# Table of Contents

**PART 1 GENERAL RADIATION SAFETY** ................................................................. 6

INTRODUCTION ................................................................................................. 6

**10 ORGANIZATION/ADMINISTRATION** ............................................................. 7

Section 11 PROGRAM ADMINISTRATION ............................................................. 7

Policy RSP-11 Management of Radiation Safety Program ................................. 7

11.1 Administration Accountabilities ................................................................... 7

CAPITAL HEALTH EXECUTIVE MANAGEMENT ............................................. 7

RADIATION SAFETY COMMITTEE ................................................................. 8

RADIATION SAFETY OFFICER ....................................................................... 8

DEPARTMENT MANAGEMENT ........................................................................ 8

CAPITAL HEALTH EMPLOYEES AND OTHER USERS OF IONIZING RADIATION MATERIAL OR DEVICES .......................................................... 9

RADIATION SAFETY ORGANIZATION CHART.............................................. 10

11.2 Radiation Safety Committee ....................................................................... 11

TERMS OF REFERENCE ................................................................................... 11

Section 12 INSPECTIONS AND AUDITS............................................................... 14

Policy RSP-12 Inspections and Audits ................................................................. 14

Section 13 INCIDENT REPORTING and INVESTIGATION ................................... 22

Policy RSP-13 Incident Reporting and Investigation ........................................... 22

13.1 Radiation Incidents .................................................................................... 22

NUCLEAR SUBSTANCES ................................................................................. 22

RADIATION EMITTING DEVICES ................................................................. 23

OTHER EMERGENCIES .................................................................................. 23

NON-EMERGENCY HAZARDOUS SITUATIONS ................................................ 23

13.2 Radiation Safety Officer Incident Investigation and Reporting ....................... 23

13.3 Reportable Incidents ............................................................................... 24

Section 14 COMPLIANCE ENFORCEMENT ....................................................... 26

Policy RSP-14 Compliance Enforcement ........................................................... 26

14.1 Compliance Enforcement .......................................................................... 26

ADMINISTRATIVE ............................................................................................ 26

IMMEDIATE RISKS TO HEALTH AND SAFETY ........................................... 27

ENFORCEMENT PROGRAM OPERATION ..................................................... 27

COMPLIANCE ENFORCEMENT PROCESS .................................................... 27

Section 15 SECURITY ........................................................................................ 28

Policy RSP-15 Security ..................................................................................... 28

VISITORS .......................................................................................................... 28

NUCLEAR SUBSTANCES ................................................................................. 28

RADIATION EMITTING DEVICES ................................................................. 29

ACCESS CONTROL ......................................................................................... 29

ROOM DESIGNATIONS ..................................................................................... 29

Section 16 LABORATORY ROOM REQUIREMENTS ............................................ 30

Policy RSP-16 Laboratory Room Requirements .................................................. 30

16.1 Licences, Permits ...................................................................................... 30

16.2 Applications, Room Authorization and Revisions ......................................... 30

16.3 Laboratory Classification and Design ........................................................ 30

16.4 Area Posting and Signs ............................................................................ 31

POSTING ........................................................................................................ 31

WARNING SIGNS ......................................................................................... 31

16.5 Decommissioning ........................................................................................................31
16.6 Working Rules ........................................................................................................34

Section 17 RECORD KEEPING and POLICIES .........................................................36

Policy RSP-17 Record Keeping and Policies ..................................................................36
17.1 Record Keeping Requirements ..............................................................................36

Table 17-A DEPARTMENT RADIATION SAFETY RECORDS ..................................37
Table 17-B RADIATION SAFETY OFFICE RECORDS ................................................38

17.2 Radiation Safety Policy and Procedures ..................................................................39

General Radiation Safety Manual (Part 1) Changes ...................................................39
Department Radiation Safety Manual (Parts 2-9) Changes .........................................39
Policy and Procedure Availability ..............................................................................39

20 EMPLOYEE QUALIFICATIONS .............................................................................40

Policy RSP-20 Employee Classification and Training ..................................................40
20.1 Employee Classification .......................................................................................40

Nuclear Energy Worker Designation .........................................................................40
20.2 Employee Qualifications and Duties ...................................................................41
20.3 Radiation Safety Training ....................................................................................41

General Radiation Safety Requirements ...................................................................41

30 RADIATION SAFETY OFFICERS ........................................................................44

Policy RSP-30 Radiation Safety Officers ....................................................................44
30.1 Corporate RSO Qualifications and Responsibilities .............................................44
30.2 On-Site RSO Responsibilities .............................................................................46
30.3 Class II Devices Radiation Safety Officer Requirements ......................................47

40 EXPOSURE AND DOSE CONTROL ....................................................................48

Policy RSP-40 Exposure and Dose Control ..................................................................48
40.1 ALARA (As Low As Reasonably Achievable) .......................................................48

Commitment .............................................................................................................48
Training ....................................................................................................................48
Monitoring ..............................................................................................................49
Planning ...................................................................................................................49
40.2 Maximum Permissible Dose and Exposure ............................................................49

Radiation Exposure Limits .......................................................................................49
Maximum Annual Permissible Radiation Dose Limits ..............................................49
40.3 Room Design and Area Surveys ..........................................................................49

50 INSTRUMENTATION AND EQUIPMENT .........................................................51

Policy RSP-50 Radiation Detection Instrument Use and Calibration .........................51
50.1 Survey Meters ......................................................................................................51

Performance Checks ...............................................................................................51
Calibration ................................................................................................................51
Records .....................................................................................................................51
50.2 Contamination Meters ........................................................................................52

Performance Checks ...............................................................................................52
Calibration ................................................................................................................52
Records .....................................................................................................................52
50.3 Efficiency – Relating Readings to Regulatory Criteria .............................................52

60 RADIOACTIVE MATERIAL INVENTORY MANAGEMENT ...............................55

Policy RSP-60 Radioactive Material Inventory Management .....................................55

Section 61 PURCHASING AND INVENTORY TRACKING .......................................55
Section 62 RECEIVING ..............................................................................................56

Delivery of Radioactive Material ..............................................................................56
Receiving – Opening Radioactive Packages ...............................................................56
Radiation Safety Program/ 11.3 Policies

Section 92 RADIATION EMITTING DEVICES EMERGENCIES ...........................................89
Section 93 OTHER RELATED RADIATION EMERGENCIES .................................................89

APPENDIX A – Policy & Procedure Revisions .................................................................91
Policy and Procedure Revisions .........................................................................................91
PART 1 GENERAL RADIATION SAFETY

INTRODUCTION

The purpose of a radiation protection program is to protect patients, personnel and visitors from unnecessary exposure to ionizing radiation. Programs will vary depending on the size of the organization, the type of work being performed and regulatory requirements that govern radiation use.

ORGANIZATION PROGRAM COMMITMENT

Capital Health is committed to provide a safe work environment relating to the use of radioactive material and devices that produce ionizing radiation used in diagnostic, therapeutic and research procedures. The radiation safety program sets out detailed requirements for practices and interventions to be used to protect workers, patients and the general public from unnecessary radiation exposure.

The Capital Health Radiation Safety Program works under a regulatory environment to promote compliance and safe radiation work practices through education, consultation and enforcement. The Capital Health Radiation Safety Officer, On-site Radiation Safety Officers and Medical Physics personnel function as a source of expertise in radiation physics, radiation biology, and regulatory assessment relating to research, education, and medical applications of radiation technologies. Program decisions and behaviour are guided by the following values:

Regulatory Compliance
To provide a program that meets regulatory compliance and promotes maintenance of a safe work environment. This enables Capital Health to assure a high level of safety when providing programs for patients that use ionizing radiation technologies.

Education
To provide an education and training program for staff who work in areas where ionizing radiation is used. Education programs are as varied as the workplace and include technical education programs in the areas of radiation safety, regulatory compliance, laboratory, medical, radiological waste management, radiation biology, transport of dangerous goods and risk assessment.

Consultation
To achieve a strong safety culture regarding the use of ionizing radiation by working together with department managers and staff. Consultation and sharing of information is provided to all staff as well as members of the Capital Health research community and other regional health groups involved in radiation safety.

Enforcement
To provide a climate where department management and employees understand they are accountable for their actions regarding the safe use of ionizing radiation. Education and a strong safety culture provide the basis for accountability; however, the program has provisions to address compliance concerns.
10 ORGANIZATION/ADMINISTRATION

Section 11 PROGRAM ADMINISTRATION

INTRODUCTION

Federal and provincial acts, regulations and standards govern the use of radioactive material and radiation emitting devices. At Capital Health, this includes nuclear substances (medical isotopes), particle accelerators, x-ray emitting devices, non-medical accelerators (cyclotron, isotope production) and radiation therapy treatment devices (brachytherapy). All levels of management and staff share the responsibility for providing a safe working environment relating to ionizing radiation.

Policy RSP-11 Management of Radiation Safety Program

Capital Health recognizes the Canadian Nuclear Safety Act and Regulations, Nova Scotia Occupational Health and Safety Act and Regulations and other relevant regulations and standards and shall provide management control to ensure a safe work environment relating to the use of radioactive material and devices that produce ionizing radiation used in diagnostic, therapeutic and research procedures.

11.1 Administration Accountabilities

Capital Health Executive Management

1.1 The Executive Management of Capital Health (generally one Vice President) assumes ultimate responsibility for the safe use of ionizing radiation and is required to implement an effective Radiation Safety Program to achieve this goal.

1.2 The Executive Management appoints an individual from their team to be designated as the ‘applicant authority’ for all Canadian Nuclear Safety Commission issued licenses. This individual is the Radiation Safety Committee contact person at the executive level and receives the Capital Health Radiation Safety Program quarterly and annual reports.

1.3 The Executive Management delegates the responsibility for monitoring the Radiation Safety Program to the Capital Health Radiation Safety Committee.

1.4 Appropriately trained personnel (Capital Health Radiation Safety Officer, On-site Radiation Safety Officers, Medical Physicists and Quality Control technologists) function as a source of expertise in radiation physics, radiation biology, and regulatory assessment relating to research, education, and medical applications of radiation technologies and are authorized and equipped by Capital Health management to ensure radiation safety practices are followed, appropriate procedures are developed and adequate radiation safety resources are available.
1.5 The Executive Management is committed to an ALARA program designed to keep individual and collective radiation exposures “As Low As Reasonably Achievable”.

Radiation Safety Committee

2.1 The Radiation Safety Committee acts on behalf of the Capital Health Executive Management in the overview and control of the Radiation Safety Program.

2.2 Review existing and any proposed changes to the corporate radiation safety manual or program policies and procedures.

2.3 Review the results of radiation safety audits and occupational radiation exposures and submit an annual report to the Executive Management and appropriate regulatory agencies on all aspects of the Capital Health Radiation Safety Program.

2.4 Support the Capital Health Radiation Safety Officer (RSO) and On-site Radiation Safety Officers in the management of the radiation safety program.

Radiation Safety Officer

3.1 The CDHA Radiation Safety Officer works under the general directives of the Radiation Safety Committee and Safety Programs Department to maintain the Radiation Safety Program in accordance with Capital Health, Provincial and Federal regulations, guidelines and policies. The Radiation Safety Officer may request a designated person (on-site radiation safety officer) to assist with the implementation of the Capital Health Radiation Safety Policies & Procedures in specified departments.

3.2 Serves as the Capital Health contact person with provincial and federal licensing agencies and ensures the licenses for all sources of ionizing radiation are properly maintained.

3.3 Provides quarterly reports to the Radiation Safety Committee as well as an annual review regarding all aspects of the established Radiation Safety Program.

3.4 Establish policies and provide information to ensure departments have effective implementation and control of radiation protection activities throughout all facilities of the organization.

3.5 Manages a radiation safety program, through routine administration, audits and enforcement, which complies with federal and provincial regulations in keeping with the ALARA policy.

Department Management

4.1 Department management has a responsibility to ensure safe radiation safety practices in their area and ensure that the employees under their supervision follow the Capital Health Radiation Safety Program Manual; Radiation Safety Policies and Procedures and any specific related department policies and procedures.
4.2 Ensure employees under their supervision, who work with ionizing radiation, use radiation protection practices and receive proper training in radiation protection.

4.3 Ensure that other people working in their area of supervision, with the potential for occupational exposure to ionizing radiation, are instructed in radiation safety as they relate to their work activities.

4.4 Promote a safe work culture and encourage employees input to improve radiation safety practices in keeping with the ALARA concept.

**Capital Health employees and other users of ionizing radiation material or devices**

5.1 All users of ionizing radiation material or devices shall comply with provincial and federal regulations and policies and procedures as prescribed by Capital Health and processes for radiation safety in their specific department.

5.2 Use safety equipment, clothing, devices and materials provided for personal protection.

5.3 Report any radiation safety issues or concerns using established guidelines such as reporting to your manager, the on-site radiation safety officer or CDHA radiation safety officer.

5.4 Work with department management and the Radiation Safety Officer, or designate, on radiation safety issues and concerns in order to meet the ALARA principle and improve work practices in the area of radiation safety.
Radiation Safety Organization Chart

- **Executive Management**
  (Vice President Designated as Applicant Authority)

- **Radiation Safety Committee**

- **Department of Organizational Health**
  Capital Health Radiation Safety Officer

- **On-Site Radiation Safety Officers**

- **Department Management**
  Directors – Managers - Supervisors

- **Employees**
11.2 Radiation Safety Committee

Terms of Reference

1.0  MEMBERSHIP:

**Full Members:** Expected to attend all meetings to provide guidance and expertise to the CDHA Radiation Safety Officer on all aspects of the Radiation Safety Program.
- Medical Physics Representative
- Radiation Therapy Representative
- Nuclear Medicine/Radiopharmacy Representative
- Radiological Technology (X-ray) Representative
- Molecular Imaging and Research Representative

**Associate Members:** Are invited to attend any meetings if they choose. Associate members will receive the minutes of the meetings and will be asked to attend any meetings where policy changes may affect their departments or when their expertise is required. Other individuals, whose expertise may assist the committee, may be invited to attend meetings as required.
- Laboratory/Permit Holder; Physicians; Nursing; Security; Housekeeping; Porters; Hospital Administration; School/Student Representative; Joint Occupational Health & Safety Committee

**Ex-Officio:** Radiation Safety Officers are non-voting members who are expected to provide quarterly reports to the committee.
- Capital Health Radiation Safety Officer
- NSCC Department On-site Radiation Safety Officer
- Nuclear Medicine Department On-site Radiation Safety Officer
- X-Ray Department On-site Radiation Safety Officer
- Molecular Imaging On-Site Radiation Safety Officer

2.1  APPOINTMENT:

Full member and Associate member representatives are chosen by their respective departments. Each member is expected to arrange for alternate representation to attend meetings when necessary. The Chairperson is chosen by the committee. The past chair is responsible for notifying the Vice President responsible for radiation safety regarding the appointment of the new chairperson.

2.2  LENGTH OF MEMBERSHIP:

The Radiation Safety Officer’s are permanent members. The remaining members are appointed for renewable two-year terms.

2.3  RESPONSIBLE TO:

The Radiation Safety Committee is responsible to the Executive Management through the designated Vice-President.

3.0  GOALS AND OBJECTIVES:
To advise management and the Radiation Safety Officers on radiation safety matters in general and the effectiveness of radiation safety programs within the organization in particular.

3.1 **ANNUAL REVIEW:**

The Radiation Safety Committee shall review the Terms of Reference annually to ensure that the membership, goals, objectives, function and responsibilities are working effectively.

4.0 **FUNCTION AND RESPONSIBILITIES:**

a) Act on behalf of the Capital Health Executive Management in the overview and control of the Radiation Safety Program.
b) Advise management of any perceived need for additional resources to establish, maintain or improve radiation safety programs.
c) Advise on problems dealing with radioactive materials, radiation emitting devices and radiation hazards.
d) Review existing and any proposed changes to the corporate radiation safety manual or program policies and procedures.
e) Review requests from, and advise the radiation safety officers regarding all aspects of the radiation safety program such as training programs, results of corporate inspections of facilities, work practices, dose assessments and research ethics criterion.
f) Review quarterly and annual reports of the program to determine whether program operations and practices are in keeping with the ALARA (As Low As Reasonably Achievable) principle of dose limitation.
g) Review reports and recommend actions concerning any incidents or unusual occurrences at the institute that involved radioactive materials or radiation emitting devices.
h) Maintain written records of its activities, decisions, advice and recommendations concerning radiation safety.

5.0 **FREQUENCY:**

The Committee meets a minimum of four times per year with additional meetings called at the discretion of the chair.

6.0 **MINUTES:**

Minutes shall be taken at all committee meetings.

7.0 **DISTRIBUTION OF COMMITTEE MINUTES:**

Minutes are distributed through electronic means by the committee secretary to the following individuals but this does not limit distribution to other department staff by the committee representative themselves.

All full and associate committee members
Designated Executive Management Vice-President
Head of Diagnostic Imaging
Head of Radiation Oncology
Head of Pathology and Laboratory Medicine
Technical Director Diagnostic Imaging
Technical Manager Radiation Therapy  
Manager Nuclear Medicine Technology  
Designated Representative, CDHA Joint Occupational Health & Safety Committee  
Chief Medical Physicist

8.0 CALENDAR OF EVENTS

ALL MEETINGS (Standing Items):
\begin{itemize}
  \item Licence Amendments (facility, program or policy changes sent to CNSC)
  \item RSO Inspection/Audit Updates
  \item Radiation Safety Program and Policy and Procedure Review
\end{itemize}

\begin{itemize}
  \item December meeting: Election of Chairperson, Membership review
  \item March meeting: Approve Annual Report to Canadian Nuclear Safety Commission and Joint Occupational Health and Safety Committee
  \item June meeting: 
  \item September meeting: Review and Update Policies and Procedures (can be done at any meeting)
\end{itemize}
Section 12 INSPECTIONS AND AUDITS

INTRODUCTION

Standards of safe practice using radioactive material and radiation emitting devices are regulated both nationally and provincially. Audit inspections attempt to provide quantifiable evidence on how well a program is operating, identify trends in performance and provide an opportunity to improve radiation safety practices. Programs are accountable to conduct regular assessments and evaluations of their program to ensure regulatory compliance. Department managers are accountable to ensure any corrective actions take place.

Policy RSP-12 Inspections and Audits

The Radiation Safety Committee and Radiation Safety Officer shall ensure that any use of radioactive prescribed substances or radiation emitting devices complies with national and provincial regulations as well as any special licence conditions. This shall be accomplished by regular inspections and auditing of department policies, procedures, records and practices.

PROCEDURE

Radiation Safety Officer
1. The Radiation Safety Officer shall plan a review of the individual department’s radiation safety practices on a yearly basis or more frequently if required.
2. The CDHA Audit Inspection Form, based on the CNSC Inspection-Audit Guides is used as the main tool.
3. The On-site Radiation Safety Officer will provide any department documentation required.
4. The audit inspection form will document any findings or follow-up.
5. The Radiation Safety Officers report the results of the audit inspection as a standing item on the Radiation Safety Committee agenda.
6. The Radiation Safety Officer may also conduct unscheduled walk through inspections, separate from the planned audit-inspection to ensure department practices comply with regulatory guidelines.

Individual Permit Holder/Responsible User
1. Ensure the records, as defined in Section 17 Record Keeping, are maintained and up to date.
2. Use the “Compliance Inspection Form” issued with the permit, as a guide to ensure the appropriate regulations are being met.
3. Notify the radiation safety officer if any deficiencies are noted. This will give the responsible user and radiation safety officer an opportunity to work together to ensure procedures are developed that maintain regulatory compliance.
4. Regularly review any department policies and procedures to ensure they meet the requirements of the Radiation Safety Policies.
5. Ensure any corrective action is followed-up and acted on.
### CAPITAL DISTRICT HEALTH AUTHORITY RADIATION SAFETY PROGRAM – AUDIT INSPECTION

**Section Regulatory, Licence or Radiation Safety Program Requirements**

<table>
<thead>
<tr>
<th>Section</th>
<th>Required Action</th>
<th>Compliance</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1.0 ORGANIZATION</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.1</td>
<td>Radiation safety information and CDHA policies available to staff.</td>
<td>Met</td>
</tr>
<tr>
<td>1.2</td>
<td>Department Radiation Safety policies/Acts and Regulations available (evidence of review/authorization process)</td>
<td>Met</td>
</tr>
<tr>
<td>1.3</td>
<td>Copy of current Licence Posted in main working area or remote locations (check for current version, correct devices, locations and listed nuclear substances as well)</td>
<td>Met</td>
</tr>
<tr>
<td>1.4</td>
<td>Laboratory Rules Posted and Correct Room Designation (basic-intermediate-high-nuclear medicine, non-controlled, controlled, exclusion)</td>
<td>Met</td>
</tr>
<tr>
<td>1.5</td>
<td>Room and Storage Warning signs posted (check that no signs are on empty containers) (24hr emergency info, radiation symbol, security colour) Greater than 100EQ or likely to receive more than 25uSv/hr</td>
<td>Met</td>
</tr>
<tr>
<td>1.6</td>
<td>Records Available (TDG 2 years; All others for 3 years after expiry of last licence unless previously authorized by CNSC to dispose) (daily output, training, inspections, servicing, leak tests, calibrations, reportable incidents)</td>
<td>Met</td>
</tr>
<tr>
<td>1.7</td>
<td>Documented Workload of Devices (tracked rather than estimated)</td>
<td>Met</td>
</tr>
<tr>
<td>1.8</td>
<td>Device Operated According to Licence Application (Beam Type, output energy, workload) ANNUAL COMPLIANCE REPORT</td>
<td>Met</td>
</tr>
</tbody>
</table>

### Section Required Action

<table>
<thead>
<tr>
<th>Section</th>
<th>Required Action</th>
<th>Due Date yyyy-mm-dd</th>
<th>Assigned To</th>
<th>Date Complete yyyy-mm-dd</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>2.0 EMPLOYEE QUALIFICATIONS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.1</td>
<td>Authorized User Lists and Nuclear Energy Worker Designations documented, available and current</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.2</td>
<td>Training records documented with dates</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Section</td>
<td>Required Action</td>
<td>Due Date yyyy-mm-dd</td>
<td>Assigned To</td>
<td>Date Complete yyyy-mm-dd</td>
</tr>
<tr>
<td>---------</td>
<td>----------------</td>
<td>---------------------</td>
<td>-------------</td>
<td>-------------------------</td>
</tr>
<tr>
<td>2.3</td>
<td>Documented Qualified medical practitioner for devices used to treat patients (Accelerator, Brachytherapy)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.0</td>
<td>RADIATION PROTECTION PERSONNEL</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.1</td>
<td>Designated and Alternate RSO Approved by CNSC, Documented (changes sent to CNSC within 15 days)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.2</td>
<td>Radiation Safety Management Structure Verified (department, corporate, responsibilities)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.0</td>
<td>EXPOSURE DOSE CONTROL</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.1</td>
<td>Procedures demonstrate ALARA principle (action levels investigated or not exceeded)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.2</td>
<td>Facility Design and Area Surveys (Note: No changes in facility design or room use; no change is room use of adjacent areas. If changes made verify they were submitted along with new radiation survey)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.3</td>
<td>Work area and personal radiation protection devices available. (shielding, trays, emergency kits, source storage)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.4</td>
<td>Facilities secured (access controlled in unattended areas including roof, signs unobstructed, authorized user access only for high level lab areas) security for required sources - alarmed doors, motion sensors, second lock)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.5</td>
<td>Procedure verifying no one is in room prior to irradiation</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Section 5.0 INSTRUMENTATION/EQUIPMENT

<table>
<thead>
<tr>
<th>Section</th>
<th>Required Action</th>
<th>Compliance</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.1</td>
<td>Beam Parameter Checks before device is operated (part of daily QC check)</td>
<td>Met</td>
</tr>
<tr>
<td></td>
<td>Device operating under max limit on licence and cannot be inadvertently altered</td>
<td>N/A</td>
</tr>
<tr>
<td>5.2</td>
<td>Camera monitor or viewing system functional (part of daily QC check) (Accelerator, Brachytherapy)</td>
<td>Not Met</td>
</tr>
<tr>
<td>5.3</td>
<td>Key access for device operation restricted to authorized users</td>
<td>N/A</td>
</tr>
<tr>
<td>5.4</td>
<td>Calibration certificates of survey meters (for dose rate measurement and calibrated within the previous 12 months)</td>
<td>Not Met</td>
</tr>
<tr>
<td>5.5</td>
<td>Operational checks for contamination meters (Cyclotron)</td>
<td>Met</td>
</tr>
<tr>
<td>5.6</td>
<td>Contamination detection readings related to licence criteria (sticker on meter) (Cyclotron)</td>
<td>N/A</td>
</tr>
<tr>
<td>5.7</td>
<td>Operational checks for non-portable radiation detectors (Area Monitors, Stack Monitors) (Brachytherapy, Cyclotron)</td>
<td>Not Met</td>
</tr>
<tr>
<td>5.8</td>
<td>Ventilation System (Documentation of air exchanges and testing)</td>
<td>Met</td>
</tr>
</tbody>
</table>

### Section 5.9 SAFETY SYSTEMS

<table>
<thead>
<tr>
<th>Section</th>
<th>Required Action</th>
<th>Compliance</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.9</td>
<td>Beam Warning Lights for Irradiation State of Device (part of daily QC check) ACCELERATOR (ON/OFF or RED/GREEN) BRACHY THERAPY (ON/OFF or RED/GREEN)</td>
<td>N/A</td>
</tr>
</tbody>
</table>
### Regulatory, Licence or Radiation Safety Program Requirements

<table>
<thead>
<tr>
<th>Section</th>
<th>Required Action</th>
<th>Compliance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Met</td>
</tr>
<tr>
<td><strong>5.10</strong></td>
<td>Emergency Stop Buttons functional and cannot be reset from the console. (part of QC check) (Accelerator, Brachytherapy, Cyclotron)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Clear of obstructions and Accessible</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Location of stops:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ACCELERATOR (console, room entrance, both sides of device or wall on both sides of device);</td>
<td></td>
</tr>
<tr>
<td></td>
<td>BRACHYTHERAPY (on console and wall on both sides of device only if dose rate &lt;10MGy/hr at 1m) if not then add back room entrance</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CYCLOTRON (on console only if dose rate &lt;200uv/hr at 30cm from device shield otherwise same as accelerator)</td>
<td></td>
</tr>
<tr>
<td><strong>5.11</strong></td>
<td>Last Person Out button functional (part of daily QC check) (Accelerator, Brachytherapy)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Prevents device operation unless person unless person leaves room and shuts door within pre-set time of pressing button.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Location of LPO button allows full view of room. (BRACHYTHERAPY does not apply if dose rate &lt;10MGy/hr at 1m) CURRENTLY APPLIES AT CDHA</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CYCLOTRON only applies if dose rate &gt;200uv/hr at 30cm from device shield and room access controlled</td>
<td></td>
</tr>
<tr>
<td><strong>5.12</strong></td>
<td>Door Interlocks Functional (part of daily QC check) (Accelerator, Brachytherapy)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stops device when door to room opened (CYCLOTRON only applies if dose rate &gt;200uv/hr at 30cm from device shield and room access controlled)</td>
<td></td>
</tr>
<tr>
<td><strong>5.13</strong></td>
<td>Door designed to prevent anyone from being locked inside the room. (Check for ease of opening doors)</td>
<td></td>
</tr>
<tr>
<td><strong>5.14</strong></td>
<td>Area Monitor Alarm operational when door opens and source is exposed (part of daily QC check) (Brachytherapy) independent of device, independent power supply (hospital emergency supply acceptable)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Not required in Accelerators BUT if present ensure they are tested as part of daily QC</td>
<td></td>
</tr>
<tr>
<td><strong>5.15</strong></td>
<td>Audible Alarm before irradiation (sufficient time to allow emergency stop to be pressed) Does not apply to any devices at CDHA For devices NOT used on patients (CYCLOTRON only applies if dose rate &gt;200uv/hr at 30cm from device shield and room access controlled)</td>
<td></td>
</tr>
</tbody>
</table>

### Service

<table>
<thead>
<tr>
<th>Section</th>
<th>Required Action</th>
<th>Due Date yyyy-mm-dd</th>
<th>Assigned To</th>
<th>Date Complete yyyy-mm-dd</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>5.16</strong></td>
<td>Quality Control Program i.e. CAPCA Standards (Documentation and Frequency of all Checks)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Radiation Safety Program Manual
### Part 1: General Radiation Safety

#### Section 11.3: Policies

<table>
<thead>
<tr>
<th>Section</th>
<th>Required Action</th>
<th>Compliance</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.17</td>
<td>Records of all Device Service available (description of service, date and result)</td>
<td>Met</td>
</tr>
<tr>
<td>5.18</td>
<td>Sign Off procedures documented before resuming normal operations following device or safety systems service</td>
<td>Met</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Section</th>
<th>Required Action</th>
<th>Progress</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.0</td>
<td>RADIOACTIVE MATERIAL INVENTORY MANAGEMENT (HDR sealed sources and Molecular Imaging Radiochemistry) Include accelerator, if storing any activated components</td>
<td>Due Date yyyy-mm-dd</td>
</tr>
<tr>
<td>6.1</td>
<td>Records of receipt of material (inspections, leak tests and wipe tests)</td>
<td></td>
</tr>
<tr>
<td>6.2</td>
<td>Protocol for lost or missing shipments</td>
<td></td>
</tr>
<tr>
<td>6.3</td>
<td>Radionuclide inventory use (cradle to grave documented and retrievable)</td>
<td></td>
</tr>
<tr>
<td>6.4</td>
<td>Records of transfers or shipping to other departments, outside agencies, storage</td>
<td></td>
</tr>
<tr>
<td>6.5</td>
<td>Copies of licences of departments or outside agencies for which shipments are sent</td>
<td></td>
</tr>
<tr>
<td>6.6</td>
<td>Properly labelled packages in storage room (ID#, isotope, activity, signature - also covered signs on empty containers)</td>
<td></td>
</tr>
<tr>
<td>6.7</td>
<td>Local department storage areas (signs, restricted/locked area, adequate shielding)</td>
<td></td>
</tr>
<tr>
<td>6.8</td>
<td>Records of disposal (all waste streams or “to storage”, all symbols defaced)</td>
<td></td>
</tr>
<tr>
<td>6.9</td>
<td>Type A package testing documents on file. (for package used in shipment)</td>
<td></td>
</tr>
<tr>
<td>Section</td>
<td>Regulatory, Licence or Radiation Safety Program Requirements</td>
<td></td>
</tr>
<tr>
<td>------------------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td><strong>Compliance</strong></td>
<td>36</td>
<td><img src="met.png" alt="met" /></td>
</tr>
<tr>
<td>Met</td>
<td>Not Met</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>7.0   PERSONNEL DOSIMETRY</strong></td>
<td>7.1</td>
<td>Whole Body Dosimeter Readings Posted (no limits exceeded)</td>
</tr>
<tr>
<td>7.2</td>
<td>Extremity Monitor Readings Posted (no limits exceeded)</td>
<td><img src="n/a.png" alt="n/a" /></td>
</tr>
<tr>
<td>7.3</td>
<td>All staff, if needed, are issued and wear radiation monitors (whole body, ring (&gt;50 MBq), head/neck)</td>
<td><img src="n/a.png" alt="n/a" /></td>
</tr>
<tr>
<td><strong>8.0   CONTAMINATION CONTROL</strong></td>
<td>8.1</td>
<td>Leak Test certificates and records for sealed sources &gt;50 MBq current and available EVERY 6 MONTHS unless STORAGE (every 24 months); IN DEVICE (every 12 months); REMOVAL FROM STORAGE (before using source); AFTER INCIDENT [no value &gt;200Bq]</td>
</tr>
<tr>
<td>8.2</td>
<td>Patient Release verification (HDR Source Procedure)</td>
<td><img src="n/a.png" alt="n/a" /></td>
</tr>
<tr>
<td>8.3</td>
<td>No evidence of food or drink in nuclear substance rooms.</td>
<td><img src="n/a.png" alt="n/a" /></td>
</tr>
<tr>
<td>8.4</td>
<td>Workers using personal protective devices (gloves, buttoned lab coat, shielding, procedural controls)</td>
<td><img src="n/a.png" alt="n/a" /></td>
</tr>
<tr>
<td><strong>RADIOCHEMISTRY-RADIOPHARMACY</strong></td>
<td>8.5</td>
<td>Daily Area Monitoring records (plan of area, counts related to licence criteria )</td>
</tr>
<tr>
<td>Section</td>
<td>Required Action</td>
<td>Compliance</td>
</tr>
<tr>
<td>---------</td>
<td>----------------</td>
<td>------------</td>
</tr>
<tr>
<td>8.6</td>
<td>Personal Monitoring Program (when finishing work with radioactive material or leaving lab)</td>
<td>Not Met</td>
</tr>
<tr>
<td>9.0</td>
<td>EMERGENCY/SPECIAL PROCEDURES</td>
<td></td>
</tr>
<tr>
<td>9.1</td>
<td>Staff aware of process for emergencies and unusual events (RSO contact and hospital codes)</td>
<td>Met</td>
</tr>
<tr>
<td>9.2</td>
<td>Emergency procedures/equipment available at the work site.</td>
<td>Met</td>
</tr>
</tbody>
</table>

GENERAL COMMENTS AND/OR RECOMMENDATIONS

COMPLETE (Reported to Radiation Safety Committee)

RSO Signature: 

Date:
Section 13 INCIDENT REPORTING and INVESTIGATION

INTRODUCTION

No planning can include every possible emergency situation that personnel may face in the day to day operation of the facility. Procedures are put in place to guide employees in the common types of incidents to report to radiation safety personnel. Radiation safety personnel have an obligation to investigate and report incidents as defined in the regulations.

Policy RSP-13 Incident Reporting and Investigation

Staff are obligated to report incidents involving nuclear substances or radiation devices and the radiation safety officer shall investigate incidents in order to mitigate the consequences of the incident, determine causes and contributing factors, identify appropriate corrective actions and report any required incidents according to regulatory requirements.

PROCEDURE

The following situations are general guidelines that are to be reported to on-site radiation safety personnel. If there are any doubts as to what to report, you are obligated to contact radiation safety personnel and let them work with you to resolve any issues. If the on-site radiation safety officer is unavailable you should contact the next available person in charge (manager, supervisor or CDHA radiation safety office)

13.1 Radiation Incidents

Events can occur that are deemed extraordinary and not typical of the day to day operations. These events have the potential to jeopardize the integrity of the radiation safety program. The Radiation Safety Officer must be promptly notified should these situations arise. They include but are not limited to:

Nuclear Substances

Reportable items include, but are not limited to:
1. Lost or Damaged Shipments
2. Major Radioactive Spills
   a. When a spill involves breakage of storage vial or loss of control of contents spilled from vial or syringe
   b. When a spill involves any radioisotope of very high radiotoxicity
   c. When a spill involves release of volatile material
   d. When it is suspected that inaccessible areas are contaminated
   e. When reasonable efforts to decontaminate are not successful
   f. When there is any doubt about appropriate decontamination procedures
   g. If personal contamination and/or injury has occurred
   h. Any rupture or suspected rupture of a sealed source
3. Lost sources
4. Medical misadministration of nuclear substance (also risk management notification)
5. Any situation where you are unsure of the protocol
6. Unplanned Release to the atmosphere

**Radiation Emitting Devices**
Reportable items include, but are not limited to:
1. Stuck sources (either failure to leave the device or failure to retract)
2. Equipment device failures including beam fails to terminate
3. Failure of any radiation safety system checks
4. Any situation where you are unsure of the protocol
5. Situations where someone may be accidentally exposed to ionizing radiation.

**Other Emergencies**
Report any other emergencies that occur in areas where nuclear substances or radiation devices are used. Reportable items include, but are not limited to:
1. Patients being treated with radiation who require emergency care
2. Fires or explosions
3. Incidents involving equipment related to radiation use not resulting in radiation exposure.

**Non-emergency Hazardous Situations**
Workplace radiation safety hazards are situations that do not pose an immediate safety violation, are a concern for the staff or require clarification regarding established regulations. These situations should not require an immediate response.
1. Questions about radiation safety in your workplace.
2. Using personal protective equipment.
3. Information or clarification on any radiation safety issue.

**13.2 Radiation Safety Officer Incident Investigation and Reporting**
Radiological incidents are to be investigated in a thorough and consistent manner. Some incidents require reporting to regulatory authorities. Radiation safety personnel should involve the appropriate individuals in all investigations and inform the Radiation Safety Committee and management as soon as practicable.

**PROCEDURE**
The tasks that should be performed following an incident are:
1. Initiate response to and management of the incident, including:
   a. Immediate assessment of the magnitude of the event based on initial and often limited information.
   b. Taking steps to terminate, control, or limit the effects.
   c. Conduct decontamination activities to control immediate and residual effects of the incident.
2. Review reporting requirements of regulatory agencies and determine whether a report may be required.
3. Thoroughly investigate the incident to confirm initial information and collect additional information to include, at a minimum:
   a. Interviewing all persons involved in the incident (technologists, physicists, authorized users such as researchers and assistants, ancillary staff and, if necessary, members of the public and patients) to determine the sequence of events, amount of radioactive material involved or radiation dose and its associated hazard, and the
potential for unintended radiation exposure of occupational workers and members of the public.
  b. Performing independent radiation surveys (exposure rate and contamination), bioassay, and dose assessments, if necessary, to determine radiation exposure to potentially affected individuals.
  c. Identifying cause(s) of the incident to prevent recurrence.
  d. Reviewing any records associated with the incident.
4. Identify and implement corrective and preventive actions.
5. Document the incident.
6. Discuss the incident with the Radiation Safety Committee and management.
7. If regulations require that the incident be reported, notify the appropriate regulatory agency.

Consider the following:
  a. The agency must be notified in a timely manner, which may mean reporting the incident much earlier in this sequence.
  b. An incident may be reportable because it “may have caused or threatens to cause” a specific consequence, i.e., and incident may be reportable before all facts are known.
  c. Appropriate facility leadership should be notified prior to reporting the incident to a regulator to apprise them of the incident and alert them of the report. Leadership prefers hearing about the incident from the RSO rather than from a regulator or a member of the media.
  d. A report should include, but is not limited to, dates and times of incident, description of the incident, any effects to environment or persons, actions taken and possible causes and remedies.

### 13.3 Reportable Incidents

Incidents required to be reported to the regulatory agencies are to be investigated as part of the radiation safety program and records kept on file for inspection. Incidents require an immediate notification to the regulatory authorities and follow-up by 21 days. Examples of incidents that are reportable to the Canadian Nuclear Safety Commission include:

<table>
<thead>
<tr>
<th>Radiation Safety Program Section</th>
<th>Incident</th>
<th>Time Frame to Report</th>
</tr>
</thead>
<tbody>
<tr>
<td>11 Organization</td>
<td>Applicant Authority Changes</td>
<td>15 days</td>
</tr>
<tr>
<td></td>
<td>Radiation Safety Officer changes (resignation, leave)</td>
<td>15 days</td>
</tr>
<tr>
<td></td>
<td>(Includes On-site RSO Changes)</td>
<td>Class II requires CNSC approved replacement within 60 days</td>
</tr>
<tr>
<td></td>
<td>Threatened or Planned Work disruption by workers</td>
<td>immediately with follow up investigation report in 21 days</td>
</tr>
<tr>
<td></td>
<td>Illness, Injury or death of a worker incurred as a result of the licensed activity</td>
<td>immediately with follow up investigation report in 21 days</td>
</tr>
<tr>
<td>15 Security</td>
<td>Activation of contingency plan, breach of security, sabotage. (ie reports generated by security services related to licensed activities in these areas)</td>
<td>immediately with follow up investigation report in 21 days</td>
</tr>
<tr>
<td>60 Inventory Management</td>
<td>Damaged or Leaking Packages</td>
<td>immediately with follow up investigation report in 21 days</td>
</tr>
<tr>
<td></td>
<td>Radiation Levels &gt;2 mSv/hr package surface</td>
<td>immediately with follow up investigation report in 21 days</td>
</tr>
<tr>
<td>70 Personnel Monitoring</td>
<td>Nuclear Energy Worker Whole Body Dose &gt; 50 mSv</td>
<td>immediately with follow up investigation report in 21 days</td>
</tr>
<tr>
<td>------------------------</td>
<td>-----------------------------------------------</td>
<td>--------------------------------------------------------</td>
</tr>
<tr>
<td></td>
<td>Nuclear Energy Worker Extremity Dose &gt; 500 mSv</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Nuclear Energy Worker Eye Dose &gt; 150 mSv</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Nuclear Energy Worker Pregnancy Dose &gt; 4 mSv</td>
<td></td>
</tr>
<tr>
<td></td>
<td>General Public Limits Whole Body Dose &gt; 1 mSv</td>
<td></td>
</tr>
<tr>
<td></td>
<td>General Public Limits Extremity Dose &gt; 50 mSv</td>
<td></td>
</tr>
<tr>
<td></td>
<td>General Public Limits Eye Dose &gt; 15 mSv</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CDHA Action Level exceeded (10% of annual dose received in any quarterly monitor period)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Event likely to result in personal exposure in excess of dose limits.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Personal skin contamination with dose estimates</td>
<td></td>
</tr>
<tr>
<td>73 Bioassay</td>
<td>Thyroid screen &gt;1kBq and &lt;10kBq</td>
<td>on annual compliance report</td>
</tr>
<tr>
<td></td>
<td>Thyroid screen &gt;10kBq</td>
<td>immediate report with follow up bioassay on annual compliance report</td>
</tr>
<tr>
<td>82 Spills</td>
<td>Spills &gt;100EQ of nuclear substance</td>
<td>immediately with follow up investigation report in 21 days (GNSC 29.1(d) Activation of contingency plan)</td>
</tr>
<tr>
<td>90 Emergencies</td>
<td>lost source or stuck source</td>
<td>immediately with follow up investigation report in 21 days</td>
</tr>
<tr>
<td></td>
<td>Leak test results in excess of 200 Bq</td>
<td>immediately with follow up investigation report in 21 days</td>
</tr>
<tr>
<td></td>
<td>Theft of Nuclear Substance-Sealed Source</td>
<td>immediately</td>
</tr>
<tr>
<td></td>
<td>surface reading &gt; 2mSv/hr when in shielded position</td>
<td>immediately with follow up investigation report in 21 days</td>
</tr>
<tr>
<td></td>
<td>unauthorized Release to the Environment</td>
<td>immediately with follow up investigation report in 21 days</td>
</tr>
<tr>
<td></td>
<td>Lost shipments (ie misplaced packages or packages not received when expected)</td>
<td>immediately with follow up investigation report in 21 days</td>
</tr>
</tbody>
</table>
Section 14 COMPLIANCE ENFORCEMENT

INTRODUCTION
The Radiation Safety Committee and the Radiation Safety Officer shall maintain a radiation safety program that is committed to education rather than enforcement. From time to time it may be necessary to enforce compliance in the interest of public and worker safety.

Policy RSP-14 Compliance Enforcement

_Note: The text replaces a section that is not visible in the image._

14.1 Compliance Enforcement
A failure to comply with a policy or procedure can result in disciplinary action being taken against the responsible user, department, or individual worker.

The hospital should have the administrative organization in place that is committed to assisting the Radiation Safety Committee and Radiation Safety Officer in resolving cases where individuals have violated internal radiation safety policies, procedures, or regulatory commitments. The senior management of the hospital may be required to make a final decision. Any decisions should be based on a fair and impartial review made by the radiation safety personnel after all affected and interested parties have had their opportunity to present relevant information.

Components of an Enforcement Program

Administrative
1. Senior Management: Is legally responsible for the radiation safety program. Senior management depends on the Radiation Safety Committee to oversee the radiation safety program and the Radiation Safety Officer to oversee the day-to-day operation of the program.
2. Radiation Safety Committee: Has the authority to implement and enforce the radiation safety program encompassing the use of radiation emitting devices and the use, handling, storage and disposal of radioactive materials. The Radiation Safety Committee is appointed by and accountable to the senior management.
3. Radiation Safety Officers: Are responsible for the day to day operations of the radiation safety program. The Radiation Safety Officers reports to the Radiation Safety Committee. The RSO is responsible for initiating investigations of deviations from approved radiation safety practices as well as any event that triggers regulatory reporting requirements. The RSO will seek to determine the root cause and contributing factors, and identify corrective actions.
4. Radiation Safety Requirements and Standards: All requirements and standards are defined in the Canadian Nuclear Safety Commission Act and Regulations, Transport Packaging of Radioactive Materials regulations, conditions of a radioisotope licence, provincial regulations, and radiation safety policies and procedures.
Immediate Risks to Health and Safety
If the radiation safety officer discovers an activity involving either radioactive materials or radiation emitting devices in which health and safety appear to be comprised to an unacceptable level, they have the authority to terminate the unsafe activity immediately without consulting other groups. At the next available opportunity the Radiation Safety Committee and/or senior management should be briefed about the event. The root cause of the problem should be identified and corrective actions and deliberations should be documented in the minutes of the Radiation Safety Committee.

Enforcement Program Operation
The main tool for compliance enforcement is the inspection-audit process covered in Section 12. This addresses licence non-compliance areas. If items in the inspection-audit are not addressed the compliance enforcement process can be activated. The compliance enforcement process can also be activated anytime for major offences.

A major offence is a violation that may cause:
   a. immediate risk or danger to the health and safety of persons
   b. release to the environment of reportable quantities of nuclear substances
   c. doses of substantial amount (above action levels) to staff
   d. the CNSC Radioisotope Licence(s) to be placed in immediate jeopardy

Compliance Enforcement Process

**Major Offence**
The Radiation Safety Officer will immediately take action to avoid danger to the health and safety of staff, patients and visitors. This may involve temporarily suspending the use of radiation emitting devices or radioisotopes until it is safe to resume use.

1. On a **first** major offence, written notification is sent to the department manager, with a copy to the department head, outlining the nature of the offence. Immediate corrective action will be required and the department manager will convey the nature of this action in writing to the RSO and the Chair of the Radiation Safety Committee.
2. On a **second** occurrence of the same offence within a twelve-month period, the department manager will be notified in writing to appear before an emergency meeting of the Radiation Safety Committee to review the incident. The department manager will be asked to explain the causes of the violation, and describe corrective actions taken or planned to prevent recurrence of the violation. The Radiation Safety Committee may recommend in writing to the senior management that radiation use be suspended until corrective actions are taken.

**Other Non-compliance**
The radiation safety officers uses the inspection-audit form to track non-compliance. Informal walkabouts also identify areas of non-compliance and are noted on the annual audit form.

1. The department manager will be notified verbally by the Radiation Safety Officer of the violation observed and suggested corrective actions to be taken. The item will be documented on the inspection-audit form and followed up as identified on the form. The time of follow-up will be based on the urgency of the non-compliance.
2. If the non-compliance is not addressed by the annual inspection-audit, written notification will be sent to the manager with copies to the department head as well as the Radiation Safety Committee.

3. The department manager will be asked to appear before the Radiation Safety committee to outline the steps being taken to insure compliance with standards. The committee will report their findings and recommendations to the senior management.

Section 15 SECURITY

INTRODUCTION

Individuals must always be aware of unauthorized use of nuclear substances or radiation emitting devices and not to hesitate to report any suspected unauthorized use, theft or damage.

The use of nuclear substances and radiation emitting devices require the presence of trained and authorized individuals. Care and control of nuclear substances must be maintained from the time of acquisition to the time of disposal. Many individuals can come in contact with nuclear substances and radiation devices so it is important that procedures ensure only those who are trained to handle material or operate devices do so.

Each department must assess their use of material and devices, security requirements and access to work areas by non-radiation workers. Capital Health has a radiation safety security plan that is protected information. The following summarized the general aspects of facility security.

Policy RSP-15 Security

*The facility where nuclear substances and radiation devices are used shall be secure to prevent unauthorized use, theft or sabotage as well as reduce the risk to non-radiation workers, the organization and general public.*

Visitors

1. Ensure visitors to controlled access facilities are accompanied by an authorized user.
2. Ensure visitor radiation dose is kept ALARA and below general public limits. This may require the use of temporary monitoring devices.

Nuclear Substances

1. Store nuclear substances in a locked room or enclosure when not in use or under the direct supervision of an authorized user.
2. Lock remote storage areas at all times.
3. Secure daily use storage areas when the department is closed.
4. Contained laboratories should be locked at all times when personnel are not present.
5. In multi use labs, the storage facilities for sources (ie. fridge or cupboards) should have locks placed on them when the laboratory cannot be secured. Another possibility is to consider securing and locking a storage box inside the fridge if the fridge is also used for non-radioactive stock.
6. Doors to rooms with radioactive material should be closed at all times during the day and locked at the end of the shift.
7. Store and secure all nuclear substances when arranging work by non-radiation users such as housekeeping or maintenance.
8. Ensure building plans indicate construction restrictions are in place for areas determined by a dose review assessment.

**Radiation Emitting Devices**
1. Ensure only authorized users operate radiation devices.
2. Ensure radiation emitting devices are either secured in locked storage or that the key to operate the device is secure when authorized users are not present.
3. Chain moveable radiation containing devices to building structures or contain them in locked cabinets.
4. Ensure signs are posted at perimeters or other controlled areas outside the device room such as building roof access.
5. Ensure building plans indicate construction restrictions are in place for areas determined by a dose review assessment.
6. If possible, secure access to devices using card controlled access for authorized users.

**Access Control**
1. Ensure facility is controlled for unauthorized users. Any unauthorized user should not have access to areas of radiation use without being escorted by authorized personnel.
2. Card access readers are the first security option; however, key pads or locked doors are also acceptable means to control access.
3. Ensure keys to devices, access ladders or any other restricted access area are secured and in a separate location if unattended.
4. Restrict access to the facility roof or perimeter if required due to dose rates from devices.
5. Follow the room security designations for access during and after work hours.

**Room Designations**

The system in place for room designations follows a colour code system for easy identification. Secured Access (Red) is the most restrictive followed by Restricted Access (Yellow) and then Normal Access (Green). Regular radiation warning signs and contact information is posted on all rooms. Some rooms may also have additional instructions and reminders for staff.

**Secured Access** – (RED) Defines rooms that are to be locked 24 hours a day. These rooms are in more remote locations. Some rooms have higher level radioactive sources but others may have low level, low risk material. Security can provide entrance by non-authorized personnel in emergency situations only. Any housekeeping or routine maintenance is to be pre-arranged.

**Restricted Access** – (YELLOW) Defines rooms that require locking after the normal operating hours of the departments. These rooms generally have staff present throughout the working day but can contain radioactive material or devices that could pose a safety hazard to untrained staff. Security can provide entrance by non-authorized personnel in emergency situations only. Any housekeeping or routine maintenance is to be pre-arranged.

**Normal Access** – (GREEN) Defines rooms that pose no safety risk to general staff and can be left open at all times. Some departments may choose to lock these rooms after hours, for equipment safety, and would make arrangements with security and other departments to restrict access. If not specified, routine access by housekeeping and maintenance is permitted without notifying security.
Section 16 LABORATORY ROOM REQUIREMENTS

INTRODUCTION
Laboratories and room vary depending on the type of use. The following provide general requirements for room use for laboratory, class II devices and x-ray facilities.

Policy RSP-16 Laboratory Room Requirements

*Laboratories shall be designed to comply with federal and provincial regulations, be appropriate for the use type and have procedures to ensure safe work practices.*

PROCEDURE

16.1 Licences, Permits
All those intending to use radioactive materials shall contact the Radiation Safety Committee for permission to do so. No work with radioactive material can be carried out unless the individual or department has a CNSC licence or Capital Health permit to do so.

16.2 Applications, Room Authorization and Revisions
The use and storage of radioactive material and radiation emitting devices is limited to those authorized users who are registered with the Radiation Safety Office for a given nuclear substance and radiation device licence or a permit issued by the Radiation Safety Committee. The use is also restricted to those locations and rooms listed on the licence or permit.

1. Ensure the room list and designated use is up to date. The list will be sent to the department on an annual basis for review and verification.
2. Notify the Radiation Safety Officer for any changes required during the year. An amendment to a licence or permit may be required.
3. Ensure only those listed as authorized users partake in any activity involving the use of radioactive material or radiation emitting devices. If a new employee is hired follow the procedures for worker training and authorization.
4. Report any of the following changes to radiation safety personnel.
   a. Changes to procedures
   b. New nuclear substances or activity increases
   c. New devices
   d. Change of locations or rooms
   e. No longer using locations or rooms (decommission is required before other use)
   f. Special projects using more than 10,000 times the Exemption quantity

16.3 Laboratory Classification and Design
Laboratory and facility design criteria must follow the strict regulatory design criteria as described in the CNSC regulatory documents or Health Canada Safety Codes. Departments must notify radiation safety personnel for any facility design, modification or change of use.

1. Laboratory room designation shall comply with the CNSC designated risk level (Basic, Intermediate, High, Nuclear Medicine, or Storage)
2. Nuclear substance laboratory design shall comply with CNSC RD-GD 52
3. Class II Facilities shall be designed to comply with CNSC Application Guides and ALARA documents.
4. X-ray facilities shall comply with Health Canada Safety Code 35

16.4 Area Posting and Signs

Posting
1. A radiation warning sign must be posted at all points of access to an area or room where the quantity of a nuclear substance is greater than 100 times the regulated exemption quantity or, if there is a reasonable probability that an individual may be exposed to a dose greater than 25 $\mu$Sv/hr.
2. Other items that shall be posted in laboratories include:
   - A copy of the licence
   - A copy of the working conditions (ie basic, intermediate, high or nuclear medicine)
   - Any permits issued
   - Emergency procedures or warning posters if required

Warning Signs
Radiation warning signs identify areas where radioactive material or radiation emitting devices are used or stored.

1. The radiation warning symbol must be either magenta or black on a yellow background. The warning sign must have the words “Caution - Radioactive Material” or “Caution - Radiation Area”.
2. While the word ‘danger’ implies a harmful area and individuals are not to enter, the Canadian Nuclear Safety Commission specifically requires the words ‘rayonnement-danger-radiation’ on warning signs. These words shall be added in smaller print at the bottom of all ‘caution’ radiation warning signs.
3. Warning signs on doors where nuclear substances or Class II devices are stored must also contain a contact name or job title as well as a 24 hour emergency contact number.
4. X-ray rooms shall have a ‘radiation area x-rays’ sign posted on all self closing doors that provide public access to the room.

16.5 Decommissioning
Any room, where nuclear substances or Class II radiation devices are used, cannot be renovated or used for any other purpose without undergoing the decommission procedure. The purpose for decommissioning is to ensure a room or area does not have radiation levels above background levels. This would permit the room to be released for general purposes. The room could only be used for general purposes once all indications of past radioactive use are eliminated. Decommissioning can take many formats depending on the room use.

PROCEDURE
Contact the Radiation Safety Officer when requesting to have a room decommissioned.

Patient Room Discharge Decommission
Patient rooms, that will continue to be used for radioactive use, must be decommissioned when each patient is discharged and before any room cleaning or preparation begins.

- Remove or store all unsealed or sealed nuclear substances.
- Conduct a radiation survey to account for all sealed sources or any contamination.
- Ensure the radiation levels following unsealed source cleanup meet licence criteria. These include area monitoring or wipe testing following room cleanup and documenting results.

**Laboratory Room or Location Decommissioning**

- Decommissioning of a laboratory or room must be performed when removing the lab or room from the active list of radioisotope use.
- The room must be returned to a state of background radiation levels.
- Once a room is decommissioned it cannot be used for storage or use of radioactive material unless an application is made to add it back as an authorized room.
- The "Laboratory Decommissioning" Form must be filled out prior to the room being released for general use.
- When decommissioning an entire laboratory or location, as indicated in the address section of a radioisotope licence, a full plan of the decommissioning procedure must be submitted to the Canadian Nuclear Safety Commission and a decommission licence obtained.

**Equipment Decommission**

Equipment decommissioning includes devices that contain radioactive sources or produce ionizing radiation such as medical accelerators, brachytherapy devices or cyclotrons. The procedure to follow is similar to that of laboratories in that all components must be surveyed to confirm there are no radiation levels in excess of background levels present.

A plan of decommissioning shall be submitted to the CNSC in order to obtain a Licence to Decommission before any work can begin. This should include the following:

- Description of the unit (make model and date of installation)
- Responsibility and training of individuals conducting the decommission
- Dismantling procedure (including date of removal from service)
- Survey equipment used
- Disposition of sources or activated parts (to storage, decay or off-site)
- Final survey of room and a record of all surveys compared to background activities.

X-ray devices do not require any special approval or authorization for decommissioning.
# Laboratory Room Decommissioning Form

<table>
<thead>
<tr>
<th>Licence Number</th>
<th>Permit Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laboratory Use</td>
<td>Isotopes Used</td>
</tr>
<tr>
<td>Requested By</td>
<td>Contact Number</td>
</tr>
</tbody>
</table>

| Rooms to Decommission (Building and Room #) | Survey Equipment Used (make, model) |

## Description of Decommissioning Procedure (Floor Plan Indicating Areas Monitored)

## Final Check

<table>
<thead>
<tr>
<th></th>
<th>Survey Results</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Background Count Rate</td>
</tr>
<tr>
<td>All isotopes removed</td>
<td>1. __________</td>
</tr>
<tr>
<td>Readings at Background Levels</td>
<td>2. __________</td>
</tr>
<tr>
<td>Radiation Warning Signs Removed</td>
<td>3. __________</td>
</tr>
<tr>
<td>Licence or Permit Removed</td>
<td>4. __________</td>
</tr>
<tr>
<td>Wipe Test Results Attached</td>
<td>5. __________</td>
</tr>
</tbody>
</table>

Area Identified Was Successfully Decommissioned

Radiation Safety Officer Signature: ___________________________ Date: _______________
16.6 Working Rules

Many laboratory and x-ray rooms have common working rules. In general one should keep in mind patient privacy, infection control measures and contamination control for all work areas.

Contamination is best controlled before it happens. This is easily accomplished with good work practices. Most contamination occurs when individuals are trying to do more than one thing at a time, are rushing, or are inattentive to the task at hand. When working with open sources of radioactive you should slow down and concentrate on the task at hand.

The same can be said for using radiation emitting devices. By limiting the use to authorized users and concentrating on the task at hand, overexposure of patients and unnecessary dose to staff can be eliminated.

All of these hazards should be taken seriously by the individual using radioactive material or radiation devices. You are accountable to your co-workers, yourself and your patients to ensure radiation exposures are kept as low as reasonable achievable.

Avoiding skin contamination and internal contamination of isotopes in the body.

1. Protective clothing shall ensure all potential areas of skin contamination, for the type of work being conducted, are covered.
2. Laboratory coats must always be worn in the laboratory or department. Coats should be buttoned at all times but must be buttoned when working with open sources of radioactivity.
3. Eating or drinking is strictly prohibited in all laboratories where radioactive material is used.
4. Extreme care must be taken to avoid cuts or puncture wounds. A suitable waterproof dressing should cover cuts when working with radioactive material, even though you will be wearing protective gloves.
5. If there is a risk of splashing (operations with syringe and vial can give rise to a spray) the face should be protected by working behind a transparent sheet, or eye shields should be worn.
6. Disposable gloves must be worn at all times. Gloves should be put on and removed without the hands touching the outside of the gloves. The possibility of transferring activity from gloves to the skin or any inactive region or object should always be kept in mind. In the event of any drips or splashes getting onto the gloves they should be immediately monitored, and if contaminated, removed, placed in the radioactive waste bin and a new pair of gloves used.
7. Hands should be washed and monitored immediately after handling radioactive material. If you are unable to wash your hands they still should be checked for contamination by using a survey meter in the work area. All personnel who have been manipulating unsealed sources of any activity must monitor their hands and clothing before going home or to meals. Any contamination should be documented and if you are unable to reduce the activity the RSO should be called.

Avoiding the spread of contamination.

1. All operations should be carried out over a counter or tray that is covered with absorbent paper.
2. Radioactive iodine with a total activity greater than 50 MBq (1.35 mCi) must be handled in a fume hood.
3. Wherever it is possible, disposable containers and instruments should be used. Glassware and plastic ware, which is not disposable, should be rinsed out immediately after use and then set aside for washing.
4. Syringes should always be disposable, stored in a sharps container after use, and properly labelled with radioactive warning symbols.
5. No contaminated material of any description must be left lying about on benches or draining boards. If radioactive material has to be stored, containers - carefully labelled should be kept in a designated area (cupboard) where there is no possibility of accidental breakage or spillage.
6. Any tools which have been used, e.g. forceps, bottle opener, etc., must be checked for contamination and decontaminated if necessary before being put away.
7. Cleaning methods (including those for floors) should avoid raising dust. Mops, pans, etc. used in a designated area must not be used in other areas and must be monitored regularly. They should be suitably labelled and kept in a cupboard.
8. If any spill of radioactive material occurs, it is the duty of the person involved to deal with the situation immediately. Important clinical results may be invalidated if cross contamination occurs because of the lack of self-discipline in this respect.
9. Avoid using the phone, computer or other such items when you are working with radioactive material. Remove gloves when handling these items.

**Avoiding external beta and gamma radiation**

1. When the source is not in use, it must be stored in a lead pot of suitable thickness if possible, or otherwise in a lead screened area.
2. The source must be transported in a suitable lead pot, or long handled container.
3. The source must never be picked up by hand but always by means of tongs or forceps.
4. All manipulation with a source outside its lead container must be carried out as quickly and as far from the source as possible.
5. Syringe shields must be used when drawing up doses, particularly gamma and high energy beta isotopes.
6. Doses must be drawn up behind shielding.
7. Distance must be used to your advantage. Do not remain in a radiation area any linger than required and if you are near a source keep as great a distance as possible from the source.

**Radiation devices**

1. All operations are to be carried out by authorized users.
2. All operations of class II devices require safety system checks prior to use.
3. All entrance doors to an X-ray room should be kept closed while a patient is in the room and must be closed while making an X-ray exposure.”

**Safety Must Become Part of the Work Culture**

*Radiation Safety Work Habits Must Become Second Nature on the Job.*

*Individuals Must Participate to Ensure Good Safe Work Practices are used*
Section 17 RECORD KEEPING and POLICIES

Policy RSP-17 Record Keeping and Policies

Radiation protection records shall be maintained, and policies revised in accordance with the Canadian Nuclear Safety Regulations, Provincial Regulations and Capital Health Policies and Procedures. All records related to radiation safety shall be made available for inspection by radiation safety personnel and officers of the regulatory bodies as requested.

INTRODUCTION

An acceptable radiation protection records program is one that has well documented policies and procedures for record and report generation and administration. A good safety culture encourages all personnel to contribute to the generation, maintenance and revision of policies, procedures and records. Every effort must be made to ensure the accuracy and completeness of the records and that they are traceable, verifiable and retrievable.

Records are used to evaluate the effectiveness of the radiation protection program, demonstrate compliance with regulations and defend the Radiation Protection Program against unwarranted litigation.

17.1 Record Keeping Requirements

PROCEDURE

1. Radiation protection records shall be maintained in consultation with the Radiation Safety Officer.
2. Sample forms, included throughout the manual, may be adapted to each department. While each department may use a method that works for them, (paper or electronic) all of the required information as stated in the manual must be recorded.
3. Departments who wish help with ensuring the appropriate records and forms are used and kept are encouraged to contact the Radiation Safety Officer.
4. Radiation safety records are kept for a minimum of three years after the expiration of the licence to which they apply. This generally means 8 years of past records.
5. The Radiation Safety Officer must be consulted before any records are to be disposed.
6. The required records for each work area are listed in Table 17-A “Department Radiation Safety Records”. Other records are kept in the Radiation Safety Office and are listed in Table 17-B “Radiation Safety Office Records”.


Table 17-A Department Radiation Safety Records

<table>
<thead>
<tr>
<th>X-Ray</th>
<th>Class II Facilities (Cyclotron, Medical Accelerators and HDR Brachytherapy)</th>
<th>Nuclear Medicine and Isotope Production Laboratories</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Organization - Administrative</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Copy of licence or permit</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Capital Health Radiation Safety Policy and Procedures Manual Online Access</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Department Policy and Procedures not covered in Radiation Safety Manual</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td><strong>Employee Qualifications</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Documented department specific radiation safety training with dates of training</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Transport of Dangerous Goods certificates if shipping/receiving radioactive material</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td><strong>Exposure or Dose Control</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exposure surveys of work areas (compliance or when facility modifications made)</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td><strong>Instrumentation - Equipment</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calibration records for survey meters</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Maintenance and Service records of equipment</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Radiation Safety System Checks of equipment, fail safes and alarms</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Authorization to return equipment to operation following service</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Fume hood calibration and flow rate checks</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td><strong>Radioactive Material Inventory Management</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Purchase records</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Receiving inspection records</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Source Changes</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Records of transfers to other departments (copies of other department licences)</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Shipping records falling under Transport of Dangerous Goods regulations</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Type A package testing certificates (if shipping radioactive material)</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Disposal records of all waste streams or to storage</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Sealed source inventory</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td><strong>Personnel Dosimetry</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whole body dosimetry readings *if required (including pregnancy dose records)</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Extremity dosimetry readings *if required</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Thyroid Screening and Bioassay records *if required</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td><strong>Contamination Control</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct daily area monitoring</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Weekly wipe testing *if required</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Record of non-use of radioactive material</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Leak test records for sealed sources</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Personal contamination monitoring before leaving lab area</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td><strong>Emergency – Special Procedures</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emergency protocols</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
Table 17-B Radiation Safety Office Records

Numbering based on relevant section of radiation safety program

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>10. Organization - Administrative</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Correspondence to Regulatory Agencies or other hospital departments.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>11.2 Radiation Safety Committee Minutes</td>
<td></td>
</tr>
<tr>
<td></td>
<td>11.2 Radiation Safety Committee Quarterly and Annual Reports</td>
<td></td>
</tr>
<tr>
<td></td>
<td>11.2 Lab Lists and Room Classifications (room number, designation and use)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>12 Inspections and Audits</td>
<td></td>
</tr>
<tr>
<td></td>
<td>13 Incidents and Investigations</td>
<td></td>
</tr>
<tr>
<td></td>
<td>15.6 Annual Compliance reports</td>
<td></td>
</tr>
<tr>
<td></td>
<td>16 Copies of licences or permits</td>
<td></td>
</tr>
<tr>
<td></td>
<td>16.5 Decommissioning records (rooms, labs, or installations)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>17.2 Capital Health Radiation Safety Policy and Procedures Manual</td>
<td></td>
</tr>
<tr>
<td><strong>20. Employee Qualifications</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>20 List of authorized users for the licence or permit</td>
<td></td>
</tr>
<tr>
<td></td>
<td>20 List of Nuclear Energy Workers</td>
<td></td>
</tr>
<tr>
<td></td>
<td>20 Documented CDHA radiation safety training with dates of training</td>
<td></td>
</tr>
<tr>
<td><strong>30. Radiation Safety Officer Qualifications</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>30 Radiation Safety Officer and Onsite RSO qualifications</td>
<td></td>
</tr>
<tr>
<td><strong>40. Exposure or Dose Control</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>41.3 Exposure surveys of storage and work areas</td>
<td></td>
</tr>
<tr>
<td><strong>50. Instrumentation - Equipment</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>50 Radiation survey equipment inventory</td>
<td></td>
</tr>
<tr>
<td><strong>60. Radioactive Material Inventory Management</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>61 Yearly Purchase inventory and authorized purchaser list (under #21)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>61 Sealed Source Inventory</td>
<td></td>
</tr>
<tr>
<td></td>
<td>63 Transport of dangerous goods certificates (under #22 with signed copied in individual departments)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>65 Disposal records of all long lived waste streams (others with individual department inventory records)</td>
<td></td>
</tr>
<tr>
<td><strong>70. Personnel Dosimetry</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>71 Personal monitoring (whole body, extremity, lifetime results)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>72 Pregnant radiation users monitoring records</td>
<td></td>
</tr>
<tr>
<td><strong>80. Contamination Control</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>81.5 Emissions monitoring (annual summaries of purchases and disposal routes)</td>
<td></td>
</tr>
<tr>
<td><strong>Other Records</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>X-ray equipment inventory (added and removed facilities in CDHA annual report)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Iodine Therapy patient room decommission and outpatient records</td>
<td></td>
</tr>
</tbody>
</table>
17.2 Radiation Safety Policy and Procedures

All procedures in the General Radiation Safety Manual and the Department (use type) Radiation Safety Manuals form part of the CNSC Licence. Any changes and adjustments to policies must go through an appropriate approval process and the licence amended before the change can be implemented. The CNSC amendment process can take months so it is expected that policy changes will be time consuming, nevertheless, this is the regulatory requirement.

A dynamic responsive radiation safety program should have continuous improvement in the policies and procedures as programs change, however, the radiation safety manuals shall be reviewed in their entirety at a minimum of once every three years.

PROCEDURE

General Radiation Safety Manual (Part 1) Changes
1. Any proposed policy changes are to be discussed with the CDHA Radiation Safety Officer.
2. Changes made are brought to next Radiation Safety Committee meeting. Urgent changes can be adopted by email consensus of the Radiation Safety Committee.
3. Once approved by the Radiation Safety Committee, the CDHA RSO modifies the manual and submits the change to the CNSC for approval and licence amendment.
4. Once the CNSC has approved the change the manual will be officially revised, posted to the Radiation Safety web site and notification sent to on-site RSO’s.
5. The on-site RSO’s will notify their areas of the change.

Department Radiation Safety Manual (Parts 2-9) Changes
1. Any proposed policy changes are to be discussed with the Onsite Radiation Safety Officer at a department meeting.
2. The On-site RSO will notify and discuss the change with the CDHA RSO.
3. Changes made are brought to next Radiation Safety Committee meeting. Urgent changes can be adopted by email consensus of the Radiation Safety Committee.
4. Once approved by the Radiation Safety Committee, the CDHA RSO modifies the manual and submits the change to the CNSC for approval and licence amendment.
5. Once the CNSC has approved the change the manual will be officially revised, posted to the Radiation Safety web site and notification sent to on-site RSO for that department.
6. The on-site RSO’s will notify the department of the change.

Policy and Procedure Availability
1. Employees working in areas where radioisotopes or radiation emitting devices are used shall have access to written safety policies and procedure manuals relevant to the job they are assigned.
2. Provide access to, or print off appropriate Radiation Safety Policies and Procedures that are available on the hospital web-site. Online access is acceptable provided ALL staff have ready access anytime they are in the workplace. If this is not possible, provide a printed copy.
20 EMPLOYEE QUALIFICATIONS

INTRODUCTION

Designation and training of workers is the key component of any occupational health and safety program. Training programs are as varied as the hazards in the workplace so the organization should ensure the risks are identified and people have the appropriate credentials and training to ensure a safe workplace.

Policy RSP-20 Employee Classification and Training

All employees who work with nuclear substances or radiation emitting devices shall be appropriately designated and provided radiation safety training in accordance with the identified hazards of their specific job including refresher radiation safety training every three years.

20.1 Employee Classification

Nuclear Energy Worker Designation

Individuals, working with radiation and with the potential for receiving annual doses exceeding the general public limits are to be designated as Nuclear Energy Workers (NEW).

PROCEDURE

1. The following information must be collected for every worker registered as a nuclear energy worker in order to obtain a radiation monitoring badge. The information is protected under privacy legislation.
   - Full name (all given names, surname, and previous surnames)
   - Social insurance number
   - Gender
   - Date and place of birth (province/state and country)

2. The following information must be provided and written acknowledgement that the individual has received the information must be obtained. This can be separate or part of the training material.
   - Notification that they are registered as nuclear energy workers
   - Information regarding the risk to individuals exposed to radiation
   - Information regarding the risks to pregnant individuals and their obligation to declare a pregnancy
   - The dose limits for Nuclear Energy Workers
   - The dose records for the individual (posted in department)

3. The categories of staff members that are generally designated as Nuclear Energy Workers would include staff and students as:
   - Nuclear Medicine Technologists
   - Cyclotron Engineers and Service personnel
   - Isotope Production or Radiopharmacy personnel
4. Other categories, unlikely to exceed the general public limits but who may be considered as Nuclear Energy Workers, include staff and students as:
   - Nuclear Medicine Physicians and Oncologists
   - Medical Physicists and Physics Assistants
   - Radiation Therapists (Accelerator and Brachytherapy)
   - Laboratory Technologists
   - Nursing Staff (Oncology)
   - Class II Device Service Technologists

5. The Radiation Safety Officer is responsible for determining and providing the information to anyone being designated a Nuclear Energy Worker. Once designated, the Nuclear Energy Worker must sign and date a record sheet that is kept on file in the Radiation Safety Office.

20.2 Employee Qualifications and Duties

All personnel working with nuclear substances or radiation devices should be familiar with the hazards inherent in their work and the procedures used to minimize these hazards. Training provides the employee with an awareness of radiation safety hazards in order to perform their job safely. Training should provide the employee with an increased awareness of the uniqueness of radiation and an ability to identify and prevent possible health and safety consequences. Many people have prior professional training and certification that can meet the needs of the employer. It is up to the employer to determine if the training is appropriate.

The most appropriate training should be based on:
   - an analysis of the tasks that are required by the employee
   - development of objectives derived from the task analysis
   - designing a training program to meet the objectives
   - evaluation and revision of the program based on employee performance or job changes

20.3 Radiation Safety Training

Training programs and methods will vary depending on the resources and personnel available. Design may take the form of training manuals, booklets or computer training in a large organization with limited training personnel. The content should be targeted to the specific employee work area and at a level appropriate for the employee. CDHA has established a Radiation Safety Training Manual to assist departments is implementing appropriate training programs. Manager accountabilities and the various task analysis sections for job categories.

General Radiation Safety Requirements

Topics for training should cover basic areas of radiation safety. Each group should have the tasks identified, level of content determined, and specific material presented to those individuals requiring the training. Material from the general radiation safety outline should be used as a guide when developing training material tailored to the specific work area.
Each group does not require all material in the outline. The content and depth of knowledge will vary with each job. The main focus for training development should be the requirements to do a job safely.

**Organization and Administration**
1. Radiation Safety Management
   1. Executive Management, Department Supervisors and Employees
   2. Radiation Safety Committee and Radiation Safety Officer
2. Radiation Safety Acts and Regulations
3. Radiation Use in the Organization
   1. Radioactive Material, Radiation Emitting Devices, Departments
   2. Lab Requirements and Record Keeping

**Exposure and Dose Control**
1. Working with Radiation
   1. Types of Radiation
   2. Radiation Exposure Limits
   3. Radiation Protection Concepts of Time, Distance, Shielding and ALARA
   4. Warning Signs and General Safe Work Procedures
2. Concepts of Radiation Risk

**Instrumentation and Equipment**
1. Radiation Detection and Measurement
   1. Selection and Use of Monitors, Meters and Counting Devices
   2. Performance Checks and Calibration
   3. Personal Protection Devices

**Radioactive Material Inventory Management**
1. Purchasing and Inventory Tracking
2. Delivery and Opening of Packages
3. Storage and Security of Devices and Radioactive Material
4. Disposal Methods and Waste Handling
5. Transportation and Handling of Inventory

**Personnel Dosimetry**
1. Dose Limits and Classification of Workers
2. Personal Monitoring
3. Pregnant Radiation Workers

**Contamination Control**
1. Prevention of Contamination and Protective Clothing
2. Contamination

**Emergency and Special Procedures**
1. Basic Emergency Response and Procedures to Contact Safety Personnel
2. Response to Spills and other Incidents such as Lost Shipments and Fires
3. Possible Department Specific Emergencies and Response

**PROCEDURE**

1. **Identify staff** that will be working as authorized users with nuclear substances or radiation emitting devices. Other employees who may provide auxiliary help in areas where ionizing radiation is used should also be identified for awareness training. This may include nursing staff, laboratory technologists, researchers, and general hospital support staff such as security and housekeeping and porters.
2. Consult with the radiation safety officer to **determine the appropriate radiation safety material** to provide based on the job category of the employee. The material may be presented in a number of formats as identified in the task list.
   a. Booklets or Fact Sheets can provide the necessary information regarding the day to day activities an employee may expect to encounter on the job. The booklet is a method that can get the information into the hands of the employee and also serve as an on the job reference.
   b. Formal lectures provide a mechanism for feedback and an opportunity for employees to make a connection with radiation safety personnel. Lectures may be appropriate for large group refresher material but can also be of benefit in a one on one orientation session.
   c. Computer training provides an opportunity for more variation in training. Specialized individuals may be required to develop the material and staff availability of computers would be required. Computers can be used to provide simple slide presentations or advanced interactive learning.

3. **Document** all radiation safety training. This can be accomplished by keeping hard copy records of training quizzes; attendance records at awareness sessions or online record documentation.

4. Provide additional **department specific training** if the general radiation safety training material does not cover the specifics of the departmental work.

5. Provide **refresher training** every three years as required for authorized users; if audits identify deficiencies; if practices in the department have changed or if there are changes in equipment or radiation hazards.
30 RADIATION SAFETY OFFICERS

INTRODUCTION
Radiation safety personnel work under a regulatory environment to promote compliance and safe radiation work practices through education, consultation and enforcement. The Capital Health Radiation Safety Officer and On-site Radiation Safety Officers function as a source of expertise in radiation physics, radiation biology, and regulatory assessment relating to research, education, and medical applications of radiation technologies. They work with department experts (Medical Physicists, Quality Control Technologists and other Safety Officers to ensure safe radiation safety practices in the workplace.

Policy RSP-30 Radiation Safety Officers

*Radiation Safety Officers (RSO) shall be responsible for the management and control of the radiation safety program to ensure that work is conducted in accordance with all regulatory requirements pertaining to ionizing radiation.*

PROCEDURE
1. Notification of CNSC when change in Corporate RSO
2. Notification of CNSC change in on-site RSO
3. Certification of Class II RSO replaced within x days of change of duties
4. RSO’s notify departments in writing of replacement or coverage when absent for vacation.

30.1 Corporate RSO Qualifications and Responsibilities

The CDHA Radiation Safety Officer is a full time position that reports to the Manager of the CDHA Safety Programs and works with the Radiation Safety Committee to maintain a Radiation Safety Program in accordance with Federal, Provincial and Capital Health regulations, guidelines and policies. The RSO should have experience working with radioactive materials and radiation emitting devices and dealing with regulatory agencies. Specific training in radiation safety, recognized by the Canadian Radiation Protection Association, through registration (CRPA(R)) shall be obtained immediately upon assuming duties as an RSO if this registration has not already been attained. The RSO shall also be able to work independently, prioritize workload, deal with many different departments and personnel and pay critical attention to detail to facilitate accuracy and completeness in the work process.

The CDHA Radiation Safety Officer is generally responsible for the development, implementation and management of a district radiation safety program that provides effective control and safe use of ionizing radiation protection activities throughout the organization.

Responsibility for Safety of Others
The RSO has the authority, as designated by senior management, to stop any unsafe practices regarding the use of nuclear substances or radiation-emitting devices in their individual areas. If there is an immediate safety concern, the RSO should notify any staff that could be immediately affected. The RSO also has the authority to address any radiation safety concerns immediately, without the need to obtain permission from other authorities.
Notification: The CDHA Radiation Safety Officer will notify department management following any stop work decisions. The CDHA Radiation Safety Officer will also notify department management for any safety-related issues with regard to use of nuclear substances or radiation-emitting devices in their individual areas. Any notifications will also be reported to the Radiation Safety Committee as part of the quarterly report. Any reportable incidents, required by the CNSC, will be reported to the CNSC.

General Organization/Administration
1. Serve as the Capital Health contact person with provincial and federal licensing agencies and ensure the licenses for all sources of ionizing radiation are properly maintained.
2. Keep the executive management informed on radiation safety issues through Radiation Safety Committee minutes, corporate annual reports and other means as required.
3. Provide quarterly reports to the Radiation Safety Committee as well as an annual review regarding all aspects of the established Radiation Safety Program.
4. Act as a resource for departments requiring assistance with radiation safety issues.
5. Develop and maintain corporate policies and procedures based on the interpretation of the legislation and licence conditions.
6. Act as a resource and provide information to assist departments in implementing and maintaining effective control of radiation protection activities.

Licensing/Inspection and Investigation
1. Monitor radiation safety compliance with national and provincial licences and regulations through a formal inspection process.
2. Investigate radiation incidents, initiate corrective action, and report incidents that are required to be sent to regulatory authorities.
4. Ensure all records and reports required by the regulations are prepared, maintained and submitted.
5. Submit, for CNSC approval, any amendments required for facility, program or policy changes related to licenses.

Employee Qualifications/Performance
1. Maintain documentation of authorized user lists and nuclear energy workers.
2. Develop training programs based on deficiencies noted in observations and inspections as well as national guidelines for radiation safety training.
3. Ensure workers, whose duties occasionally expose them to ionizing radiation, such as porters, housekeepers, security and support staff receive appropriate radiation safety training.
4. Promote a culture of safety and safe work practices by frequent contact and discussion with hospital staff, circulation of information and in-service training.

Nuclear Substances and Radiation Emitting Devices
1. Maintain a sealed source inventory of all sealed sources used in diagnosis and therapy.
2. Monitor department policy and practice includes that equipment is appropriate and functioning properly for its intended use.
3. Audit/Inspect a radioactive material inventory program to ensure compliance with regulations and ‘care and control’ of radioactive material from receiving to transportation, storage and disposal.
4. Ensure department policies and procedures comply with regulatory requirements for the protection of personas and the environment.
5. Ensure practices are in place to deal with contamination, emergency and special procedures that may arise.
6. Stop work practices for any unsafe conditions.

**Personnel Dosimetry**
1. Manage a personal radiation dosimetry program for all persons, including pregnant workers, who use ionizing radiation.
2. Investigate reports of high exposure to radiation, determine facts and confirm events and recommend appropriate action to prevent recurrence.
3. Ensure radiation levels to staff and the public are maintained below regulatory requirements and as low as reasonably achievable.

### 30.2 On-Site RSO Responsibilities

The On-Site Radiation Safety Officer acts as the liaison between the Capital Health Radiation Safety Office and the individual department. They work with their respective department management and employees to implement the Radiation Safety Program at the department level. In departments that are too small to have a designated on-site Radiation Safety Officer, the role is the responsibility of the department management (Director, Manager or Supervisor). Where departments have Class II devices, the On-site RSO must also fulfill the regulatory criteria for the devices. The On-site Radiation Safety Officer must have training specific to Radiation Safety in the area they will be working. Individuals with an educational background in a discipline involving use of radiation should have specific Radiation Safety training.

**Responsibility for Safety of Others**

The On-site RSO has the authority, as designated by senior management, to stop any unsafe practices regarding the use of nuclear substances or radiation-emitting devices in their individual areas. If there is an immediate safety concern, the RSO should notify any staff that could be immediately affected. The RSO also has the authority to address any radiation safety concerns immediately, without the need to obtain permission from other authorities.

**Notification:** The On-site RSO must notify the CDHA Radiation Safety Officer and department management following any stop work decisions. The On-site RSO must also notify the CDHA Radiation Safety Officer and department management for any safety-related or licensing issues with regard to use of nuclear substances or radiation-emitting devices in their individual areas.

**General Organization/Administration**
1. Act as a resource for department staff requiring assistance with radiation safety issues.
2. Work in consultation with the CDHA Radiation Safety Officer in the effective implementation of a radiation safety program and development of policies and procedures.
3. Monitoring implementation of department radiation safety policies and procedures
4. Submit any facility, program or policy changes related to radiation safety practices to the CDHA RSO.
5. Provide quarterly updates on radiation safety concerns, actions and improvements to the Radiation Safety Committee

**Licensing/Inspection and Investigation**
1. Ensure radiation safety practices comply with the conditions of the licence and radiation safety policies and procedures.
2. Report radiation incidents such as release of nuclear substances, contamination incidents or failed leak test results to the CDHA radiation safety officer.
3. Conduct hazard evaluations and suspend operations if hazardous situations involving radioactive material arise.

**Employee Qualifications/Performance**
1. Ensure staff are trained according to radiation safety program policy.
2. Promote a culture of safety and safe work practices by frequent contact and discussion with department staff, circulation of information and in-service training.

**Nuclear Substances and Radiation Emitting Devices**
1. Advise the CDHA RSO of any changes to the sealed source inventory.
2. Ensure appropriate radiation protection instrumentation is available, calibrated and maintained according to radiation safety policies and procedures.
3. Ensure leak testing of sealed sources, radiation surveys and contamination assessments of radioisotope laboratories, storage areas and rooms are conducted as required by regulations.
4. Manage a radioactive material inventory program to ensure ‘care and control' of radioactive material from receiving to transportation, storage and disposal.
5. Ensure radiation device safety systems checks, servicing and return to operation are conducted according to regulations and licence conditions.

**Personnel Dosimetry**
1. Notify the CDHA RSO for new employee radiation monitoring or declaration of pregnancy.

**30.3 Class II Devices Radiation Safety Officer Requirements**

There may also be a need to for additional certification for On-site Radiation Safety Officers to meet additional requirements for Class II Devices. The Canadian Nuclear Safety Commission (CNSC) requires all Radiation Safety Officers for Class II Devices to be certified by the CNSC.

The affected licences for hospital operations include:
- Medical (Linear) Accelerators
- High Dose Rate Brachytherapy
- Service of Class II Devices
- Non-Medical Accelerator (Cyclotron)

Organizations shall designate approved radiation safety officers with respect to the licensed activity. When a vacancy occurs, all duties must be covered and a new certified radiation safety officer must be designated, in writing to the CNSC, and certified within 60 days after the previous RSO has left.

**Approval Process**
1. Send a letter to CNSC indicating the RSO candidate and include the candidate’s education, training and experience.
2. The CNSC evaluates the qualifications and deems if they are acceptable.
3. A time is set for the examination/interview by either telephone or in person.
4. The candidate undergoes an examination/interview (oral exam) on the radiation physics, protection and regulations of the specific area of operation they will be supervising.
40 EXPOSURE AND DOSE CONTROL

INTRODUCTION

ALARA, an acronym for As Low As Reasonably Achievable, means making every reasonable effort to maintain exposures as far below the regulated dose limits as is practical. These efforts take into account the economics of improvement related to the state of technology, benefits to public health and safety, and other socio-economic considerations. Good training, consultation and surveillance are the basis for an effective ALARA program. All levels of management and their staff share the responsibility for providing a safe working environment relating to ionizing radiation. The ALARA concept does not mean exposures will be reduced to zero.

Policy RSP-40 Exposure and Dose Control

Capital Health shall provide a safe work environment relating to ionizing radiation by making every reasonable effort to maintain radiation exposures to staff, students and the public as far below the regulated dose limits as Low As Reasonably Achievable (ALARA).

40.1 ALARA (As Low As Reasonably Achievable)

Commitment

1. Executive Management: The Executive management is committed to providing resources for an ALARA program designed to keep individual and collective radiation exposures as low as reasonably achievable.
2. Radiation Safety Committee: The committee shall review the radiation safety program to ensure the policies and procedures are geared to maintaining radiation exposures ALARA and recommend modifications to procedures, equipment or facilities if they will reduce exposure consistent with the ALARA concepts.
3. Radiation Safety Officers: Ensure policies and procedures are maintained, regular reports to the Radiation Safety Committee are provided and work with department management and authorized users to ensure personal exposures are maintained ALARA.
4. Department Management: Ensure that the employees, under their supervision, follow the Radiation Safety Policies and Procedures and work with department staff and radiation safety personnel to make modifications to procedures and facilities when they can reduce radiation exposure.
5. Authorized users: Follow policies and procedures, rules and regulations as prescribed by the organization and work together with all levels of management in radiation safety issues and concerns as well as work to meet the ALARA principle.

Training

1. Training for personnel who are subject to occupational radiation exposure is to include provisions to explain methods for maintaining doses as low as reasonably achievable.
2. Workers are to understand any recourse available to them if they feel the ALARA, or any other safety procedure, is not being promoted on the job.
3. CDHA shall establish a radiation safety training program appropriate for each work area as identified in the department hazard assessment program.

**Monitoring**

1. Quarterly personal radiation exposure reports are to be reviewed to ensure doses are as low as possible and in keeping with the CDHA monitoring policy.
2. Environmental monitoring and room surveys are to be conducted according to the CDHA area survey, waste management and contamination monitoring policies.

**Planning**

1. Inform radiation safety personnel of any planned changes to the workplace or work practices so a review can be undertaken to ensure doses are kept ALARA and any regulatory applications can be made.

---

### 40.2 Maximum Permissible Dose and Exposure

#### Radiation Exposure Limits

Most individuals working with radiation receive an annual radiation occupational dose well below the limits set for Nuclear Energy Workers. Occupational exposure does not include personal medical or dental procedures by a qualified practitioner. While the dose limits specify a maximum acceptable level of risk it is not acceptable to be exposed to the full extent of the limit if a lower dose can be reasonably achieved (ALARA principle).

#### Maximum Annual Permissible Radiation Dose Limits

<table>
<thead>
<tr>
<th>ORGAN, TISSUE</th>
<th>GENERAL PUBLIC</th>
<th>NUCLEAR ENERGY WORKER</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Dose limit in milliSievert (mSv)</td>
<td></td>
</tr>
<tr>
<td>Whole body</td>
<td>1</td>
<td>50 (100/5yr)</td>
</tr>
<tr>
<td>Skin</td>
<td>50</td>
<td>500</td>
</tr>
<tr>
<td>Hands and feet</td>
<td>50</td>
<td>500</td>
</tr>
<tr>
<td>Lens of Eye*</td>
<td>15</td>
<td>150</td>
</tr>
<tr>
<td>Pregnant Worker*</td>
<td>1</td>
<td>4</td>
</tr>
</tbody>
</table>

*Section 70 Personnel Dosimetry describes the program monitoring procedures, consistent with the ALARA principle. Capital Health dose limits that vary from the above upper limits include **Pregnant Nuclear Energy Workers at 2mSv** and, while not official, a trend to keep the **Lens of the Eye at 20mSv**.

---

### 40.3 Room Design and Area Surveys

1. When designing any room that will be used for ionizing radiation purposes, the department must follow regulatory guidance documents. The radiation safety officers shall be consulted to ensure all necessary requirements are met. Medical physics personnel can provide the expertise when determining dose estimates and shielding requirements to comply with regulations and ALARA principles.
• For X-ray rooms the guiding document is Health Canada Safety Code 35
• For laboratories and Nuclear Medicine the guiding document is CNSC RD/GD52
• For Class II devices such as accelerators, cyclotrons and brachytherapy, the guiding document is the Facility Planning and Design Parameters of the Licence Application Guides.

2. Dose rates and dose calculations for adjacent areas must be based on the maximum anticipated activity or workload and occupancy factors.

3. A record of rooms with radiation use and surrounding areas with documented radiation surveys must be completed.

4. Any changes to room use, construction, alterations to the facility or significant workload must be reported to radiation safety personnel to ensure regulatory requirements are met.
50 INSTRUMENTATION AND EQUIPMENT

INTRODUCTION

Properly functioning equipment is essential to ensure the radioactive contamination monitoring program and department area surveys meet the regulatory requirements. Equipment may take the form of non-portable or portable survey or contamination meters. The procedures listed for the radiation safety program include regulatory requirements for dose rate measurement, radiation surveys and contamination monitoring. Department management is accountable to ensure the manufacturer’s guidelines as described in the equipment manuals are met.

Policy RSP-50 Radiation Detection Instrument Use and Calibration

Any instrument used in meeting regulatory criteria for dose rate measurements or contamination verification shall be available and calibrated within the preceding 12 months using a service provider that meets the CNSC “Regulatory Expectations for Calibration of Survey Meters”

50.1 Survey Meters

Wherever regulatory requirements require dose rate measurements, a properly functioning survey meter capable of detecting the radionuclide energy at the criteria specified shall be used. The meter must have been calibrated within the preceding 12 months.

PROCEDURE

Performance Checks

1. Verify the meter has been calibrated within the preceding 12 months.
2. Verify that the physical condition of the meter is in good shape with no evidence of damage or broken parts.
3. Conduct a battery check to verifying operational parameters. If the meter was left on the battery may not be functional and require replacing. Replace battery and recheck the meter.
4. Ensure the meter background response reading is consistent with the typical facility background levels. (0.2-0.4uSv/hr)
5. If any of the performance checks fail, do not use the meter and report it to your on-site radiation safety officer.

Calibration

1. Calibrations and efficiency determinations are to be performed under the supervision of qualified persons such as accredited medical physicists, radiation safety officers or other personnel qualified to assess the determinations.
2. For survey meters requiring calibration, ensure that the service
provider meets the *CNSC R-117 Canadian Nuclear Safety Commission Regulatory Expectations for Calibration of Survey Meters* dated February 7, 2011. This may require the service provider to provide a statement to this effect.

**Records**
Routinely service radiation detection equipment according to the manufacturer’s instructions and maintain a record of the service, calibration certificates and any references relating readings to regulatory criteria.

### 50.2 Contamination Meters

Wherever there are unsealed nuclear substances being used, a properly functioning contamination meter capable of detecting radioactive contamination at the criteria specified on the licence for that nuclear substance shall be available. If the contamination meter is used to *directly* verify regulatory criteria, it must be calibrated within the preceding 12 months.

**PROCEDURE**

**Performance Checks**

1. If using the meter to directly verify regulatory criteria, verify the meter has been *calibrated* within the preceding 12 months.
2. Verify that the *physical condition* of the meter is in good shape with no evidence of damage or broken parts.
3. Conduct a *battery check* to verifying operational parameters. If the meter was left on the battery may not be functional and require replacing. Replace battery and recheck the meter.
4. Ensure the meter *background response* reading is consistent with the typical facility background levels. (typically 30-60 counts per minute)
5. If any of the performance checks fail, do not use the meter and report it to radiation safety personnel.

**Calibration**

1. Calibrations and efficiency determinations are to be performed under the supervision of qualified persons such as accredited medical physicists, radiation safety officers or other personnel qualified to assess the determinations.
2. For survey meters requiring calibration, ensure that the service provider meets the *CNSC R117 Canadian Nuclear Safety Commission Regulatory Expectations for Calibration of Survey Meters* dated February 7, 2011. This may require the service provider to provide a statement to this effect.

**Records**
Routinely service radiation detection equipment according to the manufacturer’s instructions and maintain a record of the service, calibration certificates and any references relating readings to regulatory criteria.

### 50.3 Efficiency – Relating Readings to Regulatory Criteria

Contamination meters must be able to detect the specific nuclear substance in question and ensure the regulatory limits can be met. The general expectation is to be able to have the efficiency of the meter determined in order to know the minimum detectable activity as well as
convert the counts per minute reading to regulatory Bq/cm² contamination criteria for the isotopes being detected. Some meters will be able to read directly in Bq.

PROCEDURE

Calibrations and efficiency determinations are to be performed under the supervision of qualified persons such as accredited medical physicists, radiation safety officers or other personnel qualified to assess the determinations.

Instrument efficiencies can be obtained from the manufacturer or determined using an appropriate standard of known activity. If none are available calculate the efficiency using your own known source of activity.

Contamination limits vary, depending on the Class of the radionuclide and the area in question (controlled vs public). The specific classes of radionuclides are listed in Section 80

For each radionuclide, calculate the efficiency and relate it to licence criteria. You may use similar standard sources for different ranges of energies such as Co-57 for Tc-99m as the energies and response are very similar.

Sample Contamination Criteria Reference List

The following lists common nuclides used in the hospital. For other nuclides, see Section 80 or contact your on-site radiation safety officer.

<table>
<thead>
<tr>
<th>Isotope</th>
<th>Nuclide Class</th>
<th>Primary Energy</th>
<th>3 Bq/cm² averaged over 100cm²</th>
<th>30 Bq/cm² averaged over 100cm²</th>
<th>300 Bq/cm² averaged over 100cm²</th>
<th>4 Bq/cm² averaged over 300cm²</th>
</tr>
</thead>
<tbody>
<tr>
<td>C-14</td>
<td>C</td>
<td>β-49 keV (avg)</td>
<td>-</td>
<td>-</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Co-57</td>
<td>C</td>
<td>γ-122 keV</td>
<td>-</td>
<td>-</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>F-18</td>
<td>A</td>
<td>γ-511 keV</td>
<td>✓</td>
<td>-</td>
<td>-</td>
<td>✓</td>
</tr>
<tr>
<td>Ga-67</td>
<td>B</td>
<td>γ-93 keV</td>
<td>-</td>
<td>✓</td>
<td>-</td>
<td>✓</td>
</tr>
<tr>
<td>I-125</td>
<td>C</td>
<td>γ-35 keV</td>
<td>-</td>
<td>-</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>I-131</td>
<td>B</td>
<td>γ-364 keV</td>
<td>-</td>
<td>✓</td>
<td>-</td>
<td>✓</td>
</tr>
<tr>
<td>In-111</td>
<td>B</td>
<td>γ-245 keV</td>
<td>-</td>
<td>✓</td>
<td>-</td>
<td>✓</td>
</tr>
<tr>
<td>P-32</td>
<td>C</td>
<td>β-695 keV (avg)</td>
<td>-</td>
<td>-</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>S-35</td>
<td>C</td>
<td>β-49 keV (avg)</td>
<td>-</td>
<td>-</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Tc-99m</td>
<td>C</td>
<td>γ-141 keV</td>
<td>-</td>
<td>-</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Tl-201</td>
<td>C</td>
<td>γ-167 keV</td>
<td>-</td>
<td>-</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Y-90</td>
<td>C</td>
<td>β-2284 keV (avg)</td>
<td>-</td>
<td>-</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
SAMPLE: METHOD TO RELATE READINGS TO REGULATORY CRITERIA FOR DETECTORS THAT DO NOT READ DIRECTLY IN Bq/cm²

1. Obtain a small isotope sample and determine background reading for the area.
   Isotope: _____________ Background CPM: ______________ (Rb)

2. Calculate the Efficiency of the detector
   a. Determine the activity of the known isotope source and convert to disintegrations per second for the same day you are measuring the activity with the contamination meter. ______________ bequerels (Bq) = dps (A)
   b. Measure the observed activity of the known source on the contamination meter.
      Observed Activity ________________ counts per minute (B)
   c. Calculated Efficiency: cpm/Bq = (B) = ______________ cpm/Bq (C)

3. Calculate Minimum Detectable Activity: MDA
   \[
   \frac{3}{t} \times (\text{Rb}) = \text{Bq} \\
   \text{(C)}
   \]
   \[
   t= \text{count time in minutes or Integration time for Ludlum meter (Fast = 4sec = 0.067min) (Slow = 22sec = 0.37min)}
   
   \text{NOTE: When you are reading background the most activity that can be present is the MDA. If this is above the contamination criteria you cannot use this meter for contamination monitoring.}

4. Determine the counts per minute that relate to the contamination criteria for the radionuclide.

DIRECT MONITORING
Contamination Criteria: (from Reference list) _________ Bq/cm² x _________ Monitor Probe Surface Area = __________Bq (D)

(D) _____________ Bq x (C) ________ cpm/Bq = __________ cpm above background

WIPE TEST
Contamination Criteria: (from Reference list) _________ Bq/cm² X 100 cm² = _________ Bq (D)

Assuming a wipe efficiency of 10% then the minimum to be detected is (D)_______ x 10% = _________ Bq (E)

Taking the calculated efficiency of the detector into account the count to be detected for this isotope is (E) _________ Bq x (C) _________ cpm/Bq = _________ cpm above background

TDG CLASS 7 RECEIVING-SHIPPING
Contamination Criteria: 4 Bq/cm² x 300 cm² = 1200 Bq

Assuming a wipe efficiency of 10% then the minimum to be detected is 1200 x 10% = 120 Bq (E)

Taking the calculated efficiency of the detector into account the count to be detected for this isotope is 120 Bq x (C) _____________ cpm/Bq = _____________ cpm above background
60 RADIOACTIVE MATERIAL INVENTORY MANAGEMENT

Policy RSP-60 Radioactive Material Inventory Management

*Programs must demonstrate care and control of all nuclear substances from cradle to grave. This includes tracking of all nuclear substance purchases, production, transfer, transport, storage and disposal. All inventory shall be tracked according to regulatory guidelines.*

Section 61 PURCHASING AND INVENTORY TRACKING

INTRODUCTION
The use, movement, and transfer of licensed radioactive sources must be controlled. Purchasing procedures are used as a method to monitor the purchase of radioactive material and ensure that the quantities ordered do not exceed the limits listed on the radioisotope licence.

PROCEDURE

1. Suppliers must have a copy of the Nuclear Substance Licence. It is the responsibility of individual departments to fax copies of the current licence to the supplier. It is acceptable to omit the appendices, however, most suppliers require the entire licence to be sent.

2. Only individuals listed as authorized purchasers can place orders. Each department is to identify one or two people who have the authority to place orders.

3. A properly filled out requisition must be faxed to the purchasing department before a purchase order number will be issued.

4. A requisition must be filled out for all individual purchases and purchases made under a manual purchase order number. Standing orders should have a requisition filled out at the time the contract is decided.

5. Specific information for delivery of the radioactive material must be provided to ensure receiving or security can locate the authorized user. This includes a building and room number.

6. Purchases must not exceed the limits as stated on the permit or licence. Keep in mind that inventory still in use and in storage must be included in the licence limit so the actual purchase amount should be substantially less than the licence limit.

7. Once received, all purchases must be able to be tracked in an inventory management system.
Section 62 RECEIVING

INTRODUCTION

All radioactive material received should be designated for an authorized licence or permit holder. Receiving procedures are used as a method to monitor the integrity of the package and indirectly keep the regulatory agencies aware of company compliance with the packaging and transport regulations.

PROCEDURE

Delivery of Radioactive Material

1. All radioactive material delivered to Receiving Stores or Security will remain unopened until the package is delivered to the appropriate department.

2. Daytime deliveries by courier services will be delivered directly to the department ordering the material. If the package is undeliverable, it remains the responsibility of the courier service.

3. Security or Receiving Stores personnel will check the package for damage and contact the radiation safety officer if damage is noted. Damaged packages will remain in the receiving area until instructions are received from the Radiation Safety Officer. After hours notification will follow the “Capital Health Radiation Safety Emergencies Contact List, RSP-001.”

4. All packing slips should accompany the package to its’ final destination.
   - **Regular Working Hours Delivery:** If the package is not damaged it will be delivered by appropriately trained security or stores personnel to the department listed on the packing slip.
   - **After Hours Delivery:** If the package is not damaged it will be delivered by security personnel to the following rooms:
     - Victoria General Site - Room 3019 Dickson Building
     - Camp Hill Site - Room 3354 Halifax Infirmary

   Individual departments will be responsible for picking up their respective packages promptly upon notification.

Receiving – Opening Radioactive Packages

1. All personnel who receive radioactive material must be appropriately trained. Contact the Radiation Safety Office for training requirements.

2. Any person who receives a package that is damaged, leaking or shows signs of being tampered with shall immediately report the occurrence to the Radiation Safety Officer.
3. Any radiation levels above regulatory limits shall immediately be reported to the Radiation Safety Officer.

Opening Packages

Post and Follow CNSC guide “Identifying and Opening Radioactive Packages, INFO - 0426 rev 1”

1. Report any of the following incidents to the Radiation Safety Office.
   a. Dose rate at the package surface exceeds 2000 $\mu$Sv/hr.
   b. Dose rate at 1m from the package exceeds 100 $\mu$Sv/hr.
   c. Incorrect package label
   d. Inner package damage

2. Establish procedures that document the following:
   a. Record of shipper, carrier
   b. Accuracy of labels, shipment, activity
   c. Entering of radioactive material to department inventory
   d. Condition of package received
   e. Method used to ensure package met regulatory criteria (wipe test, surveys)

3. Maintain all receiving records unless authorized to dispose of the records by the radiation safety officer

Section 63 TRANSPORTATION AND TRANSFERS

INTRODUCTION
All radioactive material being shipped out of any Capital Health site must comply with federal, provincial and local regulatory guidelines regarding the transport of radioactive material. Radioactive material must be properly packaged and labelled to ensure the safety of all those individuals handling the material from receiving excessive radiation exposure and potential contamination.

PROCEDURE

1. All persons preparing radioactive material for transport must have appropriate training in ground or air transport and a current Transport of Dangerous Goods Certificate.

2. All departments shall have a copy of the licence of the recipient to ensure the recipient is able to receive the amount and type of radioactive material being requested.

3. The department is required to contact radiation safety personnel for any package that does not meet the criteria for Excepted or Type A.
Packaging of Radioactive Material

The following information is a guide and does not replace the specific requirements of transport of dangerous goods regulations. All persons, packaging and shipping radioactive material must follow all regulatory requirements.

1. The package must be designed so that it can be handled easily and can be secured in or on the means of transport. Certificates of package compliance should be on file.

2. Material is shipped as "Excepted Radioactive Material" if:
   a) The non-fixed activity for beta and gamma emitters, as measured by a wipe test, demonstrates an activity less than 4 Bq/cm² measured over 300 cm².
   b) The exposure reading at the surface of the package is less than 5 µSv/hr.
   c) The word "radioactive" is clearly visible to anyone opening the package.
   d) The radioactivity does not exceed the cut-off activity as indicated in the regulations or summarized in Fact Sheet 63 "Limited Activity Cut-Off".
   e) The shipping documents bear the words "Radioactive Material - Excepted Package".
   f) Documentation travelling with the package lists:
      1. Radionuclide
      2. Activity
      3. Results of wipe test (demonstrating compliance with regulations)
      4. Exposure reading at package surface (demonstrating compliance)
      5. Form of radionuclide (solid, liquid, gas)
      6. Shipping department including licence or permit number.
      7. Receiving department including licence or permit number.
      8. Signature of sender and date.

3. Material is shipped as a "Type A package" if:
   a. It does not meet the criteria for an excepted package.
   b. The non-fixed activity for beta and gamma emitters, as measured by a wipe test, demonstrates an activity less than 4 Bq/cm² measured over 300 cm².
   c. Appropriate radioactive labels are present on two opposite sides of the package.
   d. The shipping documents bear the words "Type A - Package".
   e. Documentation travelling with the package lists:
      1. Radionuclide
      2. Activity
      3. Results of wipe test (demonstrating compliance with regulations)
      4. Exposure reading at package surface (demonstrating compliance)
      5. Form of radionuclide (solid, liquid, gas)
      6. Shipping department including licence or permit number.
      7. Receiving department including licence or permit number.
      8. Signature of sender and date.
   f. A Bill of Lading for Transport of Dangerous Goods must also accompany the package.
   g. Type A packages must be categorized by the radiation level and have appropriate labels. **Category I – White** Does not exceed 5 µSv/hr at any location on the external surface of the package. **Category II – Yellow** Does not exceed 500 µSv/hr at any location on the external surface of the package and the transport index does not exceed 1. **Category III – Yellow** Does not exceed 2 mSv/hr at any location on the external surface of the package and the transport index does not exceed 10.
h. The transport index for a package is the maximum radiation level in $\mu$Sv/hr at one meter from the external surface of the package, divided by 10. Example: 1 $\mu$Sv/hr at 1 m = TI of 0.1

Shipping Radioactive Material Site to Site within Capital Health
1. All packaging guidelines are met
2. The transport shuttle is not permitted to carry any type of package containing radioactive material.
3. An approved carrier of dangerous goods, not the transport shuttle, must be used when shipping all packages, both Excepted and Type A.

Shipping Radioactive Material to Outside Institutions
1. A copy of the recipients’ licence must be on file in the shippers department.
2. The activity being shipped must not exceed the limits as defined on the recipient’s licence.
3. All packaging guidelines are met.
4. An approved carrier of dangerous goods must ship all packages, both Excepted and Type A.
5. The total quantity shipped to outside institutions must be included in the yearend transfer inventory summary supplied to the Radiation Safety Office.

Section 64 STORAGE

INTRODUCTION
Storage of radioactive waste allows the radioactive material to decay to background levels. Once the material has reached background levels it can be disposed by routine means. Proper storage of the radioactive material reduces unnecessary exposure to individuals.

PROCEDURE
1. Label any container or device that contains radioactive material as follows:
   a. radiation warning symbol
   b. wording to indicate “radioactive material”
   c. isotope, quantity, date
   d. Short lived isotopes may be stored unlabeled in the same container if the outside of the container is labelled and the material is not being accessed until decay to background levels.

2. The storage area for radioactive material requires the following:
   a. restricted access to only those persons authorized by the licence or permit
   b. radiation warning sign indicating “radioactive material”
   c. sign on storage area with the name, job title and phone number of a 24 hour contact person capable of responding to emergencies
   d. a dose rate <2.5 $\mu$Sv/hr at any occupied location outside the storage area

3. Radioactive material with a half-life of less than 90 days may be transported to the designated longer term storage area to permit the decay of the activity to background levels. Currently the designated storage area is Victoria General Site: Room 1109 Victoria Building
For radioactive material with a half-life greater than 90 days, contact the radiation safety officer or follow the "Management of Radioactive Waste Policy".

4. Any material being placed in the longer term storage area should be packaged and labelled accordingly:
   a. Radioactive waste disposal boxes, available through Tupper Stores, Dalhousie University can be used. The boxes are pre-labelled with a radiation warning symbol. Any other containers or boxes must have a radiation warning symbol attached.
   b. The contents of the boxes should be contained in an appropriate plastic bag to prevent leaking of any contents. Biohazard labels must be fastened to any boxes containing biohazard waste.
   c. A radioactive material storage tag must be filled out and attached to the box or any other container being placed in the storage room. Storage tags are available in the storage room or from the radiation safety office. Storage tags must indicate:
      - Isotope
      - Department or permit holder generating the waste
      - Activity or Exposure Reading
      - Date Placed in Storage
      - Earliest Release Date (10 half-lives)
      - Signature of Person Placing Item in Storage
   d. The department placing material in the longer term storage area must keep a record that the material was "sent to storage".
   e. Anyone releasing material from the long term storage must ensure the disposal records are complete. Any storage tags must be returned to the radiation safety office.

5. Any radionuclides being kept in individual departments for decay must meet the storage criteria and be properly labelled and a record of the disposal kept in the department.

Section 65 WASTE DISPOSAL

INTRODUCTION

The most common, and ideal, disposal method will be storage for decay. Other methods of disposal may include discharge to the environment or shipment to an approved waste management site. In some circumstances waste materials may be returned to the supplier. This would be the case for most sealed sources located in equipment or nuclear medicine isotope generators. The choice of disposal method requires consideration of the type of radioisotope, its level of activity and its physical and chemical form. Consideration must also be given to any hazards arising from the non-radioactive components of waste.

PROCEDURE

1. All radioactive waste shall be properly packaged and disposed of in accordance with Canadian Nuclear Safety Commission regulations and Capital Health procedures.
2. Records of waste disposal must be maintained indicating the name, documented dose reading as well as mode of disposal. Individual tags or log books are acceptable methods of documentation.

Responsibilities

The control, safe packaging, and identification of radioactive waste, transportation, and any costs involved are the responsibility of the individual user. It is important that radioactive waste produced in this facility be collected in designated containers reserved for this purpose only, prior to disposal.

Waste disposal records are one of the conditions of the licensing procedure. Inventory records must be maintained and include the location and methods of disposal for all radioactive wastes.

Contact the Radiation Safety Officer if you are in doubt about the method of disposal.

Categories of Waste

Radioactive waste is in the form of a solid, liquid or gas. All packaging of waste must include appropriate containers for the type of waste and a radioactive storage label.

Solid

- **Sharps**
  This type of radioactive waste includes contaminated broken glass, glassware, needles, razor blades, scalpels, or radiation tracer vials. All sharps are sent for incineration.
  
  **Method of Packaging:** All sharps must be packaged in an approved hospital sharps container, and labelled with a radiation warning symbol or tag. All radiation vials must have the radiation symbols defaced before placing them in the sharps container.
  
  **Method of Disposal:** Storage for radioactive decay and then monitoring to confirm background levels before following hospital procedure for non-radioactive waste.

- **Dry Waste**
  This type of radioactive waste includes dry solid materials, dehydrated biological materials, and contaminated papers, gloves or apparel. Intact radioactive tracer vials may also be included in this category.
  
  **Method of Packaging:** Solid waste should be packaged in radioactive waste disposal boxes. These boxes must have a radiation warning symbol. The boxes should be lined with a garbage bag for regular waste. All radiation symbols must be defaced before placing items in the bags. Tracer vials must be placed in a separate box inside the plastic bag to prevent sharps injury. Vials should only be disposed in this manner if they are able to go to the regular landfill.
  
  **Method of Disposal:** Storage for radioactive decay and then monitoring to confirm background levels before following hospital procedure for non-radioactive waste.

- **Biological or Biohazardous Waste**
  This type of radioactive waste includes tissue, organs, blood, or any infected material that requires incineration.
Method of Packaging: Waste should be packaged in plastic bags and placed in radioactive waste disposal boxes. The boxes must have a biohazard sticker on the outside of the box as these boxes will be sent for incineration following radioactive decay. Specimens that cannot be held at room temperature will have to be kept in freezer storage until they have undergone radioactive decay to background levels. All biohazard waste that is not contained in boxes, such as freezer material, must be contained in yellow plastic bags.
Method of Disposal: Storage for radioactive decay and then monitoring to confirm background levels before following hospital procedure for non-radioactive waste.

- **Sealed Sources**
  This type of waste includes sources from radiation detection equipment, calibration sources or treatment sources that are self contained and do not pose a contamination problem.
  Method of Packaging: The sources are self-contained so only require adequate shielding while in storage or being shipped.
  Method of Disposal: Storage for decay or Off Site Shipment for long term radioactive waste storage.

**Liquid**

- **Aqueous Liquid Waste**
  Aqueous wastes are those which are considered readily soluble in water. This type of radioactive waste includes liquid radioactive materials, patient urine, solutions, radioassay supernatant and contaminated rinses.
  Method of Packaging: Liquid waste that exceeds the sewer disposal limits should be contained in a leak proof plastic container with a leak proof sealed lid. The containers must be labelled with a radiation warning symbol or tag.
  Method of Disposal: Aqueous waste should be disposed of through a designated sink or toilet (in case of patient excretions) that is used exclusively for that purpose. Waste should be followed by copious amounts of water to ensure that the radioactivity is flushed from the immediate system. For aqueous waste limits please contact the Radiation Safety Officer for advice. Alternative routes include storage for decay and then disposal to the sewer.

- **Non-aqueous Liquid Waste**
  Non-aqueous wastes are those liquid wastes which are not soluble or dispersible in water. These include liquids such as organic based liquid scintillation fluids. Newer liquid scintillation fluids are environmentally friendly and vials containing these compounds may be disposed by decay or directly in waste depending on the radioisotope.
  Method of Packaging: Organic liquid scintillation cocktails need not be drained from their counting vials, but rather placed intact in a plastic bag lined cardboard box.
  Method of Disposal: Storage for radioactive decay and then monitoring to confirm background levels before following hospital procedure for non-radioactive waste.

**Gas**

- Gas is not permitted as a waste stream. There may be trace amounts from some studies such as venting iodine in a fume hood or synthesis of isotopes from a cyclotron.
  Method of Packaging: Gases need to be stored in containment devices while waiting for decay.
Method of Disposal: Storage for radioactive decay and then monitoring to confirm background levels before following hospital procedure for release of non-radioactive waste by turning on ventilation unit and pumps, opening gas valves, allowing release and then closing the system valves and pumps.

Storage for Disposal Time

In most cases it is possible to store radioactive material until the activity has decayed to negligible levels, followed by disposal as non-radioactive waste. Frequently, the elapse of ten half-lives is a sufficient decay time but the radiation levels must still be measured before disposal and determined to be at background levels.

- Radioisotopes should not be mixed. If needed isotopes with similar half-lives can be placed in the same container. The isotope with the longest half-life will determine the length of time the box will remain in storage.
- Every effort must be taken to ensure non-radioactive waste does not end up in radioactive waste boxes. This reduction in the volume of radioactive waste will ensure limited storage space is not exceeded.
- All radiation symbols in all waste streams must be defaced prior to disposal. Items that are still radioactive can have the symbol defaced as long as the outer container that is holding them still has a radiation warning symbol.
- The storage label must be completed in full.

<table>
<thead>
<tr>
<th>Isotope</th>
<th>Time for decay</th>
</tr>
</thead>
<tbody>
<tr>
<td>Co-57</td>
<td>7 years</td>
</tr>
<tr>
<td>Cr-51</td>
<td>280 days</td>
</tr>
<tr>
<td>F-18</td>
<td>24 hours</td>
</tr>
<tr>
<td>I-125</td>
<td>600 days</td>
</tr>
<tr>
<td>I-131</td>
<td>80 days</td>
</tr>
<tr>
<td>P-32</td>
<td>140 days</td>
</tr>
<tr>
<td>P-33</td>
<td>255 days</td>
</tr>
<tr>
<td>S-35</td>
<td>870 days</td>
</tr>
<tr>
<td>Tc-99m</td>
<td>60 hours</td>
</tr>
<tr>
<td>Ga-67, Tl-201, In-111, Y-90</td>
<td>30 days</td>
</tr>
</tbody>
</table>

Short Term

Radionuclides with a short half-life can be stored in the department without the need to transfer to a long term waste storage facility. The ability to store the waste in the department depends on the available space. Generally those isotopes with a half-life of less than 3-4 days can be stored in the department. If storage space permits, one box can be stored and another filled if the first box will have decayed for 10 half lives before the second box is filled. This would work in laboratories with a low volume use of radioactive material.

Long Term
Longer lived radionuclides may have to be stored for several years or indefinitely. Long term storage facilities are used for these isotopes. These facilities are limited and each user must ensure non-radioactive waste is separated from radioactive waste to reduce the volume. Arrangements for storage in the longer term facilities must be made through the Radiation Safety Officer. Those isotopes with a half life of less than 90 days can typically be stored on-site with those of greater than 90 days being shipped to an off-site storage facility.

**Off Site Shipment**

When other disposal methods are not practical, it may be necessary to arrange transportation of waste or surplus radioactive material to an approved waste management site. These sites are able to take long lived isotopes with half lives that would prohibit disposal after several years. Assistance should be obtained from the Radiation Safety Officer to ensure that the transport packaging regulations are met. All costs incurred are to be borne by the department who owns the source. The person preparing the shipment must also have a current Transport of Dangerous Goods certificate.

**Disposal to the Environment**

Typical operations include the disposal of solids as regular garbage, discharge to the sewer and the incineration of biomedical waste and organic solvents. In all cases these methods are limited by the requirement that the material discharged be compatible with the environment. Levels below these limits are deemed categorically "non-radioactive" and can be safely discharge.

The amount of discharge to the environment is different for each nuclear substance and route of disposal. The limits are set by the Canadian Nuclear Safety Commission and are a part of the licence conditions.

Each department must review their waste disposal methods with the Radiation Safety Officer to ensure the institution as a whole is meeting the regulatory requirements. The Radiation Safety Officer will request a yearly inventory of radioactive material purchased in order to calculate the waste disposal limits and ensure the hospital limits are not exceeded.

**Landfill**

Disposal of radioactive material with the normal garbage is not permitted until the radioactivity has decayed to background levels. All material for such disposal, once decayed to non-radioactive levels, must be packaged in unmarked garbage bags and all radioactive labels must be defaced.

**Sewer**

Disposal through the sewer of water soluble liquids is permitted if the disposal per building does not exceed the limits on the licence for the particular nuclide. In laboratories where this method is routinely used, a specific sink should be designated for the purpose. A yearly inventory will be requested because many different laboratories in the same building could be using the same isotope. Alternative methods such as calculating the typical amount disposed per assay or saving the decanted liquid to a storage container should be explored if building limits are being reached.

**Incineration**
Disposal to the atmosphere through incineration is not permitted as a deliberate means of disposal.

**Disposal Limits**
Generally there will be no issues with disposal limits as most waste is stored for decay to background levels before disposal. The following chart lists the acceptable limits for disposal by each waste stream.

<table>
<thead>
<tr>
<th>Isotopes</th>
<th>Garbage MBq per kg</th>
<th>Sewer MBq/year per building</th>
<th>Air kBq/m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon 14</td>
<td>3.7</td>
<td>10,000</td>
<td>0</td>
</tr>
<tr>
<td>Chromium 51</td>
<td>3.7</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>Cobalt 57</td>
<td>0.37</td>
<td>1,000</td>
<td>0</td>
</tr>
<tr>
<td>Cobalt 58</td>
<td>0.37</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>Cobalt 60</td>
<td>0.01</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Gallium 67</td>
<td>0.037</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>Hydrogen 3</td>
<td>37</td>
<td>1,000,000</td>
<td>37</td>
</tr>
<tr>
<td>Indium 111</td>
<td>0.037</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>Iodine 123</td>
<td>3.7</td>
<td>1000</td>
<td>3</td>
</tr>
<tr>
<td>Iodine 125</td>
<td>0.037</td>
<td>200*</td>
<td>0.03</td>
</tr>
<tr>
<td>Iodine 131</td>
<td>0.037</td>
<td>10</td>
<td>0.175</td>
</tr>
<tr>
<td>Phosphorous 32</td>
<td>0.37</td>
<td>1500*</td>
<td>0</td>
</tr>
<tr>
<td>Phosphorous 33</td>
<td>1</td>
<td>100*</td>
<td>0</td>
</tr>
<tr>
<td>Sulphur 35</td>
<td>0.37</td>
<td>1000</td>
<td>0</td>
</tr>
<tr>
<td>Technetium 99m</td>
<td>3.7</td>
<td>1000</td>
<td>0</td>
</tr>
<tr>
<td>Thallium 201</td>
<td>0.037</td>
<td>100</td>
<td>0</td>
</tr>
</tbody>
</table>

* Limits approved by CNSC for Capital Health Laboratory Licence
70 PERSONNEL DOSIMETRY

Personnel dosimetry programs are directed toward occupational health protection but also provide protection to visitors and others in the vicinity of the radiation use. Authorized users must make every effort to keep their radiation exposures as far below the dose limits as possible as outlined in Section 40. Determining radiation exposure dose can take many forms from direct monitoring to estimation and is generally based on the likelihood of reaching or exceeding different dose limits.

Policy RSP-70 Personal Monitoring

Capital Health shall provide a personnel monitoring program to meet regulatory requirements for external and internal radiation exposure to workers and those workers who also declare a pregnancy. Where any work requiring personal dosimeters is required, they are considered part of personal safety equipment and must be worn at all times when working with ionizing radiation.

Section 71 PERSONAL MONITORING

INTRODUCTION

Personnel monitoring devices are worn to record cumulative dose received from occupational exposures to external radiation. Most common applications are to obtain an approximation of whole body dose, but dosimeter units are available to measure localized areas (e.g. the fingers). Information obtained when the dosimeters are read is useful for evaluating the effectiveness of protective measures and the necessity of appropriate action.

PROCEDURE

1) While the regulatory guidelines require radiation monitoring if the individual is likely to exceed 5mSv/year, decisions for issuing monitoring devices are based on the work area, type of radiation work, past monitoring results and the potential to exceed the general public dose limits. Monitoring devices are only issued by the Radiation Safety Officer after the individual completes a “Request Form for Monitoring Services”.

2) Dosimetry services are provided by a number of approved vendors in Canada. This service includes the supply of dosimeters, a standardized readout of exposures at regular intervals, as well as a national dose registry. Co-ordination for this service is through the Radiation Safety Office.

3) The wearing of dosimeters is covered in the radiation safety introduction courses, however, a reminder includes:
a) Dosimeters worn for monitoring whole body torso dose should be worn anywhere between the waist and collar. The area where the plaque is worn should reflect the area of the body receiving the highest exposure.

b) If lead aprons are worn, the dosimeter for whole body torso monitoring should be worn inside the apron.

c) If the monitor is a collar (external for eye dose estimate) monitor, then it shall be worn at the shirt collar level and remain outside the lead apron. This is generally applicable to x-ray fluoroscopy areas.

d) Extremity badges, worn for monitoring the hands, must be worn with the chip closest to the radiation field (generally the dominant hand) and facing the palm of the hand.

4) The storage of monitoring devices should be away from radioactive sources when not being worn. The monitors must be accessible when the employee is not present at the institution. (i.e. on vacation or weekends).

5) Staff should review the posted monitoring reports on a regular basis.

6) CNSC requires staff to be notified, in writing, of their annual dose. At CDHA it is acceptable to have staff sign the last quarterly report of the calendar year (Oct-Dec).

Reporting Process

Copies of the reports of personnel exposures from the monitoring service are sent to the Radiation Safety Office for review. The Radiation Safety Officer reviews the reports and determines if any reportable action levels or internal investigation levels are triggered. A copy of the report is then sent to each subscribed group. The records are to be posted in each department so individual staff can keep a personal check on their radiation exposure.

If an action level is triggered or there is some question as to the dose reading, the radiation safety officer will contact the individual to review the results and investigate any possible cause for the action level being triggered.

Action Levels

Any individual reading that exceeds 10% (5mSv whole body; 15mSv collar; 50mSv ring) of the annual limit for nuclear energy workers will be investigated and the results reported to the Radiation Safety Committee and the Regulatory Body.

Internal Investigation Levels

In keeping with the ALARA program, the Radiation Safety Officer will also investigate any exposure deemed to be a deviation from the expected results for a particular group as defined in Table 1. These are the internal investigation levels and they are noted in the quarterly report to the Radiation Safety Committee and not required to be reported to the Canadian Nuclear Safety Commission.
### Table 1 Deviation from Expected Results (Internal Investigation Levels)

<table>
<thead>
<tr>
<th>Group</th>
<th>Quarterly Reading (mSv)</th>
<th>Monitor Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nova Scotia Cancer Centre</td>
<td>0.5</td>
<td>Whole Body</td>
</tr>
<tr>
<td>Laboratory (Hematology)</td>
<td>2.5</td>
<td>Extremity (Ring)</td>
</tr>
<tr>
<td>Nursing (5N Oncology)</td>
<td>0.5</td>
<td>Whole Body</td>
</tr>
<tr>
<td>Molecular Imaging (Cyclotron)</td>
<td>2</td>
<td>Whole Body</td>
</tr>
<tr>
<td>Molecular Imaging (Cyclotron)</td>
<td>20</td>
<td>Extremity (Ring)</td>
</tr>
<tr>
<td>Nuclear Medicine</td>
<td>2</td>
<td>Whole Body</td>
</tr>
<tr>
<td>Nuclear Medicine General Imaging (Ring)</td>
<td>20</td>
<td>Extremity (Ring)</td>
</tr>
<tr>
<td>Nuclear Medicine Radiopharmacy (Ring)</td>
<td>40</td>
<td>Extremity (Ring)</td>
</tr>
<tr>
<td>School of Nuclear Medicine (Whole Body)</td>
<td>2</td>
<td>Whole Body</td>
</tr>
<tr>
<td>School of Nuclear Medicine (Ring)</td>
<td>20</td>
<td>Extremity (Ring)</td>
</tr>
<tr>
<td>X-Ray Cardiac Catheterization Lab</td>
<td>15</td>
<td>External (Collar)</td>
</tr>
<tr>
<td>X-Ray Vascular Lab</td>
<td>15</td>
<td>External (Collar)</td>
</tr>
<tr>
<td>X-Ray General</td>
<td>0.5</td>
<td>Whole Body</td>
</tr>
</tbody>
</table>

### Low Exposure Groups

Low exposure groups such as general x-ray technologists or radiation therapists do not require monitoring. We have monitored these groups in the past and demonstrated that radiation exposure readings were consistently below 1% of the annual limit.

1. When radiation workers are not likely to exceed the general public limit, a representative sample of approximately 10% will be supplied with radiation monitors to act as a representation of the larger group. While this is not required, it does allow us to monitor trends in work practices and assure us that dose measurements continue to remain below the general public limits. Chosen individuals generally work full time and represent all areas of a department such that the control group are the most likely receive the highest exposure during the monitoring period.

2. New radiation workers, who fall into the low exposure group category can be issued a temporary radiation monitor for 6 months in order to establish a low dose reading for that individual. They may be added to the control group or simply not be monitored after the initial period.
Capital Health - Radiation Safety Program Request For Personal Monitoring
Forward Completed Sheet to Radiation Safety Office, QEII - Bethune Building, Room B244
NOTE: Badge will not be issued until introductory radiation safety training is complete.

The following information is required by the National Dosimetry Service and is protected information under the Privacy Act of the Federal Government

<table>
<thead>
<tr>
<th>First Name</th>
<th>Middle Name</th>
<th>Last Name</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Work Area</th>
<th>Job Title</th>
</tr>
</thead>
</table>

Date of Birth

<table>
<thead>
<tr>
<th>Gender</th>
<th>Female</th>
<th>Social Insurance Number</th>
</tr>
</thead>
</table>

Place of Birth

<table>
<thead>
<tr>
<th>city</th>
<th>province</th>
<th>country</th>
</tr>
</thead>
</table>

Have you ever been registered for a monitoring device before?
Whole body (TLD)  □ Yes  □ No
Extremity (Ring or Neck)  □ Yes  □ No
If Yes, state the hospital, city, and approximate dates worn.

Job Code (Check one box only)

<table>
<thead>
<tr>
<th>13 Laboratory Technologist</th>
<th>14 Medical Physicist</th>
<th>15 Nurse</th>
</tr>
</thead>
<tbody>
<tr>
<td>18 Radiation Therapist</td>
<td>19 Radiologist (Diagnostic)</td>
<td>20 Oncologist</td>
</tr>
<tr>
<td>(Therapeutic)  □ 72 Student</td>
<td></td>
<td>16 Physician</td>
</tr>
<tr>
<td>22 Orderly/Ward Aid</td>
<td>03 Safety Officer</td>
<td></td>
</tr>
<tr>
<td>17 X-ray Technologist</td>
<td>24 Nuclear Medicine Technologist</td>
<td></td>
</tr>
<tr>
<td>□ Other: Specify__________</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

I am authorizing the Capital Health Radiation Safety Office to obtain past radiation dose history or release radiation dose history to future employers.

Signature of Person to be Monitored ___________________________ Date __________

Office Use Only

<table>
<thead>
<tr>
<th>Date Issued</th>
<th>Group Number</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Badge Type</td>
<td></td>
</tr>
<tr>
<td>Whole Body</td>
<td>Extremity 1(Neck)</td>
</tr>
</tbody>
</table>
Section 72 PREGNANT RADIATION USERS

Introduction

A personal monitoring program for pregnancy is to ensure the radiation dose to Nuclear Energy Workers who declare a pregnancy is kept to 2mSv for the balance of the declared pregnancy. This limit is well below the regulatory limit of 4mSv for Nuclear Energy Workers and is in keeping with the ALARA principle.

For almost all work at Capital Health, the dose levels are already below the regulatory limit and work duties will not need to be adjusted. However, the employee and supervisor should work together to determine the most reasonable method of minimizing radiation exposure in keeping with the ALARA principle. This may include reducing the time spent in radiation areas, providing abdominal shielding, and maximizing the distance from radiation sources.

While the decision when to declare pregnancy is up to the employee, those working with ionizing radiation or in areas where they are exposed to ionizing radiation have an obligation to declare their pregnancy. Once a pregnancy is declared it will give the radiation safety officer an opportunity to assess work practices, potential for radiation exposure, and need for radiation monitoring. When the decision is made to declare a pregnancy, the employee should inform their supervisor and the Radiation Safety Officer (RSO).

PROCEDURE

RESPONSIBILITIES OF FEMALE WORKERS:

The following responsibilities refer to employees working with ionizing radiation or working in areas where they are exposed to ionizing radiation who choose to declare a pregnancy.

1. When a worker becomes aware of her pregnancy, she should inform her supervisor as soon as possible. She should declare her pregnancy, using a “Declaration of Pregnancy Form”. The Radiation Safety Office should be called if you are unsure about the form.

RESPONSIBILITIES OF RADIATION SAFETY OFFICE:

1. The work situation shall be assessed to ensure the radiation safety principles are being followed and radiation dose limits remain as low as reasonably achievable (ALARA).

2. Arrange to monitor the worker to ensure the dose limit is not exceeded. This may involve issuing a radiation monitor to workers who are not monitored or providing additional dosimeters in order to measure workplace exposure on a more frequent basis than normal.

3. Inform the employee of the associated risks related to radiation exposure during pregnancy.

4. Potential discrimination issues should be addressed, as well as the non-discriminatory aspects of this institution’s policy.
High Exposure Areas

There may be some areas where duties are required to be restricted or modified for pregnant radiation workers. The two main departments that must consider modified duties are Nuclear Medicine Technology and PET/CT.

The suggested restrictions for the departments are:

1. Workers shall not be placed on rotations that require volatile iodine use.
2. Worker rotations involving concentrated injection of patients shall be assessed to determine if any may push the dose reading close to the 2mSv/pregnancy limit.
3. Technologists assigned to the PET/CT rotation shall be reassigned to other rotations.
**Capital Health Radiation Safety Program**

**Declaration of Pregnancy**

The content of this form is considered confidential information.

I am voluntarily declaring that I am pregnant, for the purposes of the radiation safety program. I realize that work restrictions may be imposed to ensure that the embryo/fetus does not receive a dose in excess of regulated dose limits during the remainder of my pregnancy. I also realize that my work practices may be assessed to further lower the dose to the embryo/fetus and that supplemental dosimetry badges may be supplied to me.

Name of the Worker: _______________________________________________________

Position: ___________________________ Phone Number: ______________________

Supervisor’s Name: _______________________________________________________

Title: ___________________________ Phone Number: ______________________

Estimated Due Date: ______________________________________________________

_________________________________________ Date

Signature of Worker

_________________________________________ Date

Signature of Supervisor

Submission of this form will not affect the benefits, seniority, or potential for promotion of the person signing this form.

Submit form to: Capital Health Radiation Safety Office

QEII Bethune Building, Room 244

1276 South Park Street, Halifax, N.S., B3H 2Y9

_________________________________________ Date

Signature of Radiation Safety Officer

<table>
<thead>
<tr>
<th>Monitor Group:</th>
</tr>
</thead>
<tbody>
<tr>
<td>TLD #</td>
</tr>
<tr>
<td>-------</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

Total: mSv
Section 73 THYROID SCREENING AND BIOASSAY

Introduction

Workers may be exposed to radioactive material in a variety of chemical forms that can be inhaled, ingested, or absorbed through intact skin or open wounds. Where intake is possible, programs need to be able to estimate the quantity of radioactivity deposited in the body or confirm intake has not occurred. Thyroid screening programs monitor the intake of volatile iodine.

Procedure

1. Radiation workers that handle a total quantity of open-source volatile radioiodine in a 24-hour period exceeding:
   - 2MBq (54uCi) in an open room
   - 200 MBq (5.4 mCi) in a fume hood
   - 20,000 MBq (5400 mCi) in a glove box
   shall be screened for I-125, I-131, or both if necessary.

2. Screening shall be conducted within five days of handling volatile radioiodine and ideally between one and five days where practical.

3. Screening shall also be conducted when:
   - the individual is involved with a spill greater than 2MBq (54uCi) of I-125 or I-131
   - personal contamination with volatile radioiodine is detected
   - an individual was working in the same room as someone who has a screening result greater than 1kBq

4. The screening shall be conducted using an uptake probe capable of detecting the applicable radioiodine. The uptake probe shall have:
   - Minimum detectable activity determined for the radioiodine
   - Daily quality control procedures documented (constancy, background)
   - Regular calibration and maintenance according to the manufacturer's guidelines

Reporting

1. The radiation safety officer shall be notified of any reading exceeding 1kBq
2. All readings greater than 1kBq will be investigated by radiation safety personnel and documented in the annual compliance report
3. For readings greater than 10kBq, a bioassay will be required and the CNSC will be notified.
SAMPLE DETECTOR EFFICIENCY

Thyroid Uptake Probe Recalibrations using the BRMD Neck Phantom
For I-131 & I-125 Bioassays Detector: ATOMLAB 950 (PC)™ Uptake Probe

<table>
<thead>
<tr>
<th>Discriminator Window (keV)</th>
<th>Counting Efficiency Factor (cps/Bq)</th>
<th>Minimum Detectable Activity (Bq)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I-131</td>
<td>309 - 420</td>
<td>$1 \times 10^{-3}$</td>
</tr>
<tr>
<td>I-125</td>
<td>23 - 41</td>
<td>$3 \times 10^{-3}$</td>
</tr>
</tbody>
</table>

Results based on a 60 second (1 min) counting time and a 20 cm neck to crystal surface distance, and with the appropriate discriminator (window) setting.

SAMPLE SCREENING CALCULATION

Uptake Probe Thyroid Screening Calculation

From the Uptake Probe Calibration using the BRMD Neck Phantom we get the probe efficiency and the minimum detectable activity reported. (see medical physicist for this report)

Probe Efficiency (with fat overlay) = ____ cps/Bq = ____ cpm/Bq or ____ Bq/cpm (1)
But: Minimum Detectable Activity is ____ Bq (2) so (MDA [Bq] x Efficiency [cpm/Bq] = ____ cpm. (3)
So for any net count below (3) ____ cpm, the technologist must record the minimum detectable amount of ____ Bq (2) on the thyroid-screening sheet.
Net Counts above (3) ____ cpm must be multiplied by the probe efficiency (1) ____ Bq/cpm to convert the cpm readings to bequerels.
So...Net counts to get 1kBq (investigation level) = 1000 Bq ÷ efficiency (1) [Bq/cpm] = ____ cpm

Any net count observed from the thyroid screening greater than this would indicate a level greater than 1000 Bq and would need to be investigated. Readings greater than this should be entered on the thyroid-screening sheet and reported to the Radiation Safety Officer.

Net counts to get 10 kBq (reporting level) = 10,000 ÷ efficiency (1) [Bq/cpm] = ____ cpm
Any net count observed above this value requires immediate reporting to the Canadian Nuclear Safety Commission and a bioassay to be conducted on the individual.

SAMPLE SCREENING FORM

Thyroid Screening Name: ____________________________

Note: Figures are based on BRMD thyroid & neck calibration performed ____ (yyy-mm-dd)
If net counts <42, report Thyroid Burden = 694 Bq
Otherwise Thyroid Burden (Bq) = Net Thyroid Counts x 17 Bq/cpm
If Thyroid Burden > 1,000 Bq, contact the Radiation Safety Officer

1. All counts are to be taken for 100 seconds at a probe distance of 18cm neck to crystal surface
2. Background counts are to be taken over the shoulder
3. Atomlab 950 Model 187-225 Uptake Probe must be used with window 309-420 keV
4. Use the Atomlab’s built in manual program to count and report results

| Date 131I last handled | Date of Bioassay | Thyroid Counts (180 sec) | Bkg Counts (180 sec) | Net Counts (180 sec) | Thyroid Burden (Bq) | Performed by (initial) |
80 CONTAMINATION CONTROL

INTRODUCTION

Assessment for contamination where radioactive materials are used is an essential part of any radiation protection program. Non-fixed contamination may be transferred from one place to another unknowingly. The Canadian Nuclear Safety Commission sets limits for non-fixed contamination. Fixed Contamination is radioactive material that has bound with or leached into a surface and is not readily removable. This type of contamination may pose a radiation exposure hazard and must be assessed on an individual basis by radiation safety personnel. Monitoring all releases from the facility to the environment also need to be considered.

Policy RSP-80 Contamination Monitoring Program

Where nuclear substances are used, monitoring for personal, facility and environmental contamination shall be conducted and where contamination or spills are detected, appropriate clean-up and reporting shall be conducted according to regulatory criteria.

PROCEDURE

80.1 Contamination Criteria

The contamination monitoring program shall demonstrate how the results of the contamination monitoring program relate back to the regulatory criteria. See Section 51.3 Efficiency – Relating Readings to Regulatory Criteria for the procedure. The licence criteria for contamination are based on the limits of the particular classification of the radionuclide and whether or not the area in question is a controlled work area or a public area (See Tables 1 and 2).

<table>
<thead>
<tr>
<th>Class of Radionuclide</th>
<th>Controlled Area</th>
<th>Public Area or Decommissioning</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Class A</strong> - Typically long lived and emit alpha radiation</td>
<td>3 Bq/cm²</td>
<td>0.3 Bq/cm²</td>
</tr>
<tr>
<td><strong>Class B</strong> - Typically long lived and emit beta or gamma radiation</td>
<td>30 Bq/cm²</td>
<td>3 Bq/cm²</td>
</tr>
<tr>
<td><strong>Class C</strong> - Typically short lived and emit beta or gamma radiation</td>
<td>300 Bq/cm²</td>
<td>30 Bq/cm²</td>
</tr>
</tbody>
</table>

Consult Radiation Safety Officer for specific class of isotopes used in your laboratory.

When using more than one radionuclide in a room, the radionuclide with the lowest contamination limit must be used when determining the limit for contamination monitoring.
### Table 2 Classification of Radionuclides

<table>
<thead>
<tr>
<th>Class A</th>
<th>Class B</th>
<th>Class C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typically long lived and alpha emitters and their daughter isotopes</td>
<td>Typically long lived and emit beta or gamma radiation</td>
<td>Typically short lived and emit beta or gamma radiation</td>
</tr>
<tr>
<td>Ag-110m</td>
<td>As-74</td>
<td>Au-195m</td>
</tr>
<tr>
<td>Ar-41</td>
<td>Au-198</td>
<td>P-32</td>
</tr>
<tr>
<td>C-11</td>
<td>Ba-133</td>
<td>C-14</td>
</tr>
<tr>
<td>Co-56</td>
<td>Br-82</td>
<td>Ca-45</td>
</tr>
<tr>
<td>Co-60</td>
<td>Co-58</td>
<td>Cd-109</td>
</tr>
<tr>
<td>F-18</td>
<td>Cu-64</td>
<td>Ce-141</td>
</tr>
<tr>
<td>Ga-68</td>
<td>Fe-59</td>
<td>Ce-144</td>
</tr>
<tr>
<td>Ga-72</td>
<td>Ga-67</td>
<td>Ce-144</td>
</tr>
<tr>
<td>I-124</td>
<td>Ge-153</td>
<td>Cr-51</td>
</tr>
<tr>
<td>La-140</td>
<td>Hg-194</td>
<td>Fe-55</td>
</tr>
<tr>
<td></td>
<td>Hg-203</td>
<td>Ge-68</td>
</tr>
<tr>
<td></td>
<td>In-131</td>
<td>Ge-68</td>
</tr>
<tr>
<td></td>
<td>In-111</td>
<td>H-3</td>
</tr>
<tr>
<td></td>
<td>In-113m</td>
<td>I-123</td>
</tr>
<tr>
<td></td>
<td>In-114m</td>
<td>I-125</td>
</tr>
<tr>
<td></td>
<td></td>
<td>In-114</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>When a radionuclide is not listed, the Radiation Safety Officer or CNSC Licence Specialist can be contacted to obtain a classification. Ref:CNSC Licence Application Guide</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### 80.2 Locations of Measurements

A schematic floor plan map of the area with the monitoring sites identified, or a description of the areas monitored should be included with the records. This will maintain consistency from person to person performing the measurements. Sites for monitoring should include those areas where open source radioactive materials are routinely used. Other sites should be added to the survey on a random basis to include suspect areas or unlikely locations such as door handles, telephone receivers, computer keyboards, etc.

### 80.3 Frequency of Monitoring

**Daily monitoring** for contamination must be carried out at the end of the work day in which open sources of radioactive material are used. To ensure good work habits and in keeping with the ALARA principle contamination monitoring shall be conducted daily.

**Weekly wipe testing** surveys are generally not required if the daily monitoring does not detect any contamination and it is documented that the equipment used in the daily monitoring can...
detect to the contamination limit. If there are areas of high background, weekly wipe testing must be conducted in those areas.

When there is infrequent use of radioactive material, an indication of the weeks of use must be identified. Monitoring records must be available for the weeks that are identified when radioactive material was used. Monitoring is not required for weeks when there is no use.

<table>
<thead>
<tr>
<th>Permit Holder</th>
<th>Permit Number</th>
<th>Department or Room #</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Jan 1,1999</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Jan 7, 1999</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Jan 14, 1999</td>
<td></td>
</tr>
<tr>
<td>4..etc</td>
<td></td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>Jul 8,1999</td>
<td></td>
</tr>
<tr>
<td>28</td>
<td>Jul 15,1999</td>
<td></td>
</tr>
<tr>
<td>29</td>
<td>Jul 22,1999</td>
<td></td>
</tr>
<tr>
<td>30..etc</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Section 81 Contamination Monitoring

81.1 Non-fixed Contamination (Direct and Indirect)

Contamination monitoring may include direct measurements or indirect measurements. These measurements can both be used to determine if in fact the area is contaminated above the regulatory criteria.

DIRECT

Direct monitoring is acceptable as long as the meter can demonstrate readings to below regulatory contamination limits. This method allows the operator to survey large areas and irregular surfaces and its main advantage over indirect monitoring is speed. The disadvantage of this method is that it cannot be used in high background areas.

1. Select a suitable survey instrument that has a known and calibrated response for the specific isotope in question.
2. Obtain a background reading away from the area being monitored.
3. Monitor the locations indicated on the work area map as well as several random locations by passing the probe slowly over the area to be monitored and as close to the surface as possible without touching it. For detectors with an audible output it is important that this be turned on in advance.
4. Document that the dose reading is below regulatory criteria.
5. In any area where contamination is detected, clean the area until the reading does not change or is below the regulatory non-fixed contamination criteria. Record both the initial and final reading.
   • For very short lived isotopes such as F-18 it is acceptable to close the area and allow for decay to background levels as long as access to the area is restricted and signs are posted at the entrance.
6. If the reading remains above regulatory criteria and does not change after repeated cleaning, it is an indication of fixed contamination.

Cover the area
Identify the area with a radiation warning sign stating the isotope, date, exposure reading and your initials.
Secure the area
Contact your on-site radiation safety officer for assistance to determine restrictions for the area.

**EXAMPLE: P-32**
P-32 is a class C radionuclide
P-32 efficiency = 40% for Ludlum model 44-9
Detector = Ludlum model 44-9 probe area 20.27 cm²

\[
\frac{30 \text{ Bq/cm}^2}{0.40 \times 20.27 \text{ cm}^2 \times 60 \text{ sec/min}} \times \text{ X net cpm}
\]

X = 14594 cpm for a public area or decommissioning
X = 145940 cpm for a controlled area

**P-32 controlled area working surfaces** with a reading greater than 145940 cpm require decontamination.

**P-32 decommissioning or non-controlled work area** with a reading of greater than 14594 cpm require decontamination.

These numbers will be different for each isotope measured.

**INDIRECT**

**Indirect measurements** If the contamination meter, by the direct method, is unable to detect below the regulatory contamination criteria, indirect monitoring with wipes, using a more sensitive detection device may be needed. Indirect measurements can also be useful in areas of high background radiation or determining when a spill cleanup has only fixed contamination remaining. The counts from these devices must be referenced to licence criteria.

1. Using filter paper or cotton swabs (Q-Tip) lightly moistened with alcohol or water; wipe a representative area (100 cm²) in each of the designated locations. Use one wipe per location and make sure the wipe is identified.
2. Let the wipes air dry to prevent any loss of activity.
3. Measure the radioactivity on each wipe using detection equipment (gamma counter liquid scintillation counter) that has a known and calibrated response for the specific isotope in question.
4. Do a background count using an uncontaminated wipe.
5. In any area where contamination is detected, clean the area until repeat wipe readings are below regulatory contamination criteria. Record both the initial and final reading.
6. If the reading is still above regulatory criteria and nothing is noted on the wipe after repeated cleaning, it is an indication of fixed contamination.
   - Cover the area
   - Identify the area with a radiation warning sign stating the isotope, date, exposure reading and your initials.
   - Secure the area
   - Contact your on-site radiation safety officer for assistance.
EXAMPLE:

Indirect estimation of quantity of radioactive material on area/object in a controlled area

\[
\frac{\text{Bq/cm}^2}{\text{Ec \times Ew \times 60 \times A}} = \frac{\text{cpm - bkg}}{\text{Ew} \times \text{A}}
\]

bkg = machine background
Ec = counter efficiency as a decimal
Ew = wipe efficiency (use 10% if it is not known)
Bq = 1.0 (dps) if counting in seconds or 60 (dpm) if counting in minutes
A = area wiped in cm²

**Calculations:**

1158 cpm - 72 cpm bkg = 1086 net cpm

40% efficiency (0.4) x 100 cm² wiped x 10% wipe (0.1) x 60 dpm = 240

\[
\frac{1086}{240} = 4.52 \text{ Bq/cm}^2
\]

This level exceeds the Class A radionuclide limit for a controlled area so continue to decontaminate but it does not exceed Class B or C limits. If the radionuclide was in Class B or C the decontamination is complete. If it was a mixed lab with Class A, B and C radionuclides the lower limit for Class A is used for all measurements unless you know that the only isotope present is from another class.

81.2 Fixed Contamination

After decontamination, if the contaminated area remains above the non-fixed regulatory criteria it is considered fixed contamination. Consideration must then be given to keeping radiation doses to the workers or general public ALARA.

Prior to notification of your on-site radiation safety officer:

- Cover the area
- Identify the area with a radiation warning sign stating the isotope, date, exposure reading and your initials.
- Secure the area

Your on-site radiation safety officer will assess the area and determine the course of action based on the radiation dose rate, occupancy factor, distance, and radioisotope properties. All factors will be considered to keep radiation dose to staff and the public below annual regulatory dose limits and strive to keep the doses even lower in keeping with the ALARA principle.

**RECORDS**

The records for contamination monitoring should document the following information:

- date of measurement
- make and model of equipment
- operational checks on portable equipment
- monitoring locations
- contamination monitoring results in Bq/cm$^2$
- background levels
- reference to the count rate that would exceed licence contamination criteria
- initial of person conducting the measurement

**FORMS**

The following forms are suggestions for department use. The forms may be adapted for each department or other formats may be used. All of the regulatory information must be included in any type of data collection. It is acceptable to use a “twice background” criteria only if it can be demonstrated that twice background is still below the regulatory limit for non-fixed contamination.
### Weekly Radioisotope Use

<table>
<thead>
<tr>
<th>Permit Holder</th>
<th>Permit Number</th>
<th>Department or Room #</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Fill in all weeks for the year and place a check in the appropriate use column. For weeks where radioisotopes are used, contamination monitoring records must be available.

<table>
<thead>
<tr>
<th>Week of</th>
<th>Isotopes Used</th>
<th>Isotopes Not Used</th>
<th>Week of</th>
<th>Isotopes Used</th>
<th>Isotopes Not Used</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td>27</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td>28</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td>29</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td>30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td>31</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td>32</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td>33</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td>34</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
<td>35</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td>36</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td></td>
<td></td>
<td>37</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td></td>
<td></td>
<td>38</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td></td>
<td></td>
<td>39</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td></td>
<td></td>
<td>40</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td></td>
<td></td>
<td>41</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td></td>
<td></td>
<td>42</td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td></td>
<td></td>
<td>43</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td></td>
<td></td>
<td>44</td>
<td></td>
<td></td>
</tr>
<tr>
<td>19</td>
<td></td>
<td></td>
<td>45</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td></td>
<td></td>
<td>46</td>
<td></td>
<td></td>
</tr>
<tr>
<td>21</td>
<td></td>
<td></td>
<td>47</td>
<td></td>
<td></td>
</tr>
<tr>
<td>22</td>
<td></td>
<td></td>
<td>48</td>
<td></td>
<td></td>
</tr>
<tr>
<td>23</td>
<td></td>
<td></td>
<td>49</td>
<td></td>
<td></td>
</tr>
<tr>
<td>24</td>
<td></td>
<td></td>
<td>50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td></td>
<td></td>
<td>51</td>
<td></td>
<td></td>
</tr>
<tr>
<td>26</td>
<td></td>
<td></td>
<td>52</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Direct Monitoring  Indirect Monitoring (Wipe)

<table>
<thead>
<tr>
<th>Permit Holder</th>
<th>Permit Number</th>
<th>Department or Laboratory</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Survey Instrument | Date | Name
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Operational Checks  Background Measurement
- □ battery  □ cpm  □ µSv/hr
- □ std. source  □ other

___________ cpm  ___________

Direct Monitoring Results

<table>
<thead>
<tr>
<th>Schematic of Department or Descriptions of Areas Monitored Including Randomly Selected Sites or Suspicious Areas</th>
<th>Areas From Schematic</th>
<th>Survey Reading</th>
<th>Action Taken</th>
<th>Final Reading</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Reference to Licence Criteria (Instrument: ____________________________ )

<table>
<thead>
<tr>
<th>Isotope</th>
<th>counts per minute and Bq/cm² are based on radionuclide classification and controlled or public area contamination limit.</th>
<th>Notes:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>for multiple isotopes use the isotope with the lowest (most restrictive) limit</td>
<td></td>
</tr>
<tr>
<td></td>
<td>__________ cpm = _______ Bq/cm²</td>
<td></td>
</tr>
<tr>
<td></td>
<td>__________ cpm = _______ Bq/cm²</td>
<td></td>
</tr>
<tr>
<td></td>
<td>__________ cpm = _______ Bq/cm²</td>
<td></td>
</tr>
<tr>
<td></td>
<td>__________ cpm = _______ Bq/cm²</td>
<td></td>
</tr>
<tr>
<td></td>
<td>__________ cpm = _______ Bq/cm²</td>
<td></td>
</tr>
<tr>
<td></td>
<td>__________ cpm = _______ Bq/cm²</td>
<td></td>
</tr>
</tbody>
</table>

END
81.3 Personal Monitoring

Staff working with open sources of nuclear substances are required to don appropriate personal protective equipment and follow all safe work practices as identified in Section 16.3 Laboratory Working Rules. Personal contamination should be very rare in the workplace. Staff should still monitor for personal contamination when leaving the laboratory after working with open sources of nuclear substances and at the end of the day.

81.4 Sealed Source Leak Testing

CRITERIA
All sealed sources greater than 50MBq must be part of a sealed source leak test program and tested:
- every 6 months if the source is not in a device
- every 12 months if the source is in a device
- every 24 months if the source is in storage
- anytime a source is brought from storage for use
- after an event that may have damaged the source

Any company contracted to provide leak test results should provide a statement that they agree to follow the CNSC Expectations for Leak Testing of Sealed Radiation Sources.

SAMPLING
- Wear gloves for sampling to reduce any contamination risk.
- Wipe the entire exterior surface of the sealed source with an alcohol swab.
- If the source is inaccessible (in a device) wipe the closest opening to the source access
- Air dry the swab before placing it in a plastic bag or counting tube
- Label the bag or tube with the source ID number and date of wipe
- Complete any accompanying paperwork required by the leak testing company

REGULATORY LIMIT - RESPONSE
- If the regulatory limit of 200Bq is exceeded:
  - Discontinue use of the sealed source
  - Put measures in place to limit the possible spread of contamination
  - Immediately notify radiation safety personnel
  - Radiation safety personnel shall notify the CNSC

81.5 Emissions Monitoring

The disposal of solids as regular garbage, discharge to the sewer and the incineration of biomedical waste and organic solvents are limited by the requirement that the material discharged be compatible with the environment and below set limits for radioactive material. While there are disposal limits on each licence, general practice at CDHA is to store all material on site until it is no longer radioactive, even if it is below the regulatory limits for release. See section 65 Waste Disposal.
The disposal limits are set by the Canadian Nuclear Safety Commission and are a part of the licence conditions. Regulations state that the licensee shall ‘take all reasonable precautions to protect the environment and the health and safety of persons and to maintain security’ and ‘take all reasonable precautions to control the release of radioactive nuclear substances within the site of the licensed activity and into the environment as a result of the licensed activity’

**Landfill**
Disposal of radioactive material with the normal garbage is permitted if the concentration of radioactive material is less than the limit for the particular nuclide. Local landfill operations require all material to be at background levels. The institution must follow the most restrictive limit. Radioactive material should be held for decay to background levels before disposing the material in landfill sites.

**Sewer**
Disposal through the sewer of water soluble liquids is permitted if the disposal per building does not exceed the limits for the particular nuclide. In laboratories where this method is routinely used, a specific sink should be designated for the purpose. A yearly inventory will be requested because many different laboratories in the same building could be using the same isotope.

**Incineration**
Disposal to the atmosphere through incineration is not permitted as a deliberate means of disposal. Release to the atmosphere, incidental to normal operations, is limited to disposal of less than three million cubic metres per year. All release by this method should be avoided.

The Radiation Safety Office will track the emissions from the hospital due to the large number of locations of laboratories. Each department will be required to submit an annual inventory.

1. **Diagnostic and research laboratories** should maintain an inventory of purchase and use. This should be sent annually to the radiation safety office for emissions calculations.
2. Departments performing **radionuclide therapies** where emissions are a concern should track the number of patients and total activity discharged to the sewer. These results should be forwarded to the Radiation Safety Office.
3. Nuclear substances, injected into patients, are considered disposed under the regulations and those patients are not subject to the monitoring process.

### Section 82 SPILLS AND DECONTAMINATION

#### 82.1 Classification

**Minor spills** are those where small drops or easily cleaned spills are contained on absorbent pads and pose no major hazards to workers. All spills of radioactive material are classified as a minor spill unless any of the following conditions are met; in which case it would be defined as a major spill.

**Major Spill:**

- When a spill involves **breakage of storage vial** or **contents spilled from vial or syringe**;
• When a spill involves any radioisotope of very high radiotoxicity;
• When a spill involves release of volatile material;
• When it is suspected that inaccessible areas are contaminated;
• When reasonable efforts to decontaminate are not successful;
• When there is any doubt about appropriate decontamination procedures;
• If personal contamination and/or injury has occurred;
• Any rupture or suspected rupture of a sealed source.
• When the spill involves more than 100 Exemption Quantities

82.2 Decontamination

Decontamination following a spill response shall meet the decontamination criteria in Section 81.

PROCEDURE

A. Minor Spills:
   1. Notify all other persons in the room at once.
   2. Keep the number of persons necessary to deal with the spill to a minimum.
   3. Ensure personal protective is being worn (gloves, lab coat)
   4. Confine the spill immediately to prevent contamination spread.
   5. Decontaminate the area.
   6. Monitor for residual loose contamination.
   7. Repeat decontamination until monitoring shows acceptable levels in accordance with the Canadian Nuclear Safety Commission regulations.
   8. If unable to decontaminate to acceptable levels, notify the Radiation Safety Officer.
   9. No person can resume work until decontamination is complete.
   10. Consult Radiation Safety Officer to determine if a bioassay is required.

B. Major Spills:
   1. Notify all persons not involved in the spill to vacate the lab at once.
   2. Ensure personal protective is being worn (gloves, lab coat)
   3. If the spill is liquid take measures to contain the spill to prevent contamination spread.
   4. Delineate outer margin of spill with tape.
   5. Flush contaminated skin thoroughly and remove contaminated clothing.
   6. Switch off all air circulating devices.
   7. Vacate the room and immediately notify radiation safety personnel.
   8. Ensure persons vacating the lab remain in the immediate area to be monitor for personal contamination.
   9. Take immediate steps to decontaminate personnel involved as necessary.
   10. Post warning signs to prevent entry into contaminated area.
   12. Proceed to decontaminate area, wipe test for loose contamination and survey for fixed contamination.
      • For very short lived isotopes such as F-18 it is acceptable to close the area and allow for decay to background levels as long as access to the area is restricted and signs are posted at the entrance.
13. Prohibit any work in the area until survey results are known and approval is given by radiation safety personnel.
14. Ensure the complete history of the incident is documented.

C. Reporting Criteria:
1. Staff shall report all major spills to their on-site radiation safety officer as soon as it is safe to do so.
2. The on-site radiation safety officer will manage the situation and report to the corporate radiation safety officer.
3. The corporate radiation safety officer will report the following to the CNSC as soon as possible, conduct an investigation and file a final report with the CNSC. (See Section 13 Incident Investigation and Reporting.
   a. Spills greater than 100 exemption quantities
   b. Release of volatile material
   c. Personal Contamination
4. Personal contamination must also include if the dose exceeds regulatory limits and also if it needs to be added to the personal dose registry. (Consult physics personnel capable of assessing dose estimates) General Rule: Cumulative dose from exposure to contamination decay (infinity) = Initial Dose Rate (from contamination) x 1.44 x Half-life of contaminant.

D. Unable to Meet Decontamination Criteria:
1. If unable to decontaminate to below regulatory criteria, staff must consult with radiation safety personnel. See 81.2 Fixed contamination
90 EMERGENCIES

Policy RSP-90 Nuclear Substance and Radiation Device Emergencies

Any emergency situation in areas where nuclear substances or radiation emitting devices are used should follow radiation safety response and, if needed, hospital emergency code response and shall be reported to radiation safety personnel immediately following initial response to the situation.

Section 91 NUCLEAR SUBSTANCE EMERGENCIES

INTRODUCTION
Any work with unsealed sources of radioactive material involves the possibility of radioactive spill and/or contamination, with the consequent risk to personnel of subsequent inhalation or ingestion. Prompt and proper action is a prime consideration for limiting any consequences of an emergency. Medical life-saving emergencies of personnel or patients take precedence over any radiation safety issues.

PROCEDURE

91.1 Open Sources

Airborne Release (Mists, Fumes and Vapours)
Working with volatile nuclear substances should take place in fume hood devices. If these devices fail or you suspect airborne release:
1. Notify all other persons to vacate the area/lab at once.
2. Hold your breath, close escape valves and switch off air circulating devices if time permits.
3. Vacate room and immediately notify radiation safety personnel.
4. Ensure all access doors to the room are closed and control access to the area.
5. Inform Engineering Services to determine the cause and rectify the condition.
6. Record the name of all known or suspected persons who may have inhaled radioactive materials.
7. Monitor all persons suspected of contamination. Occupants of the lab may be required to undergo bioassays.
8. Evaluate the hazard and the necessary safety devices for safe re-entry such as protective clothing and respiratory protection.
9. Decontaminate the area including an air survey of the area.
10. Prohibit any work the area until approval is given by radiation safety personnel.

Personal Contamination
1. Notify other workers in the area for assistance and to restrict access to the area.
2. Remove and bag any contaminated clothing
3. Wash contaminated area with warm water and soap (Do Not Scrub Area)
4. Contact radiation safety personnel
5. If medical help is not required, remain in area until radiation safety personnel arrive.
Lost, Missing or Theft of an Open Source
   1. Notify other workers in the area for assistance.
   2. Contact radiation safety personnel immediately.
   3. Make a list of all possible places where the source may be such as storage areas, other areas in the department, fume hoods, places that different nuclear substances are kept or waste streams.
   4. Notify housekeeping and security to prevent any recent laundry or waste pickup from leaving the facility.

91.2 Sealed Sources
Procedures to address emergencies involving therapeutic sealed sources (HDR) are included in Part 4 (HDR Manual).

PROCEDURE

Discovery of a Sealed Source
   1. If possible, evacuate the room; otherwise keep people as far as possible from the source.
   2. Contact radiation safety personnel to deal with the source.
   3. Contact security to assist in sealing the area and restricting access.

Loss or Theft of a Sealed Source
   1. Contact radiation safety personnel immediately;
   2. Make a list of all possible places where the source may have been and most likely locations.
   3. Do not permit any items such as laundry to leave the area until it is monitored by radiation safety personnel.
   4. Notify housekeeping and security to prevent any recent laundry or waste pickup from leaving the facility.

Ruptured or Broken Sealed Source
   1. Shut off any fans and ventilators;
   2. Drop damp towel on the suspect material, throw nothing away;
   3. If possible, evacuate the room; otherwise keep people as far as possible from the source.
   4. Contact radiation safety personnel to deal with the source.

Stuck Sealed Source in Device
   1. Evacuate the area and close any access doors.
   2. Restrict access to the area.
   3. Contact radiation safety personnel to deal with the source.

Failed Sealed Source Leak Test Result
   1. If sealed source fails a routine leak test, remove it from service and notify radiation safety personnel.
   2. Any procedure, requiring the use of the sealed source, shall be postponed until radiation safety personnel provide advice on how to proceed.
Section 92 RADIATION EMITTING DEVICES EMERGENCIES

INTRODUCTION

Any work with radiation emitting devices involves the possibility of the device failing to stop emitting radiation or the requirement to enter a room as a result of a patient emergency. The devices are equipped with safety system stops that can be used in such emergencies. Prompt and proper action is a prime consideration for limiting any consequences of an emergency. Medical life-saving emergencies of personnel or patients take precedence over any radiation safety issues.

PROCEDURE

The initial response for all devices (x-ray, accelerators, brachytherapy and cyclotron) would be to stop the device by cutting the power as determined by the type of device. Specific emergency procedures are listed in the specific manual for the device.

Radiation devices should generally stop when the parameters of production or dose delivery have been met. If the beam remains on:
1. If equipped, press the nearest emergency off button and vacate the area.
2. If the device remains on, turn off the key and the main circuit breaker or power supply.
3. Ensure all access doors to the room are closed and control access to the area.
4. Contact radiation safety personnel.
5. Do not use the device until the verification to return to service is completed.
6. Identify persons who may have been exposed to radiation including time spent in the area of the beam.
7. Arrange for medical care of patients or staff.

Section 93 OTHER RELATED RADIATION EMERGENCIES

INTRODUCTION

Medical life-saving emergencies of personnel or patients take precedence over any radiation safety issues. The response for non-radiation emergencies, which occur in areas where nuclear substances or radiation emitting devices are used, is generally the established hospital response. While no one set of procedures can cover all emergencies, when possible, devices should be shut off and sources secured.

Fire-Evacuation
1. Follow hospital emergency codes for fire and evacuation.
2. If possible, turn off all radiation emitting devices (using emergency off switches if needed) and contain nuclear substances.
3. Notify, or have security notify radiation safety personnel.
4. Once the fire is dealt with, radiation safety personnel must monitor the whole area to detect any possible contamination before authorizing release of the area to routine access.

Medical Emergency
Primary life saving care takes priority over any radiation safety concerns.
1. Notify radiation safety personnel as soon as possible after initial medical response.
2. Keep personnel involved in any response to essential personnel only.
3. Advise personnel involved in any response to use routine body fluid precautions. (This should be the normal response to all medical emergencies)
4. Have someone document the names of all individuals involved in the response and their approximate time spent in the area. (This should be the normal response in a medical emergency)
5. Have all personnel involved in the response monitored before they leave the area.
6. Keep all supplies used in the response in the room or in a contained area.
7. Have all equipment and protective clothing monitored by radiation safety personnel after the procedure is completed.

Death of a Patient
Occasionally a patient treated with radioactive material may die, from the disease being treated or from an unrelated cause, while his or her body still contains a significant amount of radioactivity.

1. Notify radiation safety personnel as soon as possible after patient death.
2. If possible, keep body isolated until radiation safety personnel arrive.
3. Keep personnel involved in any response to essential personnel only.
4. Advise personnel involved in any response to use routine body fluid precautions.
5. Have someone document the names of all individuals involved in the response and their approximate time spent in the area.
6. Any further procedures would be in consultation with family, medical personnel and radiation safety personnel.
## APPENDIX A – Policy & Procedure Revisions

**Policy and Procedure Revisions**  
**Source:** Radiation Safety Office  
**Approval:** Radiation Safety Committee

<table>
<thead>
<tr>
<th>RSP Number</th>
<th>Revision</th>
<th>Name</th>
<th>Approved Date</th>
<th>Changes</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>new</td>
<td>Management of radiation Safety Program</td>
<td>2014-09-19</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>new</td>
<td>Inspections and Audits</td>
<td>2014-09-19</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>new</td>
<td>Incident Reporting and Investigation</td>
<td>2014-09-19</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>new</td>
<td>Compliance Enforcement</td>
<td>2014-09-19</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>new</td>
<td>Security</td>
<td>2014-09-19</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>new</td>
<td>Laboratory Room Requirements</td>
<td>2014-09-19</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>new</td>
<td>Record Keeping</td>
<td>2014-09-19</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>new</td>
<td>Employee Classification and Training</td>
<td>2014-09-19</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>new</td>
<td>Radiation Safety Officers</td>
<td>2014-09-19</td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>new</td>
<td>Exposure and Dose Control</td>
<td>2014-09-19</td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>new</td>
<td>Radiation Detection Instrument Use and Calibration</td>
<td>2014-09-19</td>
<td></td>
</tr>
<tr>
<td>60</td>
<td>new</td>
<td>Radioactive Material Inventory Management</td>
<td>2014-09-19</td>
<td></td>
</tr>
<tr>
<td>70</td>
<td>new</td>
<td>Personal Monitoring</td>
<td>2014-09-19</td>
<td></td>
</tr>
<tr>
<td>80</td>
<td>new</td>
<td>Contamination Monitoring Program</td>
<td>2014-09-19</td>
<td></td>
</tr>
<tr>
<td>90</td>
<td>new</td>
<td>Nuclear Substance and radiation Device Emergencies</td>
<td>2014-09-19</td>
<td></td>
</tr>
</tbody>
</table>