Personal Radiation Monitoring

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Radiation monitoring

Curtin staff and students who work with x-ray machines, neutron generators, or radioactive substances are monitored for exposure to ionising radiation. The objective of radiation monitoring is to ensure that existing safety procedures keep radiation exposure As Low As Reasonably Achievable (ALARA).

Personal radiation monitoring badges

Radiation exposure is measured using personal radiation monitoring badges. Badges contain a substance that registers how much radiation has been received. Here is the process by which a user's radiation dose is measured:

1. The user is given a badge to wear
2. The user wears the badge for a set time period (usually three months)
3. At the end of the set time, the user returns the badge
4. The badge is sent away to be read
5. A dose report is issued.

These steps are repeated until monitoring is no longer required. Badges are supplied by a *personal radiation monitoring service provider*. Curtin uses a service provider named Landauer. In addition to user badges, the service provider sends *control* badges that are kept on site in a safe place away from radiation sources. The service provider reads each badge using a process that extracts a signal from the substance contained in the badge to obtain a dose measurement. (Optically stimulated luminescence is one such process.) The dose received by the control badge is subtracted from the user badge reading to obtain the user dose during the monitoring period.

A personal radiation monitoring badge

Important

Radiation monitoring badges do **not** protect you from radiation exposure. Instead, they tell you how much radiation you received during the monitoring period. To reduce your dose, use good radiation safety habits:

1. Distance (keep away from the radiation source)
2. Time (the smaller the exposure time, the better)
3. Shielding (the more shielding between you and the radiation source, the better).

Maximising your distance from a radiation source is a very effective way to reduce your dose. (According to the inverse square law for point sources, doubling your distance reduces the dose to one quarter of the initial value. Increasing your distance by a factor of ten reduces your dose by a factor of one hundred.)

How to get a badge

Students who may be exposed to ionising radiation during their course work (e.g. medical imaging students) will be issued with badges by their School. Staff who may be exposed to ionising radiation during their teaching or research work will also be issued with badges by their School. If you should have a badge but have not been issued with one then please raise the matter with your lecturer or supervisor.

Looking after your badge

Here are some rules for wearing badges:

1. Wear your Curtin-issued badge whenever you are working with ionising radiation while at Curtin or on a Curtin placement. (There is no point having a badge if you don't wear it when you might be exposed to radiation.)
2. Only wear your Curtin-issued badge while at Curtin or on a Curtin placement. (Do **not** wear your Curtin-issued badge when your radiation work relates to another organisation. The other organisation needs to supply you with a badge instead.)
3. Do not put your badge through an airport x-ray scanner, do not put it in a washing machine, and do not put it on the car dashboard. (These things could lead to erroneous readings. Don't worry too much if you do happen to do any of these things. The badge will still provide a useful dose measurement in many cases.)
4. Do not lose your badge. (Please let your lecturer or supervisor know if you have lost your badge so that another one can be issued.)
5. Wear your badge where it says to wear it. (The proper position is indicated by a dot on the picture of a person on the badge. The badge does not have to go exactly where the dot says. For example, it's OK to clip the badge to your shirt pocket if the dot indicates the centre of your chest. Wearing the badge in the indicated position is important because the reported dose is based on calculations that assume it is worn in there.)

What does my dose report mean?

Dose reports issued by Curtin's personal radiation monitoring service provider (Landauer) include information about the monitoring period, dosimeter (i.e. badge), and cumulative doses for various time periods. (A cumulative dose is the total dose received in a given time period.) One important thing to look for is your *lifetime dose*, which says how much radiation has been recorded on the badges supplied to you by this particular service provider since you first began to be monitored (the inception date). The smallest dose able

to be detected by the badges is typically 0.01 mSv. If the badge registered less than the minimum reportable dose then a code of *M* is printed on the report.

Here are explanations of key terms found in the reports:

Dose equivalent
The equivalent dose is the risk of something bad happening because you received a radiation dose. (See below under What is my radiation risk?).

mSv
One thousandth of a sievert. The sievert is a measure of potential harm induced by exposure to ionising radiation. (See below under What is my radiation risk?).

DDE
The Deep Dose Equivalent, also known as Hp(10), is the equivalent dose at a depth of 10 mm below the skin. This is an indication of the dose received from everything besides alpha and beta particles, which don't penetrate that far. (X-rays, gamma rays, and neutrons do get that far.) The DDE is useful for estimating internal organ radiation exposure from external sources (i.e. radiation sources like x-ray machines that are outside your body).

LDE
The Lens Dose Equivalent, also known as Hp(3), is the equivalent dose to the lens of the eye at a depth of 3 mm. This quantity is useful for estimating the risk of developing cataracts as a result of radiation exposure.

SDE
The Shallow Dose Equivalent, also known as Hp(0.07), is the equivalent dose to the skin at a depth of 0.07 mm, averaged over an area of one square centimetre. This quantity is useful for estimating risk associated with manual handling of radioactive sources and surface contamination (e.g. by liquids, mineral sands, and dust).

Monitoring period
From and to dates of monitoring periods.

Import date
When dose results were imported into the service provider database.

Type
Type of radiation monitored. Pa = x-rays, gamma, beta; Ja = x-rays, gamma, beta, fast neutrons; Ta = x-rays, gamma, beta, fast and thermal neutrons; N = fast neutrons; E = fast and thermal neutrons; U = x-rays, gamma, beta (ring thermoluminescent dosimeter).

Use
Where the badge should be worn. E.g. chest, collar.

Rad Qlty
Radiation quality description. E.g. B = beta; P = photon.

Scan date
When the badge was read.

Notes

1. *Dose equivalent* is a deprecated term. These days people say *equivalent dose*. Both terms mean the same thing.

2. X-ray machines are *not* radioactive and don't make things near them radioactive.

What is my radiation risk?

The International Commission on Radiological Protection publishes reports and recommendations on radiation protection. ICRP publication 103 gives the following risk factors (J. Valentin 2007 table 1):

Exposed population	Cancer	Hereditable effects	Total
Whole population	5.5	0.2	5.7
Adult population	4.1	0.1	4.2

These figures give the risk that something bad will happen (i.e. cancer or mutated genetics) in percentage per sievert. That is, if an adult gets a dose of 1 Sv (i.e. 1000 mSv) of ionising radiation, then his or her lifetime risk of dying from cancer or passing on detrimental hereditary effects goes up by 4.2%.

As an example, say that your lifetime dose after working as a radiographer for a long time is 100 mSv (i.e. 0.1 Sv). That means that your risk of cancer has increased by 4.1% x 0.1 = 0.41%.

To put things in perspective, all of us are exposed to background radiation. This comes from rocks, the sun, outer space, and even what we eat! The background radiation dose in Perth is about 2 mSv per year. That means that if you are 25 years old then you already have a lifetime cumulative dose of 50 mSv. To give a more sobering statistic, our lifetime risk of dying from cancer is somewhere between 30 and 50%. So if you get an additional 100 mSv of radiation over your lifetime then your risk goes up to somewhere between 30.4 and 50.4%.

Dose limits

The ICRP also makes recommendations concerning dose limits for radiation workers and members of the public. These have been adopted as legal limits in Australia. That means that Curtin University is legally obliged to ensure that your dose does not exceed any of the limits.

Part of body	Radiation worker limit (mSv/yr)	Public limit (mSv/yr)
Whole body	20	1
Lens of eye	150	15
Skin	500	50
Hands and feet	500	-

Pregnancy

Children are more susceptible to radiation than adults because they have more rapidly dividing cells. This is also true of a foetus. If a woman is a radiation worker and discovers that she is pregnant then she should inform Curtin's Radiation Safety Officer (9266 1708) and her lecturer or supervisor immediately. It is advisable to reduce radiation exposure as much as possible during pregnancy. A foetus is treated as a member of the public, meaning that the public dose limit applies to pregnant radiation workers.

Keeping track of my dose

Your employer (or institution in the case of students) is responsible for keeping your dose records. Nevertheless, you should also keep track of your lifetime dose. After all, you are the one who is potentially affected by the cumulative radiation dose. You may have a number of employers and personal radiation monitoring service providers over the course of your career so it is a good idea to keep your dose records in a safe place. If you tell your current service provider what your lifetime dose is then they can enter it into their system so that it is shown in subsequent dose reports.

What happens if I get a big dose?

Expect a call from Curtin's Radiation Safety Officer if your reported dose exceeds 0.3 mSv in a three month period (or 1.2 mSv in a year). If you get a really big dose then you might be sent for medical tests.

Further information

Please do not hesitate to contact the Radiation Safety Officer (9266 1708) if you have any questions concerning personal radiation monitoring at Curtin University.

References

J. Valentin, ed. 2007. *The 2007 Recommendations of the International Commission on Radiological Protection*. ICRP Publications 103. Elsevier.

REVISION HISTORY		
Revision #	**Date**	**Amendment Description**
1.0	19/10/20	New Document