is reported to the Permit Holder. It is the responsibility of the Permit Holder to ensure that such contamination is cleaned up promptly.

4.4.2 Procedure

The procedure for Monitoring Radioisotope Laboratories is as follows:

a. Any laboratory where any open source radioisotope other than tritium is being used is surveyed with a calibrated survey meter at least once per day in the active area, and generally this survey takes place at the end of the day.

b. At least once per week, a general survey of the laboratory is done and the results recorded. The battery level of the counter should be checked and the counter tested with a check source to ensure it is operating properly before each survey.

c. Any laboratory where any open source radioisotope is being used is monitored by extensive wipe tests and the results recorded, at least once per week or within 7 days.
using the open source radioisotope. A schematic floor plan of the laboratory must be available to assist in recording and interpreting (by users, RSO, CNSC inspectors) wipe test results. The estimated area of each wipe is included in the record.

4.5 Commissioning and Decommissioning Radioisotope Laboratories

The Canadian Nuclear Safety Act and Regulations require that all laboratories in which radioisotopes are to be used must meet their standards. The CNSC must be given ample time and information in order to authorize the commissioning or decommissioning or a laboratory, and must be given an appropriate period in which they may inspect the facility if they wish. Therefore, in addition to the procedures for Laboratory Start Up and Laboratory Close Out contained in the University of Regina’s Chemical and Laboratory Safety Program, the following additional procedures apply to commission or decommission a radioisotope laboratory.

4.5.1 Commissioning a New Radioisotope Laboratory

The procedure for commissioning a new Radioisotope Laboratory is as follows:

a. The RSO is notified in writing as soon as possible that a new radioisotope laboratory is required. Information on the proposed location, radioisotopes to be used, maximum activity of each isotope required, and the nature of the experiments to be carried out is supplied.

b. The RSO uses this information to determine, using the CNSC classification criteria (Appendix 8), what level of radioisotope laboratory is required.

c. The RSO works with the Faculty and Facilities Management, completes the Design Compliance Form and forwards it to the CNSC.

d. When permission is received from the CNSC to commission the lab as planned, the laboratory construction proceeds. When the construction is complete, the RSO verifies that all requirements have been met, and then the lab is authorized for use.

e. The appropriate Radioisotope Safety Posters (Appendix 10) and emergency contact information is posted in the Radioisotope laboratory. If controlled products are being used, the Chemical and Laboratory Safety Program must be followed.

4.5.2 Decommissioning a Radioisotope Laboratory

The procedure for decommissioning a Radioisotope Laboratory is as follows:

a. The Permit Holder should give the RSO as much notice as possible that he/she wishes to decommission a radioisotope laboratory. The Permit Holder requests a permanent amendment to his/her Permit deleting the location in question, and follows the procedure for Application for a Permanent Amendment of a Permit in this Program.

b. The RSO checks all Radiation Safety Office and Permit Holder records to determine all radioisotopes that have been used in this laboratory, their maximum activity, and the conditions under which they were used.

c. The RSO and Permit Holder meet and develop a plan for cleaning and monitoring the laboratory.

d. The Permit Holder is responsible for the following:

   i. All radioactive material that the Permit Holder wishes to retain under his/her Permit is moved to another authorized location. All other radioactive material is disposed of, following the procedure for The Disposal of Radioactive Material in this Manual.

   ii. The laboratory is cleaned, following the plan developed in step c) above.
iii. The laboratory is monitored, following the plan developed in step c) above. All monitoring is recorded. If any contamination is found, the area is decontaminated and monitoring is repeated. Decontamination to below the monitoring detection limit is required.

e. When this process is complete, the RSO monitors the laboratory extensively and records the results. If any contamination is found, step d) above and this step are repeated.

f. When this process is complete, RSC inspects the laboratory and the monitoring records. The committee may recommend any additional action it considers is warranted. These actions must be completed to the committee’s satisfaction before the next step is taken.

g. The CNSC is informed of the decommissioning in writing by the RSO.

h. If, after two weeks, the CNSC has not informed the University that they wish to inspect the laboratory, the RSO removes or defaces all radiation and radioactive material signs from the area. The RSO removes the room from the list of authorized locations at which radioisotopes may be used, and issues a new Permit to the Permit holder with this location deleted. The laboratory is then released for general use.

4.6 Procedures for Disposal of Radioactive Material

Radioactive material is disposed of using the following procedure. Permit Holders are responsible for ensuring that they and all persons working under their direction use this procedure. The RSO takes responsibility for the final disposal of most radioactive material, provided this procedure is followed. Radioactive material may not be disposed of by any other means unless an alternate written procedure has been developed and approved by the RSC.

4.6.1 Disposal of Open Source Radioactive Material

The procedure for disposal of open source radioactive material is as follows:

1. Each different radioisotope is disposed of in a separate radioactive waste container, unless mixing of radioisotopes within an experiment makes this impossible. Liquids and solids are stored separately. Wastes are appropriately shielded.

2. Each radioactive waste container is labeled as follows:
   • Isotope
   • Estimate of quantity of isotope
   • Date
   • Permit Holder Name

3. Appropriate solid radioactive waste containers consist of an inner 6 mil polyethylene bag and an impervious outer container - cardboard and wooden outer containers may not be used. Any other waste container system must have the prior approval of the RSO. Nothing inside the bag should identify the material as radioactive, and no liquids such as liquid scintillation fluid can be inside the bags. When the bags are full they must be sealed.

4. Liquid scintillation vials are collected in cardboard “flats” and returned to the RSO for disposal without being opened. The flat must be labeled with the isotope, estimated quantity of isotope, date and Permit Holder Name.

5. Empty or unwanted radioisotope stock containers with inventory sheets are not disposed of in these radioactive waste packages. The stock container and completed inventory sheet are given separately to the RSO for recording and disposal.
6. When the radioactive waste is properly packaged, the RSO must be informed. The RSO removes the waste and stores it for disposal. Full records of all disposals are maintained by the RSO.

4.6.2 Disposal of Sealed Source Radioactive Material

Radioactive sealed sources which are to be disposed of are given to the RSO, who arranges for appropriate disposal. They are never disposed by the Permit Holder.

4.7 Accidents, Incidents, and Emergencies

4.7.1 Reporting Accidents, Incidents and Emergencies

Any event where a person could receive a dose of radiation greater than the yearly allowed maximum must be reported to CNSC within 24 hours. Since it is not always immediately apparent what dose may have been received in an accident, the RSC requires all Permit Holders and persons under their direction to report all accidents, incidents or emergencies involving radioactive material or radiation generating devices.

a. All accidents, incidents or emergencies involving radioactive material or radiation generating devices must be reported to the RSO, or in his/her absence the ARSO, or in his/her absence the Director, Health, Safety and Environment or in his/her absence the PACRS Chair as soon as reasonably possible.

b. The RSO, or in his/her absence the ARSO, or in his/her absence the Director, Health, Safety and Environment or in his/her absence the PACRS Chair, will investigate all accidents, incidents or emergencies involving radioactive material or radiation generating devices. Any which may have exceeded the CNSC criterion will be reported to the CNSC as soon as possible.

c. The RSO will produce a written investigation report which will be forwarded to the CNSC and to PACRS.

The following report form must be used: Incident/Accident Report Form
http://www.uregina.ca/hr/OH&S/Forms/Accident%20form%20Aug%202006.doc

For more information about the Incident/Accident Report Form refer to Incident/Accident Reporting/Recording Process:
http://www.uregina.ca/hr/OH&S/Forms/Incident%20report%20process-04-07.doc

4.7.2 Emergency Procedures

It is the responsibility of all Permit Holders to develop Emergency Procedures for dealing with emergencies involving radioisotopes or radiation exposure for each of their laboratories. It is also their responsibility to ensure that all persons working in those laboratories are familiar with these procedures and know what to do in care of emergency.

Appendix 11 contains generic emergency procedures for dealing with some types of radioisotope and radiation exposure emergencies. These may be modified to suit individual laboratories. Special procedures should be written for and situation not covered by the general procedures.

Appendix 14 contains emergency contact information for the Radioisotope Laboratories.
5 RADIATION SAFETY TRAINING

5.1 Introduction

No person may use or handle radioactive material or work in a laboratory or area containing radioactive material or a device unless they have been trained in accordance with this Section.

5.2 Radiation Safety Awareness Training

All persons who do not work on or with radioactive material, but work in an area where radioactive material is present, must have completed, within the last three years, Radiation Safety Awareness Training.

Radiation Safety Awareness Training is facilitated by Health, Safety, and Environment, HR and is comprised of a course of instruction on the following elements:
- University of Regina’s Radiation Safety Administration
- Basic Principles and practices of Radiation protection
- Emergency procedures and contact information

5.3 Radiation Safety Training

All Permit Holders and all persons working with radioactive material are required to successfully complete Radiation Safety Training.

Radiation Safety Training is facilitated by Health, Safety, and Environment, HR and is comprised of a course of instruction on the following elements:
- University of Regina’s Radiation Safety Administration (Policy, Procedures, Manual, and Roles and Responsibilities)
- Radiation Physics
- Units of Measure
- Biological Effects of Radiation
- ALARA and Radiation Exposure
- Instrumentation
- Operating Procedures
- Emergency Procedures
- Transportation
- A demonstration of a small spill clean up
- Hands on laboratory training in contamination monitoring
- Successful completion of a written exam

5.4 Permit Holder Orientation

All Permit Holders complete, in addition to Radiation Safety Training, Permit Holder Orientation. This orientation is facilitated by the RSO and is provided to Permit Holders upon the issuance or renewal of permits. It provides regulatory information to Permit Holders.
5.5 Transportation/Receipt Training

All persons who receive radioactive material delivered to the University, distribute radioactive material to Permit Holders or ship radioactive materials complete the following training:

- Certified training in the *Transportation of Dangerous Goods Class 7*
- Instruction on the University’s Detailed procedures on Ordering and Receiving of Radioactive Materials contained in Section IV Part A of this Program

5.6 Sealed Source Training

All persons who work with sealed sources or sealed sources in devices must successfully complete this training course. It provides basic safety and awareness training for individuals whose use of radioactivity is limited to sealed sources and sealed sources in devices, as well as to those who work not with but near sealed sources.

5.7 Training Certificate

All radiation safety training provided by the University is valid for three years. All persons who have successfully completed radiation safety training are issued a radiation training certificate by Health, Safety and Environment, HR which indicates the category of training received and the date the training expires. Training records are maintained by Health, Safety and Environment HR.

5.8 Exemptions

The RSC may grant an exemption to the training requirements where the committee is satisfied that the person will either be working under the Direct and Constant supervision of a Permit holder for a short or temporary period, or the person has demonstrated a full and complete understanding of radiation safety principles and procedures.

6 LASERS AND X-RAYS

6.1 Definition

For the purpose of this Program, Lasers and X-rays are:

- an operable device whose principal purpose and function is the production of X-rays (electromagnetic radiation of a wave length shorter than 0.25 nanometers).
- Class 3b lasers
- Class 4 lasers

6.2 Laser and X-Ray Registration

All employees or any other person intending to either:

a. bring a Laser or X-Ray to the University, or
b. dispose of a Laser or X-Ray at the University

must obtain approval from the RSO. Prior to issuing an approval, a completed Laser/X-Ray Registration form (*Appendix 16*) must be sent to the RSO. The RSO will meet with the
applicant to discuss the requirements of the proposed research activities. There will be a subsequent inspection of the specific equipment where the research will be conducted.

6.3 References

Further information on X-ray and Laser standards and safety can be found at:
- Radiation Emitting Devices Act and Regulations (federal)
- The Radiation Health and Safety Act and Regulations (provincial)
- Laser Pointers (Saskatchewan Labour Bulletin)
- Safety Codes and Guidelines within the x-ray and non-ionizing radiation sections (Health Canada website)

Error! Hyperlink reference not valid.
INSTRUCTIONS FOR AN APPLICATION FOR A PERMIT FOR THE USE OF RADIOACTIVE MATERIAL

Part I Identification

This is general information about the applicant, including contact information.

Part II Location of Use

This is a list of the laboratories where isotopes will be used, and where they will be stored.

Part III Open Sources Required

This section should be filled out ONLY if open sources of radioactivity will be used.

- Radioisotope – specify all radioisotopes required
- Maximum vial size required - indicate the maximum amount of radioactive material (in MBq) which would be contained in a single vial. Normally, this is the contents of the stock vial.
- Possession Limit – this is the maximum amount of isotope (in MBq) which would be required. Its value should include waste as well as unused isotope.
- Exemption Quantity – the exemption quantities for each isotope can be found on the CNSC website
- Annual Limit of Intake – This number can generally be found in the Radioactive Material Safety Data Sheet. Some common RMSDS can be found in Appendix 15.
- Type of radioactive emission – This number can also be found in the RMSDS.
- Energy of Radioactive Emission – RMSDS
- Half-Life – RMSDS
- Critical Organ – RMSDS

Part IV Sealed Sources Required

This section should be filled out ONLY if sealed sources are required.

Part V Additional Information

The information requested in this part of the application form is that which is asked for in CNSC Regulations, and is necessary for the PACRS to carry out its responsibilities under this legislation. This information is to be submitted as part of the application for a new permit if OPEN SOURCES are required or, if changed from the original application, as part of the application to amend a permit. There is no form for this section of the application, which may be provided in any reasonable format.

Each point must be addressed. If it is not applicable, state why this is the case.
Appendix 1 (cont.)

- The nature and quantity of the prescribed substance and the purpose for which it is required.

This involves a description of the proposed project, the isotope to be used and the physical and chemical form of the isotope. This information is necessary for the determination of the facilities and the nature of the laboratory space required as well as the hazards involved. There must be enough detail to allow those evaluations.

- The maximum quantity of the prescribed substance likely to be required at any one time for the purpose set out in the application.

This will show the results of a calculation starting with the initial activity of the system and resulting in the activity remaining in the material to be counted. It is done to justify the possession limit requested and to show that the end product will be measured satisfactorily by the equipment to be used. The maximum possession limit may be based on the results of these calculations as well as on the nature of the laboratory facilities. Estimates should be made of the maximum number of experiments likely to be done at one time, and allowance made for reordering isotopes while old stock is still on hand. A proposed ordering plan should be presented and any cost benefits which may be realized by ordering larger than the minimum requirement should be described.

- A description of the premises in which the prescribed substance is to be located and of any equipment in connection with which it is to be used.

The description of the premises will include the room number(s) and building as well as a description of how this room is related to or connected to other spaces such as student laboratories. Any special renovations or facilities designed for the handling of radioactive materials should be included. Handling and measuring equipment will also be described. A description of the design requirements for radioisotope laboratories, as issued by CNSC, is available from the Radiation Safety Office. For low levels of isotopes all of the special facilities or modifications may not be necessary, so discuss your needs with the Radiation Safety Officer.

- A description of the measures to be taken to prevent theft, loss or any unauthorized use of the prescribed substance.

This regulation requires that the radioactive material be stored in a locked place such as a cupboard, fridge or safe, and that the laboratory itself be kept locked when not in use. The keys to the laboratory should be restricted to authorized persons only. Describe the precautions to be taken to meet these requirements.

- A description of the measures to be taken, including any plan in case of accident, to prevent the receipt by any person of a dose of ionizing radiation in excess of any dose specified in respect of such a person in Schedule II.

Shielding and special handling equipment directed to dose reduction should be described here. Rules for working with radioisotopes must be posted in the laboratory. These are shown in Appendix 10 and are available from the CNSC, through the Radiation Safety Officer, in poster form. It is also advisable to have charts posted in the laboratory giving the characteristics, special hazards and special precautions to be used with each isotope in that laboratory. Some of these are available from the Radiation Safety Officer.
Appendix 1 (cont.)

A summary of general procedures to be followed in case of an accident or spill are outlined in Appendix 12. These should be modified for your particular facilities as necessary and developed as a concise Emergency Procedure to be posted in the working area.

- A description of the method of disposing of the prescribed substance.

The disposed material falls into two broad categories, the radioactive material itself which may be in solid or in liquid form, and the contaminated materials such as pipettes, paper wiping material or bench coverings. The latter may be of large volume. Before the permit is issued you must describe disposal procedures that have been worked out with the Radiation Safety Officer. If some radioactive material must be disposed to the sewage system during the course of experiments, the amount and concentration must be estimated.

- A description of the qualifications, training and experience of any person who is to use the prescribed substance.

Formal training in the theory or radioactivity and in safe use of radioactive material should be listed. Experience with the use of radioisotopes should be outlined.

If a permit is required for SEALED SOURCES only, address the following points:
- Describe the equipment the source will be used on or in.
- Describe the proposed storage method.
- Describe measures which will be implemented to keep the source secure and locked up.
APPLICATION FOR A PERMIT
FOR THE USE OF RADIOACTIVE MATERIAL

I. Identification

Name: ____________________________________________
Position and Department: ____________________________
Home phone number: ________________________________
Office phone number: ________________________________
Lab phone number: _________________________________
Email address: ______________________________________

II. Location of use

List Laboratories where isotopes will be used (include laboratory classification, ie basic, intermediate):

List Laboratories where isotopes will be stored:

III. Open Sources Required

List open source radioactive materials which will be used.

<table>
<thead>
<tr>
<th>Radio-isotope</th>
<th>Max. vial size required (MBq)</th>
<th>Possession limit required (MBq)</th>
<th>Exemption Quantity (MBq)</th>
<th>Annual Limit of Intake (MBq)</th>
<th>Type of Radioactive Emission</th>
<th>Energy of Radioactive Emission</th>
<th>Half Life</th>
<th>Critical Organ</th>
</tr>
</thead>
</table>
Appendix 2 (cont.)

IV. Sealed Sources Required

List sealed sources which will be required. If source is to be used for calibration of a device or is to be incorporated into a device, provide make, model and serial number of device.

<table>
<thead>
<tr>
<th>Radioisotope</th>
<th>Activity</th>
<th>Exemption Quantity</th>
<th>Type of Radioactive Emission</th>
<th>Energy of Radioactive Emission</th>
<th>Half Life</th>
<th>Make, Model, S/N of Device (if applicable)</th>
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V. Use of Radioactive Materials

Describe proposed use of radioactive materials. Include dose calculations where they can be evaluated. Attach extra pages as required. Include make, model and serial numbers of radiation detection equipment which will be used in the course of this research.

VI. Authorization

Signature of Applicant: ______________________   Date: ____________

Signature of Dean: ______________________        Date: ____________
DESIGNATION OF SIGNING AUTHORITY

I, __________________________________________________________ authorize
_____________________________________________________________ to sign orders for radioactive
material under my permit number __________________________________, subject to the conditions listed below.

Permit Holder

Person Designated

Conditions:

Date

Appendix 3

Radiation Safety Program
Last updated: February 2012
### RADIOISOTOPE INVENTORY SHEET

**Permit Holder**

- ________________________________

**Isotope / Initial Activity / Initial Volume**

- ________________________________

**Calibration Date / Activity on Calibration**

- ________________________________

**Chemical Form**

- ________________________________

**Unique Identification Number**

- ________________________________

**Date Received**

- ________________________________

**PO Number**

- ________________________________

**Pages**

- ________________________________

<table>
<thead>
<tr>
<th>Date Used</th>
<th>Experiment</th>
<th>Name of User</th>
<th>Amount available on date of use</th>
<th>Amount Used</th>
<th>Activity of Waste Disposed to garbage/liquid waste/sewer/other</th>
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<td>Volume</td>
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- Radiation Safety Program
- Last updated: February 2012
## 2012 WEEKLY WIPE TEST RECORDS

If there were no isotopes used for a particular week, indicate this in the log for that week. Attach a sketch of the lab, indicating areas to be wiped. Include background counts and calculate the contamination level for every wipe test which reads twice background or higher. If contamination is found, decontaminate the area, re-test and include results here. Sign your name for each week you wipe test.

### JANUARY

<table>
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<th>Vial #</th>
<th>Week of Jan 1 Cpm</th>
<th>Week of Jan 1 Bq/cm²</th>
<th>Week of Jan 8 Cpm</th>
<th>Week of Jan 8 Bq/cm²</th>
<th>Week of Jan 15 Cpm</th>
<th>Week of Jan 15 Bq/cm²</th>
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# Appendix 5 (cont.)

## 2012 WEEKLY WIPE TEST RECORDS

**Room #:** ____________________________  **Permit Holder:** ____________________________

*If there were no isotopes used for a particular week, indicate this in the log for that week.*

*Attach a sketch of the lab, indicating areas to be wiped. Include background counts and calculate the contamination level for every wipe test which reads twice background or higher. If contamination is found, decontaminate the area, re-test and include results here. Sign your name for each week you wipe test.*

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## 2012 WEEKLY WIPE TEST RECORDS

### Appendix 5 (cont.)

Room #: ____________________  Permit Holder: ____________________

*If there were no isotopes used for a particular week, indicate this in the log for that week. Attach a sketch of the lab, indicating areas to be wiped. Include background counts and calculate the contamination level for every wipe test which reads twice background or higher. If contamination is found, decontaminate the area, re-test and include results here. Sign your name for each week you wipe test.*

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<tr>
<th>Vial #</th>
<th>Week of Sept 2 Cpm</th>
<th>Week of Sept 2 Bq/cm²</th>
<th>Week of Sept 9 Cpm</th>
<th>Week of Sept 9 Bq/cm²</th>
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### OCTOBER

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<th>Vial #</th>
<th>Week of Oct 7 Cpm</th>
<th>Week of Oct 7 Bq/cm²</th>
<th>Week of Oct 14 Cpm</th>
<th>Week of Oct 14 Bq/cm²</th>
<th>Week of Oct 21 Cpm</th>
<th>Week of Oct 21 Bq/cm²</th>
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Signed Date

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Radiation Safety Program
Last updated: February 2012
### 2012 WEEKLY WIPE TEST RECORDS

**Room #:** ___________________________  **Permit Holder:** ___________________________

#### NOVEMBER

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<tr>
<th>Vial #</th>
<th>Week of Nov 4 Cpm</th>
<th>Week of Nov 4 Bq/cm²</th>
<th>Week of Nov 11 Cpm</th>
<th>Week of Nov 11 Bq/cm²</th>
<th>Week of Nov 18 Cpm</th>
<th>Week of Nov 18 Bq/cm²</th>
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<th>Week of Dec 9 Bq/cm²</th>
<th>Week of Dec 16 Cpm</th>
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**REMEMBER:**

\[
\text{counts} \times \frac{1 \text{ min}}{60 \text{ sec}} \times \frac{1}{\text{wipe area}} \times \frac{1}{\text{Counter Efficiency}} \times \frac{1}{0.1} = \text{Bq/cm}^2
\]

where

- wipe area is less than 100 cm²
- Counter Efficiency is 0.94 for carbon and 0.57 for tritium
The amount or removable contamination permitted in occupational and public areas is regulated through the conditions of a CNSC licence. A licence may require that removable contamination not exceed the following typical limits for all areas, averaged over not more than 100 cm$^2$.

For controlled areas:
- 3 Bq/cm$^2$ of Class A radionuclides, which are long-lived and emit alpha radiation
- 30 Bq/cm$^2$ of Class B radionuclides, which are long-lived and emit beta or gamma radiation
- 300 Bq/cm$^2$ of Class C radionuclides, which are short-lived and emit beta or gamma

For supervised public areas and for decommissioning
- 0.3 Bq/cm$^2$ of Class A radionuclides, which are long-lived and emit alpha radiation
- 3 Bq/cm$^2$ of Class B radionuclides, which are long-lived and emit beta or gamma radiation
- 30 Bq/cm$^2$ of Class C radionuclides, which are short-lived and emit beta or gamma

Contamination detected at or above the following levels must be reported immediately to the RSO, who reports this information to the CNSC.
## Appendix 7

### CONTAMINATION CRITERIA FOR SCINTILLATION COUNTERS

#### When using the Rackbeta Scintillation Counter

The limit of 30 Bq/cm\(^2\) of removable contamination of \(^{14}\text{C}\) is reached when a wipe test result of 3348 counts per minute is obtained.

\[
\frac{\text{counts}}{\text{min}} \times \frac{1 \text{ min}}{60 \text{ sec}} \times \frac{1}{20 \text{ cm}^2} \times \frac{1}{0.93} \times \frac{1}{0.1} = 30 \text{ Bq/cm}^2
\]

For a wipe area of 20 cm\(^2\)

Counter efficiency measured October 2011

\[
\frac{47464}{50795} = 0.93
\]

The limit of 30 Bq/cm\(^2\) of removable contamination of \(^3\text{H}\) is reached when a wipe test result of 2052 counts per minute is obtained.
Appendix 7 (cont.)

When using the Perkin-Elmer Scintillation Counter

<table>
<thead>
<tr>
<th>counts</th>
<th>1 min</th>
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</thead>
<tbody>
<tr>
<td>min</td>
<td>60 sec</td>
<td>20 cm²</td>
<td>0.84</td>
<td>0.1</td>
<td></td>
</tr>
</tbody>
</table>

The limit of 30 Bq/cm² of removable contamination of ^14C is reached when a wipe test result of 3024 counts per minute is obtained.

\[
\frac{\text{counts}}{\text{min}} \times \frac{1 \text{ min}}{60 \text{ sec}} \times \frac{1}{20 \text{ cm}^2} \times \frac{1}{0.84} \times \frac{1}{0.1} = 30 \text{ Bq/cm}^2
\]

For a wipe area of 20 cm²

Counter efficiency measured 13 October 2011  (Standard 127200 dpm 20 Oct 2009)

\[
\frac{107433}{127200} = 0.84
\]

The limit of 30 Bq/cm² of removable contamination of ^3H is reached when a wipe test result of 2196 counts per minute is obtained.
### RADIATION LABORATORY CLASSIFICATION

<table>
<thead>
<tr>
<th>Classification</th>
<th>Purpose of the Room</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage Room</td>
<td>A room, where any supplies of sealed or unsealed nuclear substances are kept without being handled. Examples include storage of waste and/or decaying radioactive material and supplies held for future use.</td>
</tr>
<tr>
<td>Basic-Level Room</td>
<td>A room, in which an unsealed nuclear substance is used which is larger than one “exemption quantity” as defined in section 1 of the Nuclear Substances and Radiation Devices Regulations, and where the largest quantity of each unsealed nuclear substance in one container does not exceed five (5) times its corresponding Annual Limit of Intake (ALI), as defined in section 12(1) of the Radiation Protection Regulations.</td>
</tr>
<tr>
<td>Intermediate-Level Room</td>
<td>A room, where the largest quantity of each unsealed nuclear substance in one container does not exceed 50 times its corresponding ALI.</td>
</tr>
<tr>
<td>High-Level Room</td>
<td>A room, where the largest quantity of each unsealed nuclear substance in one container does not exceed 500 times its corresponding ALI.</td>
</tr>
<tr>
<td>Containment-Level Room</td>
<td>A room, where the largest quantity of each unsealed nuclear substance in one container exceeds 500 times its corresponding ALI.</td>
</tr>
</tbody>
</table>

- The Annual Limit of Intake (ALI) is the intake in any year of a radionuclide which will result in a committed effective dose of 20 mSv during the 50 years after taking it into the body.

- Refer to CNSC for Radioisotope Laboratories, for the construction or renovation of rooms designated for the use of unsealed nuclear substances.
EFFECTIVE DOSE LIMITS

13.(1) Every licensee shall ensure that the effective dose received by and committed to a person described in column 1 or an item of the table to this subsection, during the period set out in column 2 of that item, does not exceed the effective dose set out in column 3 of that item.

**TABLE**

<table>
<thead>
<tr>
<th>Item</th>
<th>Person</th>
<th>Period</th>
<th>Effective Dose (mSv)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Nuclear energy worker, including a pregnant nuclear energy worker</td>
<td>(a) One-year dosimetry period</td>
<td>50</td>
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<td>(b) Five-year dosimetry period</td>
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<td>2.</td>
<td>Pregnant nuclear energy worker</td>
<td>Balance of the pregnancy</td>
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<td>3.</td>
<td>A person who is not a nuclear energy worker</td>
<td>One calendar year</td>
<td>1</td>
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</tbody>
</table>

**Equivalent Dose Limits**

14.(1) Every licensee shall ensure that the equivalent dose received by and committed to an organ or tissue set out in column 1 of an item of the table to this subsection, of a person described in column 2 of that item, during the period set out in column 3 of that item, does not exceed the equivalent dose set out in column 4 of that item.

**TABLE**

<table>
<thead>
<tr>
<th>Column 1</th>
<th>Column 2</th>
<th>Column 3</th>
<th>Column 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item</td>
<td>Organ or Tissue</td>
<td>Person</td>
<td>Period</td>
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<tr>
<td>1.</td>
<td>Lens of an eye</td>
<td>(a) Nuclear Energy worker</td>
<td>One-year dosimetry period</td>
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<td>(b) Any other person</td>
<td>One calendar year</td>
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<td>2.</td>
<td>Skin</td>
<td>(c) Nuclear Energy worker</td>
<td>One-year dosimetry period</td>
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<td>(d) Any other person</td>
<td>One calendar year</td>
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<tr>
<td>3.</td>
<td>Hands and feet</td>
<td>(e) Nuclear Energy worker</td>
<td>One-year dosimetry period</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(f) Any other person</td>
<td>One calendar year</td>
</tr>
</tbody>
</table>
BASIC LEVEL
Use of Unsealed Nuclear Substances

This room has been classified as “basic level” for the use of unsealed nuclear substances in accordance with Canadian Nuclear Safety Commission guidelines. Below is a list of safe work practices to be followed when working in this room.

24-hour emergency contact (name and phone number)  Room identification

- Do not eat, drink, store food, or smoke in this room.
- In case of a spill or incident involving a nuclear substance, follow emergency procedures and notify the Radiation Safety Officer.
- Clearly identify work surfaces used for handling nuclear substances.
- Use protective clothing and equipment when working with nuclear substances.
- Check all packages containing nuclear substances for damage upon receipt.
- Store nuclear substances in a locked room or enclosure when not in use.

A room is classified as “basic level” for the use of unsealed nuclear substances when more than one exemption quantity is handled and where the largest quantity (in becquerels) of a substance handled by any worker does not exceed 5 times its corresponding annual limit of intake (in becquerels). Contact your Radiation Safety Officer for a list of annual limits of intake.

For more information, contact: Canadian Nuclear Safety Commission, Directorate of Nuclear Substance Regulation, P.O. Box 1046, Station B, Ottawa, Ontario, K1P 5S9. Telephone: 1-888-229-2672. Facsimile: (613) 995-5086.
INTERMEDIATE LEVEL
Use of Unsealed Nuclear Substances

This room has been classified as “intermediate level” for the use of unsealed nuclear substances in accordance with Canadian Nuclear Safety Commission guidelines. Below is a list of safe work practices to be followed when working in this room.

24-hour emergency contact (name and phone number)  Room identification

- Do not eat, drink, store food, or smoke in this room.
- Wear appropriate dosimeter at all times.
- In case of a spill or incident involving a nuclear substance, follow emergency procedures and notify the Radiation Safety Officer.
- Clearly identify work surfaces used for handling nuclear substances.
- Use protective clothing and equipment when working with nuclear substances.
- After working with nuclear substances, monitor work area for contamination.
- Wash hands regularly and monitor them for contamination frequently.
- Check all packages containing nuclear substances for damage upon receipt.
- Store nuclear substances in a locked room or enclosure when not in use.

A room is classified as “intermediate level” for the use of unsealed nuclear substances where the largest quantity (in becquerels) of a substance handled by any worker does not exceed 50 times its corresponding annual limit of intake (in becquerels). Contact your Radiation Safety Officer for a list of annual limits of intake.

For more information, contact: Canadian Nuclear Safety Commission, Directorate of Nuclear Substance Regulation, P.O. Box 1046, Station B, Ottawa, Ontario, K1P 5S9. Telephone: 1-888-229-2672. Facsimile: (613) 995-5086.
Appendix 10 (cont.)

SPILL PROCEDURES

Name and telephone number of the person responsible for enforcing safe work practices with nuclear substances in this work area:

<table>
<thead>
<tr>
<th>Radiation Safety Officer</th>
<th>Telephone number</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Person in charge</th>
<th>Telephone number</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

General Precautions

1. Inform persons in the area that a spill has occurred. Keep them away from the contaminated area.
2. Cover the spill with absorbent material to prevent the spread of contamination.

Minor Spills (Typically less than 100 exemption quantities of a nuclear substance)

1. Wearing protective clothing and disposable gloves, clean up the spill using absorbent paper and place it in a plastic bag for transfer to a labelled waste container.
2. Avoid spreading contamination. Work from the outside of the spill towards the centre.
3. Wipe test or survey for residual contamination as appropriate. Repeat decontamination, if necessary, until contamination monitoring results meet the Nuclear Substances and Radiation Devices licence criteria.
4. Check hands, clothing, and shoes for contamination.
5. Report the spill and cleanup to the person in charge and, if necessary, to the Radiation Safety Officer.
6. Record spill details and contamination monitoring results. Adjust inventory and waste records appropriately.

Major Spills (Major spills involve more than 100 exemption quantities, or contamination of personnel, or release of volatile material)

1. Clear the area. Persons not involved in the spill should leave the immediate area. Limit the movement of all personnel who may be contaminated until they are monitored.
2. If the spill occurs in a laboratory, leave the fume hood running to minimize the release of volatile nuclear substances to adjacent rooms and hallways.
3. Close off and secure the spill area to prevent entry. Post warning sign(s).
4. Notify the Radiation Safety Officer or person in charge immediately.
5. The Radiation Safety Officer or person in charge will direct personnel decontamination and will decide about decay or cleanup operations.
6. In general, decontaminate personnel by removing contaminated clothing and flushing contaminated skin with lukewarm water and mild soap.
7. Follow the procedures for minor spills (if appropriate).
8. Record the names of all persons involved in the spill. Note the details of any personal contamination.
9. The Radiation Safety Officer or person in charge will arrange for any necessary bioassay measurements.
10. If required, submit a written report to the Radiation Safety Officer or person in charge.
11. The Radiation Safety Officer or person in charge must submit a report to the CNSC.

Major spill procedures should be implemented whenever minor spill procedures would be inadequate.

If an exposure may have occurred that is in excess of applicable radiation dose limits, the CNSC shall be contacted within 24 hours of the occurrence under Section 16 of the Radiation Protection Regulations.

For more information, contact: Directorate of Nuclear Substance Regulation, Canadian Nuclear Safety Commission, P.O. Box 1046, Station B, Ottawa, ON K1P 5S9. Telephone: 1-888-222-2672. Fax: (613) 995-5086.
The permit holder must devise and write, in point form, the immediate procedures to be followed in the case of an accident or spill involving radioactive material. These must be approved by the Radiation Safety Officer and posted in a suitable place in the lab.

The various categories of incidents and suggested detailed procedures follow.

INCIDENTS INVOLVING RADIOACTIVE MATERIALS

CATEGORY A  Spill of Radioactive Material

1. Aims
   a) Prevent exposure to people
   b) Prevent spread of radioactive material
   c) Notify person responsible for supervision of clean-up

2. Action
   a) If the occurrence is in the laboratory, take steps to prevent spread; e.g. if it is a liquid on the bench or floor, use paper towels, etc., to absorb the liquid and prevent spread.

   b) Use the monitor to check the clothes and skin of the persons involved or who by some long chance could be contaminated. If contamination is found go to category B. If personnel are "clean" proceed to step C.

   c) Notify the Permit Holder and the Radiation Safety Officer, who will direct the clean-up. If neither of these persons can be contacted, and if the material is safely confined, put up appropriate warning signs, leave and lock the lab until one of those persons can be notified.

   d) If the occurrence is not in a radiation lab, e.g. in a hallway or another lab, first take steps to confine the material as in a). Then block access to the contaminated area using ropes, chairs, etc. and place radiation warning signs. Notify a responsible person as in c) and maintain a watch on the area.

   e) As soon as possible write down the circumstances of the occurrence, the amount and type of activity involved and the actions taken.

CATEGORY B  Spill of Radioactive Material Involving Personnel

1. Aims
   a) Prevent or minimize physical radiation injury by immediate actions.
   b) Prevent spread of radioactive material.
   c) Notify responsible persons.

2. Actions
   a) If apparently on clothing only, remove items known to be contaminated. Use the monitor to check other clothing and skin for possible contamination.
b) If skin is involved, wash the contaminated areas immediately using an excess of water. Use the monitor to check skin and continue to clean by careful washing until the activity is zero. Do not use harsh soap or abrade the skin by vigorous rubbing or the isotope may enter the body.

c) Notify a responsible person as in A 2 c).

d) If area contamination is involved take steps as in Category A.

e) If the occurrence was in a public place have another worker prevent the spread and resulting public hazard by taking steps as in Category A.

f) If ingestion or material may be involved, for example in a cut, rinse the area thoroughly with water and then notify a responsible person as in A 2 c).

g) The possible radiation exposure must be estimated to allow evaluation of the necessary medical procedures. Make an estimate of the type and amount of activity involved and write it down.

h) As soon as convenient write down all the circumstances of the occurrence.

---

### CATEGORY C Possible Over-Exposure from External Sources

1. **Aims**
   a) Prevent further exposure to yourself and others.
   b) Notify persons responsible.
   c) Record sufficient data for a dose calculation.

2. **Actions**
   a) Remove yourself from the situation causing the exposure.

   b) Take action, e.g. place warning signs or shielding to prevent exposure to anyone else.

   c) Notify the Radiation Safety Officer and the Permit Holder.

   d) Write down the circumstances of the exposure. This will include the type of radioactive material involved and the time and distance of the exposure.

      The Radiation Safety Officer will notify the CNSC.
INCIDENT REPORTING/RECORDING
PROCESS & FORM

An incident is an event that results or is likely to result in the loss of control of the radiation safety program. Unacceptable exposures to radiation or spread of radioactive contamination are examples of incidents, as are the loss, theft or unauthorized use of isotope. Even minor spills must be reported to the Radiation Safety Officer.

The event must be reported immediately to the Canadian Nuclear Safety Commission and to the Saskatchewan Department of Labour, Radiation Safety Branch) by the Radiation Safety Officer. This verbal or emailed report must be followed by a complete written report of the incident investigation, including root cause analysis and remedial action taken.
INCIDENT REPORTING / RECORDING PROCESS
Health, Safety and Environment, Human Resources

Call 585-4999 immediately for all situations as outlined in the Emergency Handbook.

Incident Reporting

Any incident that involves injury to a person or damage to property, or had the potential to do so, must be reported to Health, Safety and Environment, Human Resources, **within 24 hours of occurrence**. The University of Regina’s Incident Report form must be completed for every incident, even if there were no injuries sustained. If the injured person is a student or visitor to Campus, the report form must still be completed. Injured employees must also notify their supervisor and if eligible complete a Workers’ Compensation Board (WCB) form.

Purpose

The purpose of incident reporting and investigation is to prevent a recurrence of the hazardous condition causing the event. It also ensures that the University meets regulatory requirements.

Information for Employees/Supervisors/Managers

If an employee suffers an **injury** while at work:

1. **If immediate medical attention is required, call 911.** Do not transport injured persons to the hospital – call 911 for an ambulance. Otherwise, seek medical attention as required.
2. Employees must report the incident to their supervisor immediately or as soon as possible.
3. The supervisor must call Campus Security (585-4999) immediately.
4. Following a serious incident, no person may alter the scene without the approval of Health, Safety and Environment, Human Resources (585-4776 of 585-5487).
5. The supervisor and employee must complete an incident report form and when applicable a WCB form, including medical information. Fax (585-5232) or deliver forms to Human Resources within 24 hours. Where supervisors are unable to fully complete the forms within 24 hours, the forms, with as much information as is available at the time, should be submitted with the remaining information to follow later.
6. The supervisor and employee must review the recommendations of corrective action with a focus on prevention of recurrence.
7. The employee must report capabilities to their supervisor and continue to provide further written medical information to Pension & Benefits, Human Resources. For privacy reasons, **copies cannot be retained in units**.
8. During an absence from work, employees must report regularly to their supervisor regarding their return to work date and/or changes to work schedule. To ensure a safe return to work, an employee must provide medical evidence of capability.
Appendix 12 (cont.)

If **no injury** results and damage to equipment or property occurs:
1. Employee must report the incident to their supervisor.
2. The supervisor must call Campus Security (585-4999).
3. The supervisor and employee must complete an incident report form and fax (585-5232) or deliver to Health, Safety and Environment, Human Resources, within 24 hours. Where supervisors are unable to fully complete the form within 24 hours, the form, with as much information as is available at the time, should be sent to Health, Safety and Environment with the remaining information to follow later.
4. The supervisor and employee must review the recommendations of corrective action with a focus on prevention of recurrence.

All medical information must be forwarded to Human Resources and is kept on file only in HR as per Privacy Protection legislated requirements.

Information for Students
1. Seek medical attention or call 911 for emergencies.
2. Call Campus Security immediately (585-4999).
3. Report the incident to a faculty or staff member.
4. Complete an incident report form and submit to Financial Services and Campus Security within 24 hours. Include statements obtained from witnesses.

For more information, refer to the Student Accident Benefit Plan: [http://www.uregina.ca/presoff/vpadmin/policymanual/fs/30201001.html](http://www.uregina.ca/presoff/vpadmin/policymanual/fs/30201001.html)

Responsibilities:

**Supervisors/Managers**
1. Immediately call Campus Security (585-4999) and in the case of serious incidents, Health, Safety and Environment (585-4776) to report the incident.
2. Meet with employee to discuss the incident causes.
3. Investigate all incidents.
4. Implement effective and practical action to prevent a recurrence of the hazardous condition.
   Will require short-term corrective action measures to control immediate hazard, and long-term measures to effect change.
5. In consultation with the employee complete the incident form.
   Complete the supervisors/managers portion and the WCB Employer’s Initial Report of Injury form for eligible employees (E1) if injury sustained.
   (Return form and medical information to Pension & Benefits, Human Resources.)

**Employees**
1. Immediately report your injury to your supervisor or designate.
2. Complete the incident report in consultation with your supervisor.
3. Cooperate in the investigation.
4. If you suffer an injury while at work, complete the WCB Worker’s Initial Report of Injury form (W1) if you are one of the covered employee groups: [http://www.wcbsask.com/forms/w1.pdf](http://www.wcbsask.com/forms/w1.pdf) and include pertinent medical information.
5. Report regularly to your supervisor (see part 7 & 8 on page 1).
Occupational Health Committee
1. Participate in the investigation of all incidents that require an employee to be hospitalized for a period of 24 hours or more, and all dangerous occurrences.
2. Review and analyze incident report summaries and make recommendations.
3. Attend Accident/Investigation training.

Health, Safety and Environment, Human Resources
1. Notify Saskatchewan Labour, Occupational Health and Safety Division of fatalities, accidents causing serious bodily injury and dangerous occurrences.
2. Receive all incident reports, review and analyze with the supervisor or manager and provide summary report to Occupational Health Committee. Follow up on the effectiveness of the remedial action.
3. Coordinate the training required for supervisors, Occupational Health Committee members and employees in incident investigation methods.
INCIDENT/ACCIDENT REPORT FORM

If the situation is an emergency, call Campus Security immediately: 585-4999

Please complete this form and return to Health, Safety and Environment, Human Resources (AH 435)

WITHIN 24 HOURS OF OCCURRENCE

To be completed by individual(s) directly involved or injured in the incident.

Name: ________________________________ Title/Occupation: ________________________________

Regina Address: ________________________________ Department/Faculty: ________________________________

______________________________ Work Phone: ________________________________

Permanent Address: ________________________________ Home Phone: ________________________________

(If different from above) ________________________________ Supervisor Name: ________________________________

______________________________ Supervisor Phone: ________________________________

Employment category: □ Employee □ Student* □ Faculty □ Visitor □ Contractor

*Students- refer to Student Accident Benefit Plan for information

Please select one of the following:

□ Incident with medical attention □ Incident with no medical attention □ Spill-attach MSDS

Occurrence: Date (dd/mm/yy): ______/_____/______ Time: ______am/pm Location (Bldg, rm#): __________

Details of injury/illness & treatment (e.g. body part involved, cut, strain, bruise, illness symptoms and date of onset, etc.):

___________________________________________________________________________

___________________________________________________________________________

___________________________________________________________________________

Was medical treatment received?

□ University Health Clinic □ Family physician □ Hospital □ Other □ No

Please complete a Workers’ Compensation Report as required:

Employee complete W1 form: http://www.wcbsask.com/forms/w1.pdf

Supervisor complete E1 form: http://www.wcbsask.com/forms/e1.pdf

Was a Workers’ Compensation Report filed? □ Yes □ No

Was there any property/equipment damage? □ Yes □ No

If yes, identify property involved and description of damage:

___________________________________________________________________________

___________________________________________________________________________

Was the correct equipment/tool/material available? □ Yes □ No

Was the correct equipment/tool/material used? □ Yes □ No

If no, explain:

___________________________________________________________________________

___________________________________________________________________________

Radiation Safety Program
Last updated: February 2012
Appendix 12 (cont.)

What workplace conditions were contributing factors?
(e.g. no training, no written procedures, slippery floors, noise, lighting, etc.)

Was Personal Protective Equipment (PPE) available?  □ Yes  □ No
What PPE was used?

Were emergency equipment/services available
(i.e. first aid kit, spill kit, emergency shower/eye wash)?  □ Yes  □ No
If No, explain:

Previous safety training provided?  □ Yes  □ No
If Yes, list courses with dates:

Were written procedures followed?  □ Yes  □ No
If No, explain:

Describe how the incident occurred (use additional paper if required; witness statements should be attached – provide witness name, department & phone number):
If a spill, list name of chemical, quantity, and attach MSDS.

Causes of the incident – i.e. why did it happen and what conditions and/or actions contributed to the injury/accident?  (Discuss with supervisor/manager)
Direct cause:

Indirect cause:

Employee’s Signature _______________________________ Date: ________________
I certify that the information provided is correct.

*Forward to supervisor immediately.*
What preventative measures will be taken to avoid a reoccurrence of this incident? Include short-term and long-term measures where appropriate.

______________________________________________________________________________________

______________________________________________________________________________________

______________________________________________________________________________________

______________________________________________________________________________________

Action by: _____________________________  Action will be completed by: _____________________________
(Name)  (Date)

I certify that the information provided is correct.

Supervisor’s Signature: _____________________________  Date: _____________________________

Manager’s Signature: _____________________________  Date: _____________________________

I certify that the information provided is correct.
Every individual source must be signed out or in, every time it is removed from or returned to storage.

<table>
<thead>
<tr>
<th>Date and Time source is removed</th>
<th>Name</th>
<th>Isotope and Activity</th>
<th>ID #</th>
<th>Purpose for which source is removed</th>
<th>Location source is removed to</th>
<th>Date and Time source is returned</th>
</tr>
</thead>
<tbody>
<tr>
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</tbody>
</table>
## EMERGENCY CONTACT NUMBERS

### RADIATION SAFETY OFFICER

<table>
<thead>
<tr>
<th>NAME</th>
<th>POSITION</th>
<th>ROOM NUMBER</th>
<th>U OF R PHONE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chris Dehm</td>
<td>Radiation Safety Officer</td>
<td>AH 435</td>
<td>(585)-4776</td>
</tr>
<tr>
<td>Tianna Gross</td>
<td>Assistant Radiation Safety Officer</td>
<td>AH 435</td>
<td>(585)-5198</td>
</tr>
</tbody>
</table>

### PACRS (President’s Advisory Committee on Radiation Safety)

<table>
<thead>
<tr>
<th>NAME</th>
<th>POSITION</th>
<th>ROOM NO.</th>
<th>U OF R PHONE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr. R. Manzon</td>
<td>Chairperson</td>
<td>RI 219</td>
<td>(337)-2417</td>
</tr>
</tbody>
</table>

### PERMIT HOLDERS USING RADIOACTIVE MATERIAL

<table>
<thead>
<tr>
<th>NAME</th>
<th>POSITION</th>
<th>ROOM NO.</th>
<th>U OF R PHONE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr. R. Manzon</td>
<td>Biology</td>
<td>RI 219</td>
<td>(337)-2417</td>
</tr>
<tr>
<td>Dr. T. Dahms</td>
<td>Chemistry/Biochemistry</td>
<td>RI 223</td>
<td>(585)-4246</td>
</tr>
<tr>
<td>Dr. R. Idem</td>
<td>Engineering</td>
<td>MT 211</td>
<td>(585)-4470</td>
</tr>
<tr>
<td>Dr. Peter Leavitt</td>
<td>Biology</td>
<td>LB 265.1</td>
<td>(585)-4253</td>
</tr>
<tr>
<td>Dr. E.L. Mathie</td>
<td>Physics</td>
<td>LB 236</td>
<td>(585)-4576</td>
</tr>
<tr>
<td>Dr. D. Suh</td>
<td>Chemistry</td>
<td>LB 317.2</td>
<td>(585)-4239</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LB 317</td>
<td>(585)-4278</td>
</tr>
</tbody>
</table>
# Radiation Safety Data Sheet

## Tritium

### Part 1 - Radioactive Material Identification

<table>
<thead>
<tr>
<th>Chemical Symbol:</th>
<th>H</th>
<th>Common Names:</th>
<th>Tritium</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atomic Weight:</td>
<td>3</td>
<td>Atomic Number:</td>
<td>1</td>
</tr>
</tbody>
</table>

### Part 2 - Radiation Characteristics

- **Physical Half-Life:** 12.35 years
- **Unconditional Clearance Levels:** Activity Concentration (Bq/g) $1 \times 10^5$
- **CNSC Exemption Quantity:** Activity Concentration (Bq/g) $1 \times 10^6$

<table>
<thead>
<tr>
<th>Principal Emissions</th>
<th>Average Energy of Most Abundant Emission (MeV)</th>
<th>Maximum Energy of Most Abundant Emission (MeV)</th>
<th>Gamma-Ray Dose Rate at 1m Distance (mSv/h per GBq)</th>
<th>Shielding Information$^1$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neutrons</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Gamma &amp; X-ray</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Beta* &amp; Electron</td>
<td>0.0057</td>
<td>0.0186</td>
<td>-</td>
<td>Total absorption: &lt;0.1 mm glass or &lt;0.1 mm plastic</td>
</tr>
<tr>
<td>Alpha</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

$^*$ Where beta radiation is present, bremsstrahlung radiation will be produced. Shielding for bremsstrahlung radiation must be considered.

Part 3 - DETECTION AND MEASUREMENT

**Method of Detection:**
Wipes counted by a beta probe (e.g., wipes counted by a liquid scintillation counter)

**Dosimetry:**

<table>
<thead>
<tr>
<th>External</th>
<th></th>
<th></th>
<th></th>
<th>Neutron</th>
</tr>
</thead>
<tbody>
<tr>
<td>TLD (whole body &amp; skin)</td>
<td>Extremity</td>
<td></td>
<td></td>
<td>Other</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Internal</th>
<th></th>
<th></th>
<th>Urine analysis</th>
<th>(specify)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole body</td>
<td>Thyroid</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Part 4 - PREVENTATIVE MEASURES

Tritium is not a radiation hazard unless it enters the body. Once in the body, tritiated water is uniformly distributed in the body water and can then expose tissue. The dose from inhaled elemental tritium gas is 10,000 times less than that from tritiated water. Tritiated water can be absorbed through the surface of skin, leading to an internal exposure. Gaseous tritium is a fire and explosion hazard when exposed to heat or flame and can react vigorously with oxidizing materials.

Recommended protective clothing: Lab coat and PVC gloves (0.5 mm thick) are preferred because of this material’s low permeability to tritiated water. Many tritium compounds readily penetrate gloves and skin. Handle these compounds remotely, wear two pairs of gloves and change the outer layer at least every twenty minutes. Plastic aprons provide added protection especially against tritiated water. Plastic suits may be necessary for work at TBq levels or in an atmosphere contaminated with tritiated water.

Handle tritiated water, gases and volatile liquids in ventilated enclosures. Use glass containers to store tritium compounds because tritiated water and tritiated organic solvents will pass through plastic. Use disposable absorbent liners on trays.

Consult CNSC license for requirements concerning engineering controls, protective equipment, and special storage requirements.

Part 5 - ANNUAL LIMIT ON INTAKE

<table>
<thead>
<tr>
<th>Ingestion</th>
<th>Inhalation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compound Type</td>
<td>Tritiated water</td>
</tr>
<tr>
<td>Annual Limit on Intake (Bq)</td>
<td>$1.0 \times 10^8$</td>
</tr>
</tbody>
</table>
EMERGENCY PROCEDURES

The following is a guide for first responders. The following actions, including remediation, should be carried out by qualified individuals. In cases where life threatening injury has resulted, first treat the injury, second deal with personal decontamination. In the case of an emergency, the Radiation Safety Officer should be contacted as soon as practicable.

Personal Decontamination Techniques
- Wash well with soap and water and monitor skin
- Do Not abrade skin, only blot dry
- Decontamination of clothing and surfaces are covered under operating and emergency procedures

Spill and Leak Control
- Alert everyone in the area
- Clear area
- Summon Aid

Emergency Protective Equipment, Minimum Requirements
- Gloves
- Footwear Covers
- Safety Glasses
- Outer layer or easily removed protective clothing
- Suitable respirator selected

Canadian Nuclear Safety Commission
P.O. Box 1046, Station B
Ottawa, Canada
K1P 5S9

Revision number: 1

Date of revision: 19 September 2011
## RADIATION SAFETY DATA SHEET

### CARBON

### Part 1 - RADIOACTIVE MATERIAL IDENTIFICATION

<table>
<thead>
<tr>
<th>Chemical Symbol:</th>
<th>C</th>
<th>Common Names:</th>
<th>Carbon</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atomic Weight:</td>
<td>14</td>
<td>Atomic Number:</td>
<td>6</td>
</tr>
</tbody>
</table>

### Part 2 - RADIATION CHARACTERISTICS

- **Physical Half-Life:** 5730 years
- **Unconditional Clearance Levels**
  - Activity Concentration (Bq/g) $1 \times 10^6$
- **CNSC Exemption Quantity**
  - Activity Concentration (Bq/g) $1 \times 10^4$
  - Activity (Bq) $1 \times 10^7$

<table>
<thead>
<tr>
<th>Principal Emissions</th>
<th>Average Energy of Most Abundant Emission (MeV)</th>
<th>Maximum Energy of Most Abundant Emission (MeV)</th>
<th>Gamma-Ray Dose Rate at 1m Distance (mSv/h per GBq)</th>
<th>Shielding Information$^1$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neutrons</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Gamma &amp; X-ray</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Beta* &amp; Electron</td>
<td>0.04945</td>
<td>0.156</td>
<td>-</td>
<td>Total absorption: 0.2 mm glass or 0.3 mm plastic</td>
</tr>
<tr>
<td>Alpha</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

$^1$ Where beta radiation is present, bremsstrahlung radiation will be produced. Shielding for bremsstrahlung radiation must be considered.


---

Radiation Safety Program
Last updated: February 2012
Part 3 - DETECTION AND MEASUREMENT

Method of Detection:
Beta probe
Wipes counted by a beta probe (e.g., wipes counted by a liquid scintillation counter)

Dosimetry:
<table>
<thead>
<tr>
<th>External:</th>
<th>TLD (whole body &amp; skin)</th>
<th>Extremity</th>
<th>Other</th>
<th>Neutron</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internal:</td>
<td>Whole body</td>
<td>Thyroid</td>
<td>Urine analysis</td>
<td>✓ (specify)</td>
</tr>
</tbody>
</table>

Part 4 - PREVENTATIVE MEASURES

Hazards:
- Carbon Monoxide: Chemical anoxia and asphyxiation
- Carbon Dioxide: Asphyxiation

Recommended protective clothing: Disposable lab coat, gloves (select gloves appropriate for chemicals handled) and wrist guards. Some organic compounds can be absorbed through gloves, therefore wear two pairs of gloves and change the outer layer frequently.

Use disposable absorbent liners on trays. Be careful not to generate carbon dioxide and handle potentially volatile or dusty compounds in a fume hood. Consult CNSC license for requirements concerning engineering controls, protective equipment, and storage requirements.

Part 5 - ANNUAL LIMIT ON INTAKE

<table>
<thead>
<tr>
<th>Compound Type</th>
<th>Ingestion</th>
<th>Inhalation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Ingestion</td>
<td>Inhalation</td>
</tr>
<tr>
<td></td>
<td>labelled organic compounds</td>
<td>Vapour</td>
</tr>
<tr>
<td>Annual Limit on Intake (Bq)</td>
<td>$3 \times 10^7$</td>
<td>$3 \times 10^7$</td>
</tr>
</tbody>
</table>
EMERGENCY PROCEDURES

The following is a guide for first responders. The following actions, including remediation, should be carried out by qualified individuals. In cases where life threatening injury has resulted, first treat the injury, second deal with personal decontamination. In the case of an emergency, the Radiation Safety Officer should be contacted as soon as practicable.

Personal Decontamination Techniques
- Wash well with soap and water and monitor skin
- Do Not abrade skin, only blot dry
- Decontamination of clothing and surfaces are covered under operating and emergency procedures

Spill and Leak Control
- Alert everyone in the area
- Clear area
- Summon Aid

Emergency Protective Equipment, Minimum Requirements
- Gloves
- Footwear Covers
- Safety Glasses
- Outer layer or easily removed protective clothing
- Suitable respirator selected

---

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24 Hour Emergency Hotline: (613) 995-0479

Revision number: 1  Date of revision: 19 September 2011
# RADIATION SAFETY DATA SHEET

**PHOSPHORUS**

**Canadian Nuclear Safety Commission**

**Radiation Safety Data Sheet**

This data sheet presents information on radioisotopes only. For information on chemical compounds incorporating this radionuclide, see the relevant Material Safety Data Sheet.

## Part 1 - RADIOACTIVE MATERIAL IDENTIFICATION

<table>
<thead>
<tr>
<th>Chemical Symbol:</th>
<th>P</th>
<th>Common Names:</th>
<th>Phosphorus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atomic Weight:</td>
<td>32</td>
<td>Atomic Number:</td>
<td>15</td>
</tr>
</tbody>
</table>

## Part 2 - RADIATION CHARACTERISTICS

<table>
<thead>
<tr>
<th>Physical Half-Life:</th>
<th>14.3 days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unconditional Clearance Levels:</td>
<td>Activity Concentration (Bq/g)</td>
</tr>
<tr>
<td>CNSC Exemption Quantity:</td>
<td>Activity Concentration (Bq/g)</td>
</tr>
<tr>
<td></td>
<td>Activity (Bq)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Principal Emissions</th>
<th>Average Energy of Most Abundant Emission (MeV)</th>
<th>Maximum Energy of Most Abundant Emission (MeV)</th>
<th>Gamma-Ray Dose Rate at 1m Distance (mSv/h per GBq)</th>
<th>Shielding Information&lt;sup&gt;1&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neutrons</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Gamma &amp; X-ray</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Beta* &amp; Electron</td>
<td>0.6947</td>
<td>1.710</td>
<td>-</td>
<td>Total absorption: 3.4 mm glass or 6.3 mm plastic</td>
</tr>
<tr>
<td>Alpha</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

* Where beta radiation is present, bremsstrahlung radiation will be produced. Shielding for bremsstrahlung radiation must be considered.

<sup>1</sup>Delacroix, D. et al, Radionuclide and Radiation Protection Data Handbook 2002

**Progeny**
Part 3 - DETECTION AND MEASUREMENT

Method of Detection:

Beta probe (e.g., thin window Geiger-Mueller detector)

Dosimetry:

- External: TLD (whole body & skin) ✔ Extremity ✔ Neutron □
- Internal: Whole body □ Thyroid □ Urine analysis ✔ Other (specify) □

Part 4 - PREVENTATIVE MEASURES

Chromic acid and its salts have a corrosive action on the skin and mucous membranes. Sodium phosphate is a mild irritant. Phosphocel and Sodium Phosphate (P-32) solutions may emit radioactive fumes containing P-32 when heated to decomposition.

Recommended protective clothing: Disposable plastic, latex, or rubber gloves. Wear a lab coat, which must be monitored before leaving the laboratory. Safety glasses.

Keep handling time to minimum. Use plastic syringe shields and tongs to avoid direct skin contact. When possible work behind a plastic screen. Finger dosimeters should be worn if using quantities greater than a few tens of MBq (~a mCi). Use disposable absorbent liners on trays.

Always use the principles of time, distance and shielding to minimize dose.

Consult CNSC license for requirements concerning engineering controls, protective equipment, and special storage requirements.

Part 5 - ANNUAL LIMIT ON INTAKE

<table>
<thead>
<tr>
<th></th>
<th>Ingestion</th>
<th>Inhalation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compound Type</td>
<td>All compounds</td>
<td>Unspecified compounds</td>
</tr>
<tr>
<td>Annual Limit on Intake (Bq)</td>
<td>$8.3 \times 10^6$</td>
<td>$1.8 \times 10^7$</td>
</tr>
</tbody>
</table>
**EMERGENCY PROCEDURES**

The following is a guide for first responders. The following actions, including remediation, should be carried out by qualified individuals. In cases where life threatening injury has resulted, first treat the injury, second deal with personal decontamination. In the case of an emergency, the Radiation Safety Officer should be contacted as soon as practicable.

### Personal Decontamination Techniques

- Wash well with soap and water and monitor skin
- Do Not abrade skin, only blot dry
- Decontamination of clothing and surfaces are covered under operating and emergency procedures

### Spill and Leak Control

- Alert everyone in the area
- Clear area
- Summon Aid

### Emergency Protective Equipment, Minimum Requirements

- Gloves
- Footwear Covers
- Safety Glasses
- Outer layer or easily removed protective clothing
- Suitable respirator selected

---

**Canadian Nuclear Safety Commission**

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**24 Hour Emergency Hotline:** (613) 995-0479

---

**Revision number:** 1  **Date of revision:** 19 September 2011
## RADIATION SAFETY DATA SHEET

**SULPHUR**

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### Canadian Nuclear Safety Commission

**Radiation Safety Data Sheet**

This data sheet presents information on radioisotopes only. For information on chemical compounds incorporating this radionuclide, see the relevant Material Safety Data Sheet.

---

### Part 1 - RADIOACTIVE MATERIAL IDENTIFICATION

<table>
<thead>
<tr>
<th>Chemical Symbol</th>
<th>Common Names</th>
<th>Atomic Weight</th>
<th>Atomic Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>S</td>
<td>Sulphur</td>
<td>35</td>
<td>16</td>
</tr>
</tbody>
</table>

---

### Part 2 - RADIATION CHARACTERISTICS

<table>
<thead>
<tr>
<th>Physical Half-Life</th>
<th>Activity Concentration (Bq/g)</th>
<th>CNSC Exemption Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>87.44 days</td>
<td>$1 \times 10^2$ Bq/g</td>
<td>$1 \times 10^5$ Bq/g</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$1 \times 10^8$ Bq</td>
</tr>
</tbody>
</table>

### Principal Emissions

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Average Energy of Most Abundant Emission (MeV)</th>
<th>Maximum Energy of Most Abundant Emission (MeV)</th>
<th>Gamma-Ray Dose Rate at 1m Distance (mSv/h per GBq)</th>
<th>Shielding Information$^1$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neutrons</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Gamma &amp; X-ray</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Beta* &amp; Electron</td>
<td>0.04883</td>
<td>0.167</td>
<td>-</td>
<td>Total absorption: 0.2 mm glass or 0.3 mm plastic</td>
</tr>
<tr>
<td>Alpha</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

* Where beta radiation is present, bremsstrahlung radiation will be produced. Shielding for bremsstrahlung radiation must be considered.

Part 3 - DETECTION AND MEASUREMENT

Method of Detection:
Beta probe (e.g., thin-window Geiger-Mueller detector)

Dosimetry:
External:  TLD (whole body & skin)  _____  Extremity  _____  Neutron  _____
Internal: Whole body  _____  Thyroid  _____  Urine analysis  _____

(specify)

Part 4 - PREVENTATIVE MEASURES

Sulphur dioxide: irritant to eye, nose, throat, lungs, bronchoconstriction, mutagen, suspect reproductive effects. Hydrogen sulphide: moderate irritant to eye (conjunctivitis), lung, acute systemic toxicity, CNS effects. Sulphur is combustible.

Recommended protective clothing: Wear disposable lab coat, gloves and wrist guards for secondary protection. Select appropriate gloves for chemicals handled. Lab coat must be monitored before leaving the laboratory.

S-35 is volatile and should be handled in ventilated enclosures. Take care not to generate sulphur dioxide or hydrogen sulphide which could be inhaled. Use disposable absorbent liners on trays.

Consult CNSC license for requirements concerning engineering controls, protective equipment, and special storage requirements.

Part 5 - ANNUAL LIMIT ON INTAKE

<table>
<thead>
<tr>
<th>Compound Type</th>
<th>Ingestion</th>
<th>Inhalation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Inorganic compounds</td>
<td>Elemental sulfur (inorganic)</td>
</tr>
<tr>
<td>Annual Limit on Intake (Bq)</td>
<td>$1.4 \times 10^8$</td>
<td>$1.1 \times 10^8$</td>
</tr>
</tbody>
</table>
EMERGENCY PROCEDURES

The following is a guide for first responders. The following actions, including remediation, should be carried out by qualified individuals. In cases where life threatening injury has resulted, first treat the injury, second deal with personal decontamination. In the case of an emergency, the Radiation Safety Officer should be contacted as soon as practicable.

Personal Decontamination Techniques
• Wash well with soap and water and monitor skin
• Do Not abrade skin, only blot dry
• Decontamination of clothing and surfaces are covered under operating and emergency procedures

Spill and Leak Control
• Alert everyone in the area
• Clear area
• Summon Aid

Emergency Protective Equipment, Minimum Requirements
• Gloves
• Footwear Covers
• Safety Glasses
• Outer layer or easily removed protective clothing
• Suitable respirator selected

Canadian Nuclear Safety Commission
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Revision number: 1 Date of revision: 19 September 2011
## Radiation Safety Data Sheet

### Cobalt

**Canadian Nuclear Safety Commission**

Radiation Safety Data Sheet

This data sheet presents information on radioisotopes only. For information on chemical compounds incorporating this radionuclide, see the relevant Material Safety Data Sheet.

### Part 1 - Radioactive Material Identification

<table>
<thead>
<tr>
<th>Chemical Symbol</th>
<th>Common Names</th>
<th>Mass Number</th>
<th>Atomic Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Co</td>
<td>Cobalt</td>
<td>60</td>
<td>27</td>
</tr>
</tbody>
</table>

### Part 2 - Radiation Characteristics

- **Physical Half-Life:** 5.271 years
- **Unconditional Clearance Levels:**
  - Activity Concentration (Bq/g): $1 \times 10^3$
  - Activity Concentration (Bq/l): $1 \times 10^1$
  - Activity (Bq): $1 \times 10^5$

#### Principal Emissions

| Emission Type | Average Energy of Most Abundant Emission (MeV) | Maximum Energy of Most Abundant Emission (MeV) | Gamma-Ray Dose Rate at 1 m Distance (mSv/h per GBq) | Shielding Information
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Neutrons</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Gamma &amp; X-ray</td>
<td>1.33</td>
<td>-</td>
<td>0.37</td>
<td>Half-value layer (lead): 16 mm</td>
</tr>
<tr>
<td>Beta* &amp; Electron</td>
<td>0.09577</td>
<td>0.344</td>
<td>-</td>
<td>Total absorption: 0.4 mm glass or 0.7 mm plastic</td>
</tr>
<tr>
<td>Alpha</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

*Where beta radiation is present, bremsstrahlung radiation will be produced. Shielding for bremsstrahlung radiation must be considered.*


### Progeny

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Radiation Safety Program

Last updated: February 2012
Part 3 - DETECTION AND MEASUREMENT

Method of Detection:
Gamma probe (e.g., NaI scintillation detector)
Beta probe (e.g., thin window Geiger-Mueller detector)

Dosimetry:
External: TLD (whole body & skin)  ✔ Extremity  ✔ Neutron
Internal: Whole body  ✔ Thyroid  ✔ Urine analysis  ✔ Other (specify)  ✔ Feces

Part 4 - PREVENTATIVE MEASURES

Health hazards associated with cobalt (metal, fume and dust) include cumulative lung damage and dermatitis. Cobalt dust is flammable. Cobalt-60 sealed sources presents an external gamma hazard.

Recommended protective clothing: No protective clothing is necessary for work with sealed sources. When working with unsealed sources wear appropriate protective clothing, such as laboratory coats, coveralls, gloves, and safety glasses/goggles. Laboratory coats must be monitored before leaving the laboratory. Use a suitable mask if the radioactive material is in the form of a dust, powder or if it is potentially volatile.

Optimize time, distance, shielding. Manipulate sealed sources remotely to minimize extremity doses. Use disposable absorbent liners on trays.

Consult CNSC license for requirements concerning engineering controls, protective equipment, and special storage requirements.

Part 5 - ANNUAL LIMIT ON INTAKE

<table>
<thead>
<tr>
<th>Compound Type</th>
<th>Ingestion</th>
<th>Inhalation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unspecified compounds</td>
<td>Oxides, hydroxides, inorganic compounds</td>
</tr>
<tr>
<td>Annual Limit on Intake (Bq)</td>
<td>$6 \times 10^6$</td>
<td>$8 \times 10^5$</td>
</tr>
</tbody>
</table>
EMERGENCY PROCEDURES

The following is a guide for first responders. The following actions, including remediation, should be carried out by qualified individuals. In cases where life-threatening injury has resulted, first treat the injury, second deal with personal decontamination. In the case of an emergency, the Radiation Safety Officer should be contacted as soon as practicable.

Personal Decontamination Techniques
- Wash well with soap and water and monitor skin
- Do Not abrade skin, only blot dry
- Decontamination of clothing and surfaces are covered under operating and emergency procedures

Spill and Leak Control
- Alert everyone in the area
- Clear area
- Summon Aid

Emergency Protective Equipment, Minimum Requirements
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- Outer layer or easily removed protective clothing
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Revision number: 2 Date of revision: 19 September 2011
RADIATION SAFETY DATA SHEET
STRONTIUM

Radioactive Material Safety Data Sheet: Strontium-90

This data sheet presents information on radionuclides only. For information on chemical compounds incorporating this radionuclide, see the relevant Material Safety Data Sheet.

Strontium-90

Part 1 – Radioactive Material Identification

<table>
<thead>
<tr>
<th>Common Names:</th>
<th>Strontium-90</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemical Symbol:</td>
<td>Sr-90 or ⁹⁰Sr</td>
</tr>
<tr>
<td>Atomic Number:</td>
<td>38</td>
</tr>
<tr>
<td>Mass Number:</td>
<td>90 (52 neutrons)</td>
</tr>
<tr>
<td>Chemical Form:</td>
<td>Strontium metal</td>
</tr>
<tr>
<td>Physical Form:</td>
<td>A strontium compound incorporated on a ceramic insert or rolled silver foil</td>
</tr>
</tbody>
</table>

Part 2 – Radiation Characteristics

| Physical half-life: | 28.6 years |
| Specific Activity (GBq/g): | 5,050 |

<table>
<thead>
<tr>
<th>Principle Emissions</th>
<th>Max (keV)</th>
<th>Eff (keV)</th>
<th>Dose Rate (µGy/h/MBq at 10 cm)</th>
<th>Shielding Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beta* (β)</td>
<td>546 (100%)</td>
<td>196</td>
<td>9.7*</td>
<td>-</td>
</tr>
<tr>
<td>Gamma (γ) / X-Rays</td>
<td>2,283 (99.9%)</td>
<td>935</td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>Alpha (α)</td>
<td>935</td>
<td></td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>Neutron (n)</td>
<td>935</td>
<td></td>
<td></td>
<td>-</td>
</tr>
</tbody>
</table>

*Where Beta radiation is present, Bremsstrahlung radiation will be produced. Shielding may be required. Note: Only emissions with abundance greater than 10% are shown.


* This beta is produced by the yttrium-90 progeny, which quickly comes into equilibrium with the strontium parent.

Progeny: Yttrium-90 (Yt-90) (half-life: 64.4 hours; decay progeny: zirconium-90 (Zr-90))

Part 3 – Detection and Measurement

Methods of detection (in order of preference)

1. A radiation survey meter equipped with a thin-window, energy-compensated Geiger Mueller detector.

3. A radiation survey meter equipped with a plastic scintillator detector.

Dosimetry

<table>
<thead>
<tr>
<th>Whole Body</th>
<th>Skin</th>
<th>Extremity</th>
<th>Neutron</th>
</tr>
</thead>
</table>

**Internal:** Sealed sources pose no internal radiation hazard. However, in the event of loss of containment by the sealed source, all precautions should be taken to prevent inhalation or ingestion of the material.

**Critical Organ(s):** Bone tissues

**Annual dose limits:**
- **Non-nuclear energy workers:** 1 mSv per year
- **Nuclear energy workers:**
  - a) 50 mSv in one year
  - b) 100 mSv total over five years
- **Pregnant nuclear energy workers:** 4 mSv over the balance of the pregnancy

Part 4 – Preventive Measures

*Always use the principles of time, distance and shielding to minimize dose*

**Engineering Controls:** Sealed radioactive sources used in industrial applications should always be within a protective source housing to minimize radiation dose and to protect the source capsule from damage.

**Personal Protective Equipment** (for normal handling of unsealed sources only. Always wear disposable gloves, safety glasses, personal protective equipment and clothing as appropriate to the material handled): No special PPE required.

**Special Storage Requirements:** None

Part 5 – Control Levels

<table>
<thead>
<tr>
<th>Oral Ingestion</th>
<th>Inhalation</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALI (kBq)</td>
<td>ALI (kBq)</td>
</tr>
<tr>
<td>1,110</td>
<td>740</td>
</tr>
</tbody>
</table>

**Exemption Quantity (EQ):** 10,000 Bq
Part 6 – Non-Radiological Hazards

None identified at this time.

OSHA Permissible Exposure Limit (PEL)
No limits set at this time

Part 7 - Emergency Procedures

The following is a guide for first responders. The following actions, including remediation, should be carried out by qualified individuals. In cases where life-threatening injury has resulted, first treat the injury, second deal with personal decontamination.

Personal Decontamination Techniques
- Wash well with soap and water and monitor skin
- Do not abrade skin, only blot dry
- Decontamination of clothing and surfaces are covered under operating and emergency procedures

Spill and Leak Control
- Alert everyone in the area
- Confine the problem or emergency (includes the use of absorbent material)
- Clear area
- Summon Aid

Damage to Sealed Radioactive Source Holder
- Evacuate the immediate vicinity around the source holder
- Place a barrier at a safe distance from the source holder (min. 1 meter)
- Identify area as a radiation hazard
- Contact emergency number posted on local warning sign

Suggested Emergency Protective Equipment
- Gloves
- Footwear Covers
- Safety Glasses
- Outer layer or easily removed protective clothing (as situation requires)

This information was compiled by: Stuart Hunt & Associates Ltd.
20 Rayborn Crescent
St. Albert, Alberta
T8N 5C1
Phone: (780) 458-0291 or (800) 661-4591
Fax: (780) 459-0746
Web site: www.stuarthunt.com
# Radiation Safety Data Sheet

## Iodine 125

### Part 1 - Radioactive Material Identification

<table>
<thead>
<tr>
<th>Chemical Symbol</th>
<th>I</th>
<th>Common Names:</th>
<th>Iodine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atomic Weight</td>
<td>125</td>
<td>Atomic Number:</td>
<td>53</td>
</tr>
</tbody>
</table>

### Part 2 - Radiation Characteristics

- **Physical Half-Life:** 60.14 days
- **Unconditional Clearance Levels:**
  - Activity Concentration (Bq/g): $1 \times 10^3$
  - Activity Concentration (Bq/μCi): $1 \times 10^5$
- **CNSC Exemption Quantity:**
  - Activity Concentration (Bq/g): $1 \times 10^3$
  - Activity (Bq): $1 \times 10^5$

### Principal Emissions

<table>
<thead>
<tr>
<th>Emissions</th>
<th>Average Energy of Most Abundant Emission (MeV)</th>
<th>Maximum Energy of Most Abundant Emission (MeV)</th>
<th>Gamma-Ray Dose Rate at 1m Distance (mSv/h per GBq)1</th>
<th>Shielding Information2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neutrons</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Gamma &amp; X-ray</td>
<td>0.03549</td>
<td>0.074</td>
<td>Half-value layer (lead): &lt;1 mm</td>
<td></td>
</tr>
<tr>
<td>Beta* &amp; Electron</td>
<td>&lt;0.01</td>
<td>-</td>
<td>Total absorption: &lt;0.1 mm glass or &lt;0.1 mm plastic</td>
<td></td>
</tr>
<tr>
<td>Alpha</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

* Where beta radiation is present, bremsstrahlung radiation will be produced. Shielding for bremsstrahlung radiation must be considered.


### Progeny

---

**Radiation Safety Program**

Last updated: February 2012
Part 3 – DETECTION AND MEASUREMENT

Method of Detection:
Gamma probe (e.g., NaI scintillation detector)

Dosimetry:

External: TLD (whole body & skin) ✔ Extremity ✔ Neutron

Internal: Whole body Thyroid ✔ Urine analysis ✔ Other (specify)

Part 4 – PREVENTATIVE MEASURES

Iodine compound can become volatile. Handle and store in ventilated areas. Exposure to significant amounts of radioiodine increases risk of developing thyroid cancer. Iodine is toxic by ingestion and inhalation and a strong irritant of eyes and skin. Iodine can be absorbed through the skin. When iodinated (I-125) albumin injection is heated to decomposition, radioactive fumes containing I-125 may be emitted.

Recommended protective clothing: Disposable plastic, latex, or rubber gloves. Wear a lab coat, which must be monitored before leaving the laboratory. Also wear safety glasses. Some iodine compounds can penetrate surgical rubber gloves. Wear two pairs or polyethylene gloves over rubber.

Optimize time, distance, shielding. Use syringe shields and tongs. When possible handle iodine compounds in a fume hood. Use disposable absorbent liners on trays.

Consult CNSC license for requirements concerning engineering controls, protective equipment, and special storage requirements.

Part 5 – ANNUAL LIMIT ON INTAKE

<table>
<thead>
<tr>
<th>Compound Type</th>
<th>Ingestion</th>
<th>Inhalation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual Limit on Intake (Bq)</td>
<td>$1.3 \times 10^6$</td>
<td>$1.4 \times 10^6$</td>
</tr>
</tbody>
</table>
EMERGENCY PROCEDURES

The following is a guide for first responders. The following actions, including remediation, should be carried out by qualified individuals. In cases where life threatening injury has resulted, first treat the injury, second deal with personal decontamination. In the case of an emergency, the Radiation Safety Officer should be contacted as soon as practicable.

**Personal Decontamination Techniques**
- Wash well with soap and water and monitor skin
- Do Not abrade skin, only blot dry
- Decontamination of clothing and surfaces are covered under operating and emergency procedures

**Spill and Leak Control**
- Alert everyone in the area
- Clear area
- Summon Aid

**Emergency Protective Equipment, Minimum Requirements**
- Gloves
- Footwear Covers
- Safety Glasses
- Outer layer or easily removed protective clothing
- Suitable respirator selected

---

Canadian Nuclear Safety Commission
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24 Hour Emergency Hotline: (613) 995-0479

Revision number:  2  
Date of revision:  19 September 2011
### RADIATION SAFETY DATA SHEET

**THORIUM-232**

**Canadian Nuclear Safety Commission**

This data sheet presents information on radioisotopes only. For information on chemical compounds incorporating this radionuclide, see the relevant Material Safety Data Sheet.

## Part 1 - RADIOACTIVE MATERIAL IDENTIFICATION

<table>
<thead>
<tr>
<th>Chemical Symbol</th>
<th>Th</th>
<th>Common Names</th>
<th>Thorium</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atomic Weight</td>
<td>232</td>
<td>Atomic Number</td>
<td>90</td>
</tr>
</tbody>
</table>

Note: There will always be some $^{232}$Th and a variable amount of $^{228}$Ra present in $^{232}$Th.

## Part 2 - RADIATION CHARACTERISTICS

<table>
<thead>
<tr>
<th>Physical Half-Life</th>
<th>$1.405 \times 10^{10}$ years</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Unconditional Clearance Levels:</th>
<th>Activity Concentration (Bq/g)</th>
<th>$1 \times 10^5$</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>CNSC Exemption Quantity:</th>
<th>Activity Concentration (Bq/g)</th>
<th>$1 \times 10^1$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Activity (Bq)</td>
<td>$1 \times 10^4$</td>
</tr>
</tbody>
</table>

### Principal Emissions

<table>
<thead>
<tr>
<th>Principal Emissions</th>
<th>Average Energy of Most Abundant Emission (MeV)</th>
<th>Maximum Energy of Most Abundant Emission (MeV)</th>
<th>Gamma-Ray Dose Rate at 1 m Distance (mSv/h·GBq)$^1$</th>
<th>Shielding Information$^1$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neutrons</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Gamma &amp; X-ray</td>
<td>0.059</td>
<td>-</td>
<td>0.0185</td>
<td>-</td>
</tr>
<tr>
<td>Beta* &amp; electron</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Alpha</td>
<td>4.010</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

* Where beta radiation is present, bremsstrahlung radiation will be produced. Shielding for bremsstrahlung radiation must be considered.


### Progeny

- Ra-228(5.75 y), Ac-228(6.13 h), Th-228(1.9131 y), Ra-224(3.66 d), Rn-220(55.6 s), Po-216(0.15 s), Pb-212(10.64 h), Bi-212(0.55 m), Po-212(0.305 μs), Tl-208(3.07 m)
Part 3 – DETECTION AND MEASUREMENT

Method of Detection:

Alpha probe (e.g., ZnS scintillation detector)

Dosimetry:

External:

- TLD (whole body & skin)
- Extremity
- Neutron

Internal:

- Whole body
- Measurement (progeny)
- Thyroid
- Urine analysis
- Other (specify)
- Feces, $^{220}$Rn in breath, personal air sampler

Part 4 - PREVENTATIVE MEASURES

Thorium and its decay products are toxic by ingestion and inhalation. Thorium is attracted to the bones, lungs, lymphatic glands and parenchymatous tissues. Thorium remains in the body for a long time and is known to cause changes to blood forming, nervous and reticuloendothelial systems, and functional and structural damage to lung and bone tissue. Long after the initial exposure, neoplasms may occur and immunological activity of the body impaired.

Thorium is flammable and explosive in powder form. Thorium dusts have very low ignition points and may ignite at room temperatures. No protective clothing is necessary for work with sealed sources. When working with unsealed sources wear appropriate protective clothing such as laboratory coats (which must be monitored before leaving the laboratory), coveralls, latex or plastic gloves. When handling thorium oxide or thorium nitrate take care not to generate dust. Handle unsealed sources in glove boxes. Optimize time, distance and shielding. Laboratory equipment used for radioactive work must not be used for other purposes. Monitor equipment and supplies for loose contamination before removing from laboratory. Use disposable absorbent liners on trays. Consult CNSC license for requirements concerning engineering controls, protective equipment, and special storage requirements.

Part 5 - ANNUAL LIMIT ON INTAKE

<table>
<thead>
<tr>
<th>Compound Type</th>
<th>Ingestion</th>
<th>Inhalation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unspecific compounds*</td>
<td>Unspecific compounds*</td>
</tr>
<tr>
<td></td>
<td>Oxides &amp; hydroxides*</td>
<td>Oxides, hydroxides*</td>
</tr>
<tr>
<td>Annual Limit on Intake (Bq)</td>
<td>$6.9 \times 10^4$</td>
<td>$3.8 \times 10^2$</td>
</tr>
<tr>
<td></td>
<td>$1.6 \times 10^5$</td>
<td>$4.5 \times 10^2$</td>
</tr>
</tbody>
</table>

Note: * Values are in Bq $^{222}$Th activity for intakes of natural thorium, i.e., $^{222}$Th + $^{228}$Th in equilibrium.
EMERGENCY PROCEDURES

The following is a guide for first responders. The following actions, including remediation, should be carried out by qualified individuals. In cases where life threatening injury has resulted, first treat the injury, second deal with personal decontamination. In the case of an emergency, the Radiation Safety Officer should be contacted as soon as practicable.

Personal Decontamination Techniques
- Wash well with soap and water and monitor skin
- Do Not abrade skin, only blot dry
- Decontamination of clothing and surfaces are covered under operating and emergency procedures

Spill and Leak Control
- Alert everyone in the area
- Clear area
- Summon Aid

Emergency Protective Equipment, Minimum Requirements
- Gloves
- Footwear Covers
- Safety Glasses
- Outer layer or easily removed protective clothing
- Suitable respirator selected

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24 Hour Emergency Hotline: (613) 995-0479

Revision number: 1 Date of revision: 19 September 2011
# Radiation Safety Data Sheet

**Uranium**

This data sheet presents information on radiotopes only. For information on chemical compounds incorporating this radionuclide, see the relevant Material Safety Data Sheet.

## Part 1 - Radioactive Material Identification

<table>
<thead>
<tr>
<th>Chemical Symbol</th>
<th>U</th>
<th>Common Names:</th>
<th>Uranium</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atomic Weight</td>
<td>234, 235, 238</td>
<td>Atomic Number:</td>
<td>92</td>
</tr>
</tbody>
</table>

Note: Data in this sheet is for $^{234}\text{U}, ^{235}\text{U}$ and $^{238}\text{U}$.

## Part 2 - Radiation Characteristics

### Physical Half-Life:

- $^{234}\text{U}: 2.44 \times 10^5$ years
- $^{235}\text{U}: 7.04 \times 10^8$ years
- $^{238}\text{U}: 4.47 \times 10^9$ years

### Unconditional Clearance Levels:

- Activity Concentration (Bq/g): $1 \times 10^5$

### CNSC Exemption Quantity:

- Activity Concentration (Bq/g): $1 \times 10^5$
- Activity (Bq): $1 \times 10^5$

### Progeny

U-238 decay chain:
- Th-234 (24.1 d), Pa-234 (1.17 min), U-234 (2.4E5 y), Th-230 (7.7E4 y), Ra-226 (1600 y), Rn-222 (3.8 d), Po-218 (3.1 min), Pb-214 (26.8 min), Bi-214 (19.9 min), Po-214 (164 μs), TI-210 (1.3 min), Pb-210 (22.3 y), Bi-210 (5 d), Hg-206 (8.1 min), TI-206 (4.2 min), Po-210 (138 d).

U-235 decay chain:
- Th-231 (1.06 d), Pa-231 (32.788 y), Ac-227 (21.8 y), Th-227 (18.7 d), Fr-223 (21.7 min), Ra-223 (11.4 d), At-219 (0.9 min), Rn-219 (4 s), Bi-215 (7.7 min), Po-215 (1.8 ms), Pb-211 (31.2 min), At-215 (100 ms), Bi-211 (2.14 min), TI-207 (4.8 min), Po-211 (516 ms).
Part 3 – DETECTION AND MEASUREMENT

Method of Detection:

Alpha probe (e.g., ZnS scintillation counter)

Dosimetry:

External:  
- TLD (whole body & skin)  
- Extremity  

Internal:  
- Whole body  
- Thyroid  
- Urine analysis  

Other (specify):  
- Neutron  
- Feces, personal air sampler, lung

Part 4 – PREVENTATIVE MEASURES

Soluble uranium compounds are quickly removed from the blood and deposit in the kidney, liver and bone—primarily where they may cause damage. Insoluble uranium compounds may affect the lungs because the deposited radioactive particles are cleared slowly. The inhalation of insoluble compounds may lead to osteosarcoma and lung cancer because of the prolonged irradiation of the thorax.

Uranium reacts with both air and water, and may form a pyrophoric surface when stored in the presence of moist air. Uranium dust is easily ignited and uranium in powder form will ignite spontaneously in air.

No protective clothing is necessary for work with sealed sources.

When working with unsealed sources wear appropriate protective clothing, such as laboratory coats (which must be monitored before leaving the laboratory), coveralls, gloves, and safety glasses/goggles. Use a suitable mask if the radioactive material is in the form of a dust, powder or if it is potentially volatile.

Optimize time, distance and shielding. Handle uranium and its compounds in well ventilated areas. Use metal containers for storage. Store uranyl nitrate away from organic and combustible substance. Monitor equipment and supplies for loose contamination before removing from laboratory. Use disposable absorbent liners on trays.

Consult CNSC license for requirements concerning engineering controls, protective equipment, and special storage requirements.
## Part 5 - Annual Limit on Intake

<table>
<thead>
<tr>
<th>Compound Type</th>
<th>Ingestion</th>
<th>Inhalation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unspecified</td>
<td>Most tetravalent</td>
</tr>
<tr>
<td></td>
<td>compounds*</td>
<td>compounds, e.g.,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>UO₂, UF₆*</td>
</tr>
<tr>
<td>Annual Limit on</td>
<td>4.3 × 10⁵</td>
<td>2.5 × 10⁶</td>
</tr>
<tr>
<td>Intake (Bq)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* All values consider radiological risk, however, chemical toxicity is limiting.

## EMERGENCY PROCEDURES

The following is a guide for first responders. The following actions, including remediation, should be carried out by qualified individuals. In cases where life threatening injury has resulted, first treat the injury, second deal with personal decontamination. In the case of an emergency, the Radiation Safety Officer should be contacted as soon as practicable.

### Personal Decontamination Techniques
- Wash well with soap and water and monitor skin
- Do not abrade skin, only blot dry
- Decontamination of clothing and surfaces are covered under operating and emergency procedures

### Spill and Leak Control
- Alert everyone in the area
- Clear area
- Summon Aid

### Emergency Protective Equipment, Minimum Requirements
- Gloves
- Footwear Covers
- Safety Glasses
- Outer layer or easily removed protective clothing
- Suitable respirator selected
RADIATION SAFETY DATA SHEET
AMERICIUM-241

Canadian Nuclear Safety Commission
Commission canadienne de sûreté nucléaire

Canadian Nuclear Safety Commission
Radiation Safety Data Sheet
This data sheet presents information on radioisotopes only. For information on chemical compounds incorporating this radionuclide, see the relevant Material Safety Data Sheet.

<table>
<thead>
<tr>
<th>Part 1 - RADIOACTIVE MATERIAL IDENTIFICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemical Symbol: Am</td>
</tr>
<tr>
<td>Atomic Weight: 241</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Part 2 - RADIATION CHARACTERISTICS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Half-Life: 432.2 years</td>
</tr>
<tr>
<td>Unconditional Clearance Levels</td>
</tr>
<tr>
<td>Activity Concentration (Bq/g) 1 x 10³</td>
</tr>
<tr>
<td>CNSC Exemption Quantity</td>
</tr>
<tr>
<td>Activity Concentration (Bq/g) 1 x 10⁶</td>
</tr>
<tr>
<td>Activity (Bq) 1 x 10⁷</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Principal Emissions</th>
<th>Average Energy of Most Abundant Emission (MeV)</th>
<th>Maximum Energy of Most Abundant Emission (MeV)</th>
<th>Gamma-Ray Dose Rate at 1m Distance (mSv/h per GBq)¹</th>
<th>Shielding Information²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neutrons</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Gamma &amp; X-ray</td>
<td>0.05954</td>
<td>-</td>
<td>0.085</td>
<td>Half-value layer (lead): &lt;1 mm</td>
</tr>
<tr>
<td>Beta*</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Alpha</td>
<td>5.49</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

* Where beta radiation is present, bremsstrahlung radiation will be produced. Shielding for bremsstrahlung radiation must be considered.

<table>
<thead>
<tr>
<th>Progeny</th>
</tr>
</thead>
<tbody>
<tr>
<td>Np-237(2.14E6 y), Pa-233(27.0 d), U-233(1.585E5 y), Th-229(7340 y), Ra-225(14.8 d), Ac-225(10.0 d), Fr-221(4.8 m), At-217(0.0323 s), Bi-213(45.65 m), Po-213(4.2 µs), Pb-209(3.253 h)</td>
</tr>
</tbody>
</table>
EMERGENCY PROCEDURES

The following is a guide for first responders. The following actions, including remediation, should be carried out by qualified individuals. In cases where life threatening injury has resulted, first treat the injury, second deal with personal decontamination. In the case of an emergency, the Radiation Safety Officer should be contacted as soon as practicable.

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• Summon Aid

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---

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Revision number: 1     Date of revision: 19 September 2011
Part 3 - DETECTION AND MEASUREMENT

Method of Detection:
Alpha probe (e.g., ZnS scintillation counter)

Dosimetry:
External: TLD (whole body & skin) ✔ Extremity ✔ Neutron _____
Internal: Whole body ✔ Thyroid ____ Urine analysis ✔ (specify) Feces, lung _____

Part 4 - PREVENTATIVE MEASURES

Low energy gamma radiation from sealed sources. No protective clothing is necessary for work with sealed sources.

Optimize time, distance, shielding. Manipulate sealed sources remotely to minimize extremity doses. Consult CNSC license for requirements concerning engineering controls, protective equipment, and special storage requirements.

Part 5 - ANNUAL LIMIT ON INTAKE

<table>
<thead>
<tr>
<th>Compound Type</th>
<th>Ingestion</th>
<th>Inhalation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>All compounds</td>
<td>All compounds</td>
</tr>
<tr>
<td>Annual Limit on Intake (Bq)</td>
<td>$1 \times 10^5$</td>
<td>$7 \times 10^2$</td>
</tr>
</tbody>
</table>
**Laser and X-Ray Registration Form**

**Laser Information:**

<table>
<thead>
<tr>
<th>Information</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Departmental Contact Person</td>
<td></td>
</tr>
<tr>
<td>Telephone Number</td>
<td></td>
</tr>
<tr>
<td>Fax Number</td>
<td></td>
</tr>
<tr>
<td>Email</td>
<td></td>
</tr>
<tr>
<td>Academic Staff Member</td>
<td></td>
</tr>
<tr>
<td>Faculty</td>
<td></td>
</tr>
<tr>
<td>Department/Unit</td>
<td></td>
</tr>
<tr>
<td>Location of Laser (Building and Room #)</td>
<td></td>
</tr>
<tr>
<td>Manufacturer and Model</td>
<td></td>
</tr>
<tr>
<td>Serial Number</td>
<td></td>
</tr>
<tr>
<td>Hazard Class (IIIB or IV)</td>
<td></td>
</tr>
<tr>
<td>Use</td>
<td>□ Medical Purposes □ Research Purposes</td>
</tr>
<tr>
<td>Type (lasing media)</td>
<td>□ Yes □ No</td>
</tr>
<tr>
<td>Wavelength(s) (nm)</td>
<td></td>
</tr>
<tr>
<td>Output Power (W)</td>
<td></td>
</tr>
<tr>
<td>Pulsed?</td>
<td>□ Yes □ No</td>
</tr>
<tr>
<td>Pulse Energy (j)</td>
<td></td>
</tr>
<tr>
<td>Pulse Length (s)</td>
<td></td>
</tr>
<tr>
<td>Repetition Rate (Hz)</td>
<td></td>
</tr>
<tr>
<td>Frequency of Use</td>
<td>□ Often □ Occasionally □ Seldom</td>
</tr>
</tbody>
</table>

**Laboratory Personnel Training Date (if trained)**

**Safety Related Information:**

<table>
<thead>
<tr>
<th>Information</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturers manual available</td>
<td>□ Yes □ No</td>
</tr>
<tr>
<td>Written SOP available</td>
<td>□ Yes □ No</td>
</tr>
<tr>
<td>Warning labels visible on control panel</td>
<td>□ Yes □ No</td>
</tr>
<tr>
<td>Warning signs indicating type and class</td>
<td>□ Yes □ No</td>
</tr>
<tr>
<td>Warning labels on beam path enclosure</td>
<td>□ Yes □ No</td>
</tr>
<tr>
<td>Warning system</td>
<td>□ Audible □ Light □ Verbal</td>
</tr>
<tr>
<td>On/Off key control for class IV</td>
<td>□ Yes □ No</td>
</tr>
<tr>
<td>Housing interlocks intact and tested</td>
<td>□ Yes □ No</td>
</tr>
</tbody>
</table>