Radiation Safety Operating Procedure

Dosimetry Use - External

1.0 Statement

Dosimetry shall be used to determine the external radiation exposure of persons from external beta or X-ray and gamma sources. Through routine, continuous monitoring, dosimeters shall be worn at all times during working hours.

1.1 Persons requiring external dosimetry for ionizing radiation are persons working with:

a) Nuclear substances and radiation devices:
   i) In a lab designated as Intermediate
   ii) In a Basic Laboratory with nuclear substances **other than** H-3, C-14 or S-35.
   iii) With sealed sources over 370 kBq, that are **not** contained in devices (such as moisture/density gauges, electron capture detector gas chromatographs, liquid scintillation counters).
b) X-ray equipment or regularly entering an area where X-ray equipment is used.

1.2 Individuals may be removed from the dosimetry program based on past dosimetry records and unchanged laboratory procedures.

1.3 Memorial University places great emphasis on the need to keep all exposures AS LOW AS REASONABLY ACHIEVABLE, economic and social factors being taken into account. This is known as the ALARA principle and it should be adhered to at all times.

2.0 Definitions

2.1 Nuclear Energy Worker (NEW)
A Nuclear Energy Worker means a person who is required in the course of their work at the University to perform duties in such circumstances that there is a reasonable probability that the person may receive a dose of radiation that is **greater** than the prescribed limit for the general public (1 mSv in the year).

2.2 Member of the Public
For the purposes of this procedure, a Member of the Public is defined as a person who is required in the course of their work at the University to perform duties in such circumstances that there does not exist a reasonable probability that the person may receive a dose of radiation that is greater than the prescribed limit for the general public (1 mSv in the year).

3.0 Requirements

3.1 The CNSC regulations set limits for the maximum permissible dose of ionizing radiation an individual may receive from the possession and use of nuclear substances and radiation devices. Additionally, the regulations require the RSO to give notice to all female workers designated as "NEW" of their duty to inform their Permit Holder and the RSO of their pregnancy.

3.2 To work with nuclear substances and radiation devices, MUN requires that the individual is listed as a Permit Holder or an Authorized User on the Radioisotope User Permit. All Permit Holders and Authorized Users are considered "Member(s) of the Public" unless otherwise notified by the RSO of the Nuclear Energy Worker (NEW) status.

3.3 The method of monitoring an individual's radiation exposure is dependent on the specific radioisotope or equipment used. For persons working with radioactive material, the required dosimetry is specified under "Conditions of Approval" on each Radioisotope User Permit or as specified by the RSO.

4.0 Dosimetry

4.1 Radiation dosimeters are used to provide two types of measurements:

4.1.1 **Body** - Dosimeters designated "Body" are used to measure the actual radiation dose absorbed by the body (effective dose) and monitor occupational risk. These "badge" dosimeters are normally worn clipped to the chest pocket of the person's lab coat or at the waist. Badges are measured at least quarterly. To accurately estimate a person's exposure, dosimeters must be worn under shielding such as lead aprons.

4.1.2 **Extremity** - Dosimeters designated "Extremity" (e.g.: neck/collar, ring/finger, wrist) are used to measure the radiation exposure to the extremities of the body and to monitor non-uniform radiation exposure. These "ring" dosimeters are required for users who handle a container that contains more than 50 MBq of 32P, 89Sr, 90Y, 153Sm, 186Re. They are worn under disposable gloves on the hand most likely to be exposed to radiation. Ring dosimeters are usually measured quarterly.

4.2 Optically Stimulated Luminescence (OSL) Dosimeters

OSL dosimeters contain sensitive elements that absorb radiation and store some of the energy in the form of excited electrons. The dosimeter is read by stimulating the sensitive elements using Light Emitting Diodes (LED), which releases some of the stored energy as light. The amount of released light is measured and used to determine the radiation exposure received by the dosimeter's user during the wearing period.

4.3 Procedure for wearing Dosimeters

Permit holders using dosimetry services shall specify a Dosimetry Coordinator to control, distribute and return dosimeters. All dosimeters which were not worn during the wearing period must be declared as such to the Dosimetry Coordinator. **Errant charges (late, lost or damages fees) will be charged to the permit holder.** Individuals responsible for distributing dosimetry badges shall:

- Ensure that dosimeters are collected/distributed to all users within the group in a timely fashion;
- Ensure that dust and dirt are not deposited on the plaques; and
- Inform the RSO of any chipped or damaged dosimeters;

The National Dosimetry Service (Health Canada) records each dose on an individual basis. To ensure the reported exposure is indicative of an actual personal exposure the following guidelines should be followed.

a) Dosimeters are assigned to a single individual and must only be worn by that individual when he/she is using radioactive substances or devices. If badges are not worn during the wearing period, the Dosimetry Coordinator shall ensure that the dosimeters are returned to the RSO marked as "not used." Dosimeters **must not** be worn when undergoing medical procedures involving radiation, as this may cause dosimeters to register a non-occupational exposure.

b) Dosimeters shall be stored away from X-ray areas or where nuclear substances are used or stored.

c) Dosimetry services request forms are available on the EHS Assistant or from Environmental Health and Safety (Radioisotope Worker Registration form URCC-6).

Personal exposure reports are reviewed quarterly and maintained by the RSO. If a person has a recorded reading, the RSO will inform the worker directly. The RSO will provide the users dose records on a regular basis, if requested.

d) Reports of personal exposure are investigated by RSO. The CNSC shall be informed immediately if any individual exceeds the annual dose limit (1 mSv).

e) Reports of the radiation dose received by each worker are sent to the RSO who will:

1) examine the report and note any unusually high value;
2) send a copy to the individual (minimum once a year or on request);
3) retain the original report for record purposes;
4) investigate any dose which is either:
   - Over 10 mSv per 2 consecutive periods of 3 months in the case of a NEW; or
   - Over 0.3 mSv for 2 consecutive periods of 3 months for individuals other than those with NEW status.
5) In the event of a dose exceeding the above limits the RSO shall:
   - Immediately notify the person of the dose;
   - Require the person to leave any work that is likely to add to the dose;
   - Conduct an investigation to determine the magnitude of the dose and to establish the causes of the exposure;
   - Identify and take any action required to prevent the occurrence of a similar incident

6) If the dose also exceeds CNSC effective dose limits then the following is necessary in **addition** to the above investigation:
   - Immediately notify the CNSC of the dose;
   - Within 21 days after becoming aware that the dose limit has been exceeded, report to the CNSC the results of the investigation or on the progress that has been made in conducting the investigation.

4.3 Dosimeters-Good Practices

The individual radiation worker shall:

- take good care of their assigned monitor at all times;
- wear the monitor at all times during working hours. The badge may be worn either at the wrist as a bracelet or on the finger as a ring and finally at the head/neck area or chest height as a whole body monitor. Where protective clothing such as a lead apron is worn, the badge must be placed under the protective clothing since its function is to record the radiation reaching the body, not the radiation reaching the protective clothing;
- guard the badge as a personal monitor, issued to a named individual. Under no circumstances should the badge be loaned to another person;
- take care that the badge is not dropped or accidentally placed in a position where it could be exposed to a level of radiation higher than the ambient level;
- take care that the badge is not accidentally splashed or otherwise contaminated by a radioactive liquid
- take care that, outside working hours, the monitor is stored in a safe place which is well away from any radiation source and from any source of intense heat such as a radiator; and
- report any problems with the monitor to the Dosimetry Coordinator or to the RSO.

4.4 Limitations

Personnel monitoring, of the type described in the preceding paragraphs is a satisfactory general indicator of the whole-body dose arising from external sources of penetrating radiation such as X- and gamma-rays. However, the system has some important limitations:

1. the badge reading can be interpreted in terms of a whole-body dose only if the ambient radiation is penetrating, i.e., photons in the MeV energy range, or at least several hundred keV; and isotropic i.e., either the radiation comes from several directions or the radiation worker changes his orientation frequently with respect to the source of radiation.
2. If these conditions are not met, then the badge reading represents only the dose to superficial tissues and/or to part of the body such as the front of the trunk;
3. The badge does not record any additional dose received by the extremities and/or face and neck in some procedures; the badge does not record doses due to low-energy-particles such as those from tritium (H-3), carbon-14 (C-14) and sulphur-35 (S-35);
4. The 3-monthly cycle may be too long for individuals whose work carries a higher-than-average risk of radiation exposure; and
5. The badge does not record internal exposure arising from ingestion, inhalation or injection of radioactive materials.